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Renovation management of the national economy in ensuring energy decentralization

ABSTRACT: This article is devoted to an analytical review of the situation in the energy sector of Ukraine, taking into account constructive changes in the connection of the Ukrainian energy system to ENTSO-E and the destructive situation caused by industrial infrastructure failures and economic renewal. It focuses on Ukraine in the context of the principles of decentralization in the direction of significantly increasing the net cost of microgeneration, decarbonization and the transition to “green” energy. The national resource potential of energy-efficient and energy-saving technologies is systematized and the applied recommendations are provided to support state and local trends in

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energy sector development, namely energy storage projects, distributed generation and microgeneration based on Net Energy Metering to support small projects that solve energy problems. Included are institutional proposals for the establishment of the Agency for Decarbonization in Ukraine for the “green” transition, with broad powers of communication and the ability to make decisions on reducing carbon emissions in all areas. The possibility and expediency of using the concept of innovation is considered both from the global point of view of Ukrainian industry (with the potential prospect of using Ukraine’s industrial and logistics infrastructure as a mega-industrial park for the EU) and in the local sense of national energy, including improvements to the EU’s energy balance. It has been proven that the use of the nearshoring mechanism in Ukrainian industry in general, and in the energy sector in particular, can improve Europe’s energy balance, which has deteriorated over the past five years. Thus, the negative trend of the EU energy balance in thousands of tons of oil equivalent and in percentage terms was demonstrated. To improve the situation, the forecast of energy prices for individual EU countries was calculated taking into account Ukraine’s integration into the European energy system. The analysis and calculations revealed a potentially possible level of price reductions in some EU countries up to 20%. Recommendations are for improving energy-management efficiency at the regional level in particular, ensuring transparency in the development of renewable energy sources, using significant national potential of biofuels and increasing natural gas production, developing a business model of gas distribution center in Western Ukraine, which will be part of national gas distribution system and the European energy market.

KEYWORDS: decentralized energy generation, energy sector, modernization of the energy sector, national economy, nearshoring

Introduction

The issue of energy security in Europe is becoming relevant in the turbulent geopolitical situation in which energy resources are increasingly having a significant impact on the economies of European countries. With this in mind, it is important for European countries to reduce the risk of the current vulnerability by increasing their own energy production, reducing dependence on energy supply routes, optimizing the structure of energy consumption, and ensuring competitive prices on the European domestic energy market.

The current course of events demonstrates the existing capabilities and capacity of the European Council to assist Ukraine in rebuilding its economy in new and Euro-oriented areas of development. In particular, the EU is unanimous in supporting Ukraine, while supporting several initiatives to assist the energy sector through the establishment of the Energy Support Fund of Ukraine. Such an institution enables coordinated assistance to the Ukrainian energy sector, which has already been integrated into the European energy system ENTSO-E.

However, given globalization, the impact of military aggression will have a significant impact on external economic challenges and the world. Given these conditions, there is a need to form basic trends in the renovation of Ukraine’s economy and their impact on regional development based on SMART – goals of budget decentralization, Industry 4.0, regional energy management,

eco-innovation. The above determine the essence of the study in this article and has been adapted in several European publications (Koval et al. 2022; Borodina and Trushkina 2022).

Issues of improving the efficiency of the country's energy sector have been the subject of research interests (Zellagui et al. 2021; Trushkina et al. 2021; Koval et al. 2021).

The aim of this article is to determine the current losses in the industrial infrastructure of Ukraine, provide theoretical and methodological analysis of current trends in the energy sector, and provide practical recommendations for energy decentralization, taking into account effective energy management and energy-saving technologies.

The systematization of losses in industrial infrastructure in their geographical location in old industrial regions, while synchronizing with the share of industrial regions in GDP, as well as determining the principles of energy decentralization based on the proposed SMART chain will help renovate Ukraine's economy and its potential energy technologies.

The novelty of the study is the presentation of institutional and regulatory proposals for the establishment of the Agency for Decarbonization ("green transition") in Ukraine, with broad powers and communications, and the ability to address carbon reduction in all related areas as well as the synchronization of the regulatory framework for strategic and program documents on the recovery of Ukraine's economy with the relevant European documents.

The object of study is the theoretical assumption that a comprehensive combination of the principles of Industry 4.0 as well as the effective energy management and energy decentralization, taking into account the actual European energy integration of Ukraine into the European energy system, will ensure a synergistic effect on Ukraine's economic renovation.

1. Methodology

1.1. Infrastructure failures in national value chains

Infrastructure failures affect and cover all other areas causing the greatest destruction which the transport and industrial infrastructure has experienced. The largest twenty completely or partially destroyed industrial facilities are presented in Table 1, the vast majority being in the old regions.

It is significant that the affected regions (Kharkiv, Donetsk, Luhansk, Kyiv, Sumy, Zaporizhia, Mykolaiv, Kherson regions) are firstly industrial or agro-industrial, and secondly, play a significant role in the country's gross domestic product (GDP), specifically about a third of the national GDP. And even if we remove those areas that were liberated from this list (but have not yet restored infrastructure) then the rate of their participation in the country's GDP will be 21%.

Assuming that the affected areas have industrial potential but are to some extent removed from the national value chains, the corresponding picture will appear as follows (Fig. 1, 2).

TABLE 1. Destroyed industrial facilities of Ukraine (as of early May 2022)

TABELA 1. Zniszczone zakłady przemysłowe Ukrainy

Industrial facility	Location	Actives [millions of US dollars]
Metallurgy		
MMK them. Ilyich	Donetsk region, Mariupol	1,893
PJSC MK Azovstal	Donetsk region, Mariupol	1,444
Aircraft construction		
Antonov	Kyiv	385
Heavy industry		
JSC “Ukrainian Power Machines”	Kharkiv region, Kharkiv	417
Zorya Mashproekt	Mykolaiv region, Mykolaiv	137
Oil-refining industry		
Kremenchug Refinery	Poltava region, Kremenchuk	374
Odessa refinery	Odesa region, Odesa	171
Linik	Luhansk region, Lysychansk	116
Coke industry		
Avdiivka Coke Plant	Donetsk region, Avdiivka	343
Defense industry		
Malyshev Factory	Kharkiv region, Kharkiv	101
Zhytomyr Armored Plant	Zhytomyr region, Zhytomyr	72
Chemical and insulation industry		
PJSC “Sumykhimprom”	Sumy region, Sumy	73
Obio	Zhytomyr region, Zhytomyr	28
Glass and paper industry		
Gostomel glass factory “Vetropak”	Kyiv region, Gostomel	92
Rubizhne Cardboard Plant	Luhansk region, Rubizhne	82
Vehicles		
Kharkiv Tractor Plant	Kharkiv region, Kharkiv	41
Popasnyansky car repair plant	Luhansk region, Popasna	40
Food Industry		
PJSC “Mondelis Ukraine”	Sumy region, Trostyanets	104
“Harkiv’yanka” Confectionery	Kharkiv	22
Coca Cola Beverages	Kyiv region, Velyka Dymerka	150

Source: Ministry of Strategic Industries of Ukraine 2022.

In the metallurgical industry of Ukraine, value chains have been broken, consisting of the largest plants in Mariupol PJSC MMK Ilyich, PJSC MK Azovstal and Avdiivka Coke Plant, which were destroyed or critically damaged.

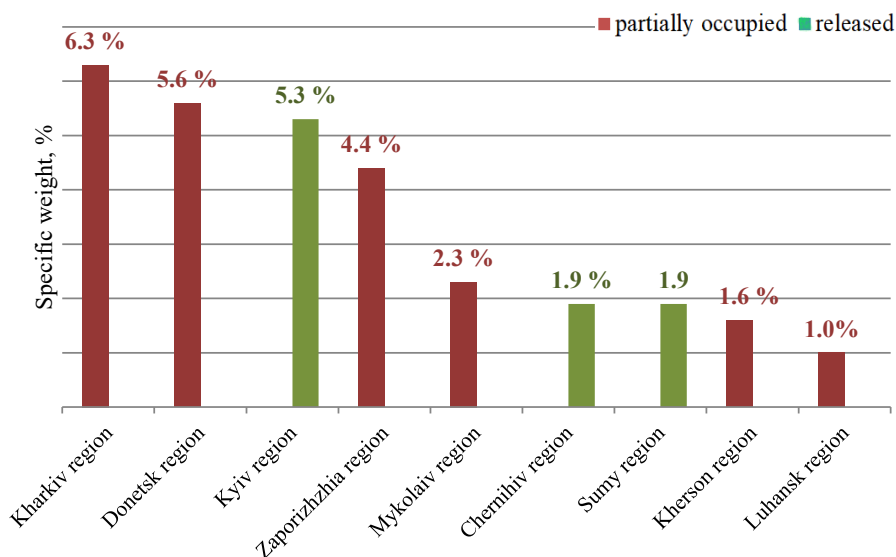


Fig. 1. The share of affected regions in the GDP of Ukraine [%]

Source: State Statistics Service 2022

Rys. 1. Udział dotkniętych regionów w PKB Ukrainy [%]

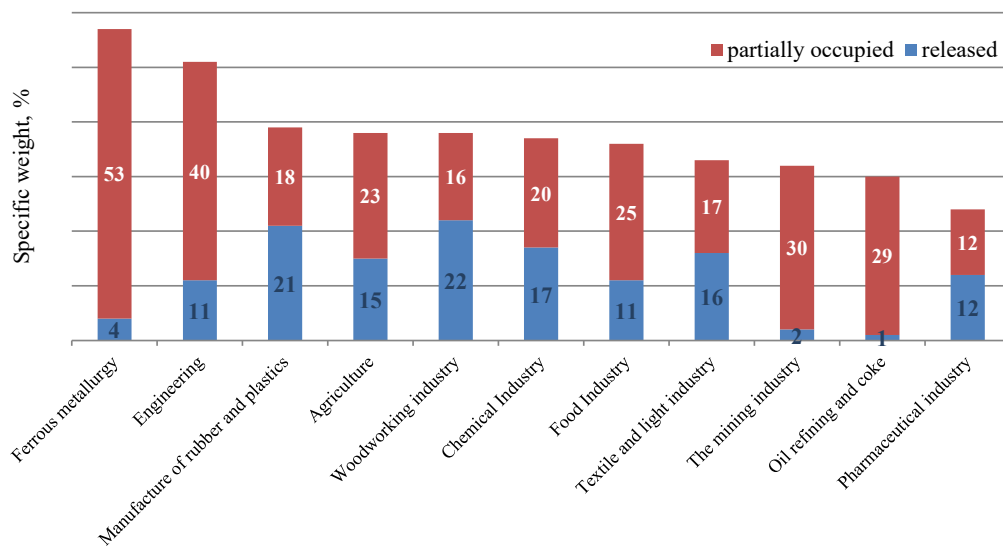


Fig. 2. The share of affected areas in national industrial and agricultural production [%]

Source: State Statistics Service 2022

Rys. 2. Udział dotkniętych obszarów w krajowej produkcji przemysłowej i rolniczej Ukrainy [%]

1.2. Analysis of current trends in the energy sector of Ukraine

For the European Union, the main objectives of energy policy can be formulated as follows (Table 2).

TABLE 2. The main objectives of EU energy policy

TABELA 2. Główne cele polityki energetycznej UE

Target	The essence of the goal
Security of supply	Reliability of energy supplies
Competitiveness	Availability of energy resources at a competitive price
Sustainability	Minimum harmful impact of energy resources (production and consumption) on the environment

Source: Enerdata 2021.

According to DTEK's analysts (DTEK 2022), electricity consumption has fallen by 36% this year, almost catching up with the country's overall projected decline in GDP (Fig. 3).

According to the Ministry of Economy, Ukraine's import-export opportunities in March were halved and tripled due to hostilities (Ministry of Economy of Ukraine 2022). Thus, exports in

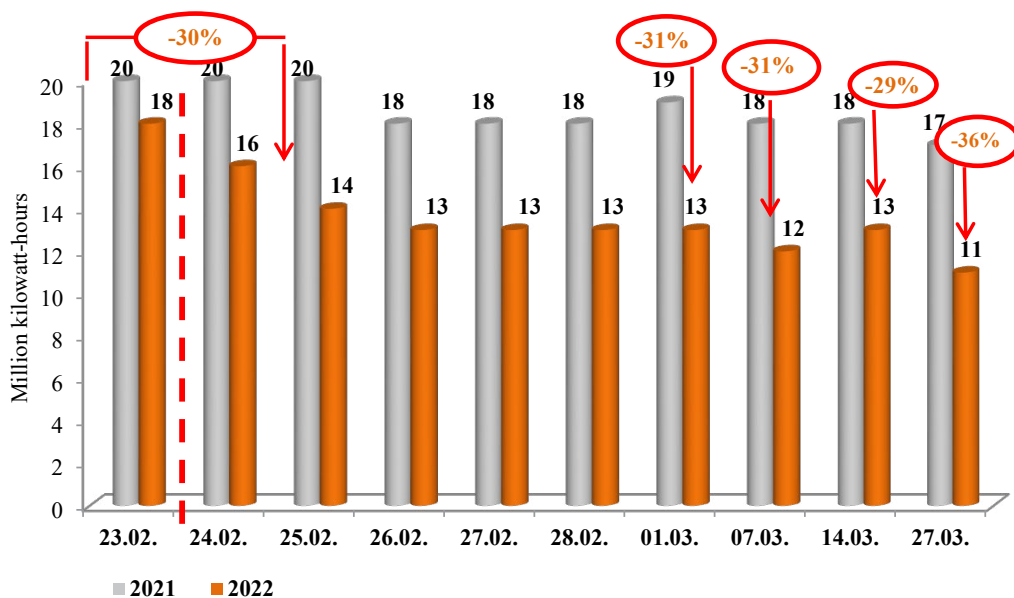


Fig. 3. Dynamics of electricity consumption from February 2022 (compared to the same period in 2021)

Source: DTEK 2022

Rys. 3. Dynamika zużycia energii elektrycznej od lutego 2022 r. (w porównaniu do analogicznego okresu w 2021 r.)

March amounted to 2.7 billion US dollars (50% of February), and imports of 1.8 billion US dollars (30% of February volume).

It should be noted, however, that these trends can be used in constructive aspects. Thus, to increase exports, the European Commission has proposed to suspend all import quotas and duties on Ukrainian goods for one year (Forbes 2022). In addition, from now on, growth prices will be restrained by administrative measures such as regulated prices for fuel, gas, heating and electricity, as well as a fixed exchange rate.

2. Results

2.1. Smart-chain of energy decentralization in Ukraine

Empirical research in the behavioral economy prove a direct link between financial decentralization and the reduction of corruption in the economy, as well as ensuring sustainable economic growth (Latysheva et al. 2020). The example of some European countries helps to understand what a SMART model of decentralization should look like. The varieties of decentralization mutually influence each other and their complex organization, which is a SMART model of decentralization, is adapted to the conditions of the country.

Significant changes brought about by hostilities, as well as potential threats of temporary loss of communication and control of territories, necessitate the synchronization of budget policies at various levels of government.

Budget decentralization will have a significant social impact on IDPs and evacuees, as it will improve the care for such families in the communities where they find themselves. With the positive advantage of budget decentralization in the form of minimizing corruption, preventing financial distribution from the center, and in the conditions of extreme lack of funds in the war-torn infrastructure, this argument is quite strong. It is the liberalization and deregulation of Ukraine's energy sector that is the basis for its effective development. The transition to decentralized energy is a global energy trend (Niekurzak 2021). The central idea of energy decentralization is the tendency to promote new environmental technologies of energy production (Shvets et al. 2013; Kuta et al. 2016; Olczak et al. 2021), while allowing individuals, households and small businesses to reduce the cost of meeting their own needs (Matuszewska et al. 2020; Niekurzak and Kubińska-Jabcoń 2021).

The current architecture of the energy market of Ukraine is presented in Figure 4.

The energy market of Ukraine is an extremely centralized system, the basis of which is the Unified Energy System. Reforming such a liberalization and decentralization system towards a significant increase in the share of microgeneration and an increase in "green" energy to up to 30% of the total energy volume by 2035 is in line with both global trends and national economic targets.

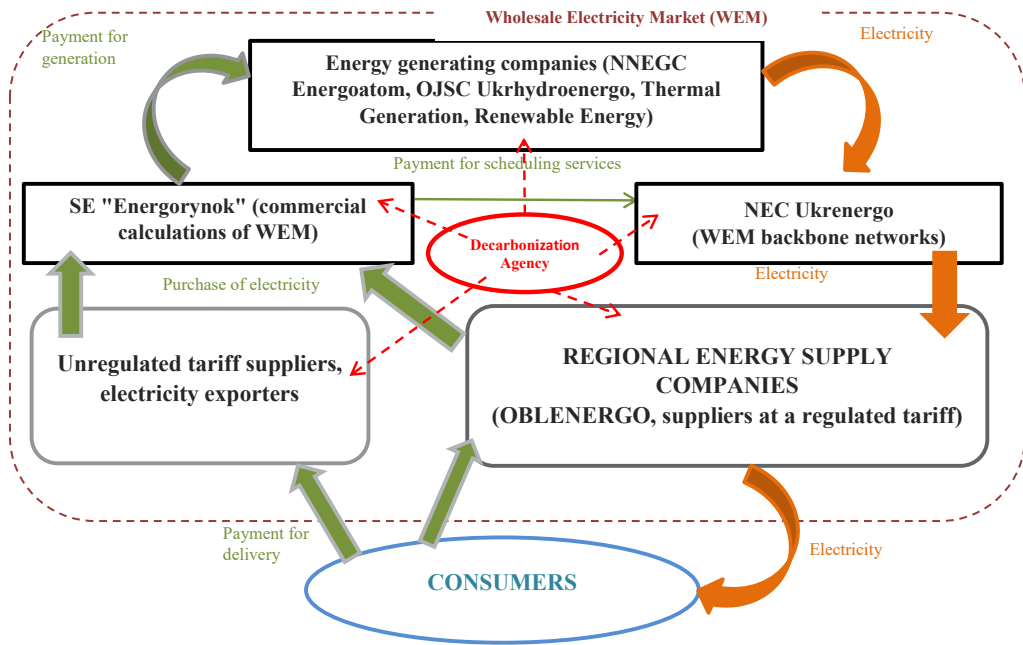


Fig. 4. Transformational model of the energy market of Ukraine
Source: Filippona and Yudin ed. 2016

Rys. 4. Transformacyjny model rynku energii Ukrainy

Thus, microgeneration provides opportunities for direct electricity consumers to install compact energy sources for their own needs near the place of consumption. At the same time, energy producers can sell surpluses to the general grid. Administrative and fiscal decentralization in Ukraine opens up wide opportunities on the ground for the development of decentralized low-capacity electricity, the sale of the surplus to the wholesale market and its effective development.

Encourage the development of microgeneration at the community level in Ukraine and meet EU requirements for the production of goods from green energy, which come into force in 2023, which will be a powerful driver for the construction of solar power plants of all sizes – from industrial facilities to rural energy cooperatives. An important factor in the development of microgeneration is the trend and economic feasibility of using renewable energy sources. Today, they are widely used in facilities designed to generate and sell energy to the wholesale market, such as wind farms and solar power plants.

With regard to medium-sized and large industrial enterprises, integration into the European energy system has provoked increased demands for non-alternative green generation from alternative energy sources. Moreover, there is even a lot of research conducted on greener energy solutions for companies based on conventional sources of energy, for example: (Kulpa et al. 2021; Dyczko et al. 2021; Stecuła and Brodny 2018; Stecuła 2018).

The effective integration of energy facilities into the energy markets of Ukraine is presented to ensure the stabilization of network operating parameters as well as allowing the saving and utilization of industrial waste in Ukrainian enterprises and stabilizing tariffs for the entire range of energy-consumption stakeholders. Table 3 lists the energy-efficient and energy-saving technologies that are potentially widely available in Ukraine.

TABLE 3. Resource potential of Ukraine for the use of energy-efficient and energy-saving technologies

TABELA 3. Potencjał zasobowy Ukrainy w zakresie wykorzystania technologii energooszczędnych i efektywnych energetycznie

Energy-efficient and energy-saving technologies	Scope	The essence of use
Cogeneration in heat energy	Industrial enterprises	The enterprises are used for the joint production of electric and thermal energy in cogeneration plants. The enterprises can use significant reserves of non-traditional and non-fossil fuels (peat, sawdust, microalgae, agricultural and food industry waste), and have a high level of fuel efficiency of up to 90%, resulting in significant resource conservation.
Small hydropower and geothermal energy	Mostly western regions of Ukraine, wide application at the level of communities and energy cooperatives is possible	Water energy does not pollute the atmosphere. Hydropower accounts for 8% of the total installed capacity of our country's power plants, and new facilities could potentially be located in any region with small or large rivers. There are more than 22,000 rivers in Ukraine, but only 110 of them are longer than 100 km, so the main resources of hydropower are concentrated in small rivers.
Solar energy	Mostly eastern and southern regions of Ukraine, wide application at the level of communities and energy cooperatives is possible	Taking into account the experience of implementing solar power plants (hereinafter - SES) in European countries with similar levels of solar radiation, and given the global trends of the continuous reduction of SES construction costs due to technological development in Ukraine by improving technology and commissioning new facilities, SES electricity production can be significantly increased.

Source: State Agency for Energy Efficiency of Ukraine 2022.

Thus, a strong global trend today is the development of distributed generation at the level of local consumers, which is primarily caused by its cheapness.

Thus, in recent years, the cost of equipment for solar power plants has become affordable even at the household level (Olczak and Komorowska 2021). In addition, solar energy has long been cheaper than electricity from any fossil fuel. It can solve the problem of providing electricity to vulnerable groups.

These arguments have become a theoretical basis for providing applied recommendations for the development of the energy sector in Ukraine, namely:

- ◆ to ensure the systematic development of the energy storage process and state support for energy projects storage;

- ◆ to start developing a strategy (program, action plan) in the energy sector based on global and European energy trends, taking into account the European energy integration that has taken place;
- ◆ to promote the development of green energy and green generation as global trends, to implement the principles of Net Energy Metering, encouraging producers at all levels to produce energy, the excess of which to sell to the wholesale market;
- ◆ to use such principles of the “mosquito” economy to actively promote small projects that address energy efficiency of specific facilities (enterprises, households, etc.);
- ◆ to institutionally support the process of green transition by establishing the Agency for Decarbonization (green transition), with broad powers and communications and the ability to address carbon reduction in all relevant areas;
- ◆ to work on the preparation of the legal framework for the systematic creation of energy storage infrastructure at the level of relevant ministries.

Thus, an urgent task to stabilize and increase the energy efficiency of the Ukrainian energy market is to replace the process of synchronization with the network with the process of forming a distributed generation network.

2.2. Industry 4.0 framework in the transformation of Ukraine’s economy

Neo-industrial modernization in the transition to the Industry 4.0 framework is conducted on the basis of increasing the share of knowledge-intensive production, the development of smart industry and widespread use in all areas of the latest information and communication technologies (Liachenko et al. eds. 2021).

The main structural elements of Industry 4.0 are: exponential (non-linear) growth of innovations, unprecedented growth of new technologies and opportunities for their use, the cheapening of management decisions, the maintenance of management systems, and innovative ecosystems.

These principles are the basis for the renovation of Ukraine’s economy in the postwar period, because it is innovation-active regions and industries that can become drivers of post-war development with a real synergistic effect from such activity.

Therefore, it is considered necessary to develop a step-by-step program of renovation of Ukraine’s economy on the principles of Industry 4.0, which will include:

- ◆ technical and technological re-equipment of enterprises in the direction of high-tech production and digitalization;
- ◆ technical measures for modernization of logistics systems and renewal of the transport network;
- ◆ support for “digital mobility” of industry and business, including those that are displaced;
- ◆ organization of additional transport corridors for the import of humanitarian aid and export;
- ◆ measures to organize the employment of displaced persons, including retraining programs for high-tech enterprises (Atstaja et al. 2022).

In general, the concept of “Industry 4.0” provides for the transfer of technology, which is extremely important for renovations in Ukraine’s economy through the development of “green” technologies, thermal modernization programs (reducing energy consumption) and climate modernization, which should be performed on the principles of decarbonization consumption and emissions, and the dependence on fossil fuels, taking into account two dimensions – regional and parametric on the basis of European principles and taking into account energy efficiency and energy management in cities and communities (Cabinet of Ministers of Ukraine 2022).

2.3. The concept of “nearshoring” in the energy sector of Ukraine

Nearshoring, as a concept of transferring business technologies to a country that is relatively close to the main country of outsourcing, can turn Ukraine into the closest industrial zone to Europe, creating an industrial park of gigantic proportions.

The conditions for using this format of relations are mutually beneficial both for Ukraine (with the attraction of foreign investment and the rapid renewal of industrial capacity) and for Western partners (because European governments can provide state guarantees to companies investing in Ukraine). An innovative nearshoring business model is adopted worldwide in the private and public sectors due to its many advantages.

In the context of nearshoring in the energy sector, Ukraine is extremely attractive to European partners, as the introduction of such an interstate economic model can provide Ukraine with the role of a kind of mega-industrial park. The next chain on this list is the restoration of transport infrastructure, which is the primary condition for doing business in general. Finally, the key basic condition for effective development is the achievement of predominant localization in the use of own resources.

Additionally, Ukraine is very interested in introducing the concept of nearshoring into the country’s economic field, and not only in the energy sector. The possibility of using the logistics, industrial and intellectual potential of Ukraine to create the nearest industrial site with the active development of the services sector, primarily IT technologies, logistics and innovation, is becoming promising.

Ukraine’s access to EU markets, which covers more than half of the world economy, will also be an absolute advantage. This is not only exports but also technology transfer to Ukraine, which is no less important for industrial modernization.

At present, Europe’s energy balance is highly dependent on a single supplier, which has a negative impact on the Commonwealth’s economy, reducing the competitiveness of its industry and other related business sectors globally.

In recent years, Europe’s energy balance in general has deteriorated, in physical terms (thousands of tons of oil equivalent) and in percentage terms as follows (Fig. 5).

First of all, nuclear is an attractive resource for Europeans traders. Ukraine’s energy system integrated into ENTSO – E can significantly influence and improve at least the pricing policy, ensuring lower prices for European consumers.

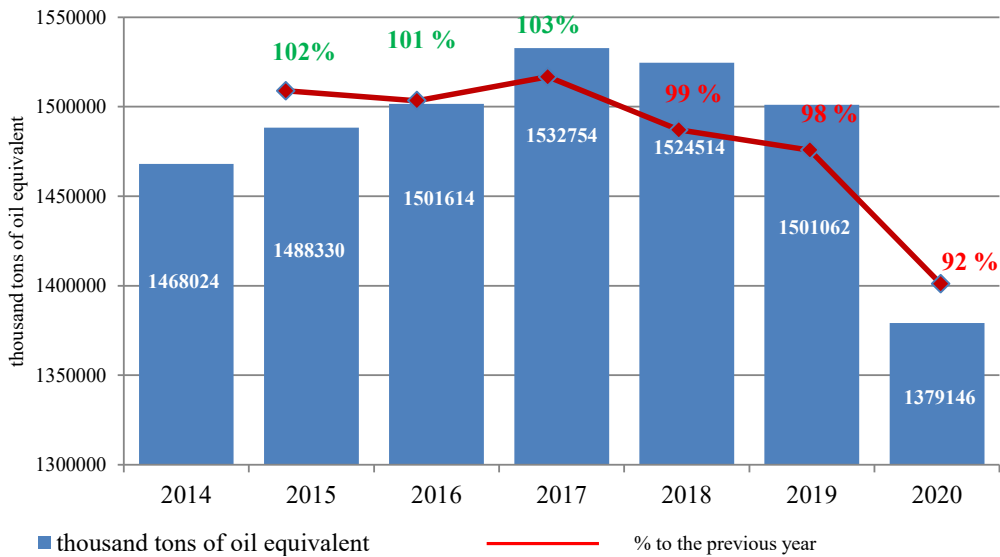


Fig. 5. EU energy balance for 2014–2020 in thousands of tons of oil equivalent
Source: EUROSTAT 2022

Rys. 5. Bilans energetyczny UE na lata 2014–2020 w tys. ton ekwiwalentu ropy

Thus, the average prices for electricity in comparison with some EU countries and Ukraine [euro per MWh] are as follows (Table 4).

There are several significant factors that can significantly change non-electricity prices in European countries, thus ensuring social justice and reducing the financial burden. Such factors are due to industrial capacity, the objective technological features of energy production, and the subjective interest in Ukrainian electricity from the respective countries. Among such factors are the following:

- ◆ the fact that the Ukrainian energy system is the fifth largest in Europe;
- ◆ the projected volume of electricity exports from Ukraine to the EU is sufficient to get rid of the EU's dependence on mono-energy suppliers;
- ◆ the fact that Ukraine will import electricity from Europe at peak consumption hours and export fairly low-cost base-load nuclear electricity to Europe during the day;
- ◆ the increase in the capacity of the interstate power transmission line from 2 GW to 4–5 GW.
- ◆ interest in Ukrainian electricity primarily from the Baltic countries and immediate neighbors: Hungary, Slovakia, Romania.

Based on the statistics of electricity prices (according to Table 4) and, taking into account the above factors, as well as using a chain of related tables, the author's calculation of projected electricity prices, potentially possible from Ukraine's integration into the EU energy system (Table 5).

Thus, in the context of the transformation of European energy into green decarbonized development paths, the main goal of the Commonwealth is to ensure energy security. Vulnerable

TABLE 4. Analysis electricity prices in European countries and Ukraine [euros per MWh]

TABELA 4. Analiza cen energii elektrycznej w krajach europejskich i Ukrainie [euro za MWh]

Country	January 2022	January 2021
Austria	177.54	133.87
Bulgaria	171.33	136.88
Croatia	182.86	145.07
Czech Republic	171.29	129.8
France	176.56	148.55
Germany	165.9	124.38
Greece	255.83	185.94
Hungary	181.3	142.77
Poland	171.22	120.84
Portugal	204.32	172.19
Romania	171.33	137.5
Slovakia	177.7	130.61
Ukraine (Ukrainian energy system)	92.4	34.8
Ukraine (Burshtyn Energy Island)	91.4	41.5

Source: EUROSTAT 2022.

TABLE 5. Forecast electricity prices in European countries [euros per MWh]

TABELA 5. Prognozowane ceny energii elektrycznej w krajach europejskich [euro za MWh]

Country	January 2022	forecast prices
Austria	177.54	142.03
Bulgaria	171.33	119.93
Croatia	182.86	146.29
Czech Republic	171.29	137.03
France	176.56	141.25
Germany	165.90	132.72
Greece	255.83	204.66
Hungary	181.30	126.91
Poland	171.22	136.98
Portugal	204.32	163.46
Romania	171.33	119.93
Slovakia	177.70	124.39

Source: EUROSTAT 2022 and own calculations.

dependence on a dominant supplier makes electricity prices in the EU uncompetitive and reduces social justice. Thus, the Ukrainian energy vector of development is extremely important for Europe's energy strategy.

Conclusions

The formation of a fully functioning integrated EU energy market is taking place with the active participation of Ukraine, which has the fifth largest energy system in Europe. The concept of nearshoring is becoming promising for Europe with the transformation of Ukraine into the nearest industrial zone of Europe, which will actively stimulate the development of the service sector. Ukraine's renovation strategy should include measures to ensure the rapid development of high value-added sectors and new industries in Ukraine, such as: renewable-energy technologies; building materials and structures for energy-efficient construction; production of batteries, electronics, electric cars, heat pumps; electrometallurgy; hydrogen steel production. Given the content of the study, we can cite as recommendations for Ukraine: increased energy efficiency; applying the experience of EU countries; further demonopolization of the energy sector; ensuring transparency in the development of renewable energy sources; use of significant national potential of biofuels; increase of natural gas production. Centered in Western Ukraine, these will be part of both the national gas distribution system and the European energy market.

Further research on the reconstruction of Ukraine's economy should focus on such development trends as regional energy management and eco-innovation to determine their impact on the transformation of the national economy.

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Odbudowa gospodarki Ukrainy z uwzględnieniem decentralizacji sektora energetycznego

Streszczenie

Artykuł poświęcony jest analitycznemu przeglądowi sytuacji w sektorze energetycznym Ukrainy z uwzględnieniem konstruktywnych zmian w przystąpieniu ukraińskiego systemu energetycznego do ENTSO-E oraz destrukcyjnej koniunktury spowodowanej uszkodzeniami infrastruktury przemysłowej i koniecznością modernizacji gospodarczej Ukrainy na zasadach decentralizacji w kierunku znacznego wzrostu wartości netto mikrogeneracji, dekarbonizacji i transformacji „zielonej” energii. Usystematyzowany potencjał zasobowy kraju do wykorzystania technologii energooszczędnych i efektywnych energetycz-

nie, dostarczył zastosowanych rekomendacji wsparcia na poziomie krajowym i lokalnym trendów rozwoju energetyki, a mianowicie: projektów magazynowania energii, generacji rozproszonej i mikrogeneracji na zasady *Net Energy Metering* do obsługi małych projektów rozwiązujących problem efektywności energetycznej konkretnych obiektów. Przedstawiono propozycje instytucjonalne utworzenia Agencji Dekarbonizacji na Ukrainie na rzecz „zielonej” transformacji, z szerokimi uprawnieniami komunikacyjnymi i możliwością decydowania o redukcji emisji dwutlenku węgla we wszystkich dziedzinach. Możliwość i wykonalność wykorzystania koncepcji innowacji rozważano zarówno z globalnego punktu widzenia przemysłu ukraińskiego (z potencjalną perspektywą wykorzystania infrastruktury przemysłowej i logistycznej Ukrainy jako megaparku przemysłowego dla UE), jak i w sensie lokalnym krajowego sektora energetycznego, w tym na poprawę bilansu energetycznego UE. Przeanalizowano kalkulację prognozowanych cen nośników energii dla niektórych krajów UE z uwzględnieniem integracji Ukrainy z europejskim systemem energetycznym oraz sformułowano zalecenia dotyczące zwiększenia efektywności gospodarowania energią na poziomie regionalnym.

SŁOWA KLUCZOWE: energetyka zdecentralizowana, energetyka, modernizacja energetyki, gospodarka krajowa, nearshoring

