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FEATURES OF DEVELOPMENT AND PROSPECTS OF TRANSFORMATION OF THE ELECTRICITY INDUSTRY OF THE REGION
ОСОБЛИВОСТІ РОЗВИТКУ ТА ПЕРСПЕКТИВИ ТРАНСФОРМАЦІЇ ЕЛЕКТРОЕНЕРГЕТИЧНОЇ ГАЛУЗІ РЕГІОНУ
ОСОБЕННОСТИ РАЗВИТИЯ И ПЕРСПЕКТИВЫ ТРАНСФОРМАЦИИ ЭЛЕКТРОЭНЕРГЕТИЧЕСКОЙ ОТРАСЛИ РЕГИОНА

Summary. *The article is devoted to a detailed analysis and a structured approach to the country's electricity industry. The place and significance in the process of reproduction of alternative energy sources are investigated. The reasons that inhibit the development of electricity are identified. The presence of a high level of danger from nuclear power plants is argued. The main investment objects, among the regional electricity markets, which need priority financial recovery, are shown. Steps to reform the electricity sector by strengthening the competitiveness of regional electricity markets are outlined. The forms of ownership are distinguished between separate functional types of works of the electric power branch of the region. The priority directions of*

electric power development are determined. The directions of increase of energy efficiency are offered, where the leading place belongs to innovations. The main directions of improving energy efficiency should be considered the use of innovative technologies, both domestic and global, including: modernization of small boilers and heat generators, the introduction of boilers with high efficiency; reconstruction of some boiler houses into more efficient mini-CHPs; reduction of energy losses; reduction of the level of heat losses in heating mains during transportation of thermal energy to the consumer due to the use of new insulating materials; wider use of the remainder of the "night failure"; wide use of local fuels, mine methane, biogas of household waste, wider introduction of boilers on peat and biomass; reduction of heat losses by thermal modernization of old buildings and the use of new heat-insulating materials in the construction industry.

Key words: *electric power, energy efficiency, capacity, nuclear power plants, wind energy, household waste.*

Анотація. *Стаття присвячена детальному аналізу та структурованому підходу до електроенергетичної галузі країни. Досліджено місце та значення в процесі відтворення альтернативних джерел енергії. Виокремлено причини, які гальмують розвиток електроенергетики. Аргументовано наявність високого рівня небезпеки від атомних електростанцій. Відображено основні інвестиційні об'єкти, серед регіональних електроенергетичних ринків, котрі потребують першочергового фінансового відновлення. Намічено кроки реформування електроенергетичної галузі шляхом посилення конкурентоспроможності регіональних електроенергетичних ринків. Розмежовано форми власності між окремими функціональними видами робіт електроенергетичної галузі регіону. Визначено пріоритетні напрями розвитку електроенергетики.*

Запропоновано напрями підвищення енергоефективності, де чільне місце належить інноваціям.

Основними напрямами підвищення ефективності енергоефективності слід вважати використання інноваційних технологій, як вітчизняних, так і світових, серед яких: модернізація малих котлів і теплогенераторів, впровадження котлів з високими показниками ККД; реконструкція частини котелень у більш ефективні міні-ТЕЦ; зниження втрат енергоресурсів; зниження рівня теплових втрат у теплотрасах при транспортуванні теплової енергії до споживача завдяки застосуванню нових ізоляційних матеріалів; ширше використання залишку «нічного провалу»; широке використання місцевих видів палива, шахтного метану, біогазу побутових відходів, ширше впровадження котлів на торфі та біомасі; зниження теплових втрат шляхом термомодернізації старих будівель і застосування нових теплоохоплюючих матеріалів у будівельній індустрії.

Ключові слова: *електроенергетика, енергоефективність, потужність, атомні електростанції, вітрова енергетика, побутові відходи.*

Аннотация. *Стаття посвящена детальному анализу и структурированному подходу к электроэнергетической отрасли страны. Исследовано место и значение в процессе воспроизведения альтернативных источников энергии. Выделены причины, тормозящие развитие электроэнергетики. Аргументировано наличие высокого уровня опасности от атомных электростанций. Отражены основные инвестиционные объекты, среди региональных электроэнергетических рынков, которые требуют первоочередного финансового восстановления. Намечено шаги реформирования электроэнергетической отрасли путем усиления конкурентоспособности региональных электроэнергетических*

рынков. Разграничены формы собственности между отдельными функциональными видами работ электроэнергетической отрасли региона. Определены приоритетные направления развития электроэнергетики. Предложены направления повышения энергоэффективности, где главное место принадлежит инновациям. Основными направлениями повышения энергоэффективности следует считать использование инновационных технологий, как отечественных, так и мировых, среди которых: модернизация малых котлов и теплогенераторов, внедрение котлов с высокими показателями КПД; реконструкция части котельных в более эффективные мини-ТЭЦ; снижение потерь энергоресурсов; снижение уровня тепловых потерь в теплотрассах при транспортировке тепловой энергии; широкое использование местных видов топлива, шахтного метана, биогаза бытовых отходов, широкое внедрение котлов на торфе и биомассе; снижение тепловых потерь путем термомодернизации старых зданий и применения новых теплоохоплюючих материалов в строительной индустрии.

Ключевые слова: *электроэнергетика, энергоэффективность, мощность, атомные электростанции, ветровая энергетика, бытовые отходы.*

Introduction. The energy crisis is a fairly common problem not only in Ukraine. Scientists are inclined to believe that the way out of the energy crisis is the significant use of renewable energy sources: solar, wind, ocean. Of these, solar radiation can give the most energy. In order not to harm the Biosphere, you can use only 3% of the solar flux coming to Earth. This percentage will allow us to obtain energy with a capacity of 1000 billion kW, which is 100 times greater than the current energy production capacity in the world. In Crimea, continue to use solar energy. The first experimental and industrial solar power plant in

Ukraine is being built near the village of Shchalkino in the eastern part of Crimea.

The world's first wind farm was built in Ukraine in 1931 near Sevastopol.

Among non-traditional energy sources, it is possible to use biomass and create biogas based on it. The developed technology of converting coal into a gaseous or liquid state is promising for Ukraine. There are also methods of growing oil-producing plants.

To date, the general technical condition of Ukraine's electricity sector is unsatisfactory. This is a consequence of the fact that the modernization of the heat and power industry has not been carried out for decades. It has also led to the fact that more than 20% of energy equipment is completely worn out, and 70% of equipment has exhausted its resource.

Donbas thermal power plants are the oldest in Ukraine, which is why they are in the worst condition. Excessive fuel consumption and a huge number of emissions of harmful substances into the air are caused by outdated combustion techniques of coal, fuel oil, gas, as well as a high level of equipment operation.

Ukraine is one of the countries with average energy consumption per capita (over 5 thousand kWh per year). However, the structure of this consumption is very different from developed countries. The main part of electricity is used for industrial needs, were large losses of electricity due to mismanagement and inefficient production technologies. For municipal needs, only one thousand kW / h is used per urban resident, while for rural residents this figure is even lower and is 500 kW / h. It is one of the lowest in the world.

Theoretical background. These problems were dealt with by researchers: A.K. Shidlovsky, V. Kupchak, V. Lear, K. Pavlov, O. Pavlova. However, the analysis is superficial and requires thorough methodological approaches.

Research objective. The purpose of the study is to study the features and prospects of transformation processes that are constantly occurring in the power industry.

Results and discussion. One of the main factors hindering the development of electricity in Ukraine is the economy. About 30% of all particulate matter entering the atmosphere are emissions from the economy due to human economic activity. Power plants on this indicator are equal to metallurgical enterprises ahead of all other industries [8].

The safety of nuclear power plants is very important for Ukraine. Since the collapse of the Soviet Union, the problem of storing nuclear fuel waste has become relevant for Ukraine. On the territory of Ukraine, there are no conditions for the disposal of nuclear fuel waste used by domestic nuclear power plants, so they are sent for disposal to neighboring Russia. The annual cost of exporting spent fuel to Ukraine is $ 100 million a year. In 2000, the price for burial rose to $ 100-120, which was usually unprofitable for Ukraine. Such changes have prompted Ukraine to bury nuclear fuel waste on its own, as scientists estimate it is much cheaper. In 2000, dry spent fuel storage facilities (SNFSFs) were established on the territory of Zaporizhzhya NPP. In addition to the Zaporizhzhya NPP, the Soviet nuclear power plant was planned to be built in Rivne, South Ukraine, and Khmelnitsky. The total cost of building storage facilities at one nuclear power plant is $ 85 million, which is much less than Russia's annual payment. When considering the problems of wind energy, it is necessary to emphasize the conditions of construction and subsequent operation.

The problem is that wind farms are unprofitable for Ukraine because 1) wind turbines are very expensive; 2) the condition for the construction of wind farms is a constant wind of at least 6-8 a / s. There are many restrictions for the construction of wind farms: - they should be built away from industrial and residential facilities, reservoirs, agricultural lands, recreational and protected areas; - it is necessary to lay highways to wind farms, to supply power lines and telephones [9].

The electricity industry and its constituent enterprises are natural monopolies. Natural monopolies occupy a special place in the system of

economic relations (natural monopoly in economic theory is mainly an industry in which gross production costs are lower if all products are produced in a single form than if the same amount of production was divided between two or more forms).

Electricity generation has several features that, unlike other natural monopolies, determine the need for a rigid unified system of operational, including automatic, management of EEC regimes, as well as prudent government regulation in order to prevent unreasonable price pressure on energy consumers and reduce the competitiveness of the economy.

Such features include: first, the close regime of parallel power plants and electrical installations of consumers, secondly, the inability to store electricity, and thirdly, the speed of spread over a huge area of transitional emergency processes, and others. In most countries with developed industry and electricity, regional or national regulatory commissions have been established and are operating to curb the negative effects of natural monopolies that constrain reasonable competition, as well as to protect the interests of consumers.

Such commissions agree on electricity tariffs and monitor the relationship between producers, electricity suppliers, and consumers. In world practice, various directions of reforming the electricity sector into a more competitive and efficient sector have been used in order to find ways to improve the energy sector and the economy as a whole. Some of these areas of reform were: - privatization of electric power enterprises; - restructuring of the industry structure; - liberalization or deregulation.

However, it should be noted that in some cases the degree of liberalization and the depth of privatization did not have a definitive effect on the level of efficiency as energy innovation was introduced. For example, the California crisis in the United States, as well as the bankruptcy of a number of large distribution companies in Argentina, Chile, and some other countries have led to

a certain increase in tariffs and a return to the regulation of the electricity market.

Creating electricity markets is one of the most effective tools for improving the efficiency of the energy sector. All subsystems of electric power generation are characterized by public ownership of electric power enterprises. In the subsystems of generation and transmission of electricity by electric networks of higher voltage classes, state ownership is widespread, and in the electricity distribution sector - private investors.

At the same time, vertically integrated energy companies are quite common in a number of countries, such as the United States, Germany, and Japan. They ensure the implementation of all functions of electricity generation, including the distribution and sale of electricity. In France and Portugal, most electricity companies' sectors are state-owned. The electricity of Great Britain, Japan, and Belgium has been completely privatized [3]. In the United States, more than 70% of generating capacity (approximately 30% owned by the government, municipalities, and other organizations) and more than 75% of distribution networks are privately owned. Local government ownership is widespread in Austria (100% networks and 85% generation), Canada (core networks - 99%, generation and distribution networks - 80% each), and the Netherlands (100% networks and 85% generation). In Norway, the state owns about 30% of generating capacity and 75% of core networks, in Sweden - 100% of core networks, half of generating capacity and distribution networks.

The goals of the transformations that are taking place in the electricity sectors of different countries are different. They should be determined by the state of the country and the amount of investment in electricity supply systems.

Therefore, it is always worth highlighting the goals and priorities set by the state in carrying out reforms: - electricity tariffs for consumers are reduced by increasing the efficiency of the industry (UK, Argentina, Australia); - to increase the efficiency of work and development of the industry it is necessary

to attract investments (Brazil, Argentina); - smoothing the difference in electricity prices in different regions of the country (USA, Norway, etc.); - maintaining a unified energy system and preventing a decrease in the reliability of energy supply. In different countries, the forms of market transformation in the energy sector differ significantly, namely: - the disintegration of electricity production was carried out in full in six countries and partially in two; - full privatization is possible only in three countries (Chile, Great Britain, and Argentina) and is being prepared in two countries (Peru and Australia).

Recalling the above, it can be argued that the strengthening of market transformations is a flexible process, which is largely determined by the current state, the development of electricity in the country, and history. There is no place for dogmatism and attempts by countries to copy anything from each other. It is necessary to carefully study the experience of different countries, choose the best solutions, and carefully apply these solutions in practice [4].

Restructuring of electricity took place in different countries in different ways: 1) In Norway, Sweden, and Colombia, disintegration, and privatization did not take place; 2) In Spain, it was planned to carry out partial transformations and the gradual introduction of competition without a significant change in the balance between public and private energy companies; 3) In the US, the reform process is at an early stage, so their private energy companies, gaining free access to the core network, are functionally disintegrated. An important role is played by the general information system. It in turn reflects the state of the main electricity grid, and which operates the wholesale electricity market (WEM). 4) In the United Kingdom, Chile, Argentina, Peru, and the Australian state of Victoria, full privatization took place, as well as profound transformations in the energy sector.

At the same time, each of the above countries had its reasons for profound transformation: Britain - a relative excess of capacity, Chile, Argentina and Peru - insufficient investment and poor quality of service, Australia - both of these

reasons. 5) In Norway there was an excess of capacity and inefficient use of resources. Norway has the most open electricity market in the world. The Norwegians claim that their main achievements are lower prices and increased competition in electricity generation and supply.

Every consumer can choose their own electricity supplier. Newmarket players have appeared - brokers and traders. [7]. 6) Private investment in Argentina has increased and wholesale electricity prices have been steadily declining. Linking competition between relevant market participants is one of the strongest tools to increase the efficiency of electricity markets and reduce them. After many years of discussion, the Council of Ministers of Electricity of the European Union decided to liberalize the Western European electricity market. The countries that are members of the NORTEL energy union (Finland, Denmark, Norway, and Sweden) are creating an international open energy market. Australia (Victoria) has provided market access to end-users with an installed capacity of 10 MW or more.

Work is intensifying to increase competition in the US electricity markets. Competition between countries or regions of one of the countries largely depends on public policy. It in turn determines the permissible types of power plants and their environmental characteristics, import and export of electricity taxes, laws on environmental protection. Local and regional reliability criteria also affect competition. In all countries, large consumers can build their own stations in order to independently regulate the use of purchased electricity. It is most effective in such cases to use industrial thermal power plants, which pra in parallel with the EEC.

Most national energy policies support industrial CHPs, wind, solar, and other energy installations that use renewable energy resources. For example, in Finland, industrial power plants produce almost a third of all electricity. U.S. law requires energy companies to purchase electricity generated by thermal

power plants and power plants in order to build industrial thermal power plants and small renewable energy plants.

The reliability of the EEC and energy associations is the most important task, which requires coordination of the management of the EEC and the EA as a single technological object. But ensuring the reliability of electricity supply is the most important economic task, as emergency power outages lead to large economic losses.

The work of the EEC and the EA is coordinated by the centralized control bodies. Such coordination of work provides a significant economic effect at all stages of energy production.

Therefore, competition is the main factor that determines the efficiency of the relevant actors in the electricity market - energy companies, end-users, independent electricity producers.

The following main directions for strengthening competition in the electricity sector can be formulated:

- competition between electricity suppliers for the consumer (free choice of the electricity supplier by the consumer);
- competition between electricity producers for participation in its supply to WEM;
- free access to electricity suppliers and buyers to electricity networks in which wholesale and retail electricity markets operate.

Competition between energy supply companies exists both in the sale of electricity to large municipal consumers and in mutual with dependent power plants (block stations of industrial enterprises). Competition is also intended in such areas as:

- construction, operation, and ownership of power plants;
- construction, ownership, and operation of main transmission lines and distribution networks;
- supply of electricity within and outside the relevant energy association;

- electricity trade with other energy companies and independent suppliers.

Conclusions and prospects for further research. The above data show that the activity of the electric power industry of Ukraine needs certain changes. The situation regarding total energy production could be due to:

- disconnection of debtors from the general energy supply system;
- obsolescence and wear of equipment that has expired [1];
- inability of generating companies to pay on time with suppliers of raw materials due to debts of users;
- dependence of Ukraine's energy on the import of fuel and energy resources, diversification of energy sources;
- low efficiency of power plants.

To establish a stable operation of the power industry, you need:

- to modernize power plants with the use of higher efficiency equipment, which will increase competitiveness;
- load stations not by 90%, but by 120%;
- use alternative energy sources;
- increase the volume of own production of resources;
- to achieve an economically feasible ratio of imports of oil and petroleum products [13].

One of the directions of electric power development is the creation of power units based on the territorial association of different types of power plants, which organically complement each other. In this direction, the Dniester complex hydroelectric power station was created on the Dniester, which includes HPPs and PSPs. One of the examples of complementarity of power plants of different types is a complex of energy facilities near Kyiv (Kyiv TPPs, CHPs, HPPs, PSPs).

A unique energy complex is being built on the Southern Buza, which will include the South Ukrainian NPP, Tashlyk PSP, and Konstantinovskaya HPP-

PSP. In the south of Ukraine, it is expedient to create energy complexes based on the territorial association of solar, wind, and geothermal power plants [12].

By 2030, Ukraine aims to reduce the energy intensity of the national product to the world average (0.4 t pp / 1000 US dollars). The main ways to increase energy efficiency are the use of innovative technologies, both domestic and global. They include:

1) Radical modernization of small boilers and heat generators, the introduction of boilers with high efficiency;

2) Reconstruction of some boilers into more efficient mini-CHPs with an electric capacity of up to 50 MW, which does not require large investments. The payback period of such installations is twice less than in the "big" energy and is 3-5 years, and specific fuel consumption is almost twice lower than in powerful thermal power plants;

3) Comprehensive reduction of energy losses. Due to the use of new insulating materials, heat consumption during the transportation is reduced. An important area is the modernization of main and distribution electrical networks;

4) Wider use of the balance of "night failure" (after PSP) with a capacity of up to 3500 MW for heat supply purposes. For this method, you can use powerful heat pumps, as well as storage systems for electric heating, which will play a role in consumers of regulators to improve the quality of electricity networks in Ukraine;

5) Widespread use of local fuels, biogas, household waste, mine methane, the wider introduction of peat and biomass boilers.

6) Significant reduction of heat losses through thermal modernization of old buildings and the use of new thermal materials in the construction industry.

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