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## THE INFLUENCE OF MARTIAL LAW ON THE INTERNATIONAL INNOVATION ACTIVITY OF ENERGY ENTERPRISES OF UKRAINE

*The article is devoted to topical issues of innovative activity of energy enterprises. Since Ukraine has been integrated into the energy space of the European Union since March 16, 2022, a detailed study of changes in the innovative activity of energy enterprises in the impact of the martial law becomes especially relevant. The study reveals theoretical approaches to the interpretation of innovative activity; the essence of the main types of innovations critically necessary for the effective functioning of energy enterprises is characterized; the content of innovative management of enterprises is disclosed; trends and volumes of investments in the energy sector, including in innovative activities, were analyzed; the main aspects of the international innovative activity of energy enterprises are revealed; as well as the changes that occurred in the energy industry under martial law. It is worth noting that the energy sector suffered significant destruction in connection with the beginning of Russia's war against Ukraine. In the light of these events, Ukrainian energy companies faced a number of important problems: rapid restoration of damaged power grids and high-quality transmission of electrical energy to end users. In this way, the legal regime of martial law significantly affected the activities of enterprises, because the problems faced by the energy industry of Ukraine required the newest and most innovative solutions. It is worth noting that in 2022, energy enterprises of Ukraine actively attracted investments for the renewal and reconstruction of fixed assets, and also developed international cooperation with various European structures in the field of energy. In general, the impact of the legal regime of martial law is assessed as negative, because a number of critical problems have arisen, but on the other hand, it contributes to the introduction of innovations and the expansion of international cooperation.*

**Keywords:** innovations, investments in innovations, energy enterprises, international activities, martial law.

**JEL classification:** F21, L10, O31

## ВПЛИВ ВОЄННОГО СТАНУ НА МІЖНАРОДНУ ІННОВАЦІЙНУ ДІЯЛЬНІСТЬ ПІДПРИЄМСТВ ЕНЕРГЕТИКИ УКРАЇНИ

*Стаття присвячена актуальним питанням інноваційної діяльності підприємств енергетики. Оскільки Україна з 16 березня 2022 року інтегрувалася у енергетичний простір Європейського Союзу, детальне вивчення змін в інноваційній діяльності підприємств енергетики в умовах режиму воєнного стану набуває особливої актуальності. Дане дослідження розкриває основні теоретичні підходи до трактування поняття «інноваційна діяльність»; розкриває суть основних видів інновацій, що критично необхідні для ефективного функціонування підприємств енергетики; зміст інноваційного менеджменту; аналізує тенденції та кількість інвестицій, що здійснюються у промисловості, в тому числі і в інновації; розкриває основні аспекти міжнародної інноваційної діяльності підприємств енергетики; а також зміни, що відбулися в енергетичній сфері в умовах воєнного стану. Варто відзначити, що енергетична сфера зазнала значних руйнувань у зв'язку із початком війни Росії проти України. Крім цього, військові дії сильно вплинули на підприємства енергетики, що спеціалізуються на виробництві електроенергії із відновлювальних джерел енергії, адже у зв'язку із окупацією частини українських територій значна частина СЕС та ВЕС були зруйновані або сильно пошкоджені. У світлі цих подій українські енергетичні підприємства стикнулися із низкою важливих проблем: швидкого відновлення пошкоджених електромереж та якісного передавання електричної енергії кінцевим споживачам. Таким чином правовий режим воєнного стану значно вплинув на діяльність підприємств, адже проблеми із якими стикнулася енергетична галузь України вимагали новітніх та інноваційних рішень. Варто зазначити, що у 2022 році підприємства енергетики України активно залучали інвестиції задля оновлення та реконструкції основних фондів, а також розвивали міжнародну співпрацю із різними європейськими структурами в галузі енергетики. Загалом вплив правового режиму воєнного стану оцінюється, як негативний, адже виник ряд критичних проблем, що ставили під загрозу функціонування усієї галузі економіки, однак з іншого боку сприяє впровадженню інновацій та розширенню міжнародної співпраці.*

**Ключові слова:** інновації, інвестиції в інновації, підприємства енергетики, міжнародна діяльність, воєнний стан.

**Statement of the problem.** In today's conditions of economic and political instability, the introduction of innovations by energy companies of Ukraine is becoming more and more important, because the competitiveness of

the entire economic sector depends on effective innovation management. Innovation is a driving force capable of bringing the development of the energy industry of Ukraine to a new level and will help to qualitatively join the world

standards in the energy industry. The study of innovative activity of enterprises became critically important in the conditions of martial law, because it was after February 24, 2022 that the energy infrastructure suffered significant destruction, therefore, the analysis of investment volumes in innovation and international innovative activity is more relevant than ever.

**Analysis of recent research and publications.** The innovative activity of enterprises is studied in many scientific works of domestic scientists, among them: Tarasova O.V. [3], Yazlyuk B., Butov A., Kostetskyi V. [4], Shpykulyak O.G., Mazur G.F. [5], Bondar T.V., Tymoshchenko V.Yu., Vakulenko I.A. [8]. However, with the beginning of Russia's war against Ukraine, there have been changes in the innovative activity of energy enterprises of Ukraine, which remain practically unresearched, so there is currently an important need for a thorough study of this topic.

**Unresolved parts of the common problem.** The complexity of the implementation of innovative processes at energy enterprises of Ukraine necessitates a detailed study of the theoretical foundations of this process, as well as a study of the factors affecting the successful implementation of the latest technologies during the war.

**Objectives of the article.** The purpose of the article is the analysis of theoretical approaches to the interpretation of innovative activity, the study of the main types of innovations that are of critical importance for energy enterprises of Ukraine, the identification of the main trends in investing in innovations and the provision of proposals for the creation of an effective strategy for the implementation of innovations in the conditions of operation the legal regime of martial law.

**Summary of the main results of the study.** The activities of all enterprises are closely related to ensuring a high level of competitiveness of their own products and services. This problem becomes especially urgent in the conditions of global instability, because their place in a certain sector of the economy depends on the decisions and actions of enterprises. Taking this into account, Ukrainian enterprises faced a new task – ensuring continuous and effective activity during the war. One of the tools for achieving this goal is the introduction of innovations, which in turn can provide leading positions in the field of economy, both on domestic and foreign markets for domestic enterprises.

Analyzing the scientific works devoted to the innovative activity of enterprises, we can come to the conclusion that there are many approaches to the interpretation of this concept, each of which takes into account the peculiarities of the functioning of the country's economy and the scientist's own position. Some approaches to the interpretation of the concept are given in the Table 1.

As can be seen, from the given definitions of the concept of "innovative activity" there is no consensus among the authors, because in its essence the authors consider this concept as an activity, a set of measures, a complex of practical actions and a process [7].

So, the concept of "innovative activity" is the enterprise's function aimed at the creation, implementation and implementation of innovations with the aim of obtaining a certain economic and social effect.

In order to effectively implement innovations in energy enterprises of Ukraine, it is necessary to apply innovative management. This concept is a functional system designed to ensure highly effective management of the processes of development, implementation and use of innovations in order to achieve sustainable development of the enterprise.

In general, innovation management is an integral part of the functioning of energy enterprises, because it allows to ensure the effective functioning of innovation processes in the short, medium and long term; and also helps enterprises to produce competitive products and provide high-quality services using innovative technologies.

The main goals pursued by energy companies of Ukraine regarding the implementation of innovative management are:

1. Improvement of the economic performance of the enterprise;
2. Creating an effective procurement process, namely building an automated and transparent process;
3. Increasing efficiency in managing investments and ensuring their use in innovative activities;
4. Creation of a centralized system of electricity generation and consumption;
5. Optimizing the personnel management process, including ensuring constant improvement of their qualifications;
6. Creation of a system for analysis and development of measures to ensure quick elimination of losses and carrying out repair work;

Table 1

**Systematization of theoretical approaches to the definition of innovative activity**

| Author                                      | Interpretation of the concept of "innovative activity"  |
|---|---|
| Law of Ukraine "On Innovative Activity" [1] | activities aimed at the use and commercialization of the results of scientific research and development and lead to the release of new competitive goods and services to the market.  |
| Law of Ukraine "On Investment Activity" [2] | set of measures aimed at the creation, implementation, dissemination and implementation of innovations with the aim of obtaining a commercial and/or social effect, which are carried out by implementing investments invested in objects of innovative activity.   |
| Tarasova O.V. [3]                           | a set of practical actions aimed at using scientific and technical results to obtain new or improve existing products, technologies, management methods, etc.   |
| Yazlyuk B., Butov A., Kostetskyi A. [4]     | activity aimed at using the results of scientific research and development to expand and update the product range and improve the quality of products, improve the technology of its production with further implementation and effective implementation on the domestic and foreign markets.                             |
| Shpykulyak O.H. [5]                         | type of activity that, based on the results of scientific research, ensures the creation of fundamentally new products, new services, as a result of which something that did not exist before appears.   |
| Kovalenko O.V. [6]                          | process aimed at implementing the results of completed scientific research and development or other scientific and technical achievements into a new or improved product sold on the market, into a new or improved process used in practical activities, as well as additional research and development related to them. |

Source: systematized by the author based on [1–6]

7. Creation of an effective business model of enterprise functioning.

So, it can be noted that the most relevant and important today are the implementation of such types of innovations as process innovations, management innovations and transactional innovations.

Let's take a closer look at the use of these types of innovations in energy enterprises. Process innovations are of basic importance for energy enterprises, because the main goal of their implementation is to improve the process of supplying electricity to end consumers [8; 10]. At the same time, this type of innovation is capable of providing a flexible enterprise management system, which in turn will increase the level of their adaptation in a changing external environment [9]. An example of the introduction of process innovations are "smart" meters, the use of which increases the transparency of the information received regarding electricity consumption, which in turn increases the level of correctness of calculations for the electricity consumed by end consumers.

Management innovations are no less important than process innovations, because they allow you to set up an effective demand management system, which allows you to build such a system of electricity consumption among consumers, which will reduce the load on the energy system during peak hours, that is, it will help create a normal consumption profile.

The main task of implementing transaction innovations is to reduce operating costs arising from the supply of electricity to end consumers. Therefore, in modern conditions, it is important to develop "smart networks", which can potentially become the basis of a new model of the energy market of Ukraine [8].

Comprehensive implementation of the above-mentioned types of innovations will allow energy companies of Ukraine to modernize the process of supplying electricity to consumers and help to more effectively solve problems arising in the energy sector.

Innovations at energy enterprises are critically important for the functioning of the entire energy industry of Ukraine. However, the implementation of innovations is a rather complex process, especially in the conditions of the legal regime of martial law, which was introduced by the decree of the President of Ukraine "On the introduction of martial law in Ukraine" dated February 24, 2022 in connection with the military aggression of the Russian Federation against Ukraine.

The introduction of the legal regime of martial law throughout Ukraine had a strong impact on the functioning of all sectors of the economy, including the energy sector. Since martial law came into effect in Ukraine, the energy sector has undergone the following changes:

1. Starting from March 16, 2022, the energy system of Ukraine is integrated into the Energy System of Continental Europe. At the same time, the government imposed special obligations on electricity exporters to pay the guaranteed buyer for the service of guaranteeing the security of electricity supply.

2. The storage of electricity is subject to licensing, while it is prohibited to engage in the activities of storage, transmission and distribution of electricity at the same time.

3. In the conditions of martial law, all consumers are guaranteed the supply of electric energy under the conditions of universal service [11].

4. In connection with mass missile attacks on the territory of Ukraine, planned and emergency power outages were used to stabilize the energy system [12].

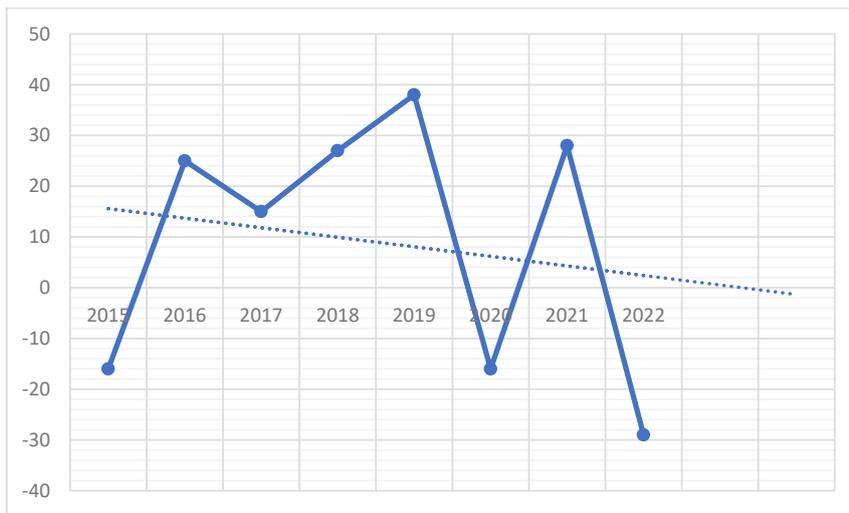
Taking into account all the above, the following data were analyzed to assess the impact of the war on the innovative activities of energy enterprises of Ukraine: expected changes in capital investments of enterprises for the supply of electricity, gas, steam and air conditioning; structure of investments by target purpose; factors affecting investment in industry. We consider it expedient to analyze precisely these data, because the innovative activity of energy enterprises depends to a greater extent on investments.

Working out the analytical material related to changes in the expected capital investments of enterprises for the supply of electricity, gas, steam and air conditioning, we can come to the conclusion that the trend is not stable and changes constantly under the influence of political and economic factors. As can be seen from Figure 1, the war on the territory of Ukraine significantly reduced expectations regarding capital investments – in 2022, this value reached the minimum value and amounted to -29%. For a more detailed analysis, we built a trend line using Excel. The trend line indicates that negative trends in changes in the volume of capital investments are expected, primarily due to military actions on the territory of Ukraine. Such a reduction in expected capital investments is an extremely negative phenomenon, because it indicates the insufficiency and reduction of investment resources for the introduction of innovations in the activities of energy enterprises.

An equally important part is the study of the structure of investments according to their intended purpose, because it determines what types of innovations resources will be directed to. As can be seen from Figure 2, for the period from 2015 to 2022, the largest share of investments was directed to the replacement of worn out machines and equipment, because the fixed assets of industrial enterprises, including energy enterprises, are in an unsatisfactory state and require immediate modernization. The largest number of investments for the replacement of fixed assets was sent in 2017 (57%), followed by 2022 (48%). The increase in investments in the modernization of fixed assets in 2022 can be associated with significant destruction and losses at energy enterprises in connection with the massive missile strikes of the Russian Federation on the territory of Ukraine.

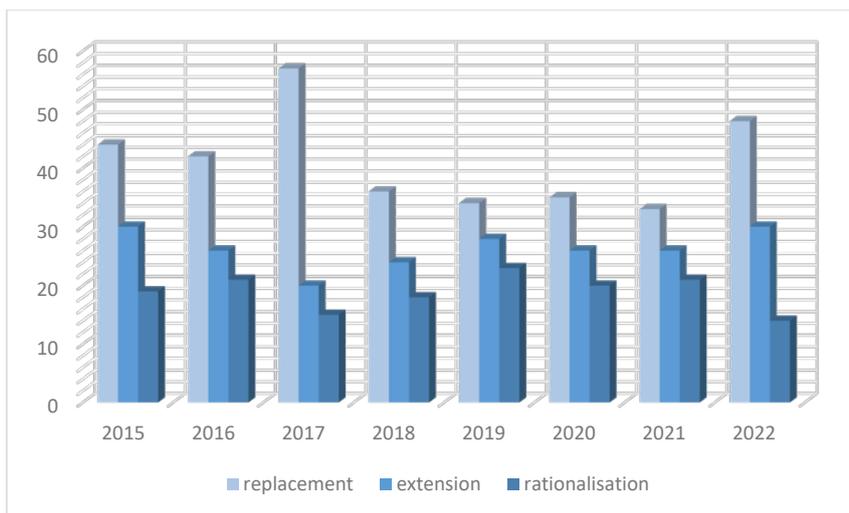
In second place are investments in the expansion of production capacities, the largest volume of which for the analyzed period in 2022 was 30%. Such a phenomenon can also be explained by military operations in all territories of Ukraine and significant destruction of the energy infrastructure.

As for investments in rationalization of production, the situation has opposite trends compared to the previous two types of investments. There is no stable trend of growth or decline of this type of investment, but starting from 2021, investment volumes will decrease. In 2022, the volume of investments in the rationalization of production is the smallest for the entire analyzed period, because since the introduction of martial law, the energy infrastructure has been operating in extreme conditions. This trend is negative for the energy industry of Ukraine, as the lack of an effective production process, that is, the lack of introduced technological innovations and new technologies, has a restraining effect.



**Figure 1. Dynamics of changes in expected capital investments of enterprises for the supply of electricity, gas, steam and air conditioning for the period from 2015 to 2022, in % compared to the previous year**

Source: built by the author based on [13]



**Figure 2. The structure of investments in industry according to their intended purpose for the period from 2015 to 2022, %**

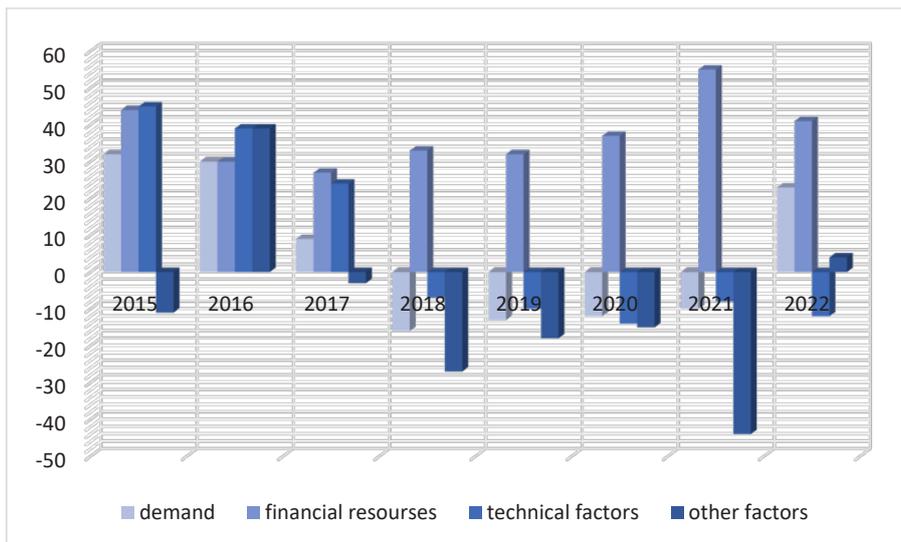
Source: built by the author based on [13]

Analyzing the factors affecting investment volumes for the period from 2015 to 2022, the following trends are available. Regarding the impact of demand, from 2015 to 2017 and in 2022, demand had a stimulating effect on the number of investments, including investments in innovation. The impact of financial resources throughout the period has only a stimulating effect on investment volumes, with 2022 being one of the largest. Technical and other factors also have an impact, but mostly restraining. In 2022, the influence of these factors was quite insignificant. Thus, in the conditions of martial law, the factors of demand and provision of financial resources had the greatest influence.

For a more detailed understanding of trends in the energy sector of the economy, we will also analyze the changes that have occurred with renewable energy sources (RES). Renewable energy sources were actively developed in

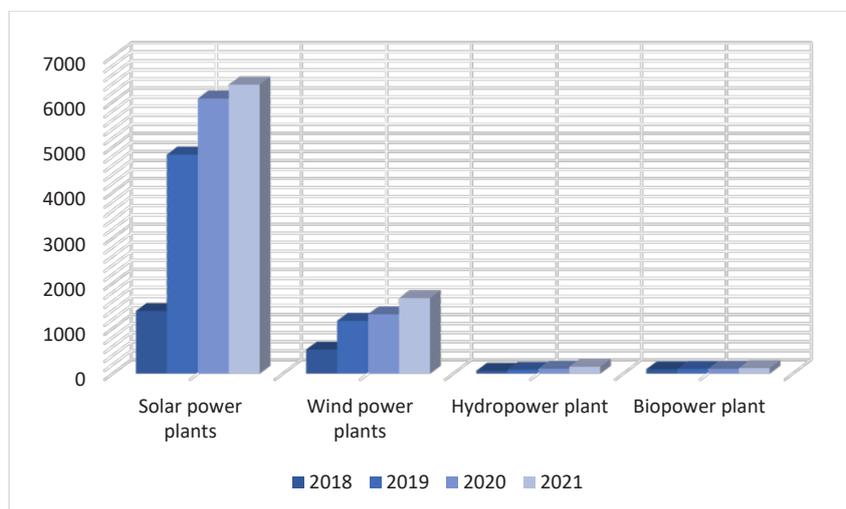
Ukraine in the pre-war period, because in 2019 Ukraine was in the TOP-10 countries in the world for the development of renewable energy sources, in addition, according to the Climatescope rating by Bloomberg New Energy Finance, it took 8th place in terms of investment attractiveness in the development of low-carbon sources energy and "green economy". Investment volumes in innovation for the development of renewable energy sources have remained consistently high since 2019, while over the past 10 years, Ukraine has been able to attract more than USD 12 billion in foreign direct investment in the development of renewable energy. At the same time, the amount of energy generated using renewable sources of electricity was constantly increasing every year, which is shown in Figure 4.

As can be seen, the growth of RES capacity is increasing every year, which indicates the efficient use of invest-



**Figure 3. Factors affecting investment in industry for the period from 2015 to 2022, %**

Source: built by the author based on [13]



**Figure 4. Dynamics of changes in the amount of energy produced by renewable energy sources facilities operating under the "green tariff", MW**

Source: built by the author based on [15]

ments by energy companies. At the same time, the renewable energy sector is dominated by solar power plants, the capacity of which increased from 1,388 MW to 6,381.1 MW, i.e., the amount of energy produced increased by 4.5 times, and wind power plants, whose capacity increased from 533 MW to 1,672.9 MW, i.e., it increased by 3.1 times.

At the same time, this positive dynamic was destroyed by Russia's invasion of Ukraine. Since the majority of renewable energy power plants are located in the southern and partly in the southeastern regions of Ukraine, where hostilities are currently taking place. Considering the different estimates, experts claim that about 30-40% of RES facilities were damaged as a result of military operations, while about two-thirds of WPPs were stopped, and the potential of SPPs is used only at 30%. Missile attacks and military actions of the Russian Federation caused the complete destruction of Myrna WPP, Siva WPP, Novotroitska

WPP, bioenergy plants in the Eastern regions of Ukraine suffered significant damage [15].

Summarizing all of the above, during the period of martial law in the energy industry, capital investment is expected to decrease, while investment in upgrading and replacing equipment is expected to increase, which is associated with significant destruction of the energy infrastructure.

In addition to the analysis of investment volumes, including investments in innovation, we conducted an analysis of the international innovative activity of energy enterprises. It is worth noting that the National Commission for State Regulation in the Energy and Utilities Sectors and NARUC have agreed on cooperation in critical areas for energy enterprises of Ukraine. The agreement provides for the expansion of technical assistance, integration of markets, assistance in the development of the capacity market, consultations on setting tariffs, develop-

ment of distributed generation demand management. In addition, NERC actively cooperates with CEER in matters of reforming the energy industry of Ukraine and bringing it to EU standards [12].

It is worth noting that NEC "Ukrenergo" also actively cooperates with foreign partners, because in 2022 a Credit Agreement was signed with KfW for 32.5 million euros for the project "Improving the efficiency of electricity transmission (Modernization of substations) II". The provided funding will be used for the modernization and automation of 8 substations in the South-Western part of Ukraine, while it is planned to create high-tech automated facilities that comply with ENTSO-E [14].

**Conclusions.** Summarizing all of the above, innovations in energy enterprises play an important role, because they stimulate the creation of an efficient process of production and transmission of electrical energy to end users. It should be noted that the introduction of innovations requires investments, with the help of which priority

directions in the energy sector are modernized. During the period of the legal regime of martial law, the volume of investments for the replacement and restoration of production capacities of energy enterprises increased. In addition, in 2022, Ukraine began to actively expand international cooperation in the field of energy, which mainly consists in the introduction of innovative technologies. In general, the legal regime of martial law poses a new challenge to the energy sector of Ukraine, because right now it must effectively respond to rapid changes in the external environment. It should be noted that for the effective implementation of innovations in the conditions of martial law in Ukraine, it is necessary:

1. To develop international partnership in the field of energy;
2. To ensure an increase in the volume of investments, including investments in innovation;
3. To create an effective system of response to political and economic factors at the enterprise in the conditions of martial law.

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