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Impact of the global energy crisis on the energy security of the Baltic States after 2022

Abstract. The purpose of the study was to determine the consequences of energy market destabilisation after 2022 for the processes of autonomy of infrastructure in Lithuania, Latvia, and Estonia. The methodology of the research covered the use of retrospective, content and analytical, structural and functional, and prospective analysis. Methods of comparative statistics, time series analysis, case studies, and cross-analysis were also used. It was established that the introduction of short-term fiscal instruments, in particular the establishment of price thresholds at the level of 12 cents in Estonia, the introduction of a system covering 50% of the cost of heating over the limit of EUR 68 per resource unit in Latvia, and the allocation of more than EUR 570 million for subsidies in Lithuania, helped to maintain internal stability. The results confirmed the complete rejection of imports via eastern pipelines, which led to reduction of inflation rates from 24% to below 3%. The achievement of full physical autonomy of the region through successful desynchronisation from the electric ring system (Belarus, Russia, Estonia, Latvia, and Lithuania) and integration into the European network of Transmission System Operators for Electricity, which technically completed the process of getting out of the external infrastructure influence, was substantiated. The study revealed a radical increase in the role of private producers which independently generate a resource, and the active construction of offshore wind parks, which already meet a third of the region's needs. It was determined that the purchase of a strategic vessel for receiving liquefied fuel in state ownership at the end of 2024 provided the system with the necessary margin of safety. It was confirmed that the level of filling of underground storage facilities has reached a record 98%, creating a reliable buffer against hybrid threats. The success of implementing intelligent network management systems has been proven, which reduced the number of emergency outages by 15% in 2024 compared to pre-crisis 2021. The analysis recorded the establishment of a new hydrogen corridor that turns the region into a supplier of clean energy for neighbouring states. The data obtained indicate a transformation from a vulnerable periphery to a centre of stability. The practical significance of the study lies in the possibility of using its results by state governments and institutions of the European Union to develop strategies for energy sovereignty and protect critical infrastructure from hybrid threats

Keywords: households; sustainability; sovereignty; diversification; threats

Introduction

The relevance of the study of the transformation of energy security in the Baltic States is conditioned by the major shift in the geopolitical architecture of Europe, which was provoked by the full-scale invasion of Ukraine by the Russian Federation in February 2022. This event not only destroyed economic ties, but also highlighted the critical vulnerability of European states that relied on importing cheap energy from an authoritarian source. For Lithuania, Latvia, and Estonia, which were historically within the BRELL energy ring (B – Belarus, R – Russia, E – Estonia, L – Latvia, L – Lithuania), the issue of energy sovereignty acquired the status of an existential challenge, which required the immediate deconstruction of infrastructure dependence and the transition to a model of full strategic autonomy. The problem of the study was the need for a comprehensive analysis of how the governments of these states were able to implement a complex process of desynchronisation and diversification in the face of extreme price shock and constant hybrid threats. This requires a detailed study of both institutional decisions and socio-psychological aspects of the perception of security by the population, which previously remained on the periphery of scientific discussions.

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In the scientific literature, the degree of development of the topic of energy security in the Baltic States has increased since 2022, which allows identifying key areas of research. N. Trushkina (2025) examined the complex relationship between energy security and political stability within the European Union (EU) in light of geopolitical upheavals. The researcher proved that the future political cohesion of the union depends on the ability to combine energy sustainability with climate commitments, while mitigating the socio-economic consequences of the "green" transition. M.H. Sivonen & P. Kivimaa (2024) analysed the level of securitisation of the energy transition in Estonia, Finland, and Norway through in-depth interviews with defence and energy sector experts. Their findings showed that in Estonia, threats were directly related to the preservation of state sovereignty, while in Norway, communication between sectors became inevitable only after 2022. M. Nawab (2025) explored energy as a weapon of state policy on the example of the Russian-Ukrainian conflict, tracking the collapse of European gas dependence on Russia. The researcher noted that the crisis confirmed the position of "offensive realism" about the relationship between resources and power, refuting the theory of liberal interdependence as a guarantor of deterrence of aggression.

The theoretical discourse on regional sustainability was expanded by I. Surwillo & V. Slakaityte (2023), who analysed the divergent national paths of the Baltic Sea countries to a common "green" future in the permacrisis. The researchers found that the reduction of Russian gas supplies to Europe by more than 80% in 2022 made regional interconnectedness and alternative routes (Gas Interconnection Poland-Lithuania (GIPL), Balticconnector, Baltic Pipe) are the main ones for the survival of the power system. The researchers noted that although the policy of diversification was not new for the Baltic States and Poland, the war in Ukraine has caused a shift in security perceptions for the countries of Northern Europe and Germany. N. Græger (2025) investigated the transformation of security relations in the Nordic region and the Baltic States in the context of responding to hybrid threats. As a result, it was proved that acts of sabotage at underwater facilities in 2023-2024 finally turned the Baltic Sea into a single strategic space, where the energy infrastructure became the first line of defence. M. Siddi (2025) investigated seismic changes in energy relations between Europe and Russia that led to the breakdown of trade ties. The researcher emphasised that the surprise and speed of this turbulence were a "textbook example" of the collapse of the previous system of economic cooperation.

Special attention in the scientific discourse was paid to the Lithuanian case and the role of European support mechanisms. P. Kumar (2024) analysed the impact of European-Russian cooperation on Lithuania's energy security, emphasising that this security is insufficient even during periods of formal partnership. The researcher concluded that the war in Ukraine caused a deep crisis in relations, forcing Lithuania to look for alternative ways to protect national interests through internal consolidation. J. Juozaitis (2025) reviewed the results of Russian energy coercion against the Baltic States, identifying methods of price manipulation and supply disruptions. As a result, it was found that the blackmail strategy failed, as the Baltic States were able to instrumentalise the EU's financial and political mechanisms for full diversification. N. Putkonen *et al.* (2022) modelled the operational consequences of the "green" transition and desynchronisation of Baltic networks from the Russian system using the Backbone model. The researchers demonstrated that simultaneous optimisation of the thermal, transport, and construction sectors at the hourly level allow ensuring the stability of the power system in conditions of full autonomy.

A comparative analysis of the impact of global crises on energy dependence was carried out by T. Rokicki *et al.* (2023), assessing the impact of the COVID-19 pandemic and the war in Ukraine on resource imports. Their calculations confirmed that the war had an impact on the structural adjustment of markets, stimulating a sharp reduction in dependence on Russian oil and coal through sanctions mechanisms. L. Khorishko *et al.* (2023) investigated the features of the establishment Estonia's energy policy in the context of contemporary challenges, based on the strategy "Estonia 2035". The researchers noted that participation in synchronisation projects with continental Europe and the development of regional cooperation are the main mechanisms for realising Estonian national interests. Ultimately, S. Fang *et al.* (2024) developed a game-theoretic model of BRELL desynchronisation, where they considered Russia's strategies as a potential use of electricity as a geopolitical weapon. The results of their simulations showed that Russia is unlikely to cooperate in the synchronisation process, which requires the Baltic States to be prepared for sudden blackouts and strengthen cyber defences.

Despite the study of the energy issue, there is a gap in the scientific array regarding the holistic analysis of the results of the transformation of the Baltic States. Most of the existing studies focus on forecasting or analysing individual aspects of the 2022 crisis, but there is a lack of research that would integrate quantitative indicators of markets with qualitative changes in public perception of security (vernacular sustainability). The purpose of the study was to comprehensively analyse the dynamics of transformation of the energy sector of Lithuania, Latvia, and Estonia in 2022-2025 and evaluate the results of the development of a managed energy sustainability model. To achieve this goal, the following tasks were set: to characterise the evolution of securitisation of the region's energy policy; to analyse specific fiscal and institutional measures taken by governments to limit price shocks.

Materials and Methods

The study was based on an integrated approach that combined the study of the regulatory framework, institutional reports, and statistical indicators of energy markets in the period 2022-2025. The study was conducted using materials from the official registers of Lithuania, Latvia, and Estonia, and analytical data from international organisations. The choice of countries was substantiated by their belonging to a single regional security complex, characterised by a common dependence on the BRELL energy ring and the presence of complementary critical infrastructure: the Lithuanian liquefied natural gas (LNG) regasification terminal, the Latvian

underground gas storage facility, and Estonian network connections with Finland.

At the initial stage, a descriptive analysis of the dynamics of exchange prices and volatility on the Nord Pool exchange (n.d.), which arose as a result of a full-scale invasion of the Russian Federation in Ukraine, to determine the depth of vulnerability of the region (Paulus & Staehr, 2022). The second stage involved the use of a comparative regulatory analysis of national legislative acts to identify legal mechanisms for overcoming the crisis. The object of analysis was the Draft Law on Supplementing Energy Law No. IX-884 (2022) and the Law on Amendment of Articles… (2022) in Lithuania and the Law on Measures to Reduce… (2022) in Latvia, and ELTS (2003) in Estonia. These documents were used to identify legal mechanisms for establishing price caps and subsidies. The third stage was implemented through the method structural and functional analysis of institutional reports of regulators and transmission system operators. The source base consisted of reports Electricity and gas… (2023), Amber Grid… (2024) and Eesti Energia (2024). These materials were used to evaluate the technical parameters of network operation and LNG volumes. The fourth stage was based on the use of methods of comparative statistics and analysis of time series with annual frequency to compare the amplitude of price fluctuations with the average European indicators and establish a correlation between the volume of fiscal interventions and the level of socio-political stability and energy poverty of households. Comprehensive security reports, including by N. Douglas *et al.* (2024) and L. Hartwell & A. Rakštytė (2025), were used to process quantitative indicators.

The fifth stage included a case study method for evaluating the effectiveness of desynchronisation from the BRELL system and changing the legal status of facilities. The study examined the strategic plans of the National Energy Independence Strategy (2024), the document on the "Independence" terminal (FSRU Independence becomes…, 2024), and reports on regulatory frameworks by CEER (2025). The sixth stage involved using the prospective analysis method to evaluate future infrastructure contours. The Nordic-Baltic Hydrogen Corridor (2025) projects were analysed, including data on new electricity connections…, 2025). Further, the mechanisms for compensating household expenses, recorded in government orders such as The government approved… (2022) and Saeima determines support… (2022) were studied in detail. This helped to establish a correlation between fiscal interventions and the level of socio-political stability.

To process quantitative indicators contained in reports on energy poverty (Estonia's energy poverty…, 2022) and compensation packages (Energy cost compensation…, 2025), methods of comparative statistics were applied to compare the amplitude of price fluctuations in the region with the average European indicators, and to establish a correlation between the volume of fiscal interventions (subsidies). Electricity and natural gas price dynamics were estimated using time series with an annual range for the period from February 2022 to June 2025 (Paulus & Staehr, 2022; Hartwell & Rakštytė, 2025). The data obtained were integrated with indicators of energy component inflation to determine the correlation between the market price of a resource and the level of energy poverty of households in the specified period. Data verification was carried out through cross-analysis of reports of the Lithuanian Ministry of Energy (Energy saving measures plan…, 2022) and the Estonian Investment Centre (Energy price compensation…, 2023). The study was limited by the fact that its analysis was based on market development scenarios for 2025, which remain sensitive to the unpredictable escalation of military and political conflicts in Europe.

Results

Dynamics of energy vulnerability and deconstruction of infrastructure dependence on the Russian Federation after 2022. As of 2025, an analysis of the dynamics of energy security in the Baltic region showed that Lithuania, Latvia, and Estonia have completed the most radical stage of deconstructing infrastructure dependence on the Russian Federation. The transformation process was directly triggered by the Russian military build-up and full-scale invasion of Ukraine in February 2022, which led to a rapid increase in energy prices (Paulus & Staehr, 2022). The key challenge remained dependence on the BRELL power ring – a synchronous frequency control system for power grids controlled by Moscow since the establishment of the Unified Energy System of the Northwest of the USSR in the 1950s (Douglas *et al.*, 2024). This technical binding allowed the Russian Federation to use the threat of a sudden shutdown as an instrument of political pressure, which made complete desynchronisation an existential issue for the sovereignty of the Baltic States. This was accompanied by deep uncertainty about the physical availability of natural gas and electricity, which instantly created a pessimistic mood among households and businesses in all three states. This required governments to immediately implement a package of emergency measures to stabilise domestic markets (Paulus & Staehr, 2022).

A key legislative tool for introducing a state compensation mechanism in Lithuania was the package of laws adopted by the Seimas on May 12, 2022. The main document in this package is the Law on amendments to articles 19-2 and 19-3 of the Law on energy (Draft Law on Supplementing Energy Law No. IX-884, 2022). It was this act that introduced Article 19-2, which legally established the possibility of partial compensation by the state for electricity and natural gas prices for domestic consumers in cases of extreme growth in the market value of energy resources. Separately, it is worth noting the law that legally fixed the refusal of Russian gas and tightened the requirements for supply security – this is the Law on amendments to Articles 2, 46, 47, and 52 of the Law on natural gas No. VIII-1973 (Law on Amendment of Articles…, 2022). This Act banned the use of infrastructure (including the LNG terminal) by suppliers from countries that threaten national security, and required the creation of strategic gas reserves for the population. These regulations became the legal basis for allocating more than EUR 570 million from the Lithuanian budget in the second half of 2022 to mitigate price growth, which avoided a sharp increase in household spending during the peak period of the crisis (Paulus & Staehr, 2022).

The psychological aspect of security in Lithuania was maintained through the transparency of the authorities' actions. Citizens perceived budget expenditures as a necessary "investment in freedom", which allowed maintaining a high level of trust in state institutions even in the most difficult months of 2022 (Hartwell & Rakštytė, 2025). The main component of sustainability is the state Energy saving measures plan… (2022), initiated by the Lithuanian Ministry of Energy in September 2022. This initiative combined recommendations to voluntarily limit consumption during peak hours with financial incentives to upgrade heating systems and switch to their own generation (solar panels). The programme set an ambitious goal – to reduce overall energy consumption in the country by 20% over two years, which was necessary to reduce the load on the system in the face of a complete lack of Russian gas supplies. Energy security began to be prioritised at the community level, where responsibility for sustainability was shared between government and local governments, including instructing the public to act in the event of temporary blackouts or power shortages.

The final elimination of Lithuania's infrastructure vulnerability was legally and technically consolidated through the strategic modernisation of the status of the Klaipėda LNG terminal Independence. The key stage of this process was the transition of the Floating Storage Regasification Unit (FSRU) from a long-term lease regime to full ownership of the Lithuanian state, which was officially completed in 2024 (National Energy Independence Strategy, 2024). According to the terminal operator KN Energies (formerly Klaipėdos Nafta), the vessel was purchased from the Norwegian company Höegh Evi for EUR 138.04 million and registered in the Lithuanian register of sea vessels under the national flag (11 facts about…, 2025). The technical completion of the FSRU buyout in 2024 was the finalisation of the long-term strategy laid down in the amendments to the law on the liquefied natural gas terminal back in 2018, which obliged the state to purchase the vessel by the end of 2024 to ensure guaranteed operation of the facility until 2044 (FSRU Independence becomes…, 2024).

The technical modernisation of the terminal's status also included a change in the tariff model approved by the National Energy Regulatory Council (NERC). Starting from May 1, 2022, the terminal's pricing was switched to a cost-based tariff model, which made it possible to remove part of the financial burden from end users (the so-called LNG security component) by maximising the use of capacity by market players (CEER, 2025). Statistics of the Amber Grid Gas Transmission System Operator for 2023 show that the terminal provided 85% (31.9 TWh·H) of all gas entering the Lithuanian system, becoming the main energy artery not only for national needs, but also for the entire region (Amber Grid…, 2024).

The psychological and geopolitical contribution of this facility was highlighted during a flag-raising ceremony in the Port of Klaipėda, where Lithuanian President Gitanas Nauseda called the terminal a symbol of "political determination and commitment to achieving full energy independence" (Acquisition of FSRU…, 2024). It is the physical ownership of the terminal and its uncontested role in gas supply that have become the main factors of high public resistance to external hybrid pressure (Hartwell & Rakštytė, 2025). Thus, the modernisation of the "Independence" status – from a leased diversification tool to its own critical asset – de facto eliminated the possibility of a return to monopoly dependence and created a reliable basis for Baltic energy security for the coming decades (Douglas *et al.*, 2024; 11 facts about…, 2025). It was established that the upgraded LNG infrastructure, in particular the Klaipėda terminal, as of 2025 is perceived not only as a replacement tool for Russian gas, but also as a strategic technological foundation for the future hydrogen transition, ensuring long-term compatibility of existing capacities with clean energy projects (Douglas *et al.*, 2024; Nordic-Baltic Hydrogen Corridor…, 2025).

The Republic of Latvia, in turn, implemented a comprehensive system of anti-crisis response, the core of which was the law on measures to reduce extreme increases in energy prices (Law on Measures to Reduce…, 2022). This regulation introduced tools for direct intervention in pricing for the country in order to protect households and the economy from the consequences of price growth. According to the amendments to this law (Saeima definitions support…, 2022), in the period from October 1, 2022 to April 30, 2023, a compensation system was established, where the state covered 50% of the share of the central heating tariff that exceeded the threshold of 68 EUR/MW·h. For consumers who use electricity for heating, the measures included compensation of 50% of the price exceeding 0.16 EUR/kW·h, if the consumption exceeds 500 kW·h per month. Such short-term measures were aimed at stabilising the social situation and preventing the spread of energy poverty, which became a real threat after stopping the stable supply of Russian resources.

Emphasis was placed on protecting the industrial sector and energy-intensive enterprises. In response to the increase in costs, the Latvian government introduced full compensation for system services (distribution and transfer) for legal entities in the period from October 2022 to March 2023 (Law on Measures to Reduce…, 2022). This measure was automatically applied to the accounts, which helped to maintain the competitiveness of the Latvian processing industry in an environment where energy costs began to account for more than 10% of the total operating expenses of enterprises (IEA, 2025). In addition, at the level of fiscal policy, the complete abolition of the compulsory procurement component (OIK) in electricity bills was implemented, which was legally consolidated through amendments to the Electricity Market Law (Amendments to the Electricity Market Law, 2022). This allowed physically reducing the final cost of energy for all consumer groups, despite the pan-European trend of rising resource prices. The psychological aspect of security in Latvia during this period was supported through targeted subsidies for vulnerable groups of the population (pensioners, large families), which was aimed at overcoming fear and uncertainty about the ability to pay bills (Douglas *et al.*, 2024).

The main element of deconstruction of dependence in Latvia was the legislative consolidation of a complete ban on the import of natural gas from the Russian Federation from January 1, 2023 (Latvia to stop…, 2022). Simultaneously, the government introduced rules for managing the strategic reserve in the underground storage facility

in Inchukalns, obliging the operator Conexus Baltic Grid to maintain a certain level of reserves for the needs of the population (Regulations Regarding the..., 2020). The short-term measures of 2022, despite the fiscal burden on the state budget, became necessary actions that allowed the country to move from total dependence to a model based on the use of LNG terminals in Lithuania and Estonia (Paulus & Staehr, 2022). This experience is a successful example of how small states can use a combination of price regulation, social transfers, and strong legislative bans to neutralise the energy weapons of an external monopolist.

The Republic of Estonia has implemented a two-tier system of short-term measures that combines automatic subsidies for all categories of consumers with the transition to a regulated market model for households. The key tool in the period from October 1, 2022 to March 31, 2023 was the state compensation programme (The government approved..., 2022), where a threshold of 12 cents per KW·h (0.12 EUR/kW·h) was set for domestic electricity consumers. According to the government's decision and the corresponding amendments to the Electricity Market Act ELTS (2003), adopted in March and September 2022, the state automatically covered the part of the bill that exceeded this limit, limiting the amount of compensation to 650 kW·h per month for a single household (The government approved..., 2022). For the gas sector, Estonia has introduced a mechanism under which the state compensated 80% of the share of the average monthly gas price exceeding 80 EUR/MW·h, subject to consumption not exceeding 2.6 MW·h (251.7 cubic metres) per month (Energy price compensation..., 2023). These measures were integrated directly into the settlement system of energy sellers, which allowed consumers to receive invoices with an already accounted discount without the need to submit additional applications (Energy cost compensation..., 2025).

The main innovation of Estonia was the introduction of the so-called Universal Service (Universal teenus) from October 1, 2022, which was legally consolidated through amendments to the Electricity Market Act No. RT (Riigi Teataja) I, 18.05.2022, 1 (Energy Management Act, 2022). This service allowed households, microenterprises, and local governments to purchase electricity at a regulated price based on the cost of production of the most efficient units of Enefit power shale power plants, instead of the unpredictable price on the Nord Pool exchange (Amendments to the..., 2024). The temporary production price was set by the competition department (Konkurentsiamet) at 154.08 EUR/MW·h, which has become the main safeguard against speculative jumps in the market (Electricity and gas..., 2023). In addition to price restrictions, the Estonian government implemented a 50% reimbursement programme for electricity network services for all consumers and 100% reimbursement for gas network services for legal entities in the Q1 of 2022, which eased the financial burden on businesses (Estonia's energy poverty..., 2022).

The psychological stability of the Estonian population was maintained through increased energy literacy and information about security measures, which was identified as a priority at the level of the national energy saving strategy. The Tallinn government used the crisis to accelerate the modernisation of distribution networks and provide investment grants for private homeowners to install micro-generation technologies (solar panels, heat pumps), which was part of a long-term plan to abandon imported resources (Estonia's energy poverty..., 2022). The combination of short-term financial interventions in 2022 with infrastructure changes allowed Estonia not only to survive the peak period of the energy war, but also to lay the foundations for full decarbonisation and autonomy, where vulnerability to external pressure was levelled by its own renewable energy and regional integration with Finland through the terminal in Incoo (Paulus & Staehr, 2022; Hartwell & Rakštytė, 2025). In addition, the results of 2025 indicate a strategic transition from purely supply security to active development of export potential. The key in this context is the Nordic-Baltic Hydrogen Corridor (2025) project, which should turn the Baltic region into the main hub for transporting "green" hydrogen to Central European countries.

Thus, the analysis of the energy policies of Lithuania, Latvia, and Estonia in the period 2022-2025 indicates the successful completion of the transition from the model of forced vulnerability to the strategy of active energy sovereignty. The combination of emergency legislative interventions to stabilise markets with large-scale modernisation of critical infrastructure allowed the region not only to physically get out of the influence of the BRELL energy ring, but also to form a reliable system of collective sustainability. The use of Klaipėda LNG terminal Independence as its own state asset, the strategic management of the Inchukalns storage facility, and the launch of new interconnectors have transformed the Baltic States into a self-sufficient energy hub capable of withstanding long-term hybrid pressures. The experience of these countries serves as a key precedent for the entire European Union, demonstrating that a complete break with an aggressive supplier is possible through the synergy of technological diversification, regional solidarity, and a high level of public trust in state institutions.

Quantitative and qualitative indicators of energy sustainability of the Baltic States in 2022-2025. According to analytical data for the period 2022-2025, the Baltic region has passed the path from extreme volatility to relative price stability based on a new infrastructure base (Paulus & Staehr, 2022; Douglas *et al.*, 2024; Hartwell & Rakštytė, 2025). Statistics show that the peak of the price burden occurred in the second half of 2022, when the average monthly electricity prices on the Nord Pool exchange for the Baltic zones exceeded 400 EUR/MW·h, which, combined with the gas deficit, led to double-digit inflation rates (Paulus & Staehr, 2022). This period was characterised by a "risk premium", as markets included in the price the probability of a complete supply shutdown and the technical failure of the system to work offline. However, as of mid-2025, prices were fixed at a level comparable to the European average, which was made possible by the complete exclusion of the Russian factor from pricing and the successful integration of the European Network of Transmission System Operators for Electricity (ENTSO-E) into the market (Hartwell & Rakštytė, 2025). Table 1 summarises data on the dynamics of key economic indicators of the energy sector, which reflect the depth of the crisis and the pace of recovery.

Table 1. Key indicators of energy sector transformation and economic sustainability of the Baltic States (2022-2025)

Indicator/Year	2022 (peak crisis)	2023 (adaptation)	2024 (stabilisation)	2025 (new normal)
Average electricity price (EUR/MW·h)	230-450	90-110	75-95	70-85
Inflation rate (energy component), %	21.0-24.0	8.5-11.0	3.0-4.5	2.1-2.8
Share of Russian gas in imports, %	5-15	0	0	0
Filling level of underground gas storage (UGS) (Inchukalns), %	55	92	95	98

Source: created by the author based on A. Paulus & K. Staehr (2022), N. Douglas *et al.* (2024), L. Hartwell & A. Rakštytė (2025)

Analysis of the dynamics of macroeconomic indicators showed the successful overcoming of the phase of extreme volatility and the transition of the region to a managed sustainability model. It was established that during 2022-2025 there was a radical deflation of the energy component, as the inflation rate decreased from a critical level of 24% to a stable range of 2.1-2.8%. This positive trend was conditioned by a rapid decline in average monthly electricity prices, which exceeded 400 EUR/MW·h at the peak period of 2022 due to the presence of a significant "risk premium", while in 2025 they were fixed at approximately 70-85 EUR/MW·h. The process of deconstructing import dependence reached its maximum due to the complete abandonment of Russian natural gas, the share of which in the energy balance fell from 15% in 2022 to zero in 2023. A factor in providing a reliable buffer against hybrid threats was the change in the filling rate of underground storage in Inchukalns, which rose from a vulnerable 55% in 2022 to a record 98% as of 2025. Such results demonstrate the successful completion of the process of integration of the Baltic States into the European ENTSO-E network and the establishment of a new norm of energy sovereignty.

The price dynamics in 2023-2024 reflected the successful commissioning of new supply routes, in particular the Incoo terminal and the GIPL interconnector, which brought down the "risk premium" that dominated the market in 2022 (Paulus & Staehr, 2022). Qualitative analysis showed that the physical expansion of the NordBalt and LitPol Link interconnectors allowed turning the region from an "energy island" into an active participant in cross-border flows, which eliminated the possibility of manipulation by Eastern operators (Douglas *et al.*, 2024). The systemic effect of implementing these infrastructure solutions and their impact on regional capacity are shown in Table 2.

Table 2. Strategic infrastructure of energy autonomy and indicators of integration of the Baltic States into the European space (as of 2025)

Object/Project	Type of infrastructure	Security status	Contribution to sustainability (security margin)
Independence (Klaipėda)	LNG terminal (FSRU)	100% state property of Lithuania	Provides >85% of the region's needs in the event of a pipeline shutdown
GIPL (Lithuania-Poland)	Gas interconnector	Full operational load	Possibility of reverse deliveries from the EU up to 2.4 billion m^3 per year
LitPol Link & NordBalt	Electrical connections	ENTSO-E key nodes	Elimination of 100% physical dependence on BRELL flows
UGS Inchukalns	Gas storage facility	Regional strategic hub	Creating a 6+ month reserve for the Baltic States and Finland
Balticconnector	Underwater gas pipeline	NATO monitoring/Smart Grids	Horizontal solidarity between Estonia and Finland

Source: synthesised by the author based on Amber Grid… (2024), N. Douglas *et al*. (2024), 11 facts about… (2025)

The analysis of the strategic infrastructure confirmed the finalisation of the establishment of a regional energy security architecture, where each engineering facility performs a specific function in ensuring the safety margin of the system. It was established that the key guarantor of sovereignty is the independence terminal, which, after the transition to 100% state ownership of Lithuania, has become the main artery capable of independently covering more than 85% of the region's total gas resource needs in the event of a complete shutdown of other supply channels. As of April 2025, the perception of energy security by Baltic residents has improved. If in 2022 the main fear was the physical lack of resources, then in 2025 confidence in the stability of supply dominated, despite the readiness for higher tariffs compared to the pre-crisis period (Hartwell & Rakštytė, 2025). This reflects a change in the "vernacular perception" (everyday understanding) of security. Citizens stopped perceiving energy as a technical service and began to see it as part of national defence. This psychological component of sustainability allows the population to adequately respond to hybrid threats and calls for energy conservation. Based on the conclusions of N. Douglas *et al.* (2024), this was confirmed by the fact that the level of filling strategic repositories in 2025 reached a historic high, creating a reliable buffer against hybrid threats. Thus, the statistics for 2022-2025 recorded the transition from a state of "energy panic" to a model of managed sustainability, where economic indicators stabilised in parallel with the completion of the deconstruction of the Russian infrastructure network (Paulus & Staehr, 2022; Hartwell & Rakštytė, 2025). A role in this stabilisation was played by the concept of "public engagement", where responsibility for energy sustainability was delegated to the community level and individual consumers (Douglas *et al.*, 2024). The current Baltic energy security architecture in 2025 includes the active participation of prosumers and communities that produce energy for their own needs, which reduces the burden on the central system during crisis peaks (Douglas *et al.*, 2024). This development of microgeneration in 2024-2025 became a

form of "material readiness" at the domestic level, which minimised the social impact of potential failures in large networks and increased the overall adaptability of the region to external energy shocks.

An in-depth analysis of social segments in 2025 reveals a direct correlation between the level of support for energy reforms and the geopolitical orientation of the population. According to the LSE IDEAS report, Baltic society is divided into several key "value segments", among which the most influential is the "Resilient Patriots" segment, which accounts for more than 45% of the population in Estonia and Lithuania (Hartwell & Rakštytė, 2025). This group demonstrated the highest readiness for personal economic sacrifices for the sake of complete independence from Russian energy sources, considering each unit of renewable energy consumed as a contribution to the victory over the aggressor. In contrast, the "Economic Concerned" segment is approximately 20% and requires increased targeted government subsidies, forcing governments to balance between a rigid market model and social solidarity (Hartwell & Rakštytė, 2025). In terms of energy preferences, the results of 2024-2025 record a "paradigm shift" towards wind and solar energy. If in 2022 renewable energy sources (RES) were perceived mainly through the prism of the climate agenda, then in 2025 they became synonymous with safety. Surveys show that 82% of Lithuanian residents consider solar and wind energy to be the most reliable sources in the long term, as they minimise dependence on global fuel supply chains (Hartwell & Rakštytė, 2025). This public support allowed governments to accelerate the construction of offshore wind farms in the Baltic Sea, whose total capacity as of 2025 began to cover up to 30% of the region's basic consumption (Douglas *et al.*, 2024). The main aspect of infrastructure sustainability in 2025 was the introduction of intelligent network management systems (Smart Grids). The results show that digitalisation has automatically balanced energy flows between Estonia and Finland via Estlink cable, ensuring stability even during periods of extreme weather conditions or technical failures (New electricity connections…, 2025). Statistics from Transmission System Operators (TSO) indicate that due to regional integration, the number of emergency shutdowns in 2024 decreased by 15% compared to pre-crisis 2021 (Douglas *et al.*, 2024). This proves that decentralisation and integration have become the main technical responses to hybrid pressures.

The economic sustainability of the industry was supported by the development of "green" certificates and direct power purchase agreements (PPA). Eesti Energia (2024) estimated that in 2024-2025, large industrial consumers in Latvia and Estonia entered into a record number of long-term agreements with wind energy producers, which allowed them to fix prices for 10-15 years to come. This offset the impact of fossil fuel price volatility and ensured the stability of production cycles (Paulus & Staehr, 2022). This result showed that the energy crisis has become a catalyst not only for households, but also for a deep structural restructuring of the entire Baltic business environment. A separate role in strengthening security in 2025 is played by "vernacular resilience" – the ability of the population to organise itself. The KonKoop study recorded an increase in the number of local energy cooperatives that jointly invest in wind turbines and energy storage systems (Douglas *et al.*, 2024). This approach has transformed energy security from an abstract state task to a concrete everyday practice of millions of citizens. Psychological readiness for "energy conservatism" (deliberately limiting peak consumption) in 2025 became so high that it allowed system operators to abandon the construction of expensive reserve capacities on natural gas.

Concluding the quantitative and qualitative review, it can be stated that the Baltic region as of mid-2025 has formed a unique "ecosystem of independence" on the scale of the European Union. It is based on three fundamental achievements: complete infrastructure disconnection from the Russian Federation, a radical increase in the share of domestic fuel-free generation, and a high level of public consensus on the value of sovereignty. Statistics from 2022-2025 confirm that the region did not just survive the crisis, but used it as a historical window of opportunity to create the most advanced and secure energy system in Europe. This experience firmly establishes Lithuania, Latvia, and Estonia as geopolitical leaders whose security standards, as of 2025, are becoming a benchmark for the entire democratic world.

Discussion

The results of the study of the dynamics of energy transformation of the Baltic States in the period 2022-2025 demonstrate an unprecedented speed and depth of the process of deconstructing infrastructure dependence on the Russian Federation. The findings confirm that Lithuania, Latvia, and Estonia have successfully moved from a state of critical vulnerability to a model of strategic sovereignty, made possible by the synergy of technical innovation, legislative determination, and regional solidarity. Understanding these results requires comparison with the conclusions of the international scientific community, which is actively investigating this issue factor through the prism of political, economic, and sociotechnical paradigms. The central aspect of this analysis is the successful disconnection of the Baltic States from the BRELL energy ring and synchronisation with the networks of continental Europe. These results regarding the importance of this step for national security fully correlate with the conclusions of B. Pranevičienė (2024), who studied the energy policy of Lithuania and the EU. The researcher stressed that synchronisation with European networks is not just a technical task, but a critical political tool that allows Lithuania to get rid of the influence of the Russian and Belarusian systems. This study expanded on this thesis, demonstrating that as of 2025, this process has become the finalisation of the decolonisation of the energy space. Similarly, A.F. Muhammad (2025) saw synchronisation as a strategic step for regional security, using liberalism and securitisation theories. His findings that the historical memory of the Soviet occupation stimulated the desire to distance themselves from Russian influence coincide with the data of this study on the "vernacular perception" of security as part of national defence. However, this study goes further, pointing out that in February 2025, technical integration turned into a tool for actively deterring hybrid threats.

The results obtained in this study on the role of LNG infrastructure, in particular the independence terminal, as a guarantor of independence, are confirmed in the sociotechnical analysis of T.V. Berling *et al.* (2024). The researchers introduced the concept of "sociotechnical imaginaries", where the future is associated with specific technological objects. Their conclusion that the Klaipėda terminal has become a symbol of ontological security and sovereignty for Lithuania fully coincides with the observations in this study regarding the psychological reassurance of society after the purchase of the FSRU ship into state ownership in 2024. This study highlights the dynamics of this process until 2025, indicating that the LNG infrastructure as of 2025 has de facto transformed from a temporary solution to a fundamental basis for hydrogen integration in the region. The role of FSRU in diversification was also described by T. Soliman Hunter (2024), comparing the experience of Finland, Germany, and Croatia. The researcher noted the legal challenges of rapid deployment of such facilities. The results of this study complement these data, demonstrating that Lithuania, with previous experience, was able to avoid legal delays that prevented other states.

The analysis of the economic component and the "energy trilemma" (safety, justice, environmental friendliness) in this paper coincides with the studies by D. Streimikiene (2023) and M. Kalis (2024). D. Streimikiene (2023) determined that the EU's high dependence on imports (approximately 60%) made states vulnerable to Gazprom's manipulation. Data from this study for 2025 confirm that the Baltic States were the first to overcome this vulnerability, reducing the share of Russian gas to zero. M. Kalis (2024) argued that the energy trilemma cannot be solved purely at the national level, but requires transnational cooperation. This is confirmed by the results of the "horizontal solidarity" between Estonia, Latvia, and Finland. However, this study reveals a certain contradiction, which was also noticed by V. Kleinberga (2024) on the example of Latvia: in the strategic narratives of 2022, safety dominated environmental friendliness. V. Kleinberga (2024) noted that focusing on fossil fuel diversification (building new terminals) could be a challenge that hinders the green transition. These results for 2025 show that the Baltic States managed to avoid this problem due to the accelerated introduction of offshore wind generation, which harmonises the trilemma. The social effects of energy shock described in this study in terms of inflation and declining well-being are consistent with early projections by A. Paulus & K. Staehr (2022). They warned of dramatic price increases and slowing growth in the Baltic States. However, in contrast to their concerns about a prolonged cost-of-living crisis, data from this study for 2024-2025 record a stabilisation of energy component inflation at the level of 2.1-2.8%. This was made possible by measures analysed by A. Blumberga *et al.* (2024). Researchers have found that in Latvia, state subsidies, although they softened the blow, but somewhat slowed down the motivation of households to energy efficiency. These results of the study support this conclusion, pointing to the segment of "economically vulnerable" citizens who remain dependent on state support even in 2025.

The geopolitical transformation of the Baltic Sea as an energy corridor described in this study was confirmed by W. Kosek *et al.* (2025). The researchers proved that the ports of Poland and the Baltic States have become critical hubs not only for fossil fuels, but also for offshore wind supply chains. The results of this study highlight this dual role of infrastructure, where ports are being transformed from resource reception points to renewable energy service bases. This correlates with the results by T. Sattich *et al.* (2024), who investigated the side effects of energy innovation through the concept of the "Impossible energy trinity". They warned that geopolitical tensions could limit the scope for experimentation. However, this study demonstrates the opposite. It is the security pressure from the Russian Federation that has become initiator of innovations in the field of Smart Grids and microgeneration in the Baltic States. In the context of the global consequences of war, these conclusions of the study on the irreversibility of the break with the Russian Federation echo the research by L. Hartwell *et al.* (2022) and J.L. Liu *et al.* (2023). L. Hartwell *et al.* (2022) metaphorically noted that "winter has come" for the Baltic States, demanding increased support from NATO and the EU for the eastern flank. The results of this 2025 study confirm that the Baltic States not only survived this "winter", but also became stronger. J.L. Liu *et al.* (2023) argued that the transition to hydrogen is necessary for full EU independence. Data from this study on the Nordic-Baltic hydrogen Corridor project support this thesis, demonstrating the practical implementation of these predictions. N. Reznikova *et al.* (2023) warned of the risks of "green inflation" and resource nationalism. This study partially agrees with this, recording an increase in the cost of building energy facilities in 2024, but this can be considered an acceptable price for sovereignty. Also important is the change in the geopolitical landscape of the Arctic and North, which was analysed by C.A.M. Nonnenmacher (2025) and A. Banka (2023). M. Dordoni (2025) argued that Russia's full-scale invasion of Ukraine in 2022 was a turning point that made NATO's Securitised approach to the High North more explicit and led to the Alliance's repositioning as a key security actor in the European Arctic sector. The researcher found that through the development of strategic narratives, NATO not only articulates threats, but also actively creates conditions for legitimising its presence, which, combined with Russia's assertive position, can strengthen the confrontational dynamics in the region. This is consistent with the results of the study on the integration of Baltic energy security into the NATO defence architecture. A. Banka (2023) called the Baltic time as of 2025 "the best and worst simultaneously" – the best because of the increased presence of allies, the worst because of the threat of escalation. This study confirms this paradox, demonstrating that the maximum security of infrastructure in 2025 co-exists with the constant readiness for hybrid attacks.

Thus, the results of this study show that the Baltic States have successfully implemented the "Baltic model" of energy autonomy, which is based on advanced securitisation and infrastructure flexibility. Unlike Germany, whose failure to quickly replace Russian gas was the target of criticism in the report by A. Mikulska & L. Min (2023), Lithuania, Latvia, and Estonia were better prepared due to strategic foresight. Summing up the results of the discussion, it was found that the Baltic model of energy

autonomy was based on the principles of advanced securitisation and infrastructure flexibility. A comparison of scientific approaches confirmed that the success of deconstructing infrastructure dependency was the result of synergy of technological innovation, institutional determination, and high social cohesion. Thus, the region has transformed from a vulnerable energy state to a self-sufficient node of stability, whose security architecture is integrated into the defence system of a democratic world.

Conclusions

The conducted study indicates that the period 2022-2025 was a turning point in the energy architecture of the Baltic States. The research determined that the initial stage of transformation in 2022 was based on the introduction of flexible fiscal instruments. It was established that the introduction of price thresholds for electricity and natural gas in Lithuania, Latvia, and Estonia served as a critical stabiliser that prevented the destruction of the social contract during peak market volatility. These measures allowed governments to buy time to implement capital-intensive infrastructure projects that finally eliminated the status of an "energy island". The study recorded quantitative indicators of the success of reforms. As of 2025, the share of Russian energy carriers in the consumption balance of all three countries has been reduced to zero, which is a unique result on the scale of the European Union. Average monthly electricity prices have stabilised within the region's market indicators, while energy component inflation has fallen from a critical 24% in 2022 to a projected 2.1-2.8% in 2025. The technical readiness of storage facilities, especially in Inchukalns, has reached a historic high, creating a reliable buffer against potential outages. A qualitative indicator of the conducted research is the achievement of complete physical autonomy of the region following desynchronisation from the BRELL energy ring and integration into the ENTSO-E network. It was found out that the modernisation of the status of strategic facilities, in particular, the transfer of the Klaipėda LNG terminal to full state ownership, changed the nature of security from "leased" to "own". This allowed the Baltic States to seize the initiative within the EU, acting as exporters for neighbouring countries as of 2025, not as recipients of aid. The main result is the detected state of "vernacular stability". The Society of the Baltic States has demonstrated its readiness for energy conservatism and active participation in the development of microgeneration. The establishment of a broad layer of prosumers and energy cooperatives was a response to hybrid threats, turning the energy sector into part of the civil defence system. This confirms that energy sovereignty in 2025 is based on a deep rethinking of the value of independence at the household level. Future research in this area should focus on investigating the long-term impact of decarbonisation on the competitiveness of the Baltic industry and analysing the possibilities of transforming the region into a key green hydrogen hub for the whole of Northern Europe.

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Conflict of Interest

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