

ECONOMIC PROSPECTS AND DIRECTIONS FOR THE DEVELOPMENT OF ALTERNATIVE ENERGY IN UKRAINE

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Abstract. In Ukraine, where the ongoing war creates additional challenges for the development of the energy sector, the economic prospects for increasing the share of renewable energy sources include a number of advantages, in particular, reducing dependence on energy imports and increasing energy and economic security. The purpose of the article is to analyze the main vectors of alternative energy development in Ukraine and the relevant economic prospects in the current context of military challenges. In the process of research, general research methods were applied, such as analysis and synthesis, generalization, comparison, systematization and specification. The article considers key economic tools for implementing the "green" energy concept, including economic incentives and business motivation for the transition to renewable energy sources. The features of the "green" economic and energy strategy of national development in developed European countries are analyzed. The economic prospects for increasing the share of renewable energy are highlighted: reducing import dependence, increasing the resilience of the energy system to external shocks due to diversification of sources, creating new jobs, stimulating the investment process, reducing greenhouse gas emissions and achieving sustainable development goals. The main vectors of innovative development of alternative energy in Ukraine are substantiated, including digital transformation of management processes, optimization of institutional support and improvement of the legislative framework in accordance with European standards, strengthening public-private cooperation in the industry, diversification of supply, technical modernization of the energy system, and improving the investment climate. The study proves the possibility of increasing the stability and resilience of the national energy system through the active development of renewable energy with the use of targeted economic tools.

Keywords: renewable energy, critical infrastructure, national security, sustainability, incentives, diversification.

JEL Classification: H12, H56, H84, F52, O19

1. Introduction

Using the potential of replacing traditional energy resources with renewable ones is currently positioned as a priority vector of sustainable economic development of the state, increasing energy efficiency, and reducing the energy intensity of gross domestic product. The concept of "green" energy, among other things, aims at decarbonization and preventing the shortage of natural resources, which is reflected in overall economic progress.

Stimulating business to intensify the transition to alternative energy is the subject of increased attention of industry international organizations (United Nations (UN), global energy organizations (WER, Energy Charter Secretariat, IEA, CIGRE), OECD, etc.) and scientific discourse. Ukraine adheres to the general

course of sustainable growth and European integration, reinforced against the backdrop of a full-scale war by the support of the international community in the field of energy transformation.

The features of the use of renewable energy sources as a direction of resource conservation and economic development in crisis conditions were studied by M. Cantarero (2020), R. Østergaard et al. (2020), S. Anton et al. (2020), A. Khotian, V. Rozen (2022), F. Lüdeke -Freund (2020). The authors emphasize the division of responsibilities of stakeholders in the energy sector: the state should determine national policy in the industry, form legislative requirements, and coordinate the work of the national energy protection system; at the same time, owners (operators) should be responsible for developing and implementing practical measures.

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The study of the causes of imbalance in the studied area is given attention in the publications of M. Parkhomets et al. (2020), S. Khan et al. (2020 a, 2020b), H. Lu et al. (2020), K. Tan et al. (2021), F. Taghizadeh-Hesary, N. Yoshino (2020), V. Yakovenko (2023), which details the analysis of energy consumption and production, economic indicators of the efficiency of the energy sector. Scientists argue for the need to establish cooperation between the public sector, the public and business in the context of the development of renewable energy, emphasizing the need for interagency coordination and public-private partnership.

The vast majority of modern researchers consider the active development of renewable energy as a conceptual solution for ensuring sustainable development within the framework of circular economic processes. However, the analysis of the relevant economic tools, innovative approaches to motivating and stimulating business, for the most part, remain out of the attention of scientists or have not been studied sufficiently, which makes the issues of this study relevant.

Purpose of the article consists in analyzing the main vectors of alternative energy development in Ukraine and related economic prospects in the modern context of military challenges.

To achieve the goal, general scientific research methods were used: analytical method, synthesis and generalization, comparison, systematization and specification. The limitations of the study are related to non-systematic research and potential regional bias.

2. Current Status of Alternative Energy Development in Ukraine

One of the main national strategic goals set out in the Energy Strategy for the period up to 2035 is for Ukraine to achieve maximum energy independence. This goal is related to increasing energy efficiency, decarbonisation processes and diversification of energy sources. The Energy Development Strategy of Ukraine is complementary to the provisions of the Climate Protection Strategy until 2050, developed by the European Commission, which envisages the maximum phasing out of fossil energy resources and stimulating the development of alternative energy (Kofanov et al., 2023).

The full-scale war demonstrated the vulnerability of Ukraine's energy infrastructure. According to KSE, as of May 2024, total losses in Ukraine's energy sector as a result of the war reached \$56.2 billion, of which direct losses to the electricity sector amounted to \$11.5 billion (Fig. 1).

As of 2025, the intensity of threats to energy infrastructure continues to grow, causing economic losses and social instability. The protection of critical infrastructure and the development of renewable energy are impossible without cooperation between the public and private sectors. A significant part of energy infrastructure facilities in Ukraine belongs to private operators, which increases the importance of integrating partnership models. Information exchange between entities, including data on threats and incidents, is important, which increases the effectiveness

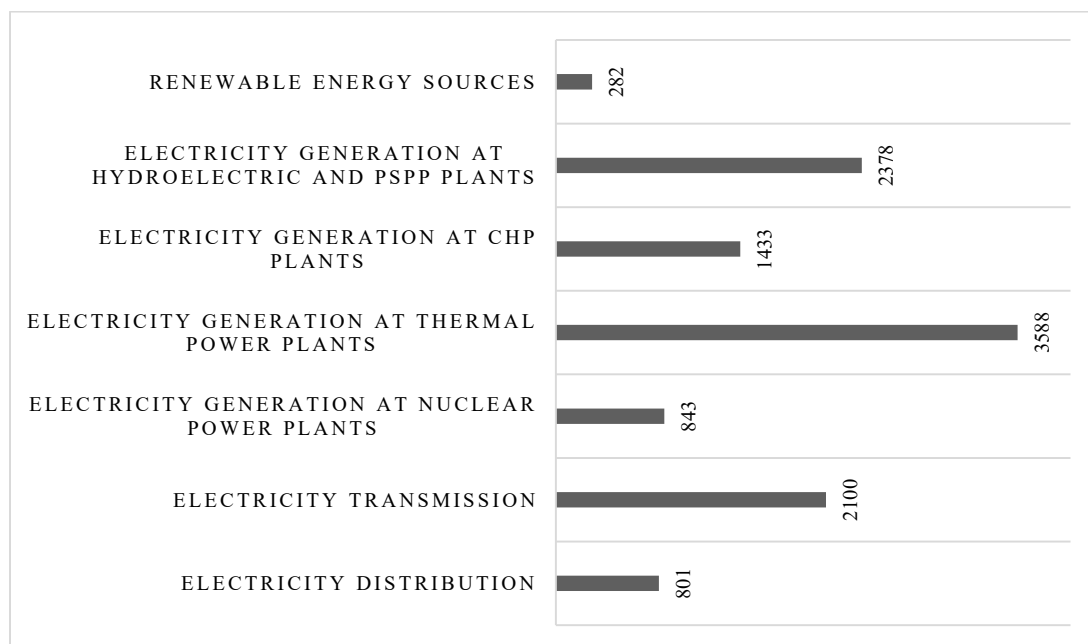


Figure 1. Direct losses to the electricity sector as a result of full-scale aggression by the Russian Federation as of May 2024, million USD

Source: compiled by the author based on KSE (2024)

of the response and optimizes the use of resources (Nikonenko et al., 2022; Tsyhanenko-Dziubenko et al., 2024).

It is worth noting that Ukraine has significant potential opportunities in the field renewable energy ethics. Although the crisis conditions of the war have led to a slowdown in the pace of its development today (Fig. 2), deepening the processes of diversification and deregulation, and creating favorable conditions for investment can optimize the situation in the near future.

A significant number of alternative energy facilities were destroyed and damaged in the first year of active hostilities. A relatively new program to stimulate business in the energy sector, developed in accordance with the "Procedure for providing financial state support to entities of the fuel and energy complex" dated September 19, 2023 No. 627-2023-p, determines the conditions and criteria for financing electricity generation enterprises from the state budget allocated to the Ministry of Energy as the main administrator of funds. State support is provided in the form of a reduction in the cost of bank loans – partial compensation of rates. Financing of energy enterprises can occur along with other forms of support, in particular on the basis of cooperation agreements, local authorities under local business support programs.

3. International Experience in Stimulating the Development of Renewable Energy Sources

An important indicator of the development of the energy system is the share of renewable energy sources

in the structure of electricity production. This indicator reflects the real ratio between electricity production from renewable energy sources (wind and solar energy, hydropower, geothermal) and the total volume of electricity production. An increase in the share indicates effective state policy in the energy sector (Sumets et al., 2022).

The practical experience of European countries in stimulating alternative energy demonstrates the variability of approaches. For example, in Sweden there is an effective system of "green" certificates, identified by securities. The rapid advancement of wind energy technologies in Romania is due to the state program of financial incentives for "green energy" producers and support for the investment process in the industry. As for Poland, the maximum emphasis is placed on the use of biofuels.

Analysis of the experience of European countries allows us to identify promising areas for stimulating renewable energy in Ukraine, including:

- motivation of energy market participants to minimize the share of traditional sources using fiscal, credit and other mechanisms;
- development and implementation of a unified national energy strategy with determination of the variability of technical and organizational and economic instruments and mechanisms for their achievement;
- centralized regulation of prices for traditional fuels;
- targeted subsidies;
- a program of grants and subsidies for pilot projects;
- introduction of a mechanism to prevent excess profits of energy producers and a significant increase in tariffs for the population and industry;

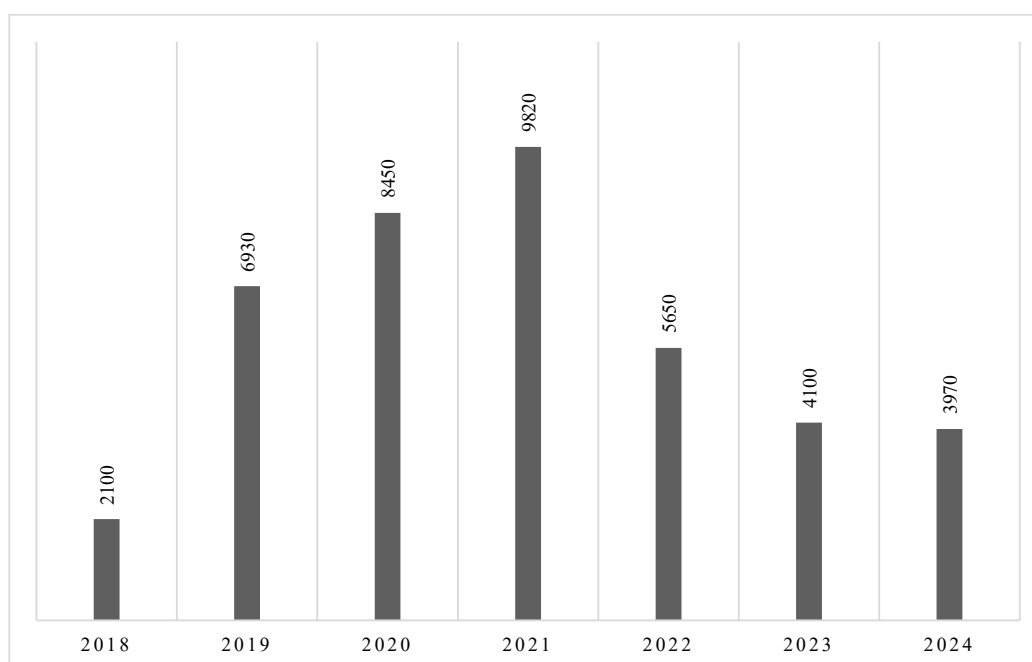


Figure 2. Development of renewable energy in Ukraine, MW

Source: compiled by the author based on NKREKP (2024)

– increasing business awareness; stimulating partnerships between the state, business and the public in the format of "green" agreements.

4. Economic Prospects for the Development of Alternative Energy in Ukraine

To regenerate the energy infrastructure and increase its resilience in wartime crisis conditions, state institutions should implement effective economic and investment mechanisms that provide for:

- military risk insurance for investment projects in priority sectors;
- interest-free lending for projects to regenerate destroyed or damaged infrastructure;
- support for industrial and infrastructure investment projects;
- development of international partnership;
- financial incentives for the transfer of "green" technologies and industrial parks.

Among the main economic mechanisms that promote investment in alternative energy and increase are financial incentives, tax breaks, special tariffs, and auction mechanisms.

The "green tariff" is an increased tariff that guarantees producers of alternative electricity (solar and wind energy, small hydropower, bioenergy) a stable financial income for each unit of energy produced. At the same time, in practice, the introduction of the "green" tariff in Ukraine has caused a number of problems for both producers and the state: the intensive growth in the number of projects leads to the inability of the state to purchase electricity in new volumes at the old price, which leads to a decrease in the "green" tariff rate. The government's response to this situation was the introduction of an innovative incentive tool – an auction for the distribution of support quotas, the purpose of which is to form an adequate price.

Another important mechanism for financial support of alternative energy producers, which protects income from the dynamics of market prices for electricity, is positioned as a contract for difference: the guaranteed buyer compensates the producer exclusively for the difference between the market price and the established "green" tariff. Also important is the support of foreign partners and the involvement of Ukraine in international initiatives, in particular, membership in the International Renewable Energy Agency (IRENA), which promotes the exchange of practical experience and the adoption of best practices.

The state strategy for stimulating the development of decentralized energy sources that operate on the basis of local renewable energy generation should be aimed at ensuring favorable economic conditions for their implementation, including reducing financial

barriers, simplifying permitting procedures, integrating an effective system of benefits and targeted subsidies, and creating a state guarantee concept to attract private investors (Yatsenko & Mohylina, 2023). It is also important to stimulate the development of innovative infrastructure ("smart grids") and involve citizens in the formation of energy cooperatives (Lunov, 2023).

Currently, new mechanisms for economic stimulation of the development of alternative energy in wartime and post-war recovery are being sought. Among them is the possibility of transitioning from a "green" tariff to a "feed-in" mechanism. This economic mechanism involves the entry of alternative energy producers into the market and receiving a certain premium to the market value of electricity generated from renewable energy sources. It is designed to stimulate investment in alternative energy and provides for the purchase of electricity generated from renewable sources at a fixed and preferential tariff, which significantly exceeds the usual wholesale prices. It is obvious that the feed-in mechanism contributes to attracting investment in green energy, making it more attractive to investors (Pakhnenko & Kolomiets, 2021). As the experience of Denmark, Poland and Serbia shows, successful support for green electricity is based on the feed-in model premium and auctions.

It is necessary to note the importance of integrating digital potential, as electronic systems create the possibility of rapid collection and consolidation of necessary data, monitoring and controlling the effectiveness of economic mechanisms for stimulating the development of alternative energy. The proposed concept will contribute to increasing the sustainability of energy infrastructure, optimizes the coordination of actions of state sectoral institutions, and simplifies permitting procedures.

Stimulating business to implement renewable energy sources should include a set of economic, environmental and strategic measures. In particular, economic motivation should be aimed at reducing operating costs, which is especially relevant against the backdrop of market instability in crisis conditions, as well as reducing dependence on fossil fuels through expanded diversification processes. Investments in "green" technologies allow improving the environmental image in the international field, which stimulates economic cooperation, reduces the carbon footprint for entering "socially responsible" markets and participating in socio-ecological programs. Stimulating alternative energy will allow achieving greater compliance with ESG standards (Environmental, Social, and Governance), which opens up new avenues for cooperation with international stakeholders. It is also worth noting that investments in renewable energy are part of a sustainable development strategy that helps maintain business competitiveness in the future.

5. Conclusions

The study proves the possibility of increasing the stability and resilience of the national energy system through the active development of renewable energy using targeted economic tools. Analysis of the practice of implementing the principles of "green" energy in various European countries and the current state of development of the industry in Ukraine allowed us to identify key economic instruments of the "green" energy concept, among which military risk insurance for investment projects in priority sectors is endowed with special promising potential; interest-free lending for projects to regenerate destroyed or damaged infrastructure; development of international partnerships; financial support for industrial and infrastructure investment projects; financial stimulation of the transfer of "green" technologies and industrial parks; financial incentives, tax breaks, special tariffs and auction mechanisms. It is worth noting that support for "green" electricity generation is based on the feed-

in model, premium and auctions, which is successfully used in European practice.

The obtained results of the study made it possible to substantiate the need to increase the share of renewable resources in the national energy sector. Timely identification of imbalance risks and their ranking by the strength of influence will strengthen the potential for economic stimulation and motivation of business in the field of renewable energy.

Ukraine has significant potential opportunities in the field renewable energy ethics. The crisis conditions of the war, which led to a slowdown in the pace of its development, necessitate the deepening of the processes of diversification and deregulation, the creation of favorable conditions for investment. Prospects for further research are seen in the development of a practical algorithm of financial incentives and fiscal benefits for small and medium-sized businesses in Ukraine regarding the development of alternative energy.

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