Mapping Renewable Energy Sources potential, challenges, and opportunities in Lithuania

RENEWSTART

September 2024

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INTRODUCTION

Lithuania's electric power system has significantly changed over the past few decades, especially after closing its Ignalina Nuclear Power Plant (NPP) in 2009. After the closure of Ignalina NPP, gas-fired plants for a time period became a key power source. The country imports natural gas through LNG (liquefied natural gas) terminal. Lithuania is rich in bioenergy resources, particularly biomass. The country has leveraged its forestry and agricultural sectors to produce biomass for heating and some electricity generation. Biomass is a stable and predictable energy source compared to wind and solar, but it requires sustainable management of resources to avoid environmental degradation. Biomass is a significant contributor to district heating, providing around 70-80% of the total heat supply in district heating systems. This high percentage underscores the country's commitment to utilizing renewable energy sources for heating, especially during the colder months. Wind, solar, and biomass have been growing steadily. Wind power is currently the largest contributor among renewable energy sources (RES), with solar energy installations also on the rise (Figure 1).

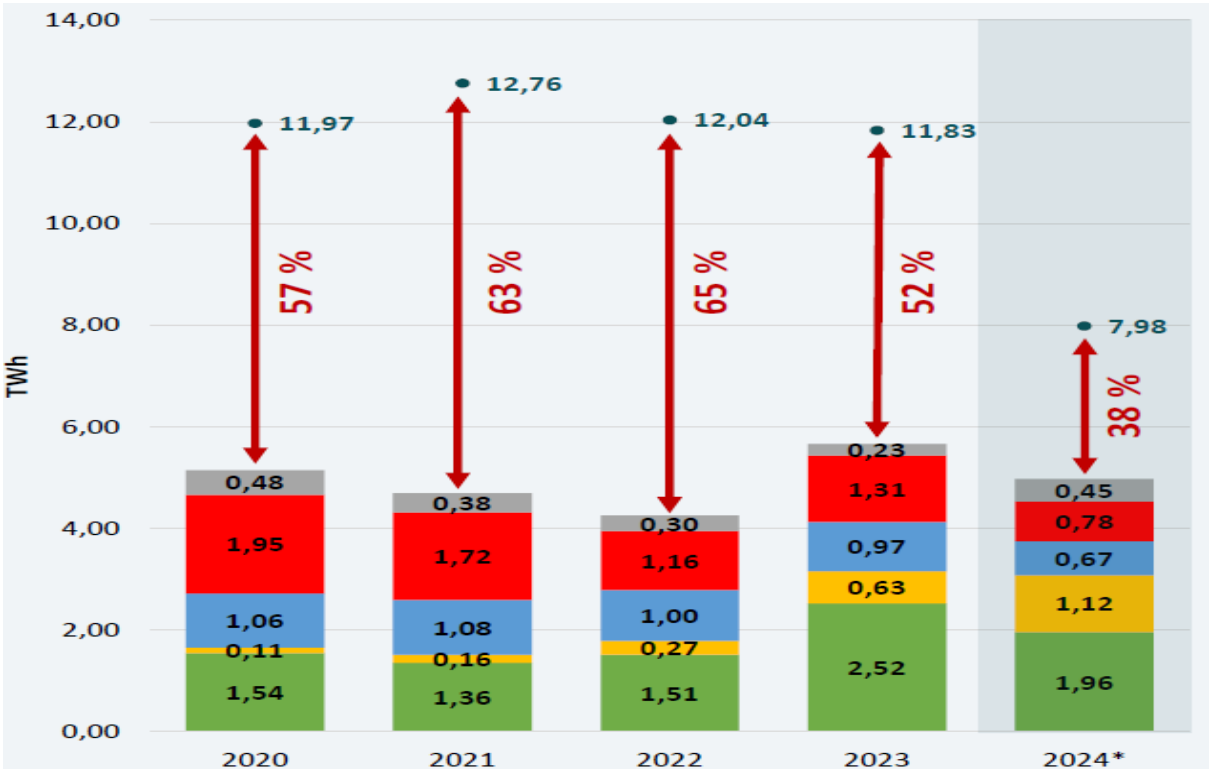

Figure 1. National Generation and Total Consumption: wind (green); solar (yellow); hydro (blue); thermal power (red); others (grey). * 2024 – first eight months. *Source: Litgrid*.

Lithuania is part of the Baltic power system and the European energy market. It has key interconnections with neighbouring countries Latvia and Estonia. Within the Baltic grid, energy exchanges happen frequently to balance supply and demand. Through the LitPol Link, Lithuania can trade electricity with Poland and connect to the wider European grid. This link is crucial for energy security and reducing dependence on the Russian power system. The NordBalt cable connects Lithuania to the Nordic grid, enabling the import of cleaner energy from Scandinavia. Lithuania has been working to synchronize its grid with the Continental European Network (CEN) by 2025. This will end its dependency on the Russian and Belarusian power grids, boosting energy security.

Solar energy has been expanding rapidly. Lithuania offers favourable conditions for residential and commercial solar installations, with incentive programs like net metering schemes encouraging local production. However, solar energy faces seasonal variability, with production peaking in summer and falling during the darker winter months.

The country's onshore wind farms have seen significant growth, and there are ongoing discussions about offshore wind potential in the Baltic Sea. Wind power is intermittent, and its increased share poses challenges for grid stability, mainly when weather patterns cause rapid changes in output.

Balancing supply and demand requires enhanced grid management, energy storage solutions, and the ability to import/export energy as needed. Investments in smart grid technologies and flexible power systems (like battery storage) are crucial to managing this variability.

Diversification through RES reduces dependence on fossil fuels and imported energy. However, stability remains a concern, especially during periods of low RES generation. Lithuania's strategic infrastructure, like LNG terminals and interconnections, provides backup to ensure reliability.

Lithuania's energy transition aims to increase the share of renewables while reducing fossil fuel dependence. Balancing between local RES development and reliable imports from European partners will be essential to ensure long-term energy security and system stability.

Lithuania has set ambitious targets for increasing its share of renewable energy. The country aims to generate 100% of its electricity from renewable sources by 2050, with intermediate goals such as achieving 45% of electricity consumption from RES by 2030. These targets are supported by national policies and EU directives to reduce carbon emissions and promote clean energy.

Renewable energy sources are increasingly critical in Lithuania's energy transition, contributing to energy independence, reducing carbon emissions, and driving economic development. However, intermittency, grid stability, and energy security challenges require a holistic approach involving investments in grid infrastructure, energy storage, and regional cooperation. If Lithuania continues on this path, it has the potential to become a leader in renewable energy in the Baltic region, mainly through the further development of wind and solar energy and the integration of smart grid technologies.

RES, such as solar, wind, hydroelectricity, and biomass, play a vital role in Lithuania's economic development. By expanding its renewable energy capacity, Lithuania can create jobs, reduce energy imports, enhance energy security, and foster technological innovation.

One of the primary economic benefits of RES is job creation, particularly in the construction, maintenance, and operation of renewable energy installations. This is especially important for rural areas, where employment opportunities can be limited. Furthermore, developing a local manufacturing sector for RES technologies can boost industrial output and create additional economic opportunities.

Lithuania's historical dependence on imported fossil fuels makes it vulnerable to global price fluctuations. By increasing its use of RES, the country can reduce energy imports, retain capital within its borders, and strengthen national energy security. In turn, this creates a more stable energy supply, which benefits both businesses and households by reducing energy costs.

Additionally, Lithuania's abundant biomass resources offer a unique advantage. Biomass energy not only generates electricity and heat but also creates markets for agricultural and forestry by-products, supporting rural development. Lastly, Lithuania's leadership in adopting RES positions it to access European Union funding and investment, further accelerating economic growth and sustainability.

In summary, renewable energy is a crucial driver of economic development in Lithuania, supporting job creation, energy independence, and innovation while contributing to long-term economic stability.

European Union (EU) directives significantly impact the development of RES in Lithuania by providing regulatory frameworks and financial incentives. The EU's Renewable Energy Directive (RED) is a key instrument that sets binding targets for member states to increase the share of RES in their energy mix. For Lithuania, this has meant adopting ambitious national goals aligned with the EU's broader targets, such as achieving climate neutrality by 2050.

Lithuania is required to develop policies that encourage the use of RES, such as support schemes for renewable energy projects, simplifying administrative procedures for permits, and ensuring the integration of renewable energy into the electricity grid. These directives push Lithuania to enhance its legal and infrastructural frameworks, fostering a conducive environment for renewable investments.

Additionally, EU directives promote cross-border cooperation and integration of energy markets, which allows Lithuania to participate in regional energy initiatives and benefit from a more connected and resilient energy system. EU funding, particularly from mechanisms like the European Green Deal and the Recovery and Resilience Facility, provides essential financial support for Lithuania to develop its RES infrastructure, enabling the country to reduce reliance on fossil fuels and meet its renewable energy targets.

In summary, EU directives guide Lithuania's renewable energy development through regulatory mandates and financial assistance, helping the country meet its sustainability goals while strengthening its energy security and economic resilience.

Recent reports indicate that RES account for approximately 30% to 35% of Lithuania's total energy consumption. The country has made significant progress in increasing the share of RES in its national energy mix, mainly through wind, solar, and biomass energy development.

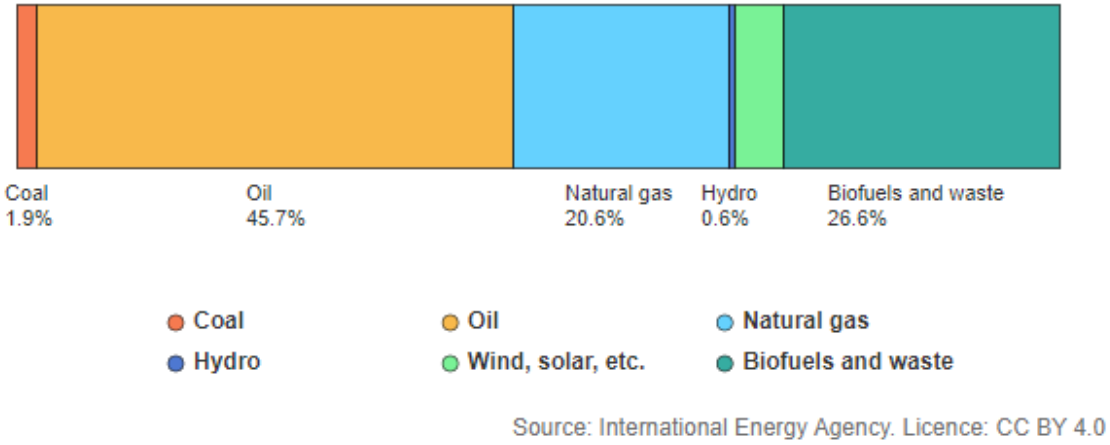

Figure 3. Total energy supply, Lithuania, 2023[1]

Lithuania's electricity sector has seen considerable growth in wind energy, which now represents a substantial portion of its renewable electricity generation (Figure 4). Biomass also plays a key role, especially in the heating sector, where it has become a primary source of renewable heat due to the country's rich forestry and agricultural resources.

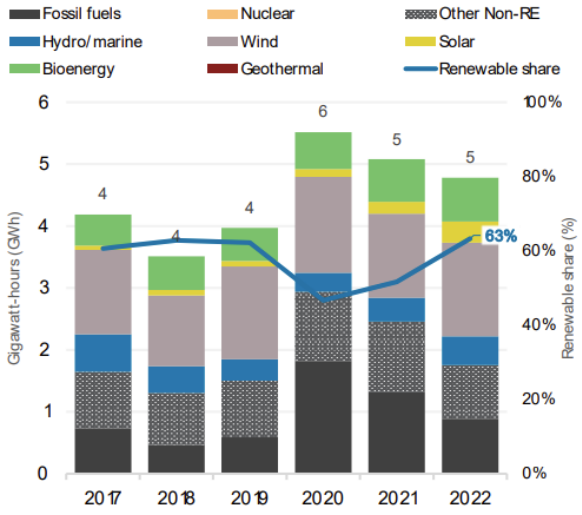

Figure 4. Electricity generation trend in Lithuania.[2]

Lithuania has set ambitious targets under the EU's Renewable Energy Directive to further increase the share of renewables in its energy mix. By 2030, Lithuania aims to reach at least 45% renewable energy in its final energy consumption, driven by continued investments in wind, solar, and biomass energy infrastructure, as well as efforts to enhance energy efficiency across various sectors.

[1] https://www.iea.org/countries/lithuania/energy-mix
[2] https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Europe/Lithuania_Europe_RE_SP.pdf

This growing share of RES in Lithuania's energy mix is vital for reducing the country's reliance on imported fossil fuels, improving energy security, and meeting EU climate goals.

Lithuania has made significant progress in increasing its installed capacities in RES, particularly in solar (photovoltaic), wind, and hydropower. Based on the latest available data:

1. **Total Installed RES Capacity**: Approximately **3,000 to 3,500 MW** across all renewable energy sectors.
2. **Solar (Photovoltaic – PV)**: Lithuania has seen rapid growth in solar energy installations, with an installed capacity reaching **more than 1 GW**. Government incentives for small-scale and residential solar projects have driven this growth.
3. **Wind Power**: Wind energy continues to be the most significant contributor to Lithuania's RES capacity. By 2024, the installed wind capacity is approximately **1,700 to 2,000 MW**. Large-scale wind farms, both onshore and offshore, are key components of this capacity.
4. **Hydropower**: Hydropower remains a minor but stable contributor to Lithuania's renewable energy mix. 2024, the installed hydropower capacity will be approximately **120 to 130 MW**. While this capacity has not seen significant growth, it continues to provide a reliable source of renewable electricity.

The RES highly influences system stability and energy security. The increasing installations of RES (Figure 5), particularly wind and solar, bring variability and intermittent challenges.

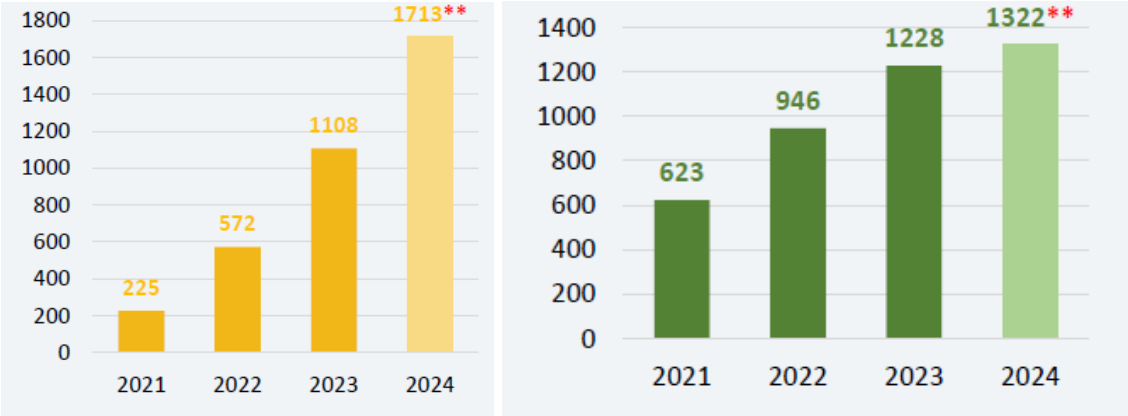

Figure 5. Solar (yellow) and wind (green) generation (MW) in Lithuania. **2024 – first eight months. *Sources: EPSO-G.*

Lithuania has ambitious plans to increase its RES capacities, particularly in wind and solar energy (Figure 6 – 7). Offshore wind projects are currently under development, and the government aims to significantly expand solar capacity to boost decentralised generation and promote energy self-sufficiency (more than 14 GW of reserved capacity).

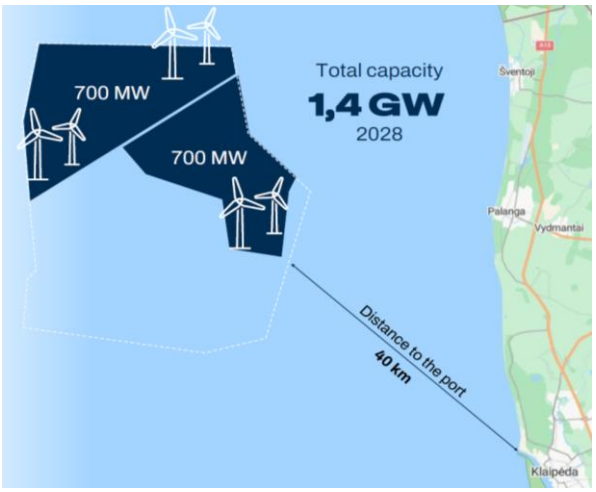

Figure 6. 1.4 GW Offshore Wind Park in 2028 (6 TWh generated electricity). Source*: Litgrid.*

These figures indicate Lithuania's progress toward a more diversified and sustainable energy mix, aligning with EU goals for green energy transition.

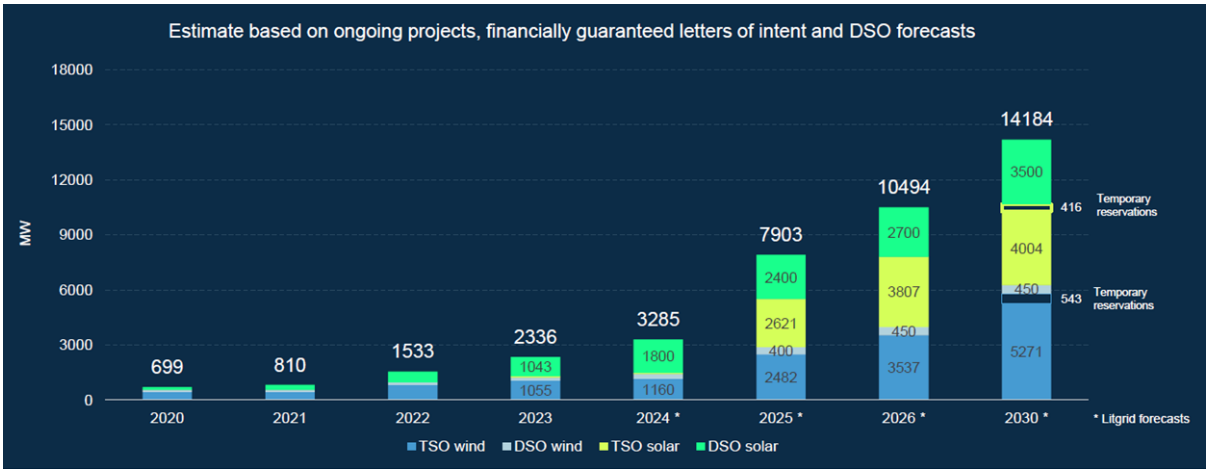

Figure 7. Energy balance till 2030 in Lithuania: estimates related to possible installed capacities. Source: *Litgrid.*

The development of RES in Lithuania is guided by several vital directions to increase the country's energy independence, meet EU climate targets, and boost economic growth. These directions include:

1. **Expansion of Wind Energy**: Both onshore and offshore wind power are central to Lithuania's future renewable energy strategy. The country aims to increase offshore wind capacity, with planned projects in the Baltic Sea contributing significantly to its energy mix by 2030.
2. **Growth in Solar Energy**: Lithuania promotes small-scale and decentralised solar installations for households and businesses. This includes supporting rooftop solar projects and incentivising local energy production through government programs and subsidies.
3. **Modernization of Biomass and Bioenergy**: Biomass remains a crucial resource for heating, especially in rural areas. The focus is on increasing the efficiency of biomass use and integrating more sustainable bioenergy technologies.

4. **Development of Energy Storage and Smart Grids**: To integrate fluctuating renewable sources like wind and solar, Lithuania invests in energy storage solutions and modernises its grid with intelligent technologies to ensure stability and flexibility.
5. **Hydropower Optimization**: While no significant expansion in hydropower capacity is expected, optimising existing hydropower plants for greater efficiency is part of Lithuania's strategy to maintain this stable renewable source.

These directions align with Lithuania's commitment to reaching at least 45% renewable energy in its total energy consumption by 2030, contributing to its long-term goals of carbon neutrality and energy security.

TYPES AND IMPORTANCE OF RENEWABLE ENERGY SOURCES

Solar power industry

Lithuania has been significantly expanding its photovoltaic (PV) solar capacity in recent years, driven by national renewable energy goals and EU incentives. Here are some of the largest PV installations in Lithuania:

Molėtai Solar Park[3]

- Capacity: ~100 MW
- Location: Molėtai
- Description: One of the largest solar parks in Lithuania, this installation covers a vast area and was developed to supply power to the local grid. It represents a significant step toward increasing solar power contributions to the national energy mix.

Ignitis Solar Parks

- Capacity: Several small to mid-scale installations, totalling over 20 MW across different sites
- Location: Multiple locations across Lithuania
- Description: Ignitis Group, one of the primary energy companies in Lithuania, has been developing several solar projects. These projects are spread nationwide, reflecting a strategic approach to distribute generation and support the national grid.

[3] https://www.nordicsolar.eu/resources/nordic-solar-and-swedbank-enter-into-credit-agreement-for-lithuanias-largest-solar-park

Future Trends

Lithuania is set to expand its PV capacity further, with several new projects in the pipeline. The government's support through auctions and subsidies and increasing interest in community-owned solar farms will likely drive significant growth. The country aims to increase the share of renewables in its energy mix, with solar playing a key role in this strategy.

Wind power industry

Lithuania has been making strides in wind energy, becoming a major contributor to the country's renewable energy mix. Here are some of the largest wind power installations in Lithuania:

1. Enefit Green Wind Park (Šilutė)

- Capacity: 60 MW
- Location: Šilutė, Western Lithuania
- Description: Operated by Enefit Green, this is one of the largest wind farms in Lithuania. It has significantly contributed to the region's energy supply and represents a significant step in Lithuania’s renewable energy strategy. Its coastal location provides favourable wind conditions, making it ideal for wind energy production.

2. Mažeikiai Wind Park

- Capacity: 63 MW
- Location: Mažeikiai, Northwestern Lithuania
- Description: Located near the town of Mažeikiai, this wind farm is one of the most significant projects developed by the Lithuanian energy sector. It was expanded in phases, reflecting a growing trend of investing in wind energy due to the strong wind potential in the region.

3. Eurakras Wind Park

- Capacity: 24 MW
- Location: Jurbarkas district, Southwestern Lithuania
- Description: This wind park consists of multiple turbines spread across the Jurbarkas area. The project was developed to harness the region's wind resources and provide a stable renewable energy output to the local grid.

Offshore Wind Development Plans

Lithuania is also looking to expand its wind energy capacity through offshore wind projects in the Baltic Sea. The country has identified potential areas for offshore wind farms and intends to add several hundred megawatts of capacity by the end of the decade. This initiative will be a crucial part of Lithuania's strategy to enhance energy security and reduce reliance on fossil fuels.

The Lithuanian government has been actively supporting the growth of wind energy through renewable energy auctions and strategic planning. As a result, the share of wind power in the

national energy mix has been steadily increasing. By 2030, Lithuania aims to significantly boost its wind energy capacity, with onshore and offshore projects playing complementary roles.

Hydropower industry

Hydropower is a traditional renewable energy source in Lithuania, contributing to a stable portion of the country's energy mix. Here are some of the most significant hydropower plants:

1. Kaunas Hydroelectric Power Plant

- Capacity: 100.8 MW
- Location: Kaunas, on the Nemunas River
- Description: This is the largest hydropower plant in Lithuania and a critical part of the country's renewable energy infrastructure. Built in the 1960s, it utilises the flow of the Nemunas River, Lithuania's largest river. The plant operates primarily as a peak-load power station, generating electricity when demand is highest. Although it has been operational for decades, it remains a critical renewable energy source.

2. Kruonis Pumped Storage Plant (PSP)

- Capacity: 900 MW (pumped storage)
- Location: Kruonis, near Kaunas
- Description: Unlike traditional hydroelectric plants, the Kruonis PSP is a pumped storage facility, which plays a crucial role in balancing the electricity grid. It stores energy by pumping water to a higher reservoir during low-demand periods and then releases it to generate electricity during peak demand. While it doesn't produce renewable energy directly, it helps integrate other intermittent renewable sources like wind and solar by providing grid stability.

3. Small Hydropower Plants

- Total Capacity: Approximately 25 MW (combined)
- Locations: Various small rivers across Lithuania
- Description: Lithuania also has several smaller hydropower plants distributed nationwide. These small-scale installations, typically ranging from a few hundred kilowatts to a few megawatts, are mainly situated on smaller rivers and streams. They play a role in local electricity supply, especially in rural areas.

Hydropower contributes a modest but reliable portion of Lithuania's electricity generation. The flexibility of hydroelectric plants, especially pumped storage like Kruonis, makes them valuable for maintaining grid stability, particularly as the share of variable renewable energy (e.g., wind and solar) increases.

- Environmental Concerns: There are concerns about the ecological impact of new hydropower projects, especially on river ecosystems and fish migration. This limits the development of new large-scale hydropower plants.
- Pumped Storage Potential: While traditional hydropower expansion is limited, the potential for enhancing the role of pumped storage is significant. Kruonis PSP is seen

as a strategic asset for managing renewable energy fluctuations, and there are discussions about expanding its capacity further to support future energy needs.

Lithuania's strategy focuses more on wind, solar, and bioenergy for new capacity additions, but existing hydropower remains a key part of the energy landscape due to its reliability and flexibility.

Geothermal power industry

Geothermal energy in Lithuania is relatively underdeveloped compared to other renewable energy sources like wind, solar, and hydropower. However, its use has some potential, particularly for heating rather than electricity generation. Here's an overview of the geothermal industry in Lithuania:

1. Geothermal Energy for Heating

- Primary Use: Direct heating applications
- Locations: Mostly in western Lithuania (Klaipėda region)
- Description: Lithuania has low to medium-temperature geothermal resources, primarily located in the western part of the country. These resources are not suitable for large-scale electricity production, but they are well-suited for direct heating purposes. Geothermal energy has been used to provide district heating, which helps reduce the reliance on fossil fuels for heating, especially in urban areas.

2. Klaipėda Geothermal Demonstration Plant

- Capacity: 41 MW (thermal)
- Location: Klaipėda
- Description: This was the Baltic region's first geothermal district heating plant. The Klaipėda Geothermal Demonstration Plant was commissioned in 2004 and used geothermal water from wells about 1.1 km deep to provide heating to the local district heating network. While it was a pioneering project, the plant faced technical and financial difficulties, leading to its temporary closure and eventual shift towards utilising other energy sources.

Geothermal Heat Pumps

- Application: Residential and commercial heating/cooling
- Description: Geothermal heat pumps have become increasingly popular in Lithuania for space heating and cooling. These systems are installed locally, taking advantage of the relatively stable temperatures just a few meters below the surface. They are an efficient way to heat buildings and have seen growing adoption in homes, offices, and commercial buildings.

Challenges for Geothermal Energy Development

- Low-Temperature Resources: Lithuania's geothermal resources are relatively low-temperature, limiting their use for electricity generation. This makes geothermal energy less competitive than wind and solar power, which have seen rapid cost reductions.

- Investment and Technical Issues: The Klaipėda plant's difficulties highlighted some challenges in developing geothermal energy in Lithuania, including financing, drilling, and maintaining efficient operation. This has slowed down further large-scale geothermal projects.

Future Potential

- Heating Sector: Given the growing need for renewable heating solutions, there is still potential for developing small – to medium-scale geothermal projects, particularly for district heating networks and individual heat pump systems. The government may consider supporting such projects to reduce reliance on imported natural gas for heating.
- Hybrid Systems: Combining geothermal with other renewable technologies (like solar or biomass) could enhance the overall efficiency of heating systems, offering a sustainable alternative to conventional heating fuels.

In summary, while geothermal energy has not reached the same level of development as wind or solar in Lithuania, it plays a role in the heating sector, primarily through heat pumps. There is some scope for growth, but the focus will likely remain on heat rather than electricity generation

LEGAL CONDITIONS

European directives, such as the **Renewable Energy Directive II (RED II)**, **Renewable Energy Directive III (RED III)**, and the **Fit for 55** package, have significantly influenced the development of RES in Lithuania. These directives establish ambitious targets and regulatory frameworks, pushing Lithuania to expand its renewable energy capacity, reduce greenhouse gas emissions, and enhance energy security, all in line with EU climate goals.

The **Renewable Energy Directive II (RED II)**, adopted in 2018, set a binding target for the EU to achieve a **32% share of renewable energy** by 2030. Lithuania, in response, aligned its national strategy, setting a goal of reaching at least **45% renewable energy** in its final energy consumption by 2030. This has led to several legal and regulatory changes, including introducing **support schemes** such as feed-in tariffs and auctions to promote investments in wind, solar, and biomass projects. Additionally, Lithuania simplified its permitting procedures for renewable energy installations, making it easier to develop projects, especially in the growing solar energy sector. Furthermore, RED II encouraged Lithuania to promote **community energy projects**, allowing households and businesses to install renewable energy systems and feed excess electricity into the grid.

The proposed **Renewable Energy Directive III (RED III)**, under the **Fit for 55** package, raises the EU renewable energy target to **42.5%** by 2030, with an additional **2.5% indicative target**. Although RED III is still under negotiation, its influence is already evident in Lithuania's policy shifts, especially in the **offshore wind sector**. Lithuania plans to develop large-scale offshore wind farms in the Baltic Sea, which are expected to contribute significantly to the country's energy mix by 2030. Additionally, RED III has led to increased emphasis on **biomass** in district heating systems and the exploration of **green hydrogen** and energy storage solutions to support the integration of intermittent renewables like wind and solar into the national grid.

The **Fit for 55** package, adopted in 2021, aims to reduce EU greenhouse gas emissions by **55%** by 2030. This has further influenced Lithuania's renewable energy development by accelerating investments in offshore wind projects, including a planned **700 MW offshore wind farm** in the Baltic Sea. The package has also driven efforts to modernise Lithuania's electricity grid and invest in **energy storage technologies** to manage the increasing share of renewable energy. In addition, Lithuania is focusing on the **electrification of transport**, expanding EV infrastructure, and promoting the adoption of EVs to reduce emissions in the transport sector, increasing demand for renewable electricity.

As a result of these EU directives, Lithuania has significantly expanded its RES capacity, particularly in **wind** and **solar energy**. Wind energy capacity has grown to approximately **1,400** MW, and solar power has expanded to around 1.3 MW. Biomass continues to play a key role, especially in heating, and future offshore wind projects will further enhance Lithuania's renewable energy portfolio. These developments have contributed to meeting Lithuania's climate targets and improved energy security by reducing reliance on imported fossil fuels.

In conclusion, EU directives such as RED II, RED III, and the Fit for 55 package have been instrumental in shaping Lithuania's renewable energy development. These directives have provided the legal and regulatory framework necessary for expanding wind, solar, and biomass capacity while driving investments in grid modernisation and energy efficiency. Lithuania is on track to meet its renewable energy and decarbonisation goals, contributing to the broader EU objective of achieving climate neutrality.

EU directives, particularly those related to renewable energy and climate action, have significantly influenced changes in Lithuania's national laws. As an EU member state, Lithuania must transpose these directives into national law, resulting in various legal reforms to promote RES, reduce carbon emissions, and improve energy security.

One of the most impactful directives has been the **Renewable Energy Directive (RED II)**, which set binding national renewable energy targets for EU member states. Lithuania revised several national laws to comply with this directive, including the **Law on Energy from Renewable Sources**, which sets clear national targets for renewable energy consumption. This law also mandates support schemes, such as feed-in tariffs and auctions, to incentivise investments in wind, solar, and biomass energy projects. Additionally, Lithuania simplified its administrative procedures, reducing bureaucratic barriers and accelerating the approval process for renewable energy installations, particularly for small-scale and community-based solar and wind projects. In line with RED II's goals of promoting decentralised energy systems, Lithuania's national laws were amended to support self-consumption and energy communities, allowing individuals and businesses to install solar PV systems and sell surplus electricity back to the grid.

The **Fit for 55** package aims to reduce EU-wide greenhouse gas emissions by at least 55% by 2030 and has also played a critical role in shaping Lithuanian climate and energy laws. As part of its commitment to this package, Lithuania updated its **National Energy and Climate Action Plan (NECP)**, outlining national strategies for reducing carbon emissions, increasing the share of renewable energy, and enhancing energy efficiency. Furthermore, the **Law on Climate Change Management Framework** was introduced to ensure national policies align with the EU's decarbonisation goals. This law provides the legal basis for Lithuania's strategies to

reduce emissions, mainly through promoting RES, improving energy efficiency, and participating in emissions trading systems (ETS).

EU directives have also shaped Lithuania's legal framework, promoting a more integrated and competitive electricity market. In compliance with the **Clean Energy for All Europeans** package, national laws were reformed to facilitate the integration of renewable electricity into the grid. These legal changes require transmission and distribution system operators to prioritise renewable energy sources, ensuring that wind and solar projects have guaranteed access to the grid and that the grid infrastructure is upgraded to handle increasing shares of intermittent renewables. Additionally, Lithuania has enacted electricity market liberalisation reforms, allowing consumers to choose their electricity suppliers, promoting green electricity, and encouraging competition in energy production.

In response to the **Energy Efficiency Directive** and the **Effort Sharing Regulation**, Lithuania has adopted laws to improve energy efficiency and decarbonise the transport sector. For example, the **Law on Energy Efficiency** mandates energy-saving programs, promotes energy-efficient building renovations, and encourages energy audits to meet the EU's energy savings targets. In the transport sector, new national laws incentivise the adoption of electric vehicles (EVs), expand EV charging infrastructure, and mandate the use of biofuels in public transportation, reflecting EU policies aimed at reducing emissions from this high-carbon sector.

While Lithuania has made significant progress in aligning its national laws with EU directives, challenges remain, particularly in modernising the grid, integrating energy storage solutions, and decarbonising sectors such as industry and transport. Further legal reforms will be necessary to meet the ambitious targets set under the **RED III** directive and the **Fit for 55** package. For example, new laws will likely be introduced to streamline investments and permit processes for large-scale offshore wind projects as Lithuania prepares to develop offshore wind capacity in the Baltic Sea. Additionally, with the increasing generation of renewable energy, legislation supporting the development and regulation of energy storage systems will be crucial for ensuring grid stability and enhancing the integration of wind and solar energy.

In conclusion, EU directives such as RED II, RED III, and the **Fit for 55** package have been instrumental in shaping Lithuania's national legal framework and driving changes in renewable energy development, energy market reform, and climate policy. These directives have helped Lithuania align its national laws with EU-wide climate goals, supporting its transition to a greener, more sustainable energy system. However, as EU targets become more ambitious, further legal reforms will be required to ensure Lithuania meets its renewable energy and decarbonisation objectives.

Lithuania's national laws play a crucial role in supporting the development of RES, aligning with the country's commitment to EU climate and energy goals. These laws provide the legal framework for promoting investments in renewable technologies, encouraging energy efficiency, and ensuring a smooth transition to a low-carbon economy. Lithuania's legal structure is designed to stimulate the growth of RES, particularly in sectors like wind, solar, and biomass energy.

One of the critical legislative instruments is the **Law on Energy from Renewable Sources**, which sets the foundation for Lithuania's renewable energy policy. This law outlines the national renewable energy targets and establishes various support mechanisms to encourage the

development of RES projects. The law also provides **feed-in tariffs** and **auction-based systems** to incentivise the generation of electricity from renewable sources, creating a stable investment environment for developers. These mechanisms have been instrumental in the growth of wind and solar energy projects, significantly contributing to the country's energy mix.

Additionally, Lithuania has enacted laws that simplify the **administrative procedures** for obtaining permits and licenses for renewable energy projects. These reforms have reduced bureaucratic hurdles and accelerated the development of both large-scale and small-scale renewable installations. For instance, simplified procedures for **solar energy installations** have spurred rapid growth in decentralised energy production, particularly rooftop solar projects for households and businesses. This focus on easing administrative barriers is essential in efficiently meeting the country's renewable energy targets.

Another critical aspect of Lithuania's legal framework is the promotion of **community energy projects**. National laws encourage households, businesses, and communities to invest in small-scale renewable energy systems like solar panels. These systems allow them to produce and consume energy while selling excess electricity back to the grid. This supports the decentralisation of energy production and engages citizens in the energy transition, making renewable energy more accessible.

Nat**ional leg**islation also strongly supports biomass energy development, particularly in the heating sector. Lithuania has significant biomass resources, and laws have been implemented to promote the use of biomass in district heating systems, reducing the country's reliance on imported fossil fuels for heating. Legal incentives for biomass energy include financial support and regulations favouring local biomass resources, further contributing to energy security and sustainability.

Furthermore, Lithuania's laws are aligned with EU directives that focus on **integrating renewable energy into the electricity grid**. National regulations require grid operators to prioritise renewable energy sources, ensuring that wind, solar, and biomass-generated electricity is given preferential access to the grid. This guarantees that renewable energy can be efficiently distributed and consumed, contributing to the overall stability of the national energy system.

Lithuania's national laws promote renewable electricity generation and target the **decarbonisation of the transport sector**. Legal frameworks have been established to encourage the use of **biofuels** and the **electrification of transport**, with policies aimed at increasing the number of EVs and expanding EV charging infrastructure. This complements the country's broader renewable energy strategy by increasing demand for clean, renewable electricity in the transport sector.

In conclusion, Lithuania's national laws strongly support the development of RES, helping to meet the country's renewable energy targets and contributing to the broader EU climate goals. Lithuania has created a favourable environment for expanding renewable energy through feed-in tariffs, simplified administrative procedures, and support for community energy and biomass projects. These laws encourage investment in renewable technologies, promote energy independence, reduce reliance on fossil fuels, and help drive the country towards a more sustainable, low-carbon future.

DETERMINANTS OF DEVELOPMENT

The development of RES in Lithuania is influenced by a combination of factors, including national policies, regulatory frameworks, economic conditions, societal awareness, and technological advancements. Over the years, these factors have evolved, shaping the growth trajectory of RES in the country. Additionally, investment costs in RES have decreased significantly, driven by a mix of global and local influences. At the same time, increased awareness among Lithuanian society has further accelerated the transition toward renewable energy.

One of the primary drivers of RES development in Lithuania is the national policy and legal framework. The Lithuanian government, committed to meeting EU climate and energy targets, has enacted laws that promote the use of wind, solar, and biomass energy. The **Law on Energy from Renewable Sources** provides a legal foundation by setting clear national targets and establishing support mechanisms such as feed-in tariffs and auctions. These have created a stable investment environment for RES projects, leading to significant growth in wind and solar energy installation. Furthermore, Lithuania has streamlined administrative procedures, making it easier for large-scale and small-scale renewable energy projects to obtain permits, particularly in the solar sector. This has helped boost decentralised energy production, with households and businesses increasingly installing rooftop solar systems.

Support from EU directives, particularly the **Renewable Energy Directives (RED II and RED III)** and the **Fit for 55** package, has also played a critical role in shaping Lithuania's renewable energy landscape. These directives mandate the integration of RES into the national energy mix and provide access to financial resources through mechanisms like the **European Green Deal** and the **Recovery and Resilience Facility**. This funding has enabled Lithuania to invest in renewable infrastructure, including wind farms, solar parks, and grid modernisation. Technological advancements have further driven RES development by making renewable technologies more efficient and cost-effective. Improved efficiency in solar panels, wind turbines, and energy storage systems has lowered the cost of producing renewable energy, making it an attractive investment for both private and public sectors. Offshore wind technology, in particular, has advanced significantly, positioning Lithuania to become a leader in offshore wind energy within the Baltic region.

A critical factor in the growth of RES in Lithuania has been the decreasing investment costs, especially in solar and wind energy. The price of solar photovoltaic (PV) panels has decreased by around **80%** over the past decade due to global improvements in manufacturing processes and increased demand. This has made solar energy more accessible and financially viable for households and businesses. The government's support schemes, including subsidies and favourable buyback rates for excess electricity, have further driven the rapid expansion of small-scale solar projects. Wind energy costs have also declined, with advancements in turbine design and efficiency significantly reducing the cost of onshore wind projects. Although initially more expensive, offshore wind is becoming increasingly attractive due to long-term economic benefits such as higher capacity factors and lower maintenance costs.

Market maturity and economies of scale have further reduced RES investment costs in Lithuania. As the renewable energy market has grown, the cost of materials, labour, and installation has decreased. Larger projects with multiple wind turbines or solar installations have benefitted from reduced overall costs, making large-scale renewable energy generation more affordable. Additionally, government incentives and access to EU funding have lowered

the financial burden on investors, encouraging broader participation in renewable energy development. These incentives and favourable financing conditions have helped attract large energy companies and individual households to invest in RES.

Increased societal awareness of climate change and environmental sustainability has also played a significant role in the growth of RES in Lithuania. Public understanding of renewable energy's environmental and economic benefits has shifted in favour of clean energy projects. More individuals and businesses opt for green energy solutions, such as installing solar panels and supporting wind energy development. Citizen engagement in energy production has risen, with community-led renewable energy projects becoming more common. These projects allow individuals to collectively invest in renewable installations, further boosting the country's renewable capacity and engaging the public in the energy transition. The societal push for sustainability has encouraged the government to set more ambitious renewable energy targets and create a favourable political environment for renewable investments.

As awareness of the importance of clean energy grows, Lithuania has seen increased public demand for renewable electricity. This has accelerated the expansion of RES and influenced the government's commitment to ambitious climate targets, such as achieving a **45% share of RES** in the national energy mix by 2030. Public support for clean energy has also shaped policies aimed at grid modernisation, energy storage, and the electrification of transport, which further integrates RES into the energy system.

In conclusion, the development of renewable energy in Lithuania has been shaped by a combination of factors, including national policies, EU directives, technological advancements, decreasing investment costs, and increasing societal awareness. Over time, investment in RES has become more affordable due to global technological improvements, economies of scale, and government support. Additionally, societal awareness of the benefits of renewable energy has driven public engagement, encouraging the government to pursue more ambitious climate goals. These factors collectively position Lithuania to meet its renewable energy targets and contribute to the EU's broader decarbonisation objectives.

BARRIERS TO THE DEVELOPMENT OF RES

While advancing steadily, the development of RES in Lithuania faces several significant barriers that must be addressed to achieve its full potential. These barriers include challenges related to the state of the power grid, the limited availability of energy storage systems, societal opposition through the **NIMBY (Not In My Backyard)** syndrome and environmental concerns. Each of these factors presents unique obstacles that slow down the integration of RES into the national energy mix and create complications for future growth.

One of the primary challenges to the development of RES in Lithuania is the state of the national power grid. Like many countries transitioning to renewable energy, Lithuania's grid infrastructure was initially designed for centralised power generation from fossil fuel-based plants, which deliver steady and predictable outputs. However, integrating large amounts of intermittent renewable energy, particularly wind and solar, presents technical difficulties. The grid must be able to handle fluctuations in energy generation caused by weather conditions, and Lithuania's current grid is not yet fully optimised to handle such variability.

Grid modernisation is essential to accommodate the growing share of renewable energy. This includes expanding grid capacity, improving grid flexibility, and ensuring that the transmission

and distribution networks can manage the increased load and intermittent supply from RES. Innovative grid technologies – which allow for real-time monitoring and more efficient energy distribution – are critical for integrating renewables, but their implementation in Lithuania is still in the early stages. In addition, the existing grid infrastructure, particularly in rural areas, may not be robust enough to support large-scale renewable energy installations, creating bottlenecks in developing new RES projects.

Another significant barrier is the limited availability of energy storage systems. The intermittent nature of renewable energy sources like wind and solar means that energy production does not always coincide with demand. For example, solar energy is only generated during daylight hours, but electricity is needed around the clock. Effective energy storage solutions are essential to balance this supply-demand mismatch. However, Lithuania's energy storage capacity is currently underdeveloped.

Battery storage systems, pumped hydro storage, and other technologies can store excess energy produced during peak generation times and release it when demand is higher, thus stabilising the grid and reducing reliance on backup fossil fuel-based power. While energy storage technology is improving and costs are declining globally, the high initial capital cost of large-scale storage solutions remains a significant barrier for Lithuania. Additionally, regulatory and market structures in the country do not yet fully incentivise investment in storage technologies. The lack of robust storage solutions limits the scalability of RES, as the grid must still rely on conventional energy sources during periods of low renewable generation.

Public opposition, particularly in the form of the NIMBY syndrome, is another significant barrier to RES development in Lithuania. While societal awareness of the benefits of renewable energy has generally increased, there is often local resistance to the construction of renewable energy infrastructure – especially large-scale wind farms and solar parks. Local communities may oppose such developments due to concerns about visual impact, noise, and potential effects on property values.

Wind farms, in particular, face substantial opposition in many parts of the country. Residents living near proposed wind turbine sites often express concerns about the visual disruption of the landscape and the potential health effects of noise generated by turbines. Although research has shown that modern wind turbines are relatively quiet and pose minimal health risks, these concerns persist. Solar installations, while less intrusive, can also encounter opposition if they are perceived to take up valuable land or disrupt local ecosystems. Addressing NIMBYism requires more effective community engagement, transparent planning processes, and possibly compensatory schemes for affected residents, such as offering shares in local renewable energy projects or other forms of economic benefits.

Fortunately, the situation is changing nowadays. The latest survey[4] showed that as many as 77% of Lithuanians believe that it is strategically vital for Lithuania to produce the necessary amount of energy on its own, and almost the same proportion (76%) agree that electricity production from renewable energy sources increases Lithuania's energy independence.

[4] https://curoniannord.com/tyrimas-vejo-elektriniu-parkus-baltijos-juroje-palaiko-dauguma-lietuvos-gyventoju/

In addition, 77% of the population believes that offshore wind farms should be developed in the Baltic Sea to meet the goals of production and energy independence. In comparison, only 9% say they do not favour such projects.

While renewable energy is generally seen as environmentally friendly, the environmental impact of large-scale RES projects can also create barriers. Wind farms, solar parks, and biomass energy plants all require land and resources, which can lead to conflicts with environmental conservation efforts. In Lithuania, wind energy projects, particularly in coastal and forested areas, can negatively affect local wildlife, including birds and bats. The placement of turbines must be carefully planned to minimise disruptions to migration patterns and regional ecosystems.

Additionally, the construction of solar parks can contribute to land use conflicts, especially in rural areas where agricultural land is valuable. Large-scale solar installations may also disrupt local flora and fauna. There is growing pressure to ensure that RES projects adhere to strict environmental standards, including preserving biodiversity and minimising land degradation. Environmental Impact Assessments (EIAs) are mandatory for many renewable energy projects, but navigating these regulatory processes can delay the implementation of projects and increase costs.

Moreover, the development of biomass energy – although renewable – raises questions about sustainability. Lithuania has abundant forestry resources, which are utilised for biomass energy, particularly in heating systems. However, the sustainability of biomass depends on how the resources are managed. Overharvesting forests for biomass production can lead to deforestation, soil degradation, and biodiversity loss. Striking a balance between using biomass as a renewable energy source and ensuring sustainable forest management practices is critical.

INVESTMENT FUNDING – SUPPORT INSTRUMENTS

Lithuania has developed a range of support instruments to promote the development of RES and help the country meet its national and EU-wide climate and energy targets. These support mechanisms encourage investment in wind, solar, biomass, and other renewable technologies by providing financial incentives, simplifying administrative procedures, and creating a favourable regulatory environment. These support instruments are qualified based on specific criteria that ensure alignment with national energy policies and EU directives, particularly the **Renewable Energy Directive (RED II)** and the **Fit for 55** package.

One of the primary support mechanisms in Lithuania is the **auction-based system** for renewable energy projects. Under this scheme, project developers compete in auctions to secure contracts for renewable energy generation, with the winners receiving financial support in the form of guaranteed tariffs or premium payments for the electricity they produce. The government organises these auctions for specific renewable energy technologies, such as wind and solar, and sets capacity targets. The qualification criteria for these auctions are typically based on factors such as the project's cost-effectiveness, technological readiness, and environmental impact. This competitive approach ensures that the most efficient and cost-effective projects are supported while encouraging innovation and reducing overall costs.

In addition to auctions, **feed-in tariffs** (stopped in 2019) and **feed-in premiums** are fundamental support mechanisms, particularly for smaller-scale renewable energy producers.

Feed-in tariffs provide fixed payments to RES producers for each kilowatt-hour (kWh) of electricity they generate, ensuring predictable and stable revenue streams. This mechanism has been essential in promoting the growth of small-scale solar photovoltaic (PV) installations, allowing households and small businesses to invest in renewable energy with a guaranteed return. On the other hand, feed-in premiums offer a premium on top of the market price of electricity, providing additional financial security for producers. Qualification for feed-in tariffs and premiums typically requires compliance with specific technical and environmental standards and registration with national regulatory authorities.

Lithuania also offers **investment subsidies** and **grants** to support the development of RES infrastructure. These financial incentives are available for a wide range of projects, including constructing new renewable energy facilities, modernising existing infrastructure, and deploying energy storage solutions. To qualify for investment subsidies, project developers must meet specific criteria, such as demonstrating the potential for significant renewable energy generation, contributing to energy security, and adhering to sustainability standards. These subsidies are often co-financed through EU funds, such as the **European Regional Development Fund (ERDF)**, which aims to support the transition to a low-carbon economy.

Net metering is another critical support instrument in Lithuania, particularly for small-scale solar producers. Under this system, households and businesses that generate solar panels can feed excess electricity back into the grid and receive credits on electricity bills. This system incentivises self-consumption and reduces overall energy costs for prosumers (producers and consumers of energy). Qualification for net metering requires compliance with grid connection standards and technical regulations to ensure renewable energy's safe and efficient integration into the grid.

Additionally, Lithuania has implemented **tax incentives** to encourage investment in renewable energy. These incentives include tax exemptions or reductions for renewable energy installations and accelerated depreciation for equipment used in renewable energy generation. To qualify for these tax benefits, businesses and individuals must meet specific conditions, such as using certified renewable energy technologies and adhering to national environmental standards.

RES DEVELOPMENT SCENARIOS

The development of RES in Lithuania can be envisioned through several potential scenarios based on policy direction, technological advancements, and investment levels. These scenarios include a **baseline** (business-as-usual) pathway, an **accelerated** (policy-driven expansion) scenario, and a **highly ambitious** (green transformation) approach. Each scenario highlights different levels of progress toward achieving Lithuania’s renewable energy goals, aligning with its commitment to EU climate targets.

In the **baseline scenario**, Lithuania continues its current trajectory with steady progress towards renewable energy targets but without introducing significant new policies or technological breakthroughs. The focus remains on existing strategies, such as expanding onshore wind and small-scale solar installations. Offshore wind development, while promising, progresses slowly due to high upfront costs and infrastructural challenges. Biomass plays a key role, particularly in heating, though its growth remains limited. Energy storage and grid modernisation

investments are modest, and while Lithuania will reach its **45% RES target by 2030**, the pace of decarbonisation slows beyond that point.

The **accelerated scenario** envisions a stronger policy push, increased investments, and faster deployment of RES technologies. Lithuania intensifies its efforts in offshore wind development in the Baltic Sea, with the first large-scale offshore wind farms operational by the early 2030s. Solar energy experiences rapid growth, supported by enhanced residential and large-scale installation incentives. Significant progress has been made in integrating energy storage systems and modernising the grid to accommodate the intermittent nature of renewable sources. In this scenario, Lithuania will surpass its **50% RES share by 2030**, positioning the country on track for achieving long-term decarbonisation goals by 2050.

In the **highly ambitious scenario**, Lithuania undergoes a comprehensive energy transformation driven by aggressive government policies, substantial public and private investments, and breakthroughs in renewable technologies. Offshore wind has become a dominant source of electricity, with gigawatt-scale projects providing a large share of the country's energy. Solar energy deployment accelerates, with urban and rural areas benefiting from solar farms and decentralised rooftop systems. Advanced bioenergy and sustainable biomass technologies are integrated into the energy system, contributing to a circular economy. Energy storage solutions, such as large-scale batteries and pumped hydro storage, are widely implemented, allowing the country to rely heavily on renewables. This scenario also involves sectoral electrification, with EVs and heat pumps powered by renewable energy becoming commonplace. By 2030, Lithuania will achieve a **55-60% RES share**, making significant strides towards **100 % carbon neutrality by 2050**.

SOCIAL ACCEPTANCE

The social acceptance of RES in Lithuania has been steadily increasing in recent years, mainly due to growing awareness of environmental issues, the economic benefits of renewable energy, and the push toward meeting EU climate goals. However, despite this positive trend, there are still challenges related to accepting certain types of renewable energy projects, particularly wind farms, which can face resistance from local communities. Concerns about visual impact, noise, and property values – often referred to as the **NIMBY** syndrome – remain significant barriers to widespread support. The Lithuanian government and various stakeholders have implemented several actions to enhance social acceptance, including public education campaigns, financial incentives, and promoting energy communities.

Public awareness campaigns have been critical to increase public acceptance of RES in Lithuania. These initiatives focus on educating citizens about renewable energy's environmental and economic benefits, emphasising its role in reducing greenhouse gas emissions, increasing energy security, and lowering long-term energy costs. The government has sought to dispel myths and address concerns about renewable energy technologies, particularly wind turbines and large-scale solar installations, through targeted information campaigns. Public education is crucial in building a more informed and supportive public, which is essential for advancing Lithuania's renewable energy goals.

In addition to awareness campaigns, **financial incentives** have been a significant tool for increasing social acceptance. Lithuania offers a range of subsidies and incentives to make renewable energy projects, especially small-scale ones, more financially attractive to

individuals, businesses, and local communities. The introduction of **feed-in tariffs** and the **net metering** system has been particularly effective in encouraging households and businesses to install rooftop solar panels and participate in small-scale renewable energy generation. Under the net metering scheme, energy consumers who generate electricity through solar panels can feed excess power back into the grid, receiving credits on their electricity bills. This lowers energy costs and allows citizens to feel directly involved in the renewable energy transition, fostering a sense of ownership and engagement.

To address the **NIMBY syndrome**, particularly regarding wind energy projects, Lithuania has implemented more **transparent planning processes** and actively engaged local communities in the decision-making process. Public consultations are often held before the construction of large wind farms, allowing residents to express their concerns and influence project outcomes. Some wind energy developers have introduced **compensation schemes** for local communities, offering benefits such as reduced electricity rates or financial compensation to those living near wind turbines. These efforts to mitigate opposition and involve residents in the development process have been vital in increasing social acceptance of wind energy in areas where resistance may have stalled project progress.

A promising development in the effort to increase public involvement and acceptance of renewable energy is the emergence of **energy communities** in Lithuania. Energy communities allow groups of citizens, local businesses, and public institutions to collectively invest in and manage renewable energy projects, such as solar or wind farms. These communities are designed to decentralise energy production, giving local actors a more direct role in generating and consuming renewable energy. The concept aligns with Lithuania's broader strategy of democratising energy production, reducing reliance on large, centralised power plants, and promoting local resilience.

Energy communities in Lithuania are typically structured as cooperatives or collectives, where members pool their financial resources to fund the development of renewable energy installations. These projects can be small-scale, such as rooftop solar panels shared by a group of residents, or more significant ventures, like community-owned wind turbines. The electricity generated is either consumed by the members themselves or sold back to the grid under Lithuania's net metering system, providing financial benefits to the participants. This collective model fosters community ownership and increases public trust and engagement in renewable energy initiatives.

The regulatory framework supporting energy communities in Lithuania has been influenced by EU directives, notably the **Clean Energy for All Europeans** package, which encourages citizen participation in the energy market. Lithuania has integrated these directives into its national legislation, mainly through the **Law on Energy from Renewable Sources**, which outlines the rights and responsibilities of energy communities and simplifies the regulatory process for forming and operating them. This legal framework ensures that energy communities can participate in the energy market on equal terms with traditional energy producers, offering the same opportunities to connect to the grid, receive financial support, and benefit from favourable pricing mechanisms like feed-in tariffs.

Beyond legal support, energy communities in Lithuania also benefit from **investment subsidies** and **tax incentives** designed to lower the financial barriers to entry. These subsidies can help cover the initial costs of installing renewable energy systems, such as solar panels or wind

turbines, making it easier for communities to launch and sustain their projects. Additionally, tax incentives for renewable energy installations help reduce the ongoing operational costs, further enhancing the economic viability of these initiatives. Regulatory support and financial incentives have made energy communities an increasingly attractive option for Lithuanian citizens, businesses, and municipalities.

RECOMMENDATIONS

The *National Energy and Climate Action Plan of the Republic of Lithuania for 2021–2030*[5] outlines several critical recommendations for developing RES in Lithuania. These recommendations are designed to meet the country's ambitious renewable energy and climate targets, focusing on integrating RES into the national energy system and aligning with the European Union's broader decarbonisation and energy independence goals.

First, the plan emphasises the need for a significant increase in the share of RES in Lithuania's energy mix. By 2030, Lithuania aims to achieve a 45% share of RES in final energy consumption. This goal will require substantial investments in wind, solar, and biomass energy, as well as the development of energy storage solutions and smart grid systems to manage the integration of these intermittent energy sources. The plan also highlights the need for further development of wind energy in the Baltic Sea, which could provide up to 1,400 MW of new capacity by 2030.

The plan also addresses the importance of decentralising energy production by promoting small-scale renewable energy installations. This includes encouraging prosumers – energy consumers who generate electricity – and supporting energy communities. The government has established financial incentives, such as subsidies and favourable regulatory conditions, to facilitate the growth of decentralised energy systems. Additionally, a target has been set for 30% of electricity consumers to become active participants in energy generation by 2030.

The plan outlines measures to modernise and expand the electricity transmission and distribution networks to ensure the successful integration of RES into the national grid. This includes the construction of new substations and power lines to accommodate the increased capacity from RES. The plan also stresses the need for innovative technologies, such as controlled transformers and voltage regulators, to maintain grid stability and improve energy transmission efficiency.

Moreover, the plan identifies the transport sector as a critical area for increasing the use of RES. The target is to achieve a 15% share of renewable energy in transport by 2030. This will involve promoting biofuels and electric vehicles and improving infrastructure for charging stations.

Finally, the plan calls for reducing energy poverty, ensuring all residents, particularly vulnerable groups, access affordable and sustainable energy. This will be achieved through targeted support programs, energy efficiency improvements in residential buildings, and the promotion of RES in urban and rural areas.

These recommendations demonstrate Lithuania's commitment to transitioning to a more sustainable energy system, reducing greenhouse gas emissions, and contributing to the European Union's broader climate and energy goals.

[5] https://energy.ec.europa.eu/system/files/2022-08/lt_final_necp_main_en.pdf

The *National Hydrogen Development Guidelines for Lithuania (2024-2050)*[6] Highlight the country's strategic plans for integrating hydrogen as a critical element in decarbonising difficult-to-electrify sectors such as heavy industry, transport, and energy. Lithuania envisions becoming a leader in the Baltic region for producing and exporting green hydrogen, aiming to reduce reliance on imported fossil fuels and lower greenhouse gas emissions.

Lithuania's **green hydrogen strategy** focuses on two development phases: up to 2030 and up to 2050. The initial phase involves creating the necessary hydrogen ecosystem and infrastructure to produce 129,000 tons of green hydrogen annually by 2030 and install **13 GW** of electrolysis capacity. The second phase, extending to 2050, aims to deepen hydrogen integration across multiple sectors, with green hydrogen becoming a critical tool for achieving climate neutrality.

Green hydrogen will play a key role in sectors where direct electrification is either impractical or uneconomical. In **industry**, hydrogen can replace fossil fuels in processes that require high temperatures, such as steel production and chemical manufacturing. In **transport**, green hydrogen and synthetic fuels will be low-emission alternatives for long-haul heavy-duty vehicles, maritime, and aviation sectors where battery-electric solutions face technical and economic challenges. **Energy storage** is another area where hydrogen technologies will help balance the intermittent nature of renewable energy by storing excess electricity generated by wind and solar power.

Lithuania plans to establish hydrogen valleys – geographical regions where hydrogen production and use are concentrated across multiple industries to support hydrogen development. The country also plans to participate in cross-border hydrogen infrastructure initiatives, creating a network of pipelines and storage facilities to facilitate the export and import of hydrogen across Europe.

Lithuania's hydrogen development strategy emphasises the need for regulatory adjustments, public investment, and a favourable environment for private sector involvement. The guidelines set ambitious goals, including regulatory frameworks for hydrogen production, transport, storage, and safety standards. By 2050, green hydrogen is expected to significantly reduce Lithuania’s carbon footprint and enhance energy independence while providing substantial economic benefits through job creation and investments in hydrogen technologies.

[6] https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/10783411040711ef8e4be9fad87afa59?jfwid=jrf97qh9r