განახლებადი ენერგიის განვითარება უკრაინის ენერგეტიკული უსაფრთხოების ფორმირების კონტექსტში

DEVELOPMENT OF RENEWABLE ENERGY IN THE CONTEXT OF ENERGY SAFETY FORMATION OF UKRAINE

ოქსანა მიკოლიუკი,
ე.მ.კ.,დოცენტი, ბუღალტრული აღრიცხვის, აუდიტის და საგადასახადო დაბეგრვისკათედრის დოქტორანტი, ხმელნიცკის ეროვნული უნივერსიტეტი, ხმელნიცკი, უკრაინა
ვალენტინა ბობროვნიკი,
ე.მ.კ., ბუღალტრული აღრიცხვის, აუდიტის და საგადასახადო დაბეგრვის კათედრის დოცენტი, ხმელნიცკის ეროვნული უნივერსიტეტი, ხმელნიცკი, უკრაინა

OKSANA MYKOLIUK,
PhD (Economics Sciences), Associate Professor, Doctoral Student at the Department of Accounting, Auditing and Taxation, Khmelnitsky National University Khmelnitsky, Ukraine
VALENTYNA BOBROVNYK,
PhD (Economics Sciences), Associate Professor at the Department of Accounting, Auditing and Taxation, Khmelnitsky National University, Khmelnitsky, Ukraine

ABSTRACT

Analysis of the state and prospects of the development of renewable energy in Ukraine based on the formation of its energy security. The link between politicization and the implementation of policies aimed at using technologies to increase the production of energy from renewable sources has been identified. The problem of replacing natural energy resources with alternative energy sources is investigated. The main ways of forming the energy security of Ukraine are set out. The categories "renewable energy sources", "alternative sources" are investigated and differences in their values are determined. Monitoring of the proportion of the usage of renewable energy in Ukraine in recent years has been carried out, which indicates its gradual growth. The impact of the use of renewable energy in reducing the energy intensity of the gross domestic product of the country has been proved. The key guidelines of the energy efficiency policy in Ukraine are given and the place of renewable energy sources in its implementation is substantiated.

Key words: *renewable energy, innovative energy sources, energy efficient technologies, national economy, energy security, strategic directions.*

ანოტაცია

განხორციელებულია უკრაინაში განახლებადი ენერგიის მდგომარეობის ანალიზი და განსაზღვრულია მისი განვითარების პერსპექტივები ენერგეტიკული უსაფრთხოების ფორმირების საფუძველზე. გამოვლენილია ურთიერთდამოკიდებულება ენერგეტიკული უსაფრთხოების ფორმირებასა და იმ პოლიტიკის დანერგვას შორის, რომელიც უზრუნველყოფს ისეთი ტექნოლოგიების გამოყენებას, რომელიც ზრდის ენერგიის წარმოებას განახლებადი წყაროებიდან. გამოკვლეულია პრობლემა ბუნებრივი ენერგეტიკული რესურსების ენერგიის ალტერნატიული წყაროებით ჩანაცვლების შესახებ. განსაზღვრულია უკრაინის ენერგეტიკული უსაფრთხოების ფორმირების ძირითადი მიმართულებები. გამოკვლეულია კატეგორიები „ენერგიის განახლებადი წყაროები", „ალტერნატიული წყაროები", და დადგენილი ნიქნა სხვაობა მათ მნიშვნელობებს შორის. განხორციელებული იქნა მონიტორინგი განახლებადი ენერგიის წილის გამოყენების შესახებ უკრაინაში ბოლო წლების მანძილზე, რაც ცხადყოფს მისი გამოყენების ზრდას. დასაბუთებულია განახლებადი ენერგეტიკის გამოყენების გავლენა ქვეყნის მთლიანი შიდა პროდუქტის ენერგოტევადობის შემცირებაზე. მოყვანილია უკრაინის ენერგოეფექტურობის საკვანძო ორიენტირებიდა დასაბუთებულია ენერგიის განახლებადი წყაროების ადგილი მათ რეალიზაციაში.

საკვანძო სიტყვები: *განახლებადი ენერგენიკა, ენერგიის ინოვაციური წყაროები, ენერგოეფექტური ტექნოლოგიები, ეროვნული ეკონომიკა, ენერგეტიკული უსაფრთხოება, სტრატეგიული მიმართულება.*

INTRODUCTION

An important criterion for sustainable development is a stable, cost-effective and environmentally acceptable procuring of the energy resources of the economy, which is the key to its energy security. With the beginning of the

military aggression in the east of Ukraine, a clear direction was taken to obtain energy independence. Among the main challenges our state faces with is the fight against inefficient energy consumption in order to improve energy efficiency and energy saving. The present of Ukraine is reflected in the need to import energy resources and the lack of sufficient possibilities for alternative generation of certain energy sources. Therefore, the formation of energy security becomes a priority vector in the economic and state policy of the state, and the processes occurring on the world energy market once again confirm the relevance of this problem both for the entire world community and for Ukraine in particular. The level of energy supply is one of the main factors of the country's socio-economic development. The bulk of the Ukrainian industry is characterized by a significant energy intensity of the manufactured products and a high dependence on imported energy, therefore the introduction of a policy aimed at energy-efficient technologies and increasing energy production from renewable sources creates the future of the country's energy security. The search for alternatives to the replacement of traditional energy sources is intended to compensate for the shortcomings of the existing energy system, since the reserves of renewable energy sources are practically unexhaustible, and also contribute to economic growth by reducing energy costs in all areas of business. Besides , Ukraine receives support from a number of international organizations. One of the examples is the EBRD initiative -IQ Energy, which is an additional source of funding for the implementation of energy efficiency measures in the housing sector of Ukraine, taking into account European standards [1].

Actual scientific researches and issues analysis. To the questions of the development of renewable energy in Ukraine a significant number of scientific works, including G. Kaletnik, G. Geletukha, S. Curls, G. Pivnyak and many others is devoted. Problems of development and implementation of energy efficiency measures are reflected in the works of such scientists as V. Barannik, O. Tsapko-Poddubnaya, N. Kazakova and others. However, the scale of the problem of developing renewable energy in Ukraine and thus ensuring its energy security necessity of further researches, in particular in the area of achieving a high level of energy efficiency.

The aim of the research. The aim of the research is to analyze the current state of renewable energy, to justify the prospects for its development and to determine ways of forming the energy security of Ukraine.

The statement of basic materials. As the results of many scientific studies show, the usage of traditional energy resources (coal, oil, gas) causes significant damage to the ecosystem of the entire planet and causes climate change, which in turn affects the health and living conditions of the population and, consequently, the world and national economies [2-6; 15-17]. That's why , in recent decades, the world community has been actively developing technologies and methods of using unexhaustible and clean energy sources, such as wind, solar radiation, renewable bioenergy resources and others. Localization of these problems is not exclusive, therefore Ukraine should actively participate in initiatives of low-carbon economic development, taking full care of today's and next generations. The aim of scientists in this context is the implementation of a comprehensive analysis of the correlations between the conditions of the usage of natural resources and the risks which they bear to the environment.

In 2015, 195 countries of the world, including Ukraine, decided to adopt the Paris Climate Agreement, which is aimed at strengthening the global response to threats of climate change in the context of their sustainable development. The main goal of the Paris Climate Agreement is to keep the increase in average temperature on the planet below 2 ° C compared to the pre-industrial level. According to the results of the 20th United Nations (UN) Climate Conference, renewable energy was recognized as the main tool for reducing greenhouse gas emissions into the atmosphere in order to minimize the effects of climate change on the planet. There is a steady trend towards the development of renewable energy sources (RES) and the gradual replacement of traditional generation with them [1, 3, 6].

The study of the category "alternative sources" should begin with a description of the types of energy sources in general. In the scientific literature, the categories "renewable and alternative energy sources" are basically identical. But, as the analysis shows, there are certain differences between these categories [7]. The term "renewable" is derived from the verb "renew ", which means to bring to its previous state. Thus, renewable energy sources are those energy sources that are not exhausted during their usage , for example, solar, wind, water, geothermal and biomass [8; 13]. In recent years, Ukraine has witnessed a gradual increase in the share of the usage of renewable energy, but the difficult economic situation in the country does not contribute to the achievement of the goals adopted in the National Action Plan for Renewable Energy. The term "alternative" means that it is possible to choose one of two or more opportunities. Alternative sources of energy in the encyclopedic literature are defined as a method, device or structure that allows to obtain electrical energy (or other

desired type of energy) from the energy of renewable or practically unexhaustible natural resources and phenomena and replaces the traditional energy source operating on oil, gas or coal [9, p. 114]. In the economic literature, alternative energy sources are defined as other sources or other methods of manufacturing than burning fossil fuels or nuclear fuel fission [9, p. 198-199]. In this definition, the essence of alternative energy sources as a substitute for traditional sources is quite clearly determined.

It is known that Ukraine is an energy-intensive state - the amount of energy resources needed to produce a unit of gross domestic product (GDP) is, on average, twice as high as the average for European countries. Researches show that the geographical position of Ukraine is favorable for the implementation of renewable energy projects, in particular the generation of solar energy. Ukraine has very good indicators in terms of solar radiation (insolation), a great number of sunny days is character for the domestic climate. By the degree of insolation of Ukraine, it significantly exceeds, for example, Germany.

However, as it is seen in fig. 1. Ukraine lags behind by the rate of the use of renewable energy sources(RES) in the economically developed countries of the world (including the Visegrad countries), including the global average. The share of renewable energy(RES) in gross final energy consumption (GFEC) in the world was 20% in 2014, while in Ukraine this figure was only 4.2%.

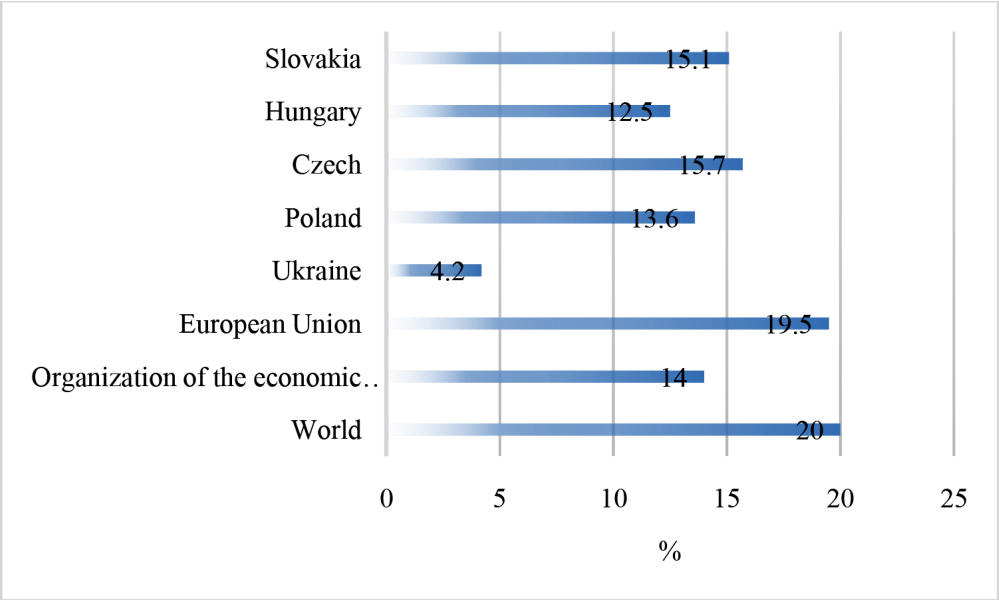


Fig. 1. Renewable energy sources in gross final energy consumption in 2016.

The problem of replacing natural energy resources with renewable energy sources is directly linked with the decrease in the energy intensity of Ukraine's gross domestic product and is due to the need to ensure energy security and independence of the state. Ukraine has significant potential in the development of alternative energy and prospects for its use. According tothe estimates of the international agency IRENA, Ukraine has the most extensive technical potential of using renewable energy among the countries of South-Eastern Europe - 408.2 GW (excluding large hydroelectric power plants). The greatest potential is the use of wind and solar power plants: 321 GW and 71 GW, respectively [4]. According to experts of the Institute of Renewable Energy of the National Academy of Sciences of Ukraine, the total annual technically achievable energy potential of renewable energy sources of Ukraine in terms of reference fuel is about 98 million tons r.f., which is more than 50% of the total energy consumption in Ukraine at the present time and 30% of energy consumption in 2030 [5]. The share of energy extracted from alternative sources today is about 3%. According to the Ukrainian energy strategy, until 2030, the share of alternative energy in the country's overall energy balance will be increased to 20% [6; 11].

The main and most effective directions of renewable energy in Ukraine are wind energy, solar energy, bioenergy, hydropower, geothermal energy.

Respectively, in 2016, the total installed capacity of wind energy in Ukraine was 525.6 MW, from which 437.8 MW are located on mainland Ukraine. Ukraine has

a significant wind energy resource, sufficient to ensure the development of large wind power objects. Therefore, the southern coast of Ukraine and the Carpathians are among the best in the country according to the existing wind potential, that is, the development of wind energy should be concentrated, first of all, in the regions mentioned above. At the present time, the Zaporozhye region is leading in terms of the current wind power capacities, with an wind power capacity of 200 MW. At the end of 2016, there were 12 wind power stations (WPSs) operating in Ukraine, the largest of which is the Botievskaya wind power station with a capacity of 200 MW, located in the Zaporizhye region [1, 4].

It should be noted that the electric energy produced at wind power stations is the cheapest among other types of electricity produced from renewable energy sources.

According to the development of solar energy, the annual technically achievable energy potential of solar energy in Ukraine which is equivalent to 6 million tons r.f., its use would allow to replace about 5 billion cubic meters of natural gas. The average annual amount of total solar radiation falling on 1 sq. M. surface in Ukraine is in the range of 1070 kW • h / m2 in its northern part up to 1400 kW • h / m2 and higher in the south of Ukraine. Ukraine has a green tariff that ensures a return on investment in the construction of solar power stations at about 6 years. At the same time, currently investments are in the range from 1,000 to 2,000 euros per kilowatt of installed capacity. The average life of the solar power station is 25-30 years, respectively, the investments return and make a real profit.

Today, in Ukraine, the capacity of large hydropower stations is about 9% of all generating capacity of the United Energy System of Ukraine (UES), but there is a potential for further upgrading to 15-20%. A separate direction of hydropower development in Ukraine is the development of small hydropower in existing reservoirs, main canals, as well as the reconstruction of small hydropower facilities that perform the function of protecting adjacent territories from flooding. The capacity of small hydropower plants in Ukraine today is 118 MW [3, 10].

The aggravation of the process of environmental pollution by organic waste and waste products of human settlements is a significant motivation to intensify scientific and technical developments to improve the process of biogas production. It should be noted that the manufacturing of electricity from biomass is only a part of a developing industry in Ukraine. Biomass-based heat generation should become more extensive and as expected a more capitalized market segment.

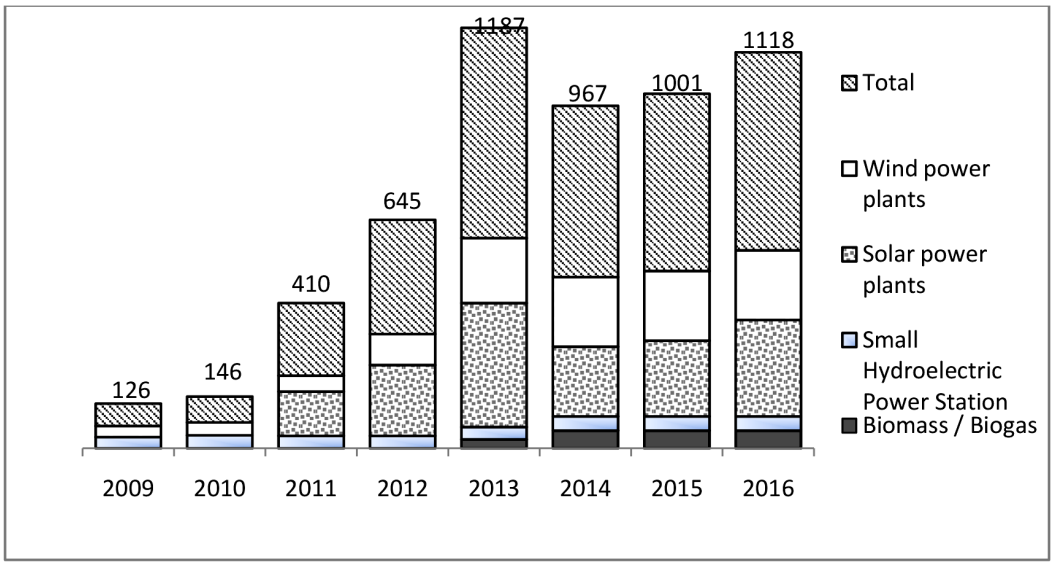
As a result of the research, it was revealed that at present 11 geothermal power stations have been built in Ukraine, and the total potential of geothermal power stations is 8,400,000 t o.e. / year Among all alternative sources of electricity, geothermal ones are the least powerful. On the other side , geothermal power stations fully satisfy the needs of small settlements and have great development prospects.

Taking into account the mentioned above , renewable energy is less than 1% of the total electricity production in present time. The role of renewable energy sources tends to increase, as it was declared by the government, as an established 10% indicator for renewable energy sources until 2020. And in accordance with the recently adopted Energy Strategy of Ukraine for the period until 2035 “Safety, energy efficiency, competitiveness”, renewable energy should reach a level of 25% in the overall structure of electric energy production.

Analysis of a number of researches shows that the installed capacities of renewable energy sources in Ukraine tend to grow annually (the fall in 2014 was due to the loss of energy facilities in the Crimea and in the ATO zone). The average annual growth rate of installed capacity of renewable energy sources is 31%. As at 1 January, 2017, the installed capacity of renewable energy facilities in Ukraine, which operate at a “green” tariff, amounted to 1,117.7 MW (Fig. 2).

In addition, in 2016, 120.6 MW of capacity was put into operation, among them more solar facilities - 99.1 MW and wind energy - 11.6 MW. Small hydropower facilities and those that produce energy from biomass and biogas were built approximately 3 MW each. According to the National Commission implementing state regulation in the spheres of energy and utilities (EUNRCU), by the end of 2016, the renewable energy industry in Ukraine already has 170 companies and 291 energy facilities. During 2016, the largest increase was demonstrated by solar energy - 36 new entities and 47 new power generation facilities. In the first half of 2018, Ukraine installed 269 MW of “green” capacity which is more than twice compared with the same period last year (127 MW) and exceeds the figures for the entire year 2017 (257 MW) [1].

Despite certain changes in the development of renewable energy sources, the Ukrainian paces of development of alternative technologies differs significantly from European ones. In the EU during the past decade, there has been an annual increase in the volume of renewable energy production by approximately 5.5%. At the same time, from 2005 to 2015, its volumes increased by 71%, and the part



Data for 2014-2016 are presented excluding the Autonomous Republic of the Crimea and the ATO zone

Fig. 2. Installed capacity of renewable energy facilities operating on the "green" tariff in Ukraine, MW [14]

of renewable energy in the total volume of primary energy production from all sources in year 2015 was 26.7%.

World hydropower industry today provides about 20% of total energy production. Only thermal power plants produce more electricity, but today they are too harmful. The capacity of hydroelectric power plants (HPP) in the world is 1267 GW, including hydro-accumulating power stations (HAPS) - 142.1 GW. The largest producers of hydropower in the world are the USA, Canada, Brazil, China and Russia. First place in the world belongs to China -27%, Brazil -8.6%, USA -7.7%, Canada -7.5%, Russia - 4.7% [14]. If we analyze the percentage of hydropower in meeting the energy needs of a state, then in China its share is 17%, in Brazil, Canada, Venezuela, Austria — more than 50%, and Norway and Paraguay - almost 100% of their electricity needs come from water resources. At the same time, Ukraine, which has huge water reserves, uses them only by 50%. The installed capacity of HPP and HAPS in the United Energy System of Ukraine (UESU) is 7350 MW. In the power balance of the power system of Ukraine, the share of hydropower plants does not exceed 9.1%. Moreover, in Ukraine there is a shortfall of shunting and regulatory capacities.

Thus, the analysis of trends in the development of world energy shows that its main factors are energy security, credibility of energy supply, energy efficiency and environmental friendliness. Indeed, in the XXI century, humanity finally started to think about the problem of energy saving and increasing the efficiency of energy usage with a steady increase in energy consumption. This was preceded by climate change and the problem of global warming caused by greenhouse gas emissions. According to experts, the global energy demand by 2030 will increase to almost 60% and can reach 30,000 billion kWh.

To enhance the national security of Ukraine and its independence, an increase in electricity exports and the integration of Ukraine's UES to the European energy system in the Ukraine's energy development Strategy until 2035 approved a whole range of hydropower development directions, including the restoration of existing hydroelectric power stations on small rivers and gutters.

The acquisition by Ukraine the status of a full member of the International Renewable Energy Agency IRENA was an important event in year 2018. Joining IRENA for Ukraine means entering the international arena of players in the renewable energy market. Such a step will contribute to improving the state's investment image, wider possibilities for attracting the world's best practices and technologies, and most importantly, green investments. The membership of Ukraine in IRENA will allow [1]:

-apply to the Abu Dhabi Development Fund to receive concessional loans for green projects (at 1-2% for up to 20 years, including a 5-year grace period, subject to co-financing of 50% of the project cost);

- closely and productively cooperate with developed countries;
- to have access to advanced research, practices and technologies for the use of renewable energy sources;
- to increase investment in domestic renewable energy industry ;
- to improve the legislative base and develop effective mechanisms to stimulate the development of "clean" energetics.

It should be noted that Ukraine's membership in IRENA for the development of renewable energy can be one of the key factors for investors when deciding on the implementation of projects in this area. However, despite the need to reach in Ukraine until 2020 a 11% share of energy produced from renewable sources, the process of developing renewable energy is characterized by rather slow dynamics. The reasons for this trend are the lack of system of economic promotion for the transition to the usage of renewable energy, the declarative nature of legal acts without specific implementation mechanisms, as well as low executive discipline. Taking into account global trends, the European Commission in its energy strategy until 2020 defines a number of priorities in ensuring energy security, such as : improving the technology for the exploration, production and consumption of excavated fuel; introducing energy saving and energy efficiency technologies; energy policy definition; development of technologies for the usage of alternative sources and the protection of consumer rights [6]. Therefore, there is no other way to improve the energy efficiency of the national economy, to achieve energy independence, than developing renewable energy, which will ensure an adequate level of the country's energy security.

Thereby , the development of renewable energy sources is intended to solve important socio-economic problems of Ukraine, in this way helping to reduce the power consumption of the gross domestic product (GDP), ensure energy security and improve the efficiency of the national economy as a whole. This will enhance the competitiveness of domestic products and, respectively , will create additional demand for products. In this case, the economic effect of the use of energy from renewable sources will be achieved.

CONCLUSIONS.

Overcoming the economic crisis caused by the energy dependence of Ukraine, as well as a number of factors of social, economic and political origin, requires the development and adoption of qualitatively new solutions on the implementation of energy efficiency policies. One of the main directions of increasing the efficiency of the national economy of Ukraine is to provide the energy security of the state through the development and implementation of renewable energy sources. The main factors determining the need for the development of renewable energetics in Ukraine are: the lack of own energy resources in Ukraine of sufficient volumes, energy dependence on energy imports, the growing shortage of traditional energy resources, the constant growth of their value on the world market, and problems with external supply; environmental problems, in particular the need to fulfill international obligations to limit harmful emissions; the negative state and trends in the fuel and energy complex, namely, the lack of efficiency in the usage of traditional fuel and energy resources; the thrust of Ukraine's state policy on integration into the European Union, which requires achieving a high level of usage of renewable energy sources.

Dependence on the import of expensive energy resources creates significant socio-economic problems. A very high degree of deterioration of the domestic infrastructure, in particular, energy, and, accordingly, low efficiency in the use of energy resources is one of the factors why Ukraine was among the countries with high energy intensity indicators of the economy. Thus, the level of energy intensity of Ukraine's GDP is 2.8 times higher than the corresponding indicators of OECD and Visegrad countries as of year 2016.

Ukraine has begun a global energy shift for future economic growth. Renewable energetics brings additional investments in the Ukrainian economy and opens up new horizons for development. In accordance with the National Action Plan on Renewable Energy, byyear 2020 we must provide 11% of the state's energy needs with energy from renewable sources already in 2020. Besides, in 2035, the share of renewable energy in the total primary supply should be 25%. So, the search for ways to accelerate the transition to sustainable energy is one of the main tasks not only to achieve energy independence, but also to ensure a decent future for future generations.

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