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Powering the future: the Baltic States' actions and European implications

Napędzanie przyszłości: działania państw bałtyckich i implikacje dla Europy

Abstract: The Baltic states—Estonia, Latvia, and Lithuania—have long faced energy security challenges due to dependence on Russian energy. The war in Ukraine and the resulting energy crisis accelerated national efforts to diversify energy sources, strengthen infrastructure, and expand renewables. This paper examines key measures undertaken by the Baltic states, including the synchronization of electricity grids with the European network, the development of LNG terminals, expansion of renewable energy capacity, and investments in energy storage. Using qualitative analysis of policy documents, public statements, and quantitative data on energy production and infrastructure, the study provides a comprehensive overview of national initiatives and regional cooperation. Findings show that the Baltic states are enhancing energy independence, improving grid resilience, and supporting broader European energy security objectives. While the focus is primarily national and regional, these initiatives offer important lessons for the EU in promoting energy diversification, infrastructure integration, and alignment of energy and climate policies.

Keywords: Baltic states, energy security, European integration, energy diversification

Streszczenie: Kraje bałtyckie – Estonia, Łotwa i Litwa – od dawna borykają się z problemami związanymi z bezpieczeństwem energetycznym ze względu na zależność od rosyjskich dostaw energii. Wojna na Ukrainie i wynikający z niej kryzys energetyczny przyspieszyły krajowe działania na rzecz dywersyfikacji źródeł energii, wzmocnienia infrastruktury i rozwoju odnawialnych źródeł energii. W niniejszym opracowaniu przeanalizowano kluczowe działania podjęte przez kraje bałtyckie, w tym synchronizację sieci energetycznych z siecią europejską, rozwój terminali LNG, rozbudowę mocy wytwórczych w zakresie energii odnawialnej oraz inwestycje w magazynowanie energii. W oparciu o analizę jakościową dokumentów politycznych, publicznych oświadczeń oraz danych ilościowych dotyczących produkcji energii i infrastruktury, badanie przedstawia kompleksowy przegląd inicjatyw krajowych i współpracy regionalnej. Wyniki pokazują, że kraje bałtyckie zwiększają swoją niezależność energetyczną, poprawiają odporność sieci i wspierają szersze cele europejskiego bezpieczeństwa energetycznego. Chociaż inicjatywy te koncentrują się przede wszystkim na wymiarze krajowym i regionalnym, stanowią one ważną lekcję dla UE w zakresie promowania dywersyfikacji energetycznej, integracji infrastruktury oraz harmonizacji polityki energetycznej i klimatycznej.

Słowa kluczowe: Kraje bałtyckie, bezpieczeństwo energetyczne, integracja europejska, dywersyfikacja energetyczna

1. Introduction

Since the Baltic States have long held a special geopolitical position on the eastern borders of the EU, there has been growing concern about their energy security, especially as tensions in the region have increased. The ongoing energy crisis, driven by the war in Ukraine and the wider geopolitical instability, has presented the Baltic states with a critical opportunity to take control of their energy future and align more closely with the EU's long-term energy security goals. This research explores the measures taken by the Baltic states to protect and diversify their energy supplies. It focuses especially on their efforts to enhance their infrastructure, boost the renewable energy production, and strengthen regional cooperation. An overview of the geopolitical situation and the shifting energy dynamics in the region, explains how the war in Ukraine and the resulting energy crisis have prompted the Baltic states to re-asses their energy policies. This introduction sets the basis for understanding the broader implications of energy security, both regionally and within the EU as a whole.

Next, the article delves into the current state of energy infrastructure in Estonia, Latvia, and Lithuania. Using qualitative research methods, the paper examines the specific energy challenges each country faces. For example, Estonia's reliance on oil shale and its plans to phase out fossil fuels, Latvia's focus on improving energy storage and grid capacity, and Lithuania's strategic development of biofuels and renewable energy sources are all explored in depth. This section highlights the distinct approaches each country has adopted to address energy security while also acknowledging the ongoing challenges they face in building a stable and sustainable energy future. The article further investigates key initiatives that have significantly influenced the region's energy landscape. One such initiative is the synchronization of the Baltic states' electricity grids with the wider European grid, a major achievement in regional cooperation. This project, backed by substantial EU funding, marks a significant break from Russia's energy influence and is an important step toward meeting the EU's energy security objectives. The construction of liquefied natural gas (LNG) terminals and the rapid development of renewable energy projects are also explored, showing how the Baltic states are actively working to reduce their dependence on external energy sources.

In terms of methodology, this study combines qualitative analysis of policy documents, public statements, and secondary sources with quantitative research, such as energy production statistics and infrastructure investment data. This mixed approach allows for a comprehensive understanding of the changes taking

place in the Baltic states' energy sectors. Finally, the paper reflects on the wider implications of these developments for EU energy security.

2. Geopolitical considerations

Estonia, Latvia and Lithuania- commonly known as the "Baltics" or "the Baltic States", are three relatively small countries on the eastern peripheries of the European Union. The difficult location increasingly became a cause of concern in different areas of daily life, among those energy prices and sourcing. Since the Russian military build-up in Ukraine, the energy prices suddenly skyrocketed and instability has been the keyword when addressing availability of gas and electricity in the region.

One example of how the conflict affected the energy sector is Estonia. The country was forced to spike up the use of oil shale to generate electricity, attempting to decrease the supply of natural gas from Russia. According to recent statistics, the use of oil shale dropped again in 2023, reaching 40%. Nonetheless, the government is set to end the usage of oil shale for electricity production by 2035, and ambitiously set also to end the usage of fossil fuel in the energy sector by 2040.[1] For Russia, the energy transition in the Baltic countries has a dual impact. It marks a definitive break with Europe in the energy sector and deprives Moscow of a major lever of influence. In fact, before the war in Ukraine, Russia was the leading supplier of gas and oil to much of the continent, which allowed it to exert pressure on its neighbors. In 2006, when Lithuania sold an oil refinery to a Polish group rather than a Russian one, the Kremlin immediately cut off oil supplies to the country. But today, this monopoly has been broken. Since February 2025, the Baltic states disconnected from the BRELL energy ring and joint the European continental electricity grid via Poland. A flagship project supported by the EU Commission with over 1.23 billion EUR in grants.[2]

The Baltic states' energy disconnection comes amid growing tensions, marked by escalating sabotage in the Baltic Sea and hybrid warfare led by Russia. For several months, there have been suspicions about a Russian "ghost fleet" suspected of attacks on undersea cables. In December 2024, an electricity cable connecting Finland to Estonia (aka Estlink 2) was damaged. Only a few weeks after two telecommunications cables "broke" in Swedish territorial waters. Finnish police suspect the Russian tanker Eagle-S of being involved, having dragged its anchor nearly 100 km along

[1] *Governance agreement for 2021–2023*, Estonian Government 26 January 2021, https://valitsus.ee/en/governance-agreement-2021-2023 [date of cces: 26.01.2021].

[2] European Commission, *Press release on EU funding for Baltic energy projects, 09.02.2025*, https://ec.europa.eu/commission/presscorner/detail/en/ip_25_436 [date of acces: 09.02.2025].

the bottom of the Baltic Sea, severing one of the two cables connecting Estonia to Finland. It must be mentioned that Russia's hybrid warfare is not limited to acts of sabotage. It also involves disinformation, such as the widespread rhetoric claiming that disconnecting the Baltic states from the Russian grid would weaken electricity supplies and cause prices to skyrocket. As a response to these threats, Lithuania and Poland have strengthened the protection of the LitPol Link cross-border power cable, by increasing surveillance, physically securing the infrastructure, and improving coordination between intelligence services. All countries have also reinforced their cybersecurity services. NATO replied with the launch of Operation Baltic Sentinel, aimed at protecting energy infrastructure and submarine cables.[3]

However, Russia's presidential aide and Chairman of the Maritime Board, Nikolay Patrushev, has recently underlined that the tensions in the Baltics Sea area are to increase to due Europe's stance: "Judging by the outcomes of the recent European Union summit, which resolved to pursue large-scale militarization, military threats will only escalate. The current forecast for the Baltic area indicates a deliberate effort to stoke regional tensions by the naval forces of European alliance countries".[4]

2. Status of energy infrastructures in the Baltics

We will explore in the following paragraph the current energy infrastructures situation in the Baltic countries.

2.1. Estonia

Estonia's most relevant mineral resource is oil shale, evaluated at 16 million barrels (World Energy Council, 2024). The country does have favourable conditions to develop RES, especially when it comes to wind power. The coastal regions above all, have high speed wind with reaches of 6.5 m/s. The solar potential on the other hand is not so high, due to unfavourable weather conditions. Indeed, the highest solar GHI only reaches 2.7-2.8 kWh/m2 per day in certain areas such as Saarema Island. Less than 1% of the total Estonian energy production, is accounted for by hydroelectricity. Estonia has a good amount of water resources and hydroelectricity could play a pivotal role in the country's effort to energy transition.

The latest information from the Energy Information Administration, show that the electricity generated by fossil fuels in 2023 was circa 62%, while renewable

[3] ESCP, *Energy independence in the Baltic States, 23 May 2025*, https://major-prepa.com/geopolitique/independance-energetique-pays-baltes/#:~:text=La%20d%C3%A9connexion%20%C3%A9nerg%C3%A9tique%20des%20pays,hybride%20men%C3%A9e%20par%20la%20Russie [date of access: 25.05.2025].

[4] ITAR TASS, *Tensions in Baltic area to increase due to Europe's stance, says Russian presidential aide, 6 February 2025*, https://tass.com/politics/1927071 [date of access: 13.03.2025].

only accounted for the production of 37% of electricity and hydro a mere 0.4%. Among the RES, bioenergy is the most present, with a strong 57%, followed by 22% produced by wind power and 20% by photovoltaics.[5] The most powerful hydro station in Estonia is the Linnamäe power station, located close to the Jägale river. In 2020, Estonia registered about 50 small-scale hydropower plants, up to 10 MW with a total installed capacity of 8.0 MW.[6]

Estonia has good infrastructure for biofuel production, especially in regard to wood pellet production plants. The largest growth registered so far was in solar energy production, which is part of the full RES transition plan. Connecto, in cooperation with Smartecon, is constructing the Raba Solar Park in Pärnu. With a total cost of 7.2 million EUR, the park is set to have a total capacity of 45 MW, with an estimated output to cover the annual energy consumption of almost 14,000 Estonian households.[7] Estonia has significantly expanded the area for wind power development, from 10% to 60% of its territory.[8] According to the Estonian Wind Energy Association, in 2023 wind farms in the country had a total capacity of 457 MW, with a total energy generation of 701 GWh. The largest wind farm is in Laehan County, the Aulepa wind farm, able to power almost 26.000 households for one year thanks to its 48 MW of total capacity[9] (Aenert, 2023).

The next steps are also highlighted by Estonian Minister for Climate Yoko Alender, stating: "Our common goal is to optimise the energy system and reduce costs for consumers. This includes the planning and procurement of external connections and new capacities from 2030 onwards. It is in the interest of Europe and our region to ensure sufficient, safe and secure connections between countries, as already planned with Estlink 3, Latvia 4 and Harmony Link between Poland and Lithuania."[10]

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[5] *Estonia—International energy data and analysis*, https://www.eia.gov/international/overview/country/EST [date of access: 13.03.2025].

[6] European Commission, *Press release on EU funding for Baltic energy projects, 09.02.2025*, https://ec.europa.eu/commission/presscorner/detail/en/ip_25_436 [date of access: 09.02.2025].

[7] *Connecto starts construction of Raba Solar Park in Pärnu County, Estonia 2025,* https://www.connecto.ee/en/connecto-starts-construction-of-raba-solar-park-in-parnu-county-estonia/ [date of access: 13.03.2025].

[8] Expoclima*, Germany, Poland, and Baltic States: Wind energy accelerates transition and strengthens energy independence,* https://www.expoclima.net/germania-polonia-e-stati-baltici-lenergia-eolica-accelera-la-transizione-e-rafforza-lindipendenza-energetica#toc_Stati-baltici--elettricit--pi--pulita-e-reti-pi-interconnesse [date of access: 02.04.2025].

[9] Aenert*, Energy industry in Estonia,* https://aenert.com/countries/europe/energy-industry-in-estonia-/#:~:text=Estonia%20has%20a%20well%2Ddeveloped,production%20in%202023%20%5B15%5D [date of access: 13.03.2025].

[10] Nova News, *Estonian Minister for Climate on the connection to the European grid*, https://www.agenzianova.com/news/la-ministra-estone-per-il-clima-a-nova-lallaccio-alla-rete-europea-e-un-passo-storico/ [date of access: 04.02.2025].

Table 1. Energy Sources in Estonia

Category	**Details**	**Figures**
Fossil Fuels	Oil shale	16 million barrels
*Electricity generation **	Fossil Fuels	62%
	RES	37%
	Hydroelectricity	0.4%
Renewable Energy Sources (RES) – share of production	Bioenergy	57% of RES
	Wind	22% of RES
	Photovoltaics	20% of RES
Hydropower	≤ 10 MW	50 plants- total capacity 8.0 MW
	Contribution to total electricity	<1%
Windpower	Coastal region	Average wind speed 6.5 m/s
	Landa available for development	Expanded from 10% to 60% of territory
	Total installed capacity	457 MW
	Total energy generation	701 GWh
	Largest wind farm	Aulepa, Laehan County, 48 MW ~26,000 households
Solar Power	Potential	GHI 2.7-2.8 kWh//day
	Largest project	Raba Solar Park, 45 MW, ~14,000 households, cost 7.2 million EUR
Bioenergy	Infrastructure	Strong biofuel production- especially wood pellets
Energy Transition plans	Interconnections	Estlink 3, Latvia 4, Harmony Link
	Aim	Optimise energy system, reduce costs, plan new capacities

Sources: World Energy Council, World Energy Trilemma Report 2024, Connecto starts construction of Raba Solar Park in Pärnu County, Estonia 2025, Expoclima. Germany, Poland, and Baltic States: Wind energy accelerates transition and strengthens energy independence, 2025, Estonian Minister for Climate on the connection to the European grid, Nova News 2025

The data in the table reveal a clear energy transition in Estonia: fossil fuels (largely oil shale) still dominate electricity generation at ~62%, but renewables are already accounting for ~37%, with bioenergy the largest share of that (~57%), followed by wind (~22%) and photovoltaics (~20%). The hydropower sector remains negligible (< 1% of total), despite a modest number of small plants. Wind power shows promising installed capacity (457 MW, producing ~701 GWh) and unused land potential, and solar is gaining traction via projects like the 45 MW Raba Solar Park. The presence of abundant bioenergy infrastructure further underpins RES growth.

In terms of policy implications, these figures suggest that Estonia must now shift from building out capacity to optimising integration, flexibility, and grid resilience. Continued reliance on oil shale-16 million barrels equivalent and still supplying most electricity- poses serious challenges under EU carbon and emissions trading regimes. The country will need to accelerate decommissioning of old shale

plants, upgrade grid infrastructure (storage, demand response, interconnectors) and scale variable renewables further. Given Estonia's goals to localise renewable electricity generation and phase out fossil fuels, aligning national policies with EU instruments such as the Just Transition Fund, Innovation Fund, and cohesion funds will become critical. Also, Estonia's planned synchronisation with the European grid via interconnectors (Estlink 3, Harmony Link, etc.) must be supported by domestic flexibility measures to manage intermittency across borders.

2.2. Latvia

The Energy system in Latvia has a strong basis in renewable resources, mainly hydropower infrastructures thanks to the Daugava River but it does not lack wind, solar and biomass resources. Natural gas imports still account for any eventual Energy shortage; however, the country committed to increase their wind and solar Energy capabilities with great improvements already recorded in statistics from 2022. Latvia is also committed to meet the European climate goals, thus needing to improve along renewable sources also energy efficiency. An outline to modernise the grid and expands energy storage has been developed in the National energy and Climate Plan (NECP).[11] Recently, mainly thanks to the Daugava hydroelectric power station, Latvia managed to expand meaningfully their renewable energy capabilities. With a striking 136 MW, wind power capacity almost doubled in 2022, and solar energy significantly increased thanks to state incentives for household solar installations. Even if numbers are getting higher and steadily improving, the capacity of the country to generate wind and solar power are still limited. Electricity consumption is subjected to constant increases, year by year. Up until now, the country relied mainly on electricity produce by hydroelectric power plants and thermal power plants, as natural gas was a relatively cheap resource. Thanks to previous years statistics, specifically from 2017 to 2022, we can see that circa half of the electricity generated in Latvia comes from renewable sources. Some other part is produced by TPPs, and the rest of the electricity needed to satisfy the overall consumption is imported. Renewable sources are highly dependable on the season and the average weather of said season; however, we can approximate that 40% of what Latvia's population consumes in electricity is produced with renewable energy sources. The Latvian electricity network is operated by Augstsprieguma tikls, acronym AST. It comprises of 1,346 km of 330kV lines and 3.893 of 110 kV lines. Other than the synchronisation with EU grid, they have ambitious projects on their way, such as a third link to Estonia and increasing

[11] Latvian Ministry of Economics, *National energy and climate plan 2021–2030,*https://www.em.gov.lv/en/national-energy-and-climate-plan-2021-2030 [date of access: 04.02 2025].

energy storage- particularly with Battery Energy Storage Systems (BESS) projects. Biomethane is also an option currently high in the national debate, the first public biomethane injection point connected to the gas transmission network is set to be open this summer in Džūkste.[12] In July last year, the Cabinet of Ministers approved a programme developed by the Ministry of Climate and Energy, with funding available for investments reaching a staggering 134.4 million EUR. Very relevant are the words from Kaspars Melnis - current Minister for Climate and Energy-regarding energy security in the country, delineating the next step for the country: "The security of citizens, including energy security, is a national priority. Since Russia's brutal invasion of Ukraine, the economic and geopolitical situation in the European Union (EU) has changed significantly. Energy security, the availability of energy resources and the stability of energy prices are at the heart of energy policy. We have abandoned gas and electricity imports from Russia and are actively working to boost our own energy production, paying particular attention to the development of wind and solar projects and strengthening the infrastructure of our electricity supply network. We - a small country with infrastructure needs that outstrip the country's short-term financial capacity - need to make the most of the advantages provided by the EU investment."[13]

Until 2029, a set of projects are set to be implemented in order to better develop the Latvian and Baltic electricity network:

- third electricity interconnection with Estonia,
- the transmission line connection Riga TEC-2- Riga HPP,
- a reconstruction of the 330 kV interconnections between Latvia and Estonia.

There are both private and public energy companies active in the electricity storage sector in the country. Among them, AST and Latvenergo are the most known. Public authorities support decentralised RES and energy storage projects, aiming at a greater energy independence. The AST transmission system operator (aka TSO) signed agreements with 12 solar and wind power developers, to connect renewable energy projects with an overall capacity of 1,100 MW to the transmission network. Eight power stations are due to be connected by the end of this year, while the rest is scheduled to be connected to the transmission network by the end of next year. The same TSO, in cooperation with the German company Rolls-Royce Solutions Gmbh, is currently constructing one of the most powerful BESSs in the EU, with a capacity of 80 MW and storage capacity of 160 MWh.[14]

[12] Bioenergy Insight, *First public biomethane injection point to open in Latvia*, https://www.bioenergy-news.com/news/first-public-biomethane-injection-point-to-open-in-latvia/ [date of access: 13.03.2025].

[13] Government of Latvia — Cabinet of Ministers, *Latvia to invest EUR 134.4 million in energy security and biomethane production*, https://www.mk.gov.lv/en/article/latvia-invest-eur-1344-million-energy-security-and-biomethane-production [date of access: 04.02.2025].

[14] *AST. Europe's most powerful battery energy storage systems to be installed in Latvia for energy security*,

To successfully achieve climate and Energy goals, Latvia is investigating the potential of hydrogen application throughout the transport and electricity sectors. A 2021 study by the Latvian Hydrogen Association, suggests that hydrogen use could rise from 2 TWh in 2030 and reach almost 37 TWh by 2050.[15]

Table 2. Energy in Latvia

Category	**Details**	**Figures**
Electricity generation	Share from renewable sources	~50% of total electricity
	Share of RES in consumption	~40%
	Thermal power plants (TPPs)	Significant portion of remaining electricity
	Electricity imports	Used to meet remaining demand
Hydropower	Major infrastructure	Daugava hydroelectric power station
Wind Power	Capacity increase (2022)	136 MW, almost doubled
	Potential limitations	Still limited compared to overall electricity demand
Solar Power	Capacity increase	Supported by state incentives for households
	Potential limitations	Still limited compared to overall electricity demand
Bioenergy / Biomethane	Biomethane project	First public injection point in Džūkste
Electricity Transmission Network	Operator	Augstsprieguma Tīkls (AST)
	Infrastructure	1,346 km of 330 kV lines; 3,893 km of 110 kV lines
	Future interconnections	Third link to Estonia; Riga TEC-2 – Riga HPP; reconstruction of 330 kV lines with Estonia
Energy Storage	Battery Energy Storage Systems (BESS)	Capacity 80 MW, storage 160 MWh
	Developers connected	12 solar and wind power developers, 1,100 MW total
	Timeline	Eight stations connected by end of 2025; rest by end of 2026
Energy Policy & Investment	Funding	134.4 million EUR approved for energy security and RES investments
	Goals	Increase energy independence, develop wind and solar, modernise grid, expand storage
Hydrogen	Potential use	2 TWh by 2030; 37 TWh by 2050
Energy Challenges	Dependence on natural gas	Previously used for shortages; Russia imports abandoned
Climate & Energy Plans	National Energy and Climate Plan (NECP)	Modernise grid, expand storage, improve energy efficiency

Sources: Latvia to invest EUR 134.4 million in energy security and biomethane production. Government of Latvia — Cabinet of Ministers, 2025, AST. Europe's most powerful battery energy storage systems to be installed in Latvia for energy security, 2024, Bioenergy Insight. First public biomethane injection point to open in Latvia, 2025.

https://ast.lv/en/events/europes-most-powerful-battery-energy-storage-systems-be-installed-latvia-security-energy [date of access: 27.12.2024].

[15] D. Töpler, M. Lehmann, *Hydrogen in Latvia*, https://h2lv.eu/hydrogen/ [date of access: 13.03.2025].

The figures indicate that Latvia already achieves a comparatively high penetration of renewables in its electricity sector (around 50% from RES) and in total consumption (~40%), while still relying on thermal generation and imports to cover residual demand. Its transmission network (over 1,300 km of 330 kV and nearly 3,900 km of 110 kV lines) underpins efforts to integrate new renewables and cross-border flows. The deployment of battery storage systems (80 MW / 160 MWh) and planned interconnections reflect a pivot toward flexibility and grid balancing. Meanwhile, ambitious hydrogen targets (2 TWh by 2030, 37 TWh by 2050) and state investments (~ €134 million) underscore the strategic push to deepen electrification and decarbonisation. From a national policy angle, these data imply that Latvia must now focus heavily on grid adaptation, storage scaling, and demand response mechanisms to absorb variable renewables. While the pace of wind and solar growth is promising, their still limited share relative to demand suggests that permitting, incentives, and public acceptance must be strengthened. The active role of AST in issuing technical specifications for over 6,100 MW of new renewables connections demonstrates a proactive grid planning stance. Moreover, balancing rules (including curtailment mechanisms) must evolve to allow system operators to maintain stability in light of high variable capacity.[16] At the EU / regional level, Latvia's progress positions it as a useful case for structural support under EU funds. The country's synchronisation with the continental grid will require strong backing for cross-border stability investments.

2.3. Lithuania

The largest share of renewable energy is solid biofuels – firewood and wood for fuel and agricultural waste. In 2022, 51.8% of it was used to produce electricity and centrally supplied heat, and 34.1% in households. Energy producers produced 67.2% of all thermal energy produced in power plants and boiler plants from biofuels and 17.1% of all electricity produced in power plants.[17]

In 2022, wind farms operating in Lithuania, together with small wind farms, produced 1.5 TWh of electricity, which accounted for just over a third of all electricity produced in the country, or 11.3% of electricity consumed in the country. Solar power plants generating renewable electricity produced 342.2 million kilowatt hours (kWh) of electricity in 2022, or 79.4% more than in 2021. This increase

[16] AST, *Europe's most powerful battery energy storage systems to be installed in Latvia for energy security*, https://ast.lv/en/events/europes-most-powerful-battery-energy-storage-systems-be-installed-latvia-security-energy [date of access: 27.12.2024].

[17] Official Statistics Portal, *Lithuanian renewable energy resources*,https://osp.stat.gov.lt/lietuvos-aplinka-zemes-ukis-ir-energetika-2023/energetika/atsinaujinantys-energijos-istekliai [date of access: 13.03.2025].

is significantly influenced by consumers producing electricity, whose activities are being developed with increasingly favourable conditions and opportunities to "store" the electricity produced and not consumed for their own needs and the needs of the economy in electricity networks. Hydropower plants produced 464.4 million kWh of electricity in 2022, e.g. 21% more than in 2021. In 2022, compared to 2021, electricity production using biogas increased by 1.35 and amounted to 158.7 million kWh. The use of biofuels reduces environmental pollution. Two types of biofuels are used in Lithuania – biodiesel and bioethanol. In 2022, 113.2 thousand tons of biodiesel and 30.5 thousand tons of bioethanol were consumed in the transport sector.[18] In the first half of 2024, solar and wind energy plants produced around 70% of the electricity. RES allowed for a production increased capacity on the grid, approximately by 1/5 to 2 885 MW.

Litgrid is the Lithuanian electricity transmission system operator (aka TSO), responsible for the country´s electricity transmission network and its development. Lithuania has more than 7000 km of electricity transmission lines and cables with installed capacity varying between 400, 330 and 110 kV. The storage needs of the national electricity grid are mainly covered by the Kruonis hydro-accumulation plant (KHPP). The latter is currently undergoing some works to expand the technical capabilities thanks to a new unit. Unit 5's generator and pump are set to increase the plant's power capacity to allow the plant to take part effectively in the common EU balancing market. To add to national energy security projects, in October 2023 the Vilnius Transformer Substation has been launched. This is one of Europe´s largest 200 MW BESS. The batteries can provide power for approx. 1 hour, or until another source of power production gets online.[19]

The next steps to ensure the country's energy reliability and security are outlined in the National Energy Independence Strategy:

- completion of the Gas Interconnection Poland–Lithuania (GIPL),
- more effective use of the liquefied natural gas (LNG) terminal in Klaipėda.

[18] Official Statistics Portal, *Lithuanian renewable energy resources*,https://osp.stat.gov.lt/lietuvos-aplinka-zemes-ukis-ir-energetika-2023/energetika/atsinaujinantys-energijos-istekliai [date of access: 13.03.2025].

[19] Lietuvos Respublikos Energetikos Ministerija, *Increasing the resilience of the power system: One of the most important energy projects is under way*,https://enmin.lrv.lt/en/news/increasing-the-resilience-of-the-power-system-one-of-the-most-important-energy-projects-is-under-way/ [date of access: 04.02.2025].

Table 3. Energy in Lithuania

Category	Details	Data / Figures
Renewable Energy – Biofuels	Solid biofuels (firewood, wood fuel, agricultural waste)	51.8% used for electricity & central heat; 34.1% used in households
	Thermal energy from biofuels	67.2% of thermal energy in power & boiler plants
	Electricity from biofuels	17.1% of total electricity
Wind Power	Electricity production	1.5 TWh in 2022
	Share of total electricity production	~33%
	Share of electricity consumption	11.3%
Solar Power	Electricity production	342.2 million kWh in 2022 (+79.4% vs 2021)
Hydropower	Electricity production	464.4 million kWh in 2022 (+21% vs 2021)
Biogas	Electricity production	158.7 million kWh in 2022 (+1.35 vs 2021)
Biofuels – Transport	Biodiesel consumption	113.2 thousand tons in 2022
	Bioethanol consumption	30.5 thousand tons in 2022
RES Contribution (H1 2024)	Solar & wind production	~70% of electricity
	Grid capacity increase	+1/5 → 2,885 MW
Electricity Transmission	Operator	Litgrid (TSO)
	Network infrastructure	>7,000 km of lines & cables; 400 kV, 330 kV, 110 kV
Energy Storage	Hydro-accumulation	Kruonis Hydro-Accumulation Plant (KHPP), undergoing upgrade (Unit 5)
	BESS	Vilnius Transformer Substation, 200 MW, provides power ~1 hour
Energy Security Projects	Gas interconnection	Completion of Poland–Lithuania GIPL
	LNG terminal	More effective use of Klaipėda terminal

Sources: Lithuanian renewable energy resources. Official Statistics Portal, 2023, Increasing the resilience of the power system: One of the most important energy projects is under way, Lietuvos Respublikos Energetikos Ministerija. 2022, National energy independence strategy. Ministry of Energy of the Republic of Lithuania 2018.

The Lithuania data point to a mature and increasingly diversified renewable portfolio: solid biofuels dominate in both heat (67.2 % of thermal energy) and electricity (17.1 % of total), while wind, solar, hydro, and biogas are all expanding—

wind alone contributing ~1.5 TWh (≈33% of domestic electricity production, ~11.3% of consumption) in 2022. Solar and hydro saw strong year-on-year growth (+79.4% and +21% respectively), and the grid's allowed renewable capacity has recently jumped by one-fifth to ~ 2,885 MW, underscoring dynamic scaling. The network backbone (over 7,000 km of lines) and storage assets (notably the Kruonis pumped storage and emerging BESS) support this diversification drive. From a national policy perspective, these trends imply that Lithuania must now concentrate on integration, flexibility, and leveraging cross-sector synergies. The growth in variable renewables demands enhanced grid management systems, demand response, and energy storage upgrades. The country's 100% renewable electricity goal by 2030 (with a shift toward a fully electrified energy system) hinges on coupling generation expansion with robust system flexibility measures. The Lithuania 100 study shows that the country has the technical potential to meet 2030 electricity demand with 100% renewables under diverse scenarios).[20] At the EU / regional level, Lithuania's trajectory aligns well with European Green Deal ambitions, but it also underscores the need for targeted support in grid reinforcement, cross-border balancing, and storage deployment. Lithuania is well positioned to access EU funding and already participates in several ERDF-supported initiatives in the energy field—such as the *Energy Equilibrium*[21] project under the Interreg Baltic Sea Region programme.[22] However, the country remains somewhat underrepresented in this domain, often taking the role of a project partner rather than assuming leadership positions, despite its strong potential to act as a lead partner in renewable energy projects.

The following comparative table brings together the key indicators from Estonia, Latvia, and Lithuania, offering an overview of their respective energy profiles and highlighting both common trends and national specificities in their transition toward greater energy independence.

[20] J. Jorgenson, K. Doubleday, I. Chernyakhovskiy, K. Obika, T. Williams, E. Rosenlieb, V. Igwe, *The Lithuania 100% Renewable Energy Study – Interim Results: Electricity System Scenarios for 2030*. Golden, CO: National Renewable Energy Laboratory, 2024. NREL/PR-6A40-89564. https://www.nrel.gov/international/lithuania-100-renewable-energy-study.html 89564 [date of access: 04.02.2025].

[21] Energy Equilibrium. Baltic Sea Region, Interreg, https://interreg-baltic.eu/project/energy-equilibrium/ [date of access: 13.03.2025].

[22] Baltic Sea Region. Interreg, https://interreg-baltic.eu/ [date of access: 13.03.2025].

Table 4. Comparison – Energy in Estonia, Latvia, and Lithuania

Category	Estonia	Latvia	Lithuania
Fossil Fuels	Oil shale (16 million barrels); ~62% of electricity (2023)	Natural gas used for shortages; previously cheap; imports from Russia abandoned	Gas used for energy security; LNG terminal |in Klaipėda
Total RES share of electricity	37% (2023)	~50% of electricity generation; ~40% of consumption	H1 2024: ~70% from solar & wind; 2022: biofuels & other RES significant
Bioenergy / Biofuels	Strong infrastructure; wood pellets	Biomethane first public injection in Džūkste; public & private projects	Solid biofuels (firewood, wood, agricultural waste): 51.8% for electricity/heat, 34.1% in households; transport biodiesel 113.2k tons, bioethanol 30.5k tons
Wind Power	Coastal regions: 6.5 m/s; capacity 457 MW (2023), 701 GWh; largest wind farm Aulepa 48 MW	136 MW in 2022, almost doubled; still limited capacity	1.5 TWh in 2022; ~33% of electricity production; 11.3% of consumption
Solar Power	Low GHI: 2.7–2.8 kWh/m^2/day; Raba Solar Park 45 MW (~14,000 households)	Significant increase due to household incentives; limited overall capacity	342.2 million kWh in 2022 (+79.4% vs 2021); favorable conditions for prosumers
Hydropower	<1% of electricity; 50 small-scale plants, Linnamäe largest	Major source from Daugava; seasonal dependent	464.4 million kWh in 2022 (+21% vs 2021); Kruonis hydro-accumulation plant
Biogas	–	Investigating hydrogen potential; biogas potential implied	158.7 million kWh in 2022 (+1.35 vs 2021)
Electricity Transmission / TSO	–	AST: 1,346 km (330 kV), 3,893 km (110 kV)	Litgrid: >7,000 km; 400, 330, 110 kV
Energy Storage	–	Battery Energy Storage System: 80 MW / 160 MWh; projects ongoing	Kruonis hydro-accumulation plant upgrade; Vilnius Transformer Substation 200 MW, ~1 hour backup
Energy Infrastructure / Projects	Wind expansion from 10% to 60% of territory; interconnections planned (Estlink 3, Harmony Link)	12 RES developers connected (1,100 MW); interconnections with Estonia; grid modernization	GIPL gas interconnection; more effective LNG terminal use; increased RES capacity on grid (+1/5 → 2,885 MW)
Policy / Goals	Optimize energy system, reduce costs, increase RES	Energy independence, wind & solar expansion, climate goals, grid modernization	National Energy Independence Strategy; RES expansion, energy security, grid modernization, storage & hydrogen potential

Source: own study, compiled by author based on the sources previously quoted in the other tables available in this article.

The comparative data highlight how the three Baltic states, despite differing resource endowments and energy legacies, are converging toward the same strategic objective—full energy independence within a decarbonised European framework. Estonia is advancing rapidly in wind and solar deployment, Latvia leverages hydropower and grid flexibility, while Lithuania leads in bioenergy integration and storage innovation. Collectively, their progress illustrates the value of regional complementarity: by pooling strengths and aligning investments, the Baltics not only reinforce their own security but also contribute to the EU's broader goals of resilience, market integration, and a unified low-carbon energy system.

3. Baltic leadership & Implications for the EU

For the Baltic countries, energy independence represents a strategic step forward, but it also poses economic challenges. For decades, the Baltic states—Estonia, Latvia, and Lithuania—were heavily reliant on Russian energy supplies, particularly after the closure of the Ignalina Nuclear Power Plant. As Romas Švedas, former Vice-Minister of Energy of Lithuania, noted, Lithuania's energy system became 70–80% dependent on Russian supplies, rendering it vulnerable to potential political or economic leverage by Russia. This dependency was exemplified in 2006 when the supply of oil through the Druzhba pipeline was disrupted following Lithuania's decision to sell its Mažeikiai refinery to Poland instead of Russia. Additionally, gas prices for Lithuania were set higher than for Western Europe due to the lack of alternative suppliers until the Klaipėda liquefied natural gas (LNG) terminal began operations in 2014.[23]

The integration of the Baltic countries into the European electricity grid is a major achievement for the European Union. Now fully sovereign over their supply, they no longer depend on Moscow. Since they gave up the BRELL system, the Baltic states are in full control of their energy infrastructure, thus ending the danger of energy being used as a political weapon. This security in terms of energy supply is, yes, a benefit for the three countries involved, but it strengthens the entirety of the European network. However, this success must be put in perspective. To replace Russian gas, Europe is now importing American shale gas, replacing one dependency with another. The challenge is therefore to achieve sufficient diversification so that no external actor can exert pressure on the EU. As for its own infrastructure, the EU must ensure that it is entirely its own and that it is resilient to external threats, in order to ensure strategic autonomy. From

[23] M. Giuli, S. Oberthür, *Third time lucky? Reconciling EU climate and external energy policy during energy security crises*, "Journal of European Integration" 2023, no. 45(3), pp. 395–412.

an economic point of view, the new energy link between Western Europe and the Baltic countries fuels hopes for increased European competitiveness, according to the vision of Mario Draghi, for whom European competitiveness is based on a single energy market.[24]

Beyond achieving energy independence, the Baltic states are slowly emerging as leaders in renewable energy within the European Union. All three countries are actively developing onshore and offshore wind projects, adhering to the EU's recommendations for simple Contracts for Difference (CfD) auctions. Estonia is enhancing its wind energy capacity by installing new radar systems to minimize distortions from wind farms, thereby expanding the area suitable for wind energy development from 10% to over 60% of the country. Latvia has expedited environmental permits for its first 400 MW of onshore wind and plans additional projects in state-owned forests. Lithuania is exploring innovative ways to electrify industry using wind energy. Malgosia Bartosik, Deputy Chief Executive Officer, European Wind Energy Association, commended the Baltic states, stating, "Estonia, Latvia and Lithuania are models for how renewables enhance energy security and competitiveness. The enthusiasm and determination of their Governments and stakeholders involved in wind is stunning."[25] Regarding gas supply, alternative infrastructure helps ensure network stability. In Lithuania, the floating LNG regasification terminal, named "Independence," plays a key role: it receives liquefied natural gas (LNG), mainly from the United States and Norway. After regasification, this gas is then distributed throughout Lithuania and the rest of the Baltic states. Some countries are also developing the exploitation of their own reserves, such as Latvia and Estonia, with oil shale. The Baltic states are not alone in this approach. Ukraine and Moldova have also chosen to redirect their energy ties toward the European Union, marking a definitive break with their former Russian partner, which has become a threat. Because "being sovereign over one's energy means being sovereign over one's own territory"[26] as Ursula von der Layen points out.

[24] ESCP, *Energy independence in the Baltic States, 23 May 2025*, https://major-prepa.com/geopolitique/independance-energetique-pays-baltes/#:~:text=La%20d%C3%A9connexion%20%C3%A9nerg%C3%A9tique%20des%20pays,hybride%20men%C3%A9e%20par%20la%20Russie [date of access: 25.05.2025].

[25] WindEurope, *Power shift: How the Baltic synchronisation strengthens Europe's energy security*, https://windeurope.org/news/power-shift-how-the-baltic-synchronisation-strengthens-europes-energy-security/ [date of access: 04.02.2025].

[26] ESCP, *Energy independence in the Baltic States, 23 May 2025*, https://major-prepa.com/geopolitique/independance-energetique-pays-baltes/#:~:text=La%20d%C3%A9connexion%20%C3%A9nerg%C3%A9tique%20des%20pays,hybride%20men%C3%A9e%20par%20la%20Russie [date of access: 25.05.2025].

Conclusion

The journey of the Baltic states—Estonia, Latvia, and Lithuania—towards energy independence marks a remarkable transformation in a region that for decades relied heavily on Russian energy supplies. Over the past ten years, these countries have pursued a wide-ranging strategy aimed at diversifying energy sources, modernizing infrastructure, and integrating renewable energy into their national grids. These efforts, motivated by both geopolitical pressures and climate objectives, have allowed the Baltic states to reduce their dependence on external suppliers and build energy systems that are increasingly resilient and self-sufficient.

In Estonia, the energy transition has focused on gradually phasing out fossil fuels, particularly oil shale, which once played a dominant role in electricity generation. Even as recently as 2023, fossil fuels accounted for approximately 62% of Estonia's electricity, while renewable energy sources made up 37%, with bioenergy representing the majority of the renewable share and wind and solar contributing 22% and 20%, respectively (EIA, 2023). The country has invested heavily in wind energy, expanding suitable land for wind farms from 10% to 60% of its territory,[27] and it has developed the Raba Solar Park, projected to generate 45 MW—enough to supply roughly 14,000 households annually.[28] Estonia's infrastructure investments, including interconnections like Estlink 3 and Harmony Link, demonstrate a deliberate approach to system reliability, efficient electricity flows, and regional cooperation.[29]

Latvia has taken a complementary approach, making use of its hydropower resources along the Daugava River while rapidly increasing wind and solar capacities. By 2022, wind power capacity had nearly doubled to 136 MW, and solar energy production rose sharply, spurred by household incentives. Latvia has also implemented energy storage solutions, including an 80 MW, 160 MWh battery system[30], and is exploring the use of hydrogen for future energy diversification, with projections of up to 37 TWh by 2050.[31] These initiatives not only expand

[27] Expoclima, *Germany, Poland, and Baltic States: Wind energy accelerates transition and strengthens energy independence*, https://www.expoclima.net/germania-polonia-e-stati-baltici-lenergia-eolica-accelera-la-transizione-e-rafforza-lindipendenza-energetica#toc_Stati-baltici--elettricit--pi--pulita-e-reti-pi--interconnesse [date of access: 02.04.2025].

[28] *Connecto starts construction of Raba Solar Park in Pärnu County, Estonia 2025*, https://www.connecto.ee/en/connecto-starts-construction-of-raba-solar-park-in-parnu-county-estonia/ [date of access: 13.03.2025].

[29] Nova News, *Estonian Minister for Climate on the connection to the European grid*, https://www.agenzianova.com/news/la-ministra-estone-per-il-clima-a-nova-lallaccio-alla-rete-europea-e-un-passo-storico/ [date of access: 04.02.2025].

[30] AST*, Europe's most powerful battery energy storage systems to be installed in Latvia for energy security*, https://ast.lv/en/events/europes-most-powerful-battery-energy-storage-systems-be-installed-latvia-security-energy [date of access: 27.12.2024].

[31] D. Töpler, M. Lehmann, *Hydrogen in Latvia, 2021*, https://h2lv.eu/hydrogen/ [date of access: 13.03.2025].

renewable capacity but also strengthen grid reliability and cross-border connections with Estonia and other neighboring countries.

Lithuania has pursued a similar path, emphasizing bioenergy alongside wind, solar, and hydropower while investing in grid modernization and storage capacity. In 2022, biofuels accounted for over half of electricity and heat production, while wind and solar together contributed around 70% of electricity generation in the first half of 2024. Investments in the Kruonis hydro-accumulation plant and the Vilnius 200 MW battery storage system have enhanced system flexibility, allowing better integration of variable renewable sources. Additionally, the Gas Interconnection Poland–Lithuania (GIPL) and the Klaipėda LNG terminal have provided alternative energy sources, reducing Lithuania's dependence on Russian gas.

Taken together, the achievements of the Baltic states reflect a combination of national determination and regional collaboration. The disconnection from the BRELL network in February 2025 and the integration of Baltic grids into the European electricity network represent a historic milestone. By assuming full control over their energy systems, Estonia, Latvia, and Lithuania have eliminated a significant source of external influence, enhancing domestic security while also contributing to the stability of the European energy network.[32] As Ursula von der Leyen observed, "[b]eing sovereign over one's energy means being sovereign over one's own territory,"[33] underscoring the strategic significance of these national achievements for the Union.

Beyond these national gains, the Baltic experience offers valuable lessons for the EU. While the states' actions are focused domestically, their successful integration into the European network shows how coordinated infrastructure investment, renewable deployment, and storage development can strengthen resilience across a region. Countries with limited energy resources can use policy, technology, and investment to reduce vulnerability to external shocks, integrate renewables at scale, and support broader EU objectives in energy diversification, decarbonization, and market integration.

Nonetheless, challenges remain. Achieving full energy self-sufficiency will require roughly doubling electricity capacity, enhancing cross-border interconnections, and further reinforcing grid resilience and critical infrastructure protection. Financing these projects continues to be a hurdle, especially in markets with low

[32] European Commission, *Press release on EU funding for Baltic energy projects, 09.02.2025*, https://ec.europa.eu/commission/presscorner/detail/en/ip_25_436 [date of access: 09.02.2025].

[33] ESCP, *Energy independence in the Baltic States, 23 May 2025*, https://major-prepa.com/geopolitique/independance-energetique-pays-baltes/#:~:text=La%20d%C3%A9connexion%20%C3%A9nerg%C3%A9tique%20des%20pays,hybride%20men%C3%A9e%20par%20la%20Russie [date of access: 25.05.2025].

electricity prices and underdeveloped capital sectors.[34] Coordinating policies among the Baltic states and EU partners will be crucial to ensure system stability and protect against geopolitical risks, including sabotage and cyberattacks.

In conclusion, the Baltic states have made substantial progress in transforming their energy sectors, reducing dependence on Russian energy, and establishing themselves as resilient and innovative actors within Europe. Their investments in infrastructure, renewable energy, and regional cooperation enhance national security while supporting EU-wide energy resilience. By documenting these strategies and outcomes, this study highlights practical lessons for policymakers and stakeholders aiming to balance energy security, sustainability, and regional integration. The Baltic experience demonstrates that well-coordinated national action can advance domestic priorities while reinforcing wider European energy objectives, offering a model for other regions navigating complex energy transitions in challenging geopolitical contexts.

Bibliography

1. Aenert, *Energy industry in Estonia, 2023,* https://aenert.com/countries/europe/energy-industry-in-estonia/#:~:text=Estonia%20has%20a%20well%2Ddeveloped,production%20in%202023%20%5B15%5D.
2. AST, *Europe's most powerful battery energy storage systems to be installed in Latvia for energy security*, 2024, https://ast.lv/en/events/europes-most-powerful-battery-energy-storage-systems-be-installed-latvia-security-energy.
3. Baltic Sea Region, https://interreg-baltic.eu/.
4. Bioenergy Insight, *First public biomethane injection point to open in Latvia,* https://www.bioenergy-news.com/news/first-public-biomethane-injection-point-to-open-in-latvia/.
5. *Connecto starts construction of Raba Solar Park in Pärnu County, Estonia 2025,* https://www.connecto.ee/en/connecto-starts-construction-of-raba-solar-park-in-parnu-county-estonia/.
6. Energy Equilibrium, https://interreg-baltic.eu/project/energy-equilibrium/.
7. ESCP, *Energy independence in the Baltic States, 23 May 2025,* https://major-prepa.com/geopolitique/independance-energetique-pays-baltes/#:~:text=La%20d%C3%A9connexion%20%C3%A9nerg%C3%A9tique%20des%20pays,hybride%20men%C3%A9e%20par%20la%20Russie.
8. Estonia—International energy data and analysis. Energy Information Administration, https://www.eia.gov/international/overview/country/EST.
9. Estonian Government, *Governance agreement for 2021–2023,. 26.01.2026*, *2021, January 26).* https://valitsus.ee/en/governance-agreement-2021-2023.
10. European Commission, *Press release on EU funding for Baltic energy projects, 09.02.2025,* https://ec.europa.eu/commission/presscorner/detail/en/ip_25_436.

[34] V. Vilčinskas, A. Budžytė, *Factors explaining energy consumption behavioral intentions in Lithuania*, "Journal of Baltic Studies" 2024, no. 55(1), pp. 91–108.

11. Expoclima, *Germany, Poland, and Baltic States: Wind energy accelerates transition and strengthens energy independence,* https://www.expoclima.net/germania-polonia-e-stati-baltici-lenergia-eolica-accelera-la-transizione-e-rafforza-lindipendenza-energetica#toc_Stati-baltici--elettricit--pi--pulita-e-reti-pi--interconnesse.
12. Giuli M., Oberthür S., *Third time lucky? Reconciling EU climate and external energy policy during energy security crises*, "Journal of European Integration" 2023, no. 45(3), pp. 395–412.
13. Government of Latvia — Cabinet of Ministers, *Latvia to invest EUR 134.4 million in energy security and biomethane production,*https://www.mk.gov.lv/en/article/latvia-invest-eur-1344-million-energy-security-and-biomethane-production.
14. ITAR TASS, *Tensions in Baltic area to increase due to Europe's stance, says Russian presidential aide, 6 February 2025,* https://tass.com/politics/1927071.
15. Jorgenson J., Doubleday K., Chernyakhovskiy I., Obika K., Williams T., Rosenlieb E., Igwe V., *The Lithuania 100% Renewable Energy Study – Interim Results: Electricity System Scenarios for 2030*. Golden, CO: National Renewable Energy Laboratory, 2024. NREL/PR-6A40-89564, https://www.nrel.gov/international/lithuania-100-renewable-energy-study.html.
16. Latvian Ministry of Economics, *National energy and climate plan 2021–2030,* https://www.em.gov.lv/en/national-energy-and-climate-plan-2021-2030.
17. Lietuvos Respublikos Energetikos Ministerija, *Increasing the resilience of the power system: One of the most important energy projects is under way,*https://enmin.lrv.lt/en/news/increasing-the-resilience-of-the-power-system-one-of-the-most-important-energy-projects-is-under-way/.
18. Ministry of Energy of the Republic of Lithuania, *National energy independence strategy*, https://enmin.lrv.lt/uploads/enmin/documents/files/National_energy_independence_strategy_2018.pdf.
19. Nova News, *Estonian Minister for Climate on the connection to the European grid,* https://www.agenzianova.com/news/la-ministra-estone-per-il-clima-a-nova-lallaccio-alla-rete-europea-e-un-passo-storico/.
20. Official Statistics Portal, *Lithuanian renewable energy resources,* https://osp.stat.gov.lt/lietuvos-aplinka-zemes-ukis-ir-energetika-2023/energetika/atsinaujinantys-energijos-istekliai.
21. Official Statistics Portal, *Sources: Lithuanian renewable energy resources*., 2023, Increasing the resilience of the power system: One of the most important energy projects is under way, Lietuvos Respublikos Energetikos Ministerija. 2022.
22. National energy independence strategy. Ministry of Energy of the Republic of Lithuania 2018.
23. *Sources: Lithuanian renewable energy resources,* Töpler D., Lehmann M., *Hydrogen in Latvia,* https://h2lv.eu/hydrogen/.
24. Vilčinskas V., Budžytė A., *Factors explaining energy consumption behavioral intentions in Lithuania*, "Journal of Baltic Studies" 2024, no. 55(1), pp. 91–108.
25. WindEurope, *Power shift: How the Baltic synchronisation strengthens Europe's energy security,* https://windeurope.org/news/power-shift-how-the-baltic-synchronisation-strengthens-europes-energy-security/.
26. World Energy Council, *World Energy Trilemma Report 2024,* https://www.worldenergy.org/publications/entry/world-energy-trilemma-report-2024.