ECONOMIC SECURITY OF THE STATE AND ECONOMIC ENTITIES

UDC 338.242(477)
JEL O000, L510
DOI: 10.26906/EiR.2024.3(94).3494

STRENGTHENING ENERGY SECURITY OF UKRAINE

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Стаття отримана редакцією 12.08.2024 р.
The article was received by editorial board on 12.08.2024

Introduction. In today's global energy landscape, energy security has become a critical concern as geopolitical shifts, technological advancements, and environmental challenges increasingly shape national development strategies. The importance of energy security is underscored by the growing complexity of international energy markets and the transition towards more sustainable and low-carbon energy systems. Countries around the world are reevaluating their energy policies to ensure stable access to energy resources, enhance resilience to external shocks, and meet climate commitments. For Ukraine, these challenges are particularly acute, given the current context of martial law and ongoing military aggression from russia.

Since the full-scale invasion in 2022, Ukraine has faced unprecedented threats to its energy security. Russia's relentless attacks on critical energy infrastructure, including power plants, substations, and gas pipelines, have severely disrupted energy supplies and created an acute energy crisis in many regions. These attacks have targeted both civilian and industrial energy systems, leading to widespread power outages, fuel shortages, and heating crises, particularly during the winter months. The destruction of energy infrastructure has highlighted Ukraine's vulnerability and the urgent need for a comprehensive strategy to enhance its energy resilience.

Key priorities of state policy include cooperation with international partners, integration into the European energy system, diversification of energy sources, and efficient management of available resources. At the same time, in the face of the risks and threats posed by martial law [1], it is necessary to develop new strategies to ensure Ukraine's energy sustainability and bolster its energy security.

Analysis of recent researches and publications. The issues of energy security have been extensively explored by numerous foreign scholars. The problem of energy security in Europe and Central Asia, particularly in relation to the geopolitical dimensions of energy policy, is addressed in the works of A. Cohen [2] and F. Umbach [3]. G. Luft, in his research [4], suggests strategies for enhancing the energy independence of countries through diversification of energy sources, advocating for a broader mix of energy supplies to mitigate risks. K. Smith Stegen examines energy security policies in the context of military conflicts and the evolving global energy landscape [5], highlighting how security concerns shape national and regional energy strategies. Meanwhile, Jing H. [6] outlines contemporary directions for energy strategies, emphasizing that realistic approaches should delay the phase-out of coal, impose stricter energy conservation measures in the residential and transportation sectors, accelerate the adoption of renewable energy sources, improve overall energy efficiency, and mandate the buildup of strategic energy reserves.

The issue of energy security and energy independence in Ukraine is actively studied by Ukrainian scientists. I. Gnatushchenko [7] and O. Adamenko [8] examine the challenges of achieving energy efficiency and utilizing renewable energy sources in the context of Ukraine's energy independence. A. Lisovyi's study [9] identifies

the factors influencing Ukraine's energy security. In particular, the author highlights the geopolitical position, availability of energy resources, infrastructure and technology, energy efficiency, and dependence on imported suppliers. Understanding these factors helps to identify potential threats and develop strategies to ensure Ukraine's energy security. D. Korniienko [10] investigates the issues of international energy cooperation and Ukraine's role in the European energy system. Considering the ongoing processes of digitalization, the study conducted by V. Onyshchenko, S. Onyshchenko, and K. Verhal [11] focuses on the effects of digital economy agreements on energy efficiency. The authors outline key mechanisms through which information and communication technologies can affect CO_2 emissions.

These studies significantly contribute to our understanding of the challenges surrounding energy security and the pathways to achieving Ukraine's energy independence. They provide valuable insights into the complex interplay between geopolitical factors, resource availability, and technological capabilities. As Ukraine strives to enhance its energy efficiency and integrate renewable energy sources, the findings of researchers like Gnatushchenko, Adamenko, Lisovyi, and Korniienko are crucial for informing policymakers and stakeholders.

However, the ongoing conditions of martial law present unique challenges that require a reevaluation and updating of state policy directions aimed at strengthening energy security. The current geopolitical landscape, characterized by heightened tensions and uncertainty, necessitates a proactive approach to ensure the resilience of Ukraine's energy infrastructure. This includes not only diversifying energy sources but also enhancing domestic production capacities and fostering international partnerships.

In light of these circumstances, it is essential to develop strategies that not only address immediate energy security concerns but also lay the groundwork for long-term sustainability and independence. This may involve investing in advanced technologies, improving energy efficiency measures, and promoting the development of local renewable energy projects. By adapting state policies to reflect the realities of martial law, Ukraine can better position itself to navigate the complexities of energy security in an unstable environment.

Objectives of the article. The purpose of the study is to identify the destructive factors affecting Ukraine's energy security and to substantiate directions for its strengthening, taking into account the conditions of martial law.

The main material of the study. Today, energy security is one of the key components of a country's economic sustainability, as the reliable supply of fuel and energy resources is a prerequisite for the effective functioning of economic and governmental structures [12].

Experts provide various definitions of energy security. For instance, an accurate definition states that energy security involves the 'timely, complete, and uninterrupted supply of fuel and energy of the required quality for material production, non-production, the population, households, and other consumers; the prevention of harmful effects on the environment; and the transportation, transformation, and consumption of fuel and energy resources within the context of modern market relations, trends, and indicators of the global energy market,' as provided in the Resolution of the Cabinet of Ministers of Ukraine [13].

In today's world, energy serves as a fundamental basis for various aspects of life and plays a crucial role in a country's economic progress. It is also essential for the sustainable development of society as a whole. However, ensuring a consistent and adequate level of energy supply under diverse social and political conditions remains a significant challenge. The issue of providing the Ukrainian economy and social sector with sufficient quantities and quality of energy resources is one of the most pressing concerns for the nation. Since gaining independence, this challenge has occupied a central place in the considerations of every government and political leader in Ukraine.

The significance of energy security extends beyond mere economic calculations; it profoundly affects multiple dimensions of life, including social stability, environmental sustainability, and national security. A reliable energy supply is vital for maintaining public services, supporting industrial production, and enhancing the quality of life for citizens. Moreover, the energy sector is intrinsically linked to the broader economic framework, influencing investment decisions, employment rates, and overall economic resilience.

In the context of Ukraine, the interplay between energy supply and socio-political dynamics is particularly pronounced. The ongoing geopolitical tensions and economic instability underscore the necessity of developing robust energy policies that not only secure adequate supplies but also promote diversification and the use of renewable energy sources. This multifaceted approach is essential for mitigating risks associated with energy dependence and ensuring a sustainable energy future for Ukraine.

Furthermore, addressing these challenges requires a comprehensive understanding of the underlying factors that affect energy security, including infrastructure adequacy, technological advancements, and international cooperation. By prioritizing these elements, Ukraine can pave the way toward a more resilient energy sector that supports its economic development and meets the evolving needs of society.

The analysis of scientific sources allows us to identify three main factors that have a destructive impact on the formation of Ukraine's energy independence:

1) critical dependence on energy imports;
2) excessive transit capacities;
3) insufficient energy efficiency of the national economy.

Ukraine is currently facing a challenging energy security situation, primarily due to its heavy dependence on energy imports, particularly gas, coal, and oil products. Despite significant steps taken in recent years to reduce this reliance and diversify energy sources, the ongoing conflict with russia has severely complicated these efforts. In response to the crisis, Ukraine has made considerable progress by leveraging reverse gas supplies from the European Union and implementing measures to reduce overall consumption. As a result, the country has successfully minimized its dependence on Russian gas. Nevertheless, Ukraine continues to import substantial volumes of gas, which exposes it to vulnerabilities related to fluctuations in the European market and potential price shocks.

The geopolitical landscape further exacerbates these vulnerabilities, as the European gas market remains subject to supply disruptions and price volatility influenced by various factors, including geopolitical tensions, weather conditions, and market demand. Consequently, any significant changes in the market can have immediate and profound impacts on Ukraine's energy security and economic stability.

Furthermore, while reverse gas supplies from the EU represent a positive development, they also highlight the need for a more resilient energy infrastructure within Ukraine. Relying on imports from neighboring countries can create bottlenecks and limit the nation's ability to respond swiftly to disruptions. To enhance energy security, Ukraine must not only diversify its energy sources but also invest in modernizing its energy infrastructure, including storage facilities and distribution networks. In addition to infrastructural improvements, fostering domestic energy production through the development of renewable energy sources presents an opportunity for Ukraine to reduce its dependence on imports. Investing in wind, solar, and biomass energy can help stabilize the energy supply and contribute to a more sustainable energy future. By prioritizing these initiatives, Ukraine can build a more robust energy security framework that mitigates the risks associated with external dependencies.

Another factor that negatively affects Ukraine's energy security is excess transit capacity. When not fully utilized, these capacities can pose a number of challenges to Ukraine's energy security. Underutilization leads to decreased economic profitability of the gas transmission system, undermines its technical stability, and diminishes Ukraine's role as a key energy transit country.

The economic implications of excess transit capacity are significant. When infrastructure remains underused, the costs associated with maintenance and operation can become burdensome, resulting in reduced financial returns for state-owned enterprises and potentially limiting the funds available for necessary upgrades and investments. Furthermore, an underperforming gas transmission system can deter foreign investments and collaborations, as stakeholders may perceive instability and inefficiency as risks.

To mitigate these negative consequences, Ukraine must focus on several strategic initiatives. Diversifying its energy sources is essential for reducing reliance on any single supplier and enhancing overall energy security. This diversification could involve increasing investments in domestic production of energy resources, particularly in renewable energy sectors such as wind, solar, and biomass. By tapping into these local resources, Ukraine can not only boost its energy independence but also create new economic opportunities and jobs within the country. Additionally, modernizing the existing gas transmission system is critical. Upgrading infrastructure to improve efficiency, safety, and reliability can help maximize the utilization of transit capacities while minimizing operational costs. Implementing advanced technologies such as smart grid systems and digital monitoring can enhance the overall performance of the gas transmission network, ensuring it meets both domestic and international demand effectively.

Expanding cooperation with European countries is also vital. Strengthening partnerships within the European energy market can provide Ukraine with access to new technologies, financial resources, and best practices in energy management. By aligning its energy policies with European standards and regulations,

Ukraine can enhance its competitive position as a transit country and reinforce its role in the broader European energy security framework.

The third identified factor that negatively affects Ukraine's energy security is the insufficient level of energy efficiency within the national economy. This situation indicates that the country consumes an excessively large amount of energy resources to generate a unit of GDP, meaning that economic development is accompanied by significant energy consumption. This phenomenon creates several challenges for both the economy and energy security [14].

A key measure of energy efficiency in the national economy is the energy intensity of GDP, which serves as a generalized indicator of how effectively energy resources are utilized in producing economic output. High energy intensity reflects inefficiencies in energy use, suggesting that economic growth is occurring at an unsustainable rate concerning energy consumption. This inefficiency can lead to several problems, including increased energy imports, heightened vulnerability to energy price fluctuations, and environmental degradation due to higher emissions associated with excessive energy use.

The insufficient energy efficiency of the Ukrainian economy not only undermines energy security but also hampers overall economic competitiveness. Countries with lower energy intensity can produce goods and services more efficiently, allowing them to be more resilient in the face of global market shifts. In contrast, Ukraine's high energy consumption per unit of GDP can limit its competitiveness in international markets, ultimately affecting trade balances and economic stability.

A comparison of the energy intensity of Ukraine's GDP and the global energy intensity is shown in Figure 1.

In recent years, Ukraine's economy has shown a certain decline in the energy intensity of GDP; however, compared to the European Union, this rate is insufficient to prevent the country from being among the least energy-efficient countries in the world. A global analysis of energy intensity shows a steady downward trend (see Fig. 1). Even the energy crisis of 2022, caused by Russia's full-scale aggression against Ukraine, failed to significantly alter the global trend toward a decrease in energy intensity. This outcome is a consequence of the consistent and strategically balanced energy policies of the world's leading countries, including the EU, which are actively implementing measures to improve energy efficiency and develop renewable energy sources. These efforts have enabled them to respond effectively to the crisis and mitigate its negative impact on their economies and the welfare of their populations.

Ukraine must prioritize improving energy efficiency across various sectors, including industry, transportation, and residential areas. Implementing energy-saving technologies, promoting energy-efficient practices, and incentivizing investments in efficiency measures can significantly reduce energy consumption while maintaining economic growth. Additionally, raising public awareness about the importance of energy

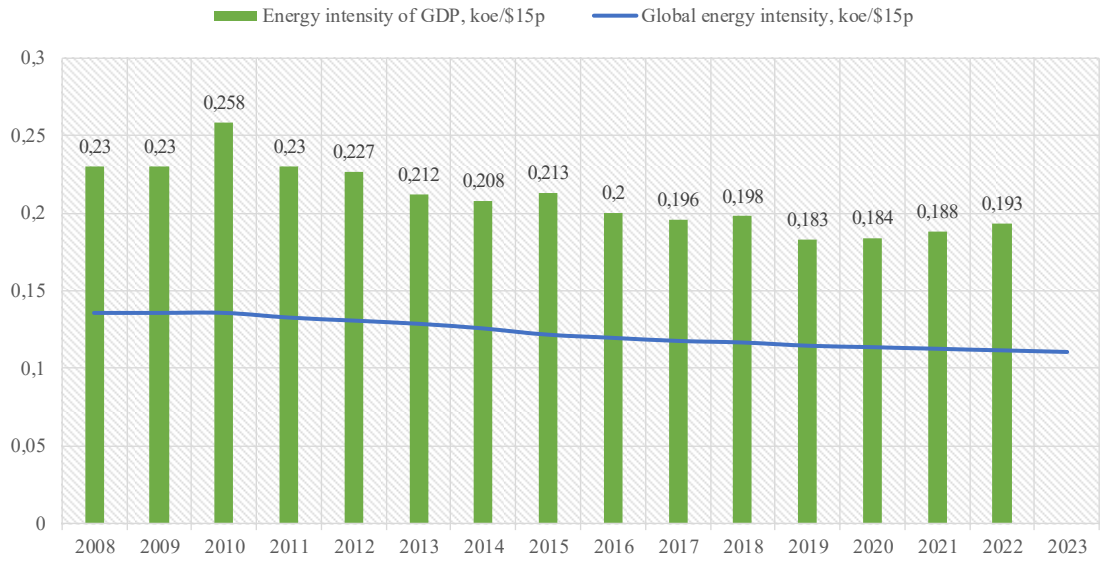

Figure 1. Dynamics of energy intensity of Ukraine's GDP and global energy intensity

Source: compiled by the author according to [15]

conservation can foster a culture of sustainability and responsibility among consumers and businesses alike. Furthermore, integrating energy efficiency measures into national policy frameworks is essential for creating a coherent strategy that aligns with broader economic goals. Establishing regulatory standards and providing financial incentives for energy-efficient technologies can drive innovation and investment in this crucial area.

In conclusion, enhancing energy efficiency is vital for strengthening Ukraine's energy security and ensuring sustainable economic development. By addressing the issues related to high energy intensity, Ukraine can not only improve its energy independence but also create a more resilient and competitive economy in the long run.

To improve energy efficiency as a foundation for strengthening energy security, it is essential to create an effective framework and mechanism for interaction between the government, businesses, and the scientific community in this area. This involves taking into account positive international experiences and continuing cooperation with European partners, such as the EU4Energy Governance project [16], to enhance energy infrastructure. Targeted regulatory measures and further improvement of the regulatory framework in the field of energy efficiency will contribute to increasing Ukraine's energy security and strengthening its position on the global stage.

One of the key steps in improving the regulatory framework was the adoption of the Energy Strategy of Ukraine until 2050 [17]. The mission of this strategy is to create conditions for the sustainable development of the national economy by ensuring access to reliable, environmentally friendly, and modern energy sources. The main goal of the strategy is to achieve climate neutrality in the energy sector, which includes the transition to clean energy, the elimination of energy poverty, and the introduction of innovative technologies and decentralized energy systems.

By 2050, the Ukrainian energy system should ensure the full functioning of domestic energy markets, with further integration into international markets. This model involves not only reducing dependence on fossil fuels but also actively developing renewable energy sources, energy-saving technologies, and innovations in energy generation, transportation, and consumption. The implementation of this strategy will help achieve climate goals and ensure Ukraine's energy security and economic stability.

Thus, energy security, as one of the most important components of economic security, can ensure the sustainable development of Ukraine's economy. The main ways to address this issue include reducing energy dependence, diversifying sources of supply, increasing energy efficiency, and ensuring social stability. The national energy sector should be transformed from a subsidized and problematic sector into an economically profitable, competitive, and flexible component of the economy. Additionally, new opportunities should be created to find and implement innovative developments in the areas of extraction, processing, production, transformation, supply, and consumption of fuel and energy resources [18, 19].

The primary task in strengthening Ukraine's energy security amid the challenges and threats posed by martial law is to ensure stable energy production and use, which is essential for supporting economic growth and improving the quality of life for the population.

Conclusions. Based on the conducted research, it is reasonable to state that although Ukraine has undertaken a series of measures to reduce energy intensity and enhance energy independence, the issue of strengthening energy security, particularly in the context of martial law, remains highly relevant. This highlights the necessity for further modernization of the energy sector and the active implementation of innovative technologies to improve energy efficiency.

The global trend toward decreasing energy intensity indicates the success of strategies focused on the development of renewable energy sources and the optimization of energy consumption. For Ukraine, it is crucial to continue collaboration with international partners, adapting best practices and technologies not only to reduce dependence on imported energy carriers but also to enhance the economy's resilience to future energy crises. Given the global experience, focusing on energy efficiency and the development of renewable energy sources emerges as key components of sustainable economic growth and energy security. In particular, Ukraine should prioritize investments in research and development, fostering a culture of innovation that can lead to breakthroughs in energy technology.

Furthermore, public-private partnerships can play a vital role in advancing energy projects, facilitating knowledge transfer, and ensuring that modern practices are effectively integrated into the energy sector. By leveraging international cooperation and aligning with global energy trends, Ukraine can position itself as a leader in the transition to a more sustainable energy landscape.

In summary, the pursuit of energy independence and security in Ukraine must be underpinned by a strategic commitment to energy efficiency and renewable energy development. This approach not only supports economic stability and growth but also ensures that Ukraine is better equipped to navigate the complexities of a rapidly changing global energy market. The integration of these elements will be fundamental in establishing a resilient and sustainable energy framework for the future.

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UDC 338.242(477)
JEL O000, L510

Alina Hlushko, Candidate of Economic Science, Associate Professor, National University "Yuri Kondratyuk Poltava Polytechnic". **Strengthening energy security of Ukraine**.

As part of the conducted research, the current situation in Ukraine regarding energy security was analyzed, revealing several critical factors that adversely affect the country's energy independence. These factors include

dependence on imported energy resources, the presence of excessive transit capacities, and an insufficient level of energy efficiency in the national economy, as evidenced by the high energy intensity of GDP. The primary task in strengthening Ukraine's energy security amidst the challenges and threats posed by martial law is to ensure stable energy production and usage to support economic growth and improve the quality of life for the population. It is substantiated that to achieve energy independence, Ukraine must adopt a comprehensive approach that includes diversifying energy sources, modernizing infrastructure – particularly through the integration of digital technologies – decentralizing energy systems, enhancing energy efficiency, and actively collaborating with international partners. This will enable Ukraine to bolster its energy security and increase its level of energy independence.

Keywords: energy independence, energy efficiency, energy intensity, energy sector, critical energy infrastructure, decentralization of energy systems.

УДК 338.242(477)
JEL O000, L510

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У рамках проведеного дослідження була проаналізована сучасна ситуація в Україні в контексті енергетичної безпеки, що виявила низку критичних факторів, які негативно впливають на енергетичну незалежність країни. По-перше, Україні притаманна значна залежність від імпортованих енергоресурсів, зокрема газу, вугілля та нафтопродуктів. В умовах збройної агресії з боку росії даний аспект набуває особливої актуальності, оскільки впливає на стабільність енергетичних поставок і контроль цін на енергію. По-друге, наявність надмірних транзитних потужностей є ще одним серйозним викликом для енергетичної безпеки. Їх недостатнє використання знижує економічну ефективність газотранспортної системи, що підриває позицію України як ключової транзитної держави. У цьому контексті важливим є модернізація інфраструктури та активізація співпраці з європейськими партнерами для підвищення ефективності транзиту. По-третє, недостатній рівень енергоефективності національної економіки, відображений у високій енергоємності ВВП, свідчить про неефективне використання енергетичних ресурсів. Це обумовлює підвищену енергетичну залежність та негативно впливає на конкурентоспроможність України на міжнародному ринку. У зв'язку з цим, впровадження інноваційних технологій і енергозберігаючих практик є критично важливими для підвищення енергоефективності. Основним завданням у зміцненні енергетичної безпеки України в умовах викликів і загроз воєнного стану визначено забезпечення стабільного виробництва та використання енергії для підтримки економічного зростання та покращення якості життя населення. Обґрунтовано, що для досягнення енергетичної незалежності Україні необхідно впроваджувати комплексний підхід, який включає диверсифікацію джерел енергії, модернізацію інфраструктури, в тому числі на основі цифрових технологій, децентралізацію енергетичних систем, підвищення енергоефективності та активну співпрацю з міжнародними партнерами. Це дозволить Україні зміцнити енергетичну безпеку та підвищити рівень енергетичної незалежності.

Ключові слова: енергетична незалежність, енергоефективність, енергоємність, енергетичний сектор, об'єкти критичної енергетичної інфраструктури, децентралізація енергетичних систем.