

UDC 330

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STRUCTURE AND FUNCTIONING SYSTEM OF THE FUEL AND ENERGY COMPLEX OF UKRAINE

The energy potential of Ukraine under wartime conditions has been clarified. The work of scientists, researchers, and practitioners regarding the goals and strategies of developing the fuel and energy potential system is analyzed. The main approaches to its formation and structure are outlined. Significant flaws in the organizational and territorial significance of the fuel and energy complex of Ukraine are outlined. It became known that the energy and hydropower industries lagged the main branches of fuel and energy resources relative to the broad scale of the increase in energy consumption. This, in turn, provoked a shortage of coal mass consumption at the state electric and thermal capacities. It was determined that after the collapse of the USSR, in Ukraine, the energy system occupied the first place in the state economy. Its priority was the satisfaction of the potential of the domestic energy demand, as well as exports to the countries of the European Union. This process supplies primary energy resources, including oil products, natural gas, oil, and nuclear fuel. At the same time, Ukraine somehow failed to form an adequate basis for the implementation of energy policy with the aim of stable and balanced development of the energy sector and the formation of a system of energy independence from foreign suppliers. It is known that once, the energy industry of Ukraine became the leading supplier of energy raw materials for other countries. As a result of the analysis of indicators regarding the income of companies in various industries, it can be stated that in 2021, the Ukrainian economy will remain raw-based and will continue. Even though the solution to the problems of the existence of the fuel and energy complex of Ukraine is aimed at achieving national goals, at the same time, there are minor problems. Therefore, in our opinion, the short-term and long-term stages of its implementation should be considered when developing an appropriate strategy. As for the effectiveness of the mentioned strategy, it is worth justifying the necessary conceptual toolkit and the methodological directions for further generalization. Considering the content of the Energy Strategy of Ukraine until 2035, "Security, energy efficiency, competitiveness," we believe it is worth developing appropriate types of energy strategies regarding the increasing level of energy efficiency, strengthening the norms and principles of energy security.

Keywords: fuel, energy, complex, structure of the energy complex, fuel crisis, energy strategies, combined gas transportation system, electric power enterprises, energy conservation policy, fuel, and energy sector, hydropower, nuclear power, renewable energy sources

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1. INTRODUCTION

Territorial and economic prerequisites for forming Ukraine's FEC system (fuel and energy complex) began in the 70-80s of the last century. The expected effect of macrostructural changes did not occur due to the centralized management structure. Significant flaws in the organizational and territorial planning of heat, power, and hydropower investment programs led to the lag

of the main branches of fuel and energy resources on the scale of the increase in energy consumption. This, in turn, caused a shortage of coal consumption in electric and thermal capacities.

After the collapse of the USSR, the energy system in Ukraine took the first place in the country's economy, the priority of which was the satisfaction of the domestic energy demand, as

well as exports to the countries of Western Europe. This process involved the supply of primary energy resources: oil products, natural gas, oil, and nuclear fuel.

However, the state somehow failed to form an adequate basis for energy policy to stabilize the energy sector's development and form a system of energy independence from foreign suppliers.

Then, the energy industry of Ukraine became the leading supplier of raw materials for other countries. Analyzing data on companies' revenues in various industries, we can say that in 2021, the Ukrainian economy will remain raw based despite the consolidation of energy cooperation with European countries and the transit nature in general.

2. ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Many studies at the theoretical, applied, and fundamental levels were devoted to studying the formation system and structure of the fuel and energy complex.

All of them, in a certain way, affect the main provisions highlighted in Ukraine's Energy Strategy. It is worth noting the main scientists-researchers in this field: I. Zablotska, S. Erlimova, V. Dzhezdzhula, A. Shidlovskiy, L. Yakovenko, C. Izmalkova, and others.

O. Pavlova, V. Kupchak, V. Lagodienko, O. Sukhodol, K. Pavlova, O. Novosad, O. Strishenets, and others should be singled out among the scientists who advocate the opinion regarding the consolidation and socialization of energy security goals in the context of the development of the Energy Concept of the Commonwealth. However, the volatility of Ukraine's economy and military aggression on the part of Russia brought to the other goals and guidelines for developing the fuel and energy complex to which the article is devoted.

3. FORMULATION OF THE OBJECTIVES OF THE ARTICLE

This article aims to define and characterize the system of the fuel and energy complex of Ukraine and outline its structure and approaches to its formation.

4. PRESENTATION OF THE MAIN MATERIAL OF THE RESEARCH WITH FULL JUSTIFICATION OF THE OBTAINED SCIENTIFIC RESULTS

No doubt, energy remains one of the critical sectors of our country's economy. This is clear due to data on enterprises of the energy complex, which show their income of UAH 1.13 trillion. The ranking of the largest enterprises of the pre-war period is shown in Table 1.

Table 1

Rating of the largest energy companies in Ukraine

<i>Company</i>	<i>Activity</i>	<i>Owner</i>	<i>Revenue, UAH billion</i>	<i>Profit/Loss, million hryvnias</i>
"Naftogaz of Ukraine"	Import and sale of natural gas	State	121,1	-18001,65
"Guaranteed buyer"	Sale of electricity	State	66,99	16,65
"D. Trading"	Coal, electricity, natural gas	Rinat Akhmetov	63,35	1 594,06
"Operator of the GTS of Ukraine"	Gas transportation and gas transportation system management	State	62,29	28 354,48
"Ukrenergo"	Management of trunk power networks	State	58,27	-27 496,47
"Market Operator"	Guide to electricity spot exchanges	State	58,19	20,64
"Ukrgezvydobuvannya"	Production of oil products and gas extraction	State	56,97	4 946,97
"Energoatom"	Production of electricity	State	45,75	-4 845,65
"Ukratnafta"	Production of oil products	Volodymyr Kunitskyi	34,38	42,29
"United Energy"	Resale of state-generated electricity	Ihor Kolomoiskyi	33,34	83,35

The table shows that the most significant profit for 28 billion hryvnias is Operator of the GTS of Ukraine, which carried out the transit of Russian gas to Europe.

Analyzing the data of Naftogaz of Ukraine, it is worth saying that in 2021 it lost its leadership and today takes the second position, both in terms of profit and losses. The company received UAH 120 billion in revenue but also UAH 19 billion in the loss. After Naftogaz left the Main Gas Pipeline Operator group in 2020, it ceased to be the largest company in Ukraine.

Currently, the group's critical asset is Ukrgezvydobuvannya, the largest gas production company in Ukraine. In 2019, Naftogaz was the most profitable company due to Gazprom's \$3 billion gain in Stockholm.

In 2021, state-owned companies became the most unprofitable companies: Naftogaz and Ukrenergo. The two received more than 2 billion dollars in losses in 2021. Ukrenergo suffered the most significant loss, even though the company's main activity of electricity transmission is profitable.

Naftogaz attributes its losses to low gas prices in the first half of 2021 and reserves for debts from gas distribution companies and heat utilities.

However, the situation with energy security changed significantly during the war with Russia. Providing the national economy and social sphere with energy resources in sufficient quantity was one of the most critical problems for Ukraine during the war period. Under such conditions, energy security already has a more significant political impact. This is influenced by three components: high dependence on energy imports, the energy intensity of GDP, and the supply of energy resources to consumers and the military.

Currently, the import of primary energy resources in Ukraine is 62%, among which the most significant share is natural gas, which is 41%. In Ukraine, the average level of gas consumption is twice as high as in the European Union. Solving the gas issue today has a political nature to a greater extent.

Modern crisis phenomena and military operations on the territory of Ukraine call into question the regularities of the market's natural functioning of the energy system. Under these conditions, A. Smith's postulate about the "invisible hand of the market," which reproduces market imbalances under any circumstances,

does not always come true. It is more appropriate to use the expression of the German economist Walter Auken "competing as much as possible, planning as much as necessary" [21].

Combining the energy sphere with all other life-supporting spheres of the economy forms an environment of systematic energy and economic development. The understanding of systematicity, in this case, covers the interdependent sequence of the variability of some parameters as a result of the modification of others. After all, the relations between the elements of the system should take place according to the determined properties and homogeneity of the elements.

According to the conviction of V.I. Vernadsky, the system is a set of elements in a functional environment designed to serve as a holistic achievement of the set goal (energy, biological, motivational orientation) [2].

As a rule, the system is characterized by the following features: integrity, as an interconnected component of the density and complementarity of elements; harmonization and inseparability with the surrounding environment; consistency in the formation of the sequence of influence and result between the elements of the system; hierarchy of system elements relative to necessity and ultimate substitutability in the formation of processes and phenomena.

The difference between a system and a non-system, which is also in specific contact, is multifaceted relations that arise between internal variables.

The complexity and versatility of the energy system are manifested in the sequence and technological combination of the chain processes of the fuel-energy balance. The fuel and energy balance includes the stages of extraction, transportation, distribution, and consumption of energy resources.

It should be outlined that these stages are accompanied by significant intermediate energy losses based on the laws of the natural environment (exogenous and endogenous circumstances) and the socio-economic environment (income level, uneven supply of energy resources, etc.).

Ukraine has signs of a highly polarized state with fuel and energy resource extraction centers from their transportation to places of direct consumption. Territorial dispersion between extraction and regional consumption is the reason for the technological placement of robust

highway transportation of fuel energy resources (natural gas, fuel, energy).

The specified asymmetry is manifested in the region's territorial differentiation of fuel and energy prices. Therefore, understanding the system of the energy complex is extremely important, first of all, for the application of unified approaches to regulation methods.

The importance of the energy security system as a whole is derived from the efficiency of the national energy market (industries, sectors, types, organizational and legal forms, relationships of territorial and technical density of communication between the specified elements). Therefore, streamlining production and technological connections in the middle of the energy system requires current and more progressive conditions for enterprises in the relevant industry to reduce manifestations of corporate misinformation.

At the same time, the affinity of structural modernization approaches to forming the energy security system is in the relations between economic entities and the functioning of the energy industry as a whole [11].

The specified structural modernization approaches primarily affect the prerequisites for creating a competitive environment for energy companies, regardless the type and creation of an energy product. These changes depend, secondly, on restructuring of the entire energy system, in particular, as regards disproportions between the system of subjects and objects of the energy industry.

Overcoming the problems of structural disproportions between the elements of the energy system should be considered in the context of streamlining the complex interdependent relationships between components to increase industry density and organizational and effective management.

Consequently, the most optimal options should be chosen, which include measures to apply the necessary organizational and economic policy levers of the state and market regulation to achieve the necessary conditions of energy security. Also, the Ukrainian energy system's peculiarities should be considered. All energy enterprises are territorially distributed according to forms of corporate subordination and are autonomous from state regulation.

This makes it possible to introduce the feature that most characterizes the energy system

into scientific circulation. We are discussing the "corporate dissystem" of energy complexes and enterprises. In this case, we can talk about such features of this term as:

1. Integrative kinship manifests in the sequence of technological processes and the unity of the consumer environment.

2. Corporate versatility will manifest in various forms of organizational and economic support, the size of assets, the formation of profits, and corporate policy.

3. Non-orderliness of state and market regulation (routinization of energy enterprises, monopoly position, foreign capital investment) [5].

The overall planning of the fuel and energy complex formed an understanding of the branch markets of fuel and energy with the localization of closing costs of technical and economic indicators. Closing costs were of significant economic importance, as they led to the systemic accumulation of the production component of the energy system. Subsequently, further integration led to the formation of gas transportation and electric energy complexes in the energy system. At the same time, the energy system has interregional differences in the closing costs of fuel and energy.

The specified circumstances require a rethinking of the terminologically-content approach to the concept of the energy system by introducing a new concept: "the balance of the system consolidation of energy security." This happens in the interests of economic entities of this market and involves achieving an optimal balance of state and market levers of influence through the organizational and technological transformation of the corporate structures of energy industry enterprises.

It should be noted that under the current state regulation of the energy system, the level of threats to energy security has increased due to the uncertainty of forecast trends, the need for modernization models, and military threats [6].

Ukraine has a strong mineral resource potential, including oil, natural gas, and coal, as well as significant reserves of hydropower and biomass. Before the war, Ukraine was one of the largest energy markets in Europe due to its large population and energy consumption. In addition, for a long time, Ukraine transited the most significant volumes of natural gas in the world, occupying a leading position in the supply of Russian gas to European markets. Experts of the

International Energy Agency estimate hydrocarbon reserves in Ukraine at 9 billion tons of oil equivalent and gas reserves at 5.4 trillion m³, 1.1 tm³ of natural gas, more than 400 million tons of gas condensate, and 850 million tons of oil has been proven [20].

Historically, there are three regions of concentrated hydrocarbon resources in Ukraine: 1. Carpathian; 2. Dnipro-Donetsk; 3. Black Sea-Azov.

The Dnipro-Donetsk region accounts for 80% of proven reserves and approximately 90% of gas production, while the Carpathian region accounts for 13% of proven reserves and 6% of production.

The remaining 6% of proven reserves are in the southern region, where production is carried out both on land and sea on the shallow shelves of the Black and Azov seas. Cumulative production in this region is 5% of Ukraine's total oil and gas production.

Ukraine has sufficient gas potential in the form of coalbed methane in the main coal mining areas in the east of Ukraine and two shale gas basins: a part of the Lublin Basin extending into Poland and the Dnipro-Donets Basin in the east.

Coal reserves in Ukraine account for more than 90% of the country's fossil fuel reserves. They include various coal types, from anthracite to lignite, thermal, and coking coal.

The most significant amount of coal in Ukraine is located in the Donbas region (Donetsk coal basin) in the east of Ukraine in the regions of Donetsk, Luhansk, and Dnipropetrovsk. There are two smaller basins – the Lviv-Volyn coal basin in Western Ukraine (this basin extends to Poland) and the Dnipro coal basin, a lignite basin in Central Ukraine. Intensive mining of minerals for more than a century in the Donetsk region has exhausted the best deposits.

Also, Ukraine has significant renewable energy potential, including significant biomass resources and waste utilization opportunities. Nowadays, this potential remains largely untapped.

The oil refining system is strategically important for Ukraine. However, the infrastructure and material resources since Soviet times provide for the provision of most of the demand for oil at the expense of imports.

According to the energy balance of 2018 compiled by Ukrstat, the total final consumption of oil products was 10,613 thousand tons of oil equivalent, while the import of oil products was

10,443 thousand tons [16]. Another vital aspect is an energy infrastructure and investments in it.

Electric network. Ukraine's power grid, consisting of lines with a voltage of 220 kV to 750 kV, has a length of more than 22,000 km, and the total length of the distribution network is more than 1 million km.

The electrical network of Ukraine is fully integrated and interconnected with the networks of its neighbors. Burshtyn Island in the western part of the country is synchronized with Central European networks and facilitates direct export to Slovakia, Hungary, and Romania [14].

Most thermal power plants burn coal, but some (about 5.4 GW) burn gas or oil and are used during peak demand. Four nuclear plants with a total number of 15 units account for 13.8 GW of installed capacity. Several large 5.9 GW run-of-river and pumped hydroelectric plants along the Dnieper and Dniester rivers play an essential role in the power system, compensating for the lack of flexibility of aging thermal plants.

In the hydropower sector, UkrHydroEnerg, the state-owned company that manages the Ukrainian electricity grid, operates nine hydroelectric power plants on the Dnipro and Dniester rivers with a total capacity of 5,900 MW. The World Bank, which supports the modernization and expansion of Ukraine's hydropower capacity, sponsored the replacement of turbines at the Dnipro and Dnistrovsky plants as part of the UkrHydroEnerg program in order to increase the safety, efficiency, and capacity of the hydroelectric system.

Regarding nuclear energy, the Ministry of Energy and Coal Industry of Ukraine emphasizes the need to build new nuclear power units to replace outdated ones reaching the end of their service life. It is proposed to install three or two at Khmelnytskyi nuclear power station and one at Rivne with the help of foreign investors from Korea and the USA [1].

Heating. According to the Ministry of Regional Development, Construction and Housing, Ukraine has 33,122 km heat transmission and distribution networks. The transport pipelines are approximately 3,500 km, and the distribution pipelines belong to the municipalities, a total of 20,800 km. In addition, there is 12,400 km of industrial pipeline networks.

Natural gas. When Ukraine gained independence from the Soviet Union in 1991, it

inherited a gas transportation system uniquely dense network of many primary and secondary pipelines and significant storage facilities. This allows redirecting gas flows through other pipelines in case of an accident or breakdown.

The system covers 38,600 km of pipelines: 22,200 km of the trunk and 16,400 km of distribution pipelines. It is fed by 72 compressor stations with a total capacity of 5443 MW. It can transport up to 80 billion cubic meters per year for domestic consumption from indigenous and imported sources. It can also transport up to 142.5 billion cubic meters per year of gas from Russia and Belarus to European countries [20].

Ukraine's gas transportation system has the second largest capacity in Europe. Storage is a crucial factor in the security and stability of domestic supply operations and is critical to the gas transit system. 13 underground gas storage facilities have a total capacity of 30.9 billion cubic meters per year; UkrTransGas operates 12 of these facilities. Both domestically produced gas and gas imported from Russia are stored in the storage facilities. Domestic and imported gas is delivered to Ukraine's storage facilities between mid-April and mid-October and withdrawn during winter. During the winter peak, the five storage facilities on the western border can provide up to 40% of daily transit volumes.

Oil. The central oil transportation system of Ukraine consists of 4,767 km of pipelines, 51 pumping stations, and 11 tank farms, with a total of seventy-nine tanks and a total nominal capacity of about 1 million cubic meters. Pumping stations have 176 installations. About 65% of pipelines are between 30 and 40 years old; 27% are older than 40 years; 6% are from 20 to 30 years old, and only 2% are between 10 and 20 years old. In addition, there is 4,625 km of smaller pipelines for oil products, mostly in private ownership, although the level of their technical support is unclear [20].

Ukraine has seven oil refineries with a design capacity of 50.4 Mt/year, which is about four times larger than the market for oil products in Ukraine. However, the vast majority of this capacity is currently unused due to aging infrastructure, poor economy, and damage from the war in Ukraine. At the beginning of 2017, there was only one working oil refinery in Ukraine, Kremenchuk, in addition to the Shebelinsky Gas Refinery in Kharkiv Oblast, which also produces oil products. Today, the

shortage of oil is connected to the mass bombings of Russia, which caused the price of this strategic product to rise.

In addition, Ukraine has three marine oil terminals. The Southern oil terminal has tanks that store up to 200,000 cubic meters (m³) of oil. The Southern port is designed to receive and discharge crude oil, which is transported by main pipelines. Unfortunately, Ukraine lost legal control over the oil terminal in Feodosia following Russia's annexation of Crimea, so in response, Ukraine closed all Crimean seaports to international navigation.

It is also connected with the fact that as a result of the war, the Druzhba pipeline, which ran throughout Ukraine from Belarus (Atyrau-Samara-Unecha-Mozyr-southern Druzhba), stopped operating; the pipeline Samara-Lysychansk; and the Nizhnevartovsk-Lysychansk-Kremenchuk-Odesa pipeline. Therefore, Ukraine is currently solving the issue of the oil crisis.

Policy and emergency response measures were the responsibility of the State Emergency Service of Ukraine [28] (until December 2012) until the country undertook to create minimum reserves of crude oil and oil products by 2020 under the Energy Community Treaty with EU Directive 2009/119/EU [3].

The oil sector in Ukraine is now fully liberalized, and the government does not interfere with or regulate the oil business. The state is currently unable to regulate oil prices and influence its volumes. The oil and oil products market is provided exclusively at the expense of foreign traders and has different price manifestations depending on the region. The formation of the price is influenced by two circumstances: the price of a barrel of oil on the world currency markets and logistics costs to the regions of Ukraine. Given the fact that since March, oil, and oil products have been transported only through the Western border, prices are rising for Eastern and Central Ukraine as logistics progress. This is a consequence of the destroyed infrastructure.

The war with Russia provoked multi-level disruptions in the energy supply. It contributed to the creation, under the leadership of the Prime Minister, of a Crisis Management Group to address the issues of electricity and gas emergency preparation, the formulation of emergency scenarios, the determination of who

qualifies as a "consumer," and conducting stress tests under various scenarios.

The energy system of Ukraine forms a homogeneous market with a regional structure and has the following structure. The electricity market of Ukraine consists of separate production facilities, the wholesale market, transmission system operation, distribution, and supply.

The wholesale electricity market created in 1996 was managed by the state-owned company Energorynok as a single wholesaler based on the one-buyer model from 2000 to mid-2019; it also acted as a clearinghouse for all payments until July 2019. In order to meet the Association Agreement obligations for the implementation of the EU's Third Energy Package, Ukraine transitioned successfully from a single-buyer model to a model with a more competitive energy market structure consisting of bilateral day-ahead market contracts intraday, balancing, and ancillary services in July of 2019.

The electricity sector has undergone several reform stages: it was primarily unbundled and privatized partially in the 1990s, and state assets were consolidated in 2004. Most of the power plants were partially or fully privatized, and the private company DTEK controlled the central part. In 1995, regional distribution and retail companies (Oblenergos) were created, one for each administrative region. As part of the electricity market reforms and ensuring competition in the retail market, Ukraine separated Oblenergos between operators of distribution systems and companies that supply electricity. Since 1995, several rounds of privatization have been carried out, with the result that most SSOs and electricity supply companies are now privately owned by domestic or foreign investors. Ukrenergoatom is a state operator of nuclear power plants [10].

Oil and natural gas market. Naftogaz State JSC, subordinate to the Cabinet of Ministers of Ukraine, is the largest company in Ukraine. By January 2020, it was a vertically integrated company engaged in the entire cycle of gas and oil exploration operations: drilling, development, and production; transport, processing, and storage; supply of natural gas and liquefied petroleum gas to consumers. However, to meet the Third EU Energy Package requirements, Ukraine separated Naftogaz, transferring the Operator of the Gas Transportation System of

Ukraine from Naftogaz to the state-owned Main Gas Pipelines of Ukraine.

The Operator of the gas transportation system of Ukraine operates the gas transportation mains, but Naftogaz continues to operate the gas storage facilities since the separation. Regional gas distribution and gas supply companies have Ukrtransgaz permits for gas transportation through the trunk and regional pipelines and are responsible for gas distribution.

The state participates in oil and gas exploration and production through NJSC Nadra of Ukraine, which conducts geological surveys, provides resource and economic assessments, and enters into joint venture agreements with private investors. Naftogaz and its 11 subsidiaries occupy the largest share of all oil and natural gas produced in Ukraine [17].

In turn, Ukrtransnafta, another subsidiary of Naftogaz, operates the oil pipeline system. Theoretically, a state company, but in practice, under the control of a private company, Ukrnafta is the leading oil producer and produces a small amount of gas [13].

Coal. Endowed with significant coal reserves, most of Ukraine's mines are in the Donbas area. Approximately 300 mines in Ukraine were either privatized or transferred to long-term concessions, mostly DTEK. The remaining mines that need to be subsidized remain owned by state-owned companies. Ukraine's largest mountainous region in the east has been severely affected by recent political instability, and, in addition, the region is home to hundreds of illegal (often small-scale) mines.

Nuclear power. Nuclear power was responsible for approximately 54% of electricity production in Ukraine in 2019. The net nuclear capacity is 13.1 GW (total capacity of 13.8 GW), or 28% of Ukraine's installed electrical capacity, supplied by 15 Soviet-designed water-to-water power reactors at four nuclear power plants. Zaporizhzhia has the largest nuclear power plant in Europe, with a net capacity of 5.7 GW (6 GW gross). All nuclear power plants operating in Ukraine are owned and operated by Energoatom, which also operates small hydroelectric power plants and pumped storage hydroelectric power plants used for different loading.

Hydropower. Large hydropower provided about 5% of electricity production in 2019. Nine large hydroelectric stations on the Dnieper and Dniester rivers are operated by the state company

UkrHydroEnergo. Hydropower generation is essential to the stability of the power system because it provides peak load reserves, regulates system frequency and capacity, and provides emergency reserves that legacy fossil-fueled power plants cannot guarantee. In 2016, the government approved a hydropower development program to increase installed production capacity by 3.3 GW and increase the share of hydropower in electricity production to 15.5% by 2026. Currently, there are no plans to privatize UkrHydroEnergo [23, 24, 29].

Renewable energy. Renewable energy sources accounted for 4.6% of TPP in 2018: 3.4% biofuels and waste, 1% hydropower, and 0.2% other renewable energy sources [20].

In 2018-2019, Ukraine experienced a boom in the deployment of renewable energy. The share of renewable energy in the electricity production mix increased 3.6 times, from 1% in 2015 to 3.6% in 2019. Despite the low share of renewable energy sources in thermal power plants in Ukraine compared to the European Union (30% in 2018), it has the significant technical potential for further development of renewable energy sources.

However, the economic feasibility of developing this potential depends on factors such as fossil fuel prices, technology availability, and government support [25].

Based on the above, the energy system should be understood as a set of industries providing the country's fuel and energy resources needs. The systemic nature of the fuel and energy complex forms the environment of extraction, processing of various types of fuel and energy resources such as coal, oil, gas, nuclear, as well as transportation to the consumer [7, 8, 9, 20, 22, 26, 30, 31, 32].

Under such conditions, all primary energy products, their extraction, processing into other fuel, and raw materials are integrated into electrical and thermal energy.

The conceptualization of the proposed structure is evidence of the systematic nature of the industries that form the fuel and energy complex and include technological and production processes: the volumes of production and consumption of energy resources, the cost component, the length of networks, etc. Under such conditions, it would be appropriate to consider two options for developing the country's energy system, progressive and predictive.

5. CONCLUSIONS FROM THIS STUDY AND PROSPECTS FOR FURTHER INVESTIGATION IN THIS DIRECTION

The proposed scenarios can be implemented depending on the adopted energy policy. In general, the energy system is in a synergistic interaction with security phenomena; at the same time, it has a branched structure that combines natural, economic, geographical, and technological elements, the consequent result of which is energy security [22, 27, 28].

Synergistic interaction is primarily a chain of phased impacts on energy supply, energy efficiency, availability, and protection. The presence of the specified synergistic chain is a manifestation of the dynamics of energy services between vital objects of the country's industrial and commercial activity. Different steps of this chain are the stages of production, transportation, storage, and consumption of energy products.

The fundamental units of the energy system are energy resources, infrastructure, energy entities, etc., divided by industry or territorial boundaries.

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Анотація

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Структура побудови та система функціонування паливно-енергетичного комплексу України

З'ясовано енергетичний потенціал України за умов військового часу. Проаналізовано напрацювання вчених, дослідників та практиків стосовно цілей та стратегій розвитку системи паливно-енергетичного потенціалу. Окреслено основні підходи до її формування та структури. Окреслено значні огріхи організаційного та територіального значення паливно-енергетичного комплексу України. Відомо, що енерго- та гідроенергетика призвели до відставання основних галузей паливно-енергетичних ресурсів відносно загальних масштабів збільшення енергоспоживання, що в свою чергу спровокувало дефіцит споживання вугільної маси на електричних та теплових потужностях держави. Визначено, що після моменту розпаду СРСР в Україні енергетична система займала першочергове місце в економіці держави, в її пріоритеті було задоволення потенціалу внутрішнього енергетичного попиту, а також експорт для країн Європейського Союзу. Даний процес передбачає постачання первинних енергоресурсів, серед яких: нафтопродукти, природний газ, нафта, ядерне паливо. В цей же час, Україні певним чином не вдалося сформувати належну базу для реалізації енергетичної політики з метою стабільного та збалансованого розвитку енергетичного сектору, формування системи енергетичної незалежності від закордонних постачальників. Не секретом є й те, що свого часу енергетична галузь України стала і основним постачальником енергетичної сировини для інших держав. В результаті аналізу показників щодо доходів компанії різних галузей можна стверджувати, що в 2021 році українська економіка залишалася сировинною і надалі. Попри те, що вирішення проблем існування паливно-енергетичного комплексу України націлено на досягнення загальнодержавницьких цілей, водночас дрібні проблеми мають місце. Тому, на нашу думку, варто брати до уваги при розробці відповідної стратегії короткострокові та довгострокові етапи її реалізації. Що стосується результативності зазначеної стратегії, то варто обґрунтувати необхідний понятійно-концептуальний інструментарій, а також методологічні напрями подальшого узагальнення. Враховуючи зміст Енергетичної стратегії України до 2035 року «Безпека, енергоефективність, конкурентоспроможність», вважаємо, що варто розробити відповідні види енергетичних стратегій відносно підвищення рівня енергоефективності, зміцнення норм та принципів енергетичної безпеки.

Ключові слова: паливо, енергетика, комплекс, структура енергетичного комплексу, паливна криза, енергетичні стратегії, об'єднана газотранспортна система, електроенергетичні підприємства, політика енергозбереження, паливно-енергетичний сектор, гідроенергетика, атомна енергетика, відновлювальні джерела енергії.

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