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## Economic approach to the formation of strategic vectors for strengthening the country's energy security

**Abstract.** The relevance of the research on strengthening the country's energy security is stipulated by modern challenges, unstable economic situation in the country and the change in strategic tasks of Ukraine's development in the direction of strengthening its energy independence. The goal of the article was to determine the essence of the country's energy security and strategic vectors of its development on the basis of economic approach. Methods of logical generalization and data systematization, graphic method of data visualization, comparative analysis of statistical data and performance indicators of stations to identify interdependencies between data have been applied to achieve the goal of the study. Scientific approaches to defining the notion of energy security have been analysed. The analysis of economic approach to considering the essence of energy security is presented. The economic approach provides for three tools for the successful and effective development of the energy sector: the development of renewable energy sources, energy efficiency and energy diversification. Analytical data on the implementation of alternative energy sources in Ukraine, their investment attractiveness and operating costs have been studied. The costs of electricity production using various technologies have been considered and it has been discovered that wind and solar power plants are the least expensive and have the potential for effective operation on the territory of Ukraine. It was revealed that the lack of policy on the energy-efficient use of resources and its investment development strategy reduces the level of competitiveness among business representatives. Key directions for strengthening the country's energy security have been formulated based on the obtained data of the analysis. The results of the research will enable energy companies to develop effective solutions for the successful implementation of energy efficiency policies and will serve as key aspects when searching for potential investors and partners

**Keywords:** alternative energy sources, costs, generation, energy independence, development, stability

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### INTRODUCTION

Strengthening energy security and energy availability are key provisions for the transformation of the global energy system. Energy security is a key component in the national security of every country. For countries dependent on the import of raw materials and fuel, the development of renewable energy sources is not solely a way to attract investments but also a factor in reducing dependence and political pressure on importing countries. Renewable energy is quite a wide alternative to energy sources compared to traditional types. The transformation of the sustainable energy system in the direction of renewable energy will contribute to significant socio-economic positive changes,

new economic opportunities for the development and strengthening of national security. Taking into account difficult challenges that Ukraine is facing in the sphere of economy, politics and ecology, one of the most important priorities of the government is to define the main strategic directions for strengthening energy security. This is necessary to ensure a stable and continuous supply of energy resources at the level satisfying the needs of society.

Models of state administration are taken into account in the formation of energy security policy, mechanisms for its implementation and definition of its main goals. This approach is based on the principles of diversi-

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ty, which provides for considering features of the energy supply for critical state needs and functions, society and economy (environmental friendliness, innovation, safety, resource intensity, managerial and administrative aspects, socio-economic factors, etc.). According to the analytical report on “Energy security of Ukraine: System analysis methodology and strategic planning” [1], the role in the field of energy security may change significantly over time due to transformational processes in the energy services market, the development of technological and scientific potential and changes in the socio-economic environment. N.V. Pryshliak, D.M. Tokarchuk and Y.V. Palamarenko [2] point out that the essence of the country’s energy independence is determined by the need to find alternative sources of fuel and energy supply. This is due to Ukraine’s dependence on the import of oil and natural gas and significant environmental pollution caused by emissions. Energy generated through renewable energy sources will be ecological and will contribute to the country’s independence of external supplies of raw materials.

A.Yu. Deina’s scientific work [3] represents a comprehensive statistical study of ways to ensure energy independence. The scientist has proved that energy independence can be studied as an object of statistical analysis. He has introduced a quantitative characteristics of the country’s energy independence level based on special indicator systems and methods. Moreover, the country’s energy independence is interpreted as a complex category, allowing to determine energy security and depending on various conditions (ecological, political, social, economic, etc.), affecting it. Also, from this scientist’s perspective, energy independence shows the degree of country’s independence as to its ability to resist external and internal destabilizing factors. At the same time, he points out that the formation of the level of energy independence depends on a number of factors, among which are the following: the efficiency of energy resources uses, the amount of investments, the condition of material and technical support, the dependence on raw materials import, the volume of production and consumption of energy resources, etc.

O.O. Okhrimenko and U.V. Bigun [4] suggest interpreting the notion of economic security as the level of protection of enterprises’, country’s and society’s interests at the expense of a sufficient number of resources available to meet basic needs. Considering the fact that energy resources are the driving force of progress, it is energy security that occupies an important place in the system of economic security. In particular, according to S.V. Shcherbyna [5], energy security is defined as the protection of the country as a whole and its citizens from threats of energy resources shortage caused by external and internal threats. Energy security is seen as one of the most important and main components of national security. It is difficult to overestimate its impact on energy system processes and the national economy as a whole. The importance of a gradual transition to alternative energy sources under the conditions of the transition stage of the economy was described in the work of M. David, N. Schulte-Römer [6]. This study once again proves the multidimensional nature of energy security in different countries of the world. Taking into account the scientific potential and meaningfulness of the issue of energy security, the goal of this research is to shape

directions for the strategic development of energy security based on economic approach, to determine its essence and advantages of the policy of energy-efficient use of resources by market entities.

## MATERIALS AND METHODS

The following methods of specific and general scientific analysis have been applied in research: methods of logical generalization and data systematization, graphic method of data visualization, analysis and synthesis for information collection, comparison and classification to identify interdependencies between data, method of theoretical generalization for determining the key idea, statistical methods of information collection and processing, a systematic approach and analysis to identify interdependencies between data. Legislative and regulatory documents of Ukraine, methodological documents and regulations, official data of the State Statistics Service of Ukraine, data of the State Agency for Energy Efficiency and Energy Saving of Ukraine, analytical reports, scientific works of Ukrainian and other scientists on the research issue, serve as a basis for scientific research.

## RESULTS AND DISCUSSION

Foreign policies of the world’s leading countries are increasingly directed at the formation of national security on the basis of energy security. Foreign policy is increasingly aimed at ensuring the sustainable development of the economy with the provision of energy resources. The importance of the research topic is stipulated by the dynamics of threats development in the global and national dimensions, the change of conceptual approaches to the formation of security at different levels [7-8]. The modern national economy ensures its growth primarily by safe energy supply, which meets the principles of reliability, profitability and availability. Moreover, an effective energy policy of each country is a guarantee of an effective policy for the development of foreign trade, industrial production, innovative technologies, and the development of small and medium-sized businesses. The energy component is extremely important for ensuring national security.

Guided by Ukraine energy strategy 2030 [9], energy security is a key requirement for ensuring the existence and successful development of the country. Moreover, energy security is an integral part of national and economic security. Agreeing with the data provided by the energy strategy, it is considered expedient to interpret the energy security of Ukraine as the country’s ability to rationally and effectively use fuel and energy potential, by diversifying their supply channels and expanding the sources of obtaining energy carriers. This approach provides for understanding that the country fully supplies its population, economy and business representatives with fuel resources on the everyday basis and when destabilizing factors occur. As noted in “Energy security of Ukraine: System analysis methodology and strategic planning” [1], energy security is aimed at supplying the social and economic spheres of the country with energy resources. This goal is achieved by securing a stable, reliable, environmentally safe and economically profitable energy policy.

Ensuring the country’s energy security provides for basic approaches to the formation of strategic vectors for

its strengthening. The assessment of the level of country's energy security is carried out by using different approaches based on certain quantitative indicators. However, when it comes to the formation of strategic vectors for strengthening the country's energy security, basic approaches appear to be unsystematic and ungrouped. This means that they are not clearly defined and are indirect. Therefore, further research is needed to determine more effective basic approaches to ensuring the energy security of the country.

A strategic approach to ensuring the country's energy security is crucial, given the complexity of the energy sector. The Ukrainian energy sector is affected by a number of factors, ranging from limited energy resources and the importance of adhering to environmental standards, to unpredictable factors of external and internal nature. With such a dynamic development of the business environment, the strategy is a key factor that allows us to take into account the forecasting of development and stability of the country's energy system. Basic approaches to the formation of strategic vectors for strengthening the country's energy security are distinguished, taking into account world experience, peculiarities of the interaction between the approaches themselves, the post-war recovery of the country and the attraction of international support. In practice, resource-technological, complex (basic) and risk-oriented approaches are distinguished. In connection with the relationship between the mentioned approaches, it is proposed to investigate in more detail the economic approach that ensures security and creates equal terms for consumers. All development programs and strategies have economic interest and the approach to ensuring energy independence is no exception.

The government actively attracts investors to the energy sector, creates prerequisites for the development of alternative energy sources, contributes to the development of energy-efficient technologies and promotes energy diversification. The main goal of the economic approach is to achieve energy self-sufficiency for the country without dependence on the import of energy resources. This is believed to reduce risks associated with pressure from energy suppliers and ensure the stability of the country's energy sector. Therefore, the economic approach is an important component in the formation of strategic vectors for strengthening the country's energy security.

The country's energy security is based on the economic approach, which provides for applying key tools for the successful and effective development of the energy sector. Such tools include the development of renewable energy sources, energy efficiency and energy diversification. Renewable energy sources are an important tool for the country's energy security in the economic approach as they contribute to reducing dependence on the import of traditional types of fuel and make it possible to reduce greenhouse gas emissions. Ukraine energy strategy 2030 [9] provides for the government encouragement and support of renewable energy development through financial measures such as subsidies and tax incentives or regulatory mechanisms such as limiting carbon emissions and setting targets for the use of renewable energy sources. S.A. Kudrya [10] believes that practical inexhaustibility and environmental friendliness should be mentioned among the advantages of using alternative energy sources. The specified factors

will positively effect the ecological state of the planet and will not entail the change in the energy balance in the biosphere. Also, the implementation of alternative energy in production will result in the reduction of the negative impact of extraction processes, processing and transportation of traditional types of fuel and the elimination of disposal problem connected with a large amount of harmful waste.

Effective activation of the key tools of the economic approach to ensuring the country's energy security will allow Ukraine to realize its energy and investment potential. According to the State Agency on Energy Efficiency and Energy Saving of Ukraine [11], in 2019 3.7 billion euros were invested in 4,500 MW of renewable power generation capacity in Ukraine. In particular, the following were introduced: 3,537 MW (78.5%) of solar power plants (SPP); 637 MW (14.1%) of wind power plants (WPP); 243 MW (5.4%) of solar power plants in households (SPPH); 15 MW (0.33%) of mini hydroelectric power stations (mini-HPS); 73 MW (1.6%) of capacities using biomass/biogas.

The given data suggest the investment attractiveness of Ukraine for the development of alternative energy. Due to investments, business activity, government incentives and the development of the alternative energy sector potential, Ukraine rose to the 8<sup>th</sup> place in the rating of investment attractiveness of countries developing green energy [9] in 2019. At that time, according to the data released by Bloomberg New Energy Finance, a consulting company that provides in-depth analytical data on changes in the global energy market [12], Ukraine occupied the 63<sup>rd</sup> place in the rating in 2018. The main reasons for strengthening the rating positions of Ukraine were reforms in the energy sector, attractive "green" tariffs and tax rates.

In general, according to Bloomberg New Energy Finance, 107 GW of renewable energy sources were installed in countries with developing economies in 2018. Solar energy received the first place with the capacity of 66 GW put into operation. Wind energy occupies the second place with a result of 29 GW. The total capacity of small biomass, hydroelectric power stations and geothermal sources makes up 12 GW [12]. On the whole, based on the statistical data of the analytical report [1], the current 6.8 GW of green energy capacities allow the annual production of more than 8.4 billion kWh of electricity (about 5.5% from total production) and supply electricity to more than 3.3 million households. As far as the energy efficiency tool is concerned, according to the report on "Assessment of adequacy of generating capacities" [13] all TPPs (thermal power plants) of Ukraine have exceeded their 40-year projected operation period. Nine TPPs have exceeded 50 years of operation – all of them require urgent equipment renewal.

Negative consequences of excessive wear and tear of TPP equipment include: an increase in unit cost of energy carriers, a decrease in electricity production, an increase in the number of large-scale accidents causing the disruption of power system stability and power outages, possible global disasters. Thus, it is clear that the Ukrainian electricity industry requires urgent equipment renovation. B. Tuchynskyi, S. Kudrya, I. Ivanchenko and V. Ivanchuk [14] believe that further delay in solving this problem leads to a significant decrease in electricity production, an increase in the risks of energy and man-made disasters, an increase in air emissions of substances harmful for both human health and the

environment. Modern coal-fired thermal power plants desperately need the introduction of environmentally friendly coal burning technologies, which enormously increases investments in this electricity generation technology.

On the basis of data supplied by the Lazard company [15], specializing in investment banking, Table 1 shows

costs of electricity production using various technologies. According to the results of the research, the costs are the lowest when producing electricity in wind and solar power plants. This indicates the economic expediency of using the above-mentioned alternative energy sources instead of traditional electricity production technologies.

**Table 1.** Energy generation costs for different technologies

|                                 | Capacity | Capital costs | Fixed operating costs | Variable operating costs | IUCR  | Cost of fuel | Construction lag | Project implementation period | LCOE           |
|---------------------------------|----------|---------------|-----------------------|--------------------------|-------|--------------|------------------|-------------------------------|----------------|
|                                 | MW       | \$/kW         | \$/kW per year        | \$/MW per year           | %     | \$/MMBTU     | Month            | Year                          | \$/MW per year |
| WPP                             | 150      | 1100-1500     | 28-36.5               | -                        | 55-38 | -            | 12               | 20                            | 28-54          |
| SPP                             | 100      | 1100-900      | 12.0-9.0              | -                        | 34-23 | -            | 9                | 30                            | 32-42          |
| Nuclear power plants            | 2200     | 6900-12200    | 108.5-133             | 3.5-4.25                 | 91-90 | 0.85         | 69               | 40                            | 118-192        |
| Coal-fired thermal power plants | 600      | 3000-6250     | 4.75-81.75            | 2.75-5.00                | 83-66 | 1.45         | 60-66            | 40                            | 66-152         |
| Gas power plants                | 240-50   | 700-950       | 5.5-20.75             | 4.75-6.25                | 10    | 3.25         | 12.0-18.0        | 20                            | 150-199        |

**Note:** IUCR – the installed utilization capacity ratio, LCOE – leveled cost of energy, an indicator of the given energy costs

**Source:** designed by the author based on [15]

Wind and solar power plants are quite prospective in Ukraine as there are significant capacities for their development on the territory of the country. Taking into account high efficiency and economic profitability of using the mentioned technologies, the importance of further development of alternative energy sources in Ukraine can be emphasized.

V. Vartsaba, S. Sivitska and O. Filonych [16] have presented a scientific approach to determining strategic investment priorities in the complex restoration of territories affected by natural and technical accidents. The scientists have introduced a matrix for the selection of strategic priorities with the coordination of investment processes in regional and alternative energy sectors for the introduction of energy-efficient technologies and alternative energy sources. S. Onyshchenko, S. Yehorycheva, O. Furmanchuk and O. Maslii [17] study the issue of innovative development management of the construction complex. Scientists emphasize that regional inter-industry complexes are affected by a fairly wide range of factors, threats and dangers of socio-economic life of the region and call for safe operation. Energy, like construction, is a multifactorial industry, that is why the scientists' point of view on the importance of innovative development can be considered relevant for the energy industry.

The second key tool of the economic approach to ensuring energy security is energy efficiency. It consists in reducing energy consumption in the economy through rational use and increasing energy efficiency. The government support for this tool is carried out at the legislative level by regulating the energy efficiency of buildings and energy-saving technologies, as well as by providing subsidies for the installation of energy-saving equipment.

Generally, energy efficiency is an integral component of the country's energy and national security, innovative development and eco-friendly country. The issue of reducing the dependence of countries on the import of energy resources is becoming more and more relevant with every year, considering possible political pressure from importing countries and the deterioration of the ecological situation in the world due to excessive energy consumption. In this context, the issue of energy efficiency is of strategic importance for individuals, enterprises, authorities and the country's independence. V.O. Onyshchenko, S.P. Sivitska, A.V. Cherviak, and V.D. Datsenko, [18] suggest attributing the notion of energy efficiency to the components of economic security and financial institutions. As energy carriers, ensuring the operation of the facility (electricity, water supply, heating, etc.), are becoming more and more expensive with every year, leading to an increase in costs.

In economics there is a notion of energy intensity of the gross domestic product (GDP), which characterizes the ratio of total energy consumption in relation to GDP. The absence of policy on energy-efficient resource consumption leads to negative consequences for the country as a whole. Among such consequences are the following.

Poor enterprise competitiveness – industry without investments in energy efficiency is unable to bring its product to the world market. The higher energy consumption for the produced article is, the higher the market price for this product will be. Moreover, the concept of environmentally friendly business is gaining more and more popularity, which will be one of the criteria for foreign partners when choosing an investment project in the future.

Reduction of investment potential – when choosing a partner for a joint investment policy, those business representatives will be chosen, who monitor and adhere to advanced technologies in the energy-efficient direction and are ready to introduce innovative policies and implement the latest technologies.

The country’s constant import of energy resources - high energy intensity of enterprises leads to excessive energy consumption throughout the country. Since the own production of energy will not be enough to meet the needs, the only way out will be to import the energy. The country’s dependence on imported energy resources causes political and economic danger. Based on the data of the State Agency on Energy Efficiency and Energy Saving of Ukraine [11], Ukraine imported 36% of all the necessary energy at the end of 2018. Industry consumes 32% of the country’s energy with a 40% potential for increasing energy efficiency. That is, if

the energy efficiency policy were introduced and the material and technical base were updated, energy consumption for production would be 40% less. This would have a significant economic effect on both the company and the country.

Climate changes – with the irrational use of traditional energy sources, emissions of greenhouse gases, resulting from their use, create a greenhouse effect and lead to the planet warming. Introduction of efficient environmentally friendly technologies into production will contribute to the reduction of energy consumption and significantly reduce CO2 emissions, as well as counteract climate change.

According to the State Statistics Service of Ukraine [19] Ukraine’s GDP energy intensity is gradually decreasing (Fig. 1), whereas there is evidence for the excess of the total supply of primary energy and final energy intensity. This means that during transportation a significant part of the primary energy gets lost.

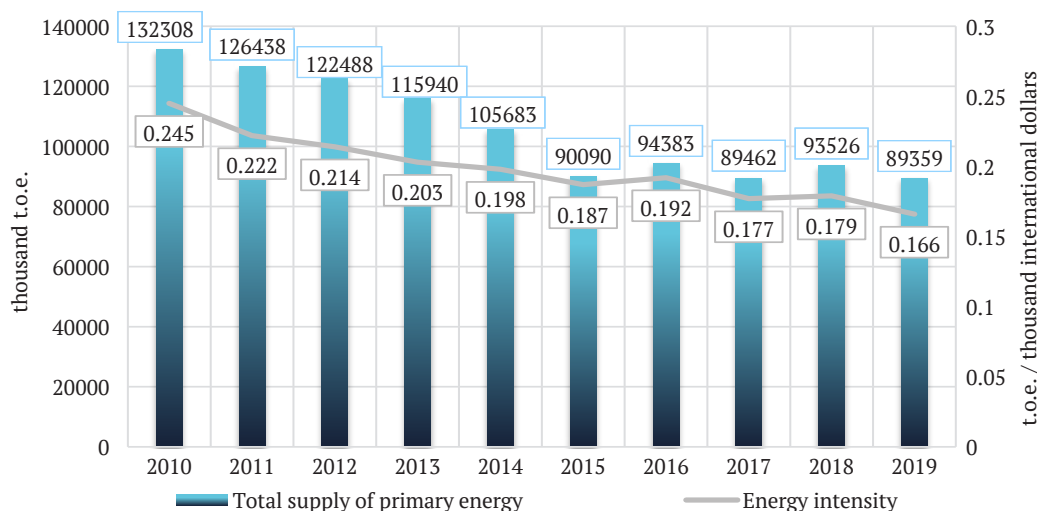


Figure 1. Ukraine’s GDP energy intensity during 2010-2019

Note: t.o.e. – tons of oil equivalent

Source: designed by the author based on [19]

According to I.V. Miniailenko [20] Ukraine is one of the most energy-intensive countries in the world and one of the

few European countries with the lack of government support for energy efficiency in industry, which can be seen in Table 2.

Table 2. Indicators of energy consumption throughout the world

| Country         | GDP (PPP). bln. \$ | Fuel consumed. mln. t.o.e. | GDP energy intensity*. t.o.e. /\$1000 |
|-----------------|--------------------|----------------------------|---------------------------------------|
| Great Britain   | 1263.39            | 232.64                     | 0.18                                  |
| Denmark         | 137.17             | 19.46                      | 0.14                                  |
| France          | 1356.48            | 257.13                     | 0.19                                  |
| Germany         | 1910.12            | 339.64                     | 0.18                                  |
| Italy           | 1265.97            | 171.57                     | 0.14                                  |
| Norway          | 118.09             | 25.62                      | 0.22                                  |
| Spain           | 719.11             | 124.88                     | 0.17                                  |
| Sweden          | 203.8              | 47.48                      | 0.23                                  |
| OECD countries  | 24624.05           | 5316.93                    | 0.22                                  |
| Poland          | 348.35             | 89.98                      | 0.26                                  |
| USA             | 8986.9             | 2299.67                    | 0.26                                  |
| <b>Ukraine</b>  | <b>174.64</b>      | <b>139.59</b>              | <b>0.8</b>                            |
| The whole world | 41753.21           | 10109.59                   | 0.24                                  |

Note: PPP – purchasing power parity; t.o.e. – tons of oil equivalent

Source: [21]

The lack of an effective energy efficiency policy can lead to significant losses of competitive positions on the world market and a gradual decline in industrial production. This can have a negative impact on the country's economy and result in the economic growth recession. Moreover, lack of energy efficiency contributes to increased dependence on energy imports, which can lead to significant economic costs and create problems for ensuring the country's energy security.

Implementation of an effective energy efficiency policy is an important step to ensure sustainable economic growth. This can help reduce dependence on energy imports and ensure production sustainability for Ukrainian goods and services on the world market. Apart from this, the introduction of energy-efficient technologies can stimulate innovative development and create new markets for products and services. Thus, it can be asserted that an effective energy efficiency policy is important for ensuring sustainable economic development of the country, increasing competitiveness in the world market and ensuring energy security. The third tool of the economic approach to energy security is energy diversification. It consists in the development of infrastructure for import and use of energy resources of various origin, including traditional and non-traditional sources. Energy diversification creates prerequisites for reducing excessive dependence on one type of energy.

In the modern world more and more attention is paid to the production and use of alternative energy sources, which is an important element on the way to sustainable development. In Ukraine there is also a gradual introduction of the latest technologies and the use of energy resources in industry and the utility sector. Energy diversification can become an important step towards strengthening Ukraine's energy independence. Expanding the spectrum of used energy sources will reduce dependence on supplies from other countries and reduce risks for the national economy in the event of a change in the political situation in the international arena. In addition, energy diversification will positively affect the economic development of Ukraine. Expanding the exploitation of alternative energy sources will reduce the cost of importing traditional resources, as well as increase the number of vacancies in the field of production and installation of equipment for the exploitation of new energy sources. The exploitation of alternative energy sources also has a positive environmental impact. Decreasing the use of coal and other types of energy resources pollutants will reduce the level of environmental pollution and improve the health of the population. Other possible tools of the economic approach to ensuring energy security may include supporting national energy companies, increasing competition on the energy market, ensuring energy stability and energy infrastructure security.

Given the growing demand for energy, oil and gas prices instability, reducing energy dependence is becoming an increasingly urgent problem for countries around the world. That is why it is important to consider main directions for reducing the country's energy dependence and supplement them with others. One of the most important directions for reducing the country's energy dependence is the diversification of energy sources. This may include the development of renewable energy sources such as solar,

wind, hydro and geothermal energy, as well as the use of biofuels. This makes it possible to reduce dependence on oil and gas imports and decrease the environmental impact of energy production. Improving the investment climate in the energy sector is also an important step in reducing energy dependence, in particular by creating favourable conditions for investors through improving legislation, reducing bureaucratic obstacles, increasing transparency and supporting new projects in the field of renewable energy and energy efficiency. Another way to reduce energy dependence is to increase energy efficiency through the introduction of innovative technologies. This may include the exploitation of energy-efficient building materials, intelligent energy management systems and the use of energy-efficient devices and equipment.

One of the main directions for reducing energy dependence is the provision of high-quality material and technical equipment for the energy infrastructure. It provides for the modernization and expansion of energy infrastructure, as well as the use of the latest technologies and equipment to ensure high-quality and reliable energy supply to the population and industrial enterprises. An additional important measure is solving environmental problems of energy use and ensuring sustainable development. To do this, it is necessary to make a transition to energy-efficient technologies and the use of renewable energy sources. Moreover, it is important to develop energy-saving programs, in particular, by introducing the latest energy-saving technologies and the production of energy-efficient materials. In general, the economic approach to ensuring the country's energy security can be considered the most appropriate one, as it contributes to stability and independence of the energy sector. The use of economic tools such as support of renewable energy, energy efficiency and energy saving, makes it possible to reduce the costs of energy resources and increase the competitiveness of the national economy. Fuel and energy resources are a key factor of social and economic development for any sphere of production. The country's energy security serves as one of the main characteristics of economic security, given the heavy dependence of the economy on the import of natural resources and the constant increase in their cost. That is why the notion of energy security appears quite often in regulatory documents and scientific studies on energy and energy management.

In the Draft Law of Ukraine "On the Principles of State Policy in the Energy Security of Ukraine" [22] energy independence is defined as the country's ability to independently shape and implement internal and external policy in the field of energy supply. At the same time, it is independent of internal and external influencing factors. In Yu.V. Dziadykevych's scientific research [23] energy independence is treated as the level of country's independence, which is directly related to the fuel and energy complex activity. However, this approach is somewhat narrow as energy is present in all sectors of the economy and this stipulates a more in-depth study of energy independence. S. Sivitska [24] interprets energy efficiency and the use of renewable energy sources as an urgent need of nowadays as it helps to solve not only the issue of energy supply but also many environmental, economic and social problems. Studying the condition and prerequisites for the alternative energy development, the scientist focuses on the world trends

regarding the main obstacles inhibiting the development of alternative energy and its growth factors.

Quite a big number of scientific works is dedicated to the issue of energy security. The author shares J. Braun's [25] understanding of energy security as the state of economy, allowing for covering the current and future demand of customers for fuel and energy. However, we find this interpretation somewhat narrow, since energy security is not limited only to the demand for fuel or energy. A. Azzuni and C. Breyer [26] present a broader interpretation of the notion of energy security, treating it as a universal issue capable of ensuring a high level of social development by creating its own rules and principles for the energy sector. Energy security is studied by leading Ukrainian and foreign scientists. In particular, interesting views on energy security and energy efficiency under the conditions of energy transition are expressed by B.K. Sovacool [27] and other scientists, who actively study energy security, socio-technological approaches and their role in the implementation of energy transition process [28-30]. The studied scientific works make it possible to determine the multidimensional nature of energy security research and its complexity in different countries.

## CONCLUSIONS

In the course of the conducted research, the views of scientists regarding the understanding of the notion of energy security have been summarized and on this basis approaches to the formation of strategic vectors for strengthening energy security have been determined. The expediency of considering energy security both from energy efficiency and economic expediency perspectives has been

substantiated since investment flows are attracted to the energy sector, prerequisites for technological development are created and more attention is paid to promoting the idea of transition to alternative energy. The conducted research made it possible to confirm the role and significance of the economic approach to the formation of strategic vectors for strengthening the country's energy security and to determine key tools for the successful and effective development of the energy sector. It has been proved that due to a rather significant energy intensity of GDP, Ukraine is dependent on energy imports and cannot successfully implement innovative programs for the development of alternative energy. Effective, rational and ecological energy consumption is becoming more and more relevant compared to investing in the import of energy carriers. Threats to energy security affect both all sectors of social production and the interests of all citizens, since the cost of energy resources has a direct impact on the cost of consumer goods and the quality of the environment. Based on the analysis of statistical data, it has been proved that the introduction of energy-efficient technologies and operation programs have a positive effect on the economic development of the country and the formation of its energy independence.

On the basis of the research results, business representatives should develop a strategy for energy-efficient development of the enterprise as it makes the company socially responsible and investment attractive for partners. The research opens perspectives for the further study of the energy security development strategy of Ukraine in the view of ensuring an effective information policy and the development of effective business projects for business representatives in cooperation with government programs.

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## Економічний підхід до формування стратегічних векторів зміцнення енергетичної безпеки держави

**Анотація.** Актуальність дослідження посилення енергетичної безпеки держави обумовлена сучасними викликами, нестабільною економічною ситуацією в країні та зміною стратегічних завдань розвитку України в напрямку зміцнення своєї енергетичної незалежності. Метою статті було визначення суті енергетичної безпеки держави, визначення стратегічних векторів її розвитку через призму економічного підходу. Для досягнення мети дослідження використано методи логічного узагальнення та систематизації даних, графічний метод візуалізації даних, порівняльний аналіз статистичних даних та показників результативності роботи станцій для виявлення взаємозалежностей між даними. Проаналізовано наукові підходи до визначення поняття «енергетична безпека». Представлено аналіз економічного підходу до розгляду суті енергетичної безпеки, який передбачає використання трьох інструментів для успішного та результативного розвитку енергетичного напрямку: розвиток відновлювальних джерел енергії, енергоефективність та енергетична диверсифікація. Проведено дослідження аналітичних даних із впровадження альтернативних видів енергії на території України, їх інвестиційної привабливості та вартості експлуатації. Розглянуто витрати на виробництво електроенергії за різними технологіями та встановлено, що вітрові та сонячні електростанції найменш витратні і мають потенціал до ефективною експлуатації на території України. Визначено, що відсутність політики енергоефективного використання ресурсів та її інвестиційної стратегії розвитку знижує рівень конкурентоспроможності представників бізнесу. Згідно з отриманими даними аналізу сформульовано ключові напрямки зміцнення енергетичної безпеки держави. Результати дослідження дозволять енергетичним компаніям розробляти ефективні рішення для успішного впровадження політики енергоефективності та слугуватимуть ключовими аспектами при дослідженні потенційних інвесторів та партнерів

**Ключові слова:** альтернативні джерела енергії, витрати, генерація, енергетична незалежність, розвиток, стабільність