Convergence of the Russian power industry in a period of declining reliability and sustainability of the industry

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Abstract. The article is devoted to the problem of reliable and stable functioning of the Russian electric power complex. The analysis of structural transformations in the electric power industry and statistical data allowed the authors of the study to conclude that in the industry there is a decrease in the reliability of energy facilities, the stability of the energy system is being violated, and the level of physical and moral depreciation of fixed assets is increasing. It was established in the work that in order to maintain the balance of production and consumption of electric energy, to ensure the necessary level of development of the electric power complex and economic stability, it is necessary to integrate energy enterprises into a single structural mechanism, which can be represented as a holding company. At the end of the work, a mechanism of convergence and ensuring the sustainability of the electric power complex is presented, containing measures for the integration of energy enterprises, the development of a program for ensuring stability and monitoring the technical condition of the energy system. In conclusion, the study presents the main findings and results of the work.

1. Introduction
The modern electric power complex of the Russian Federation over the past decades has been subject to various reforms and privatization, which was associated with the need to switch to market relations and ensure its sustainable growth. The first stage of the reforms took place after the collapse of the Soviet Union and was expressed in the transition of all energy facilities under the control of the state corporation RAO UES of Russia, which performed functions related to the management and development of the electric power complex [1]. The second stage of the reforms was associated with the transfer of the generating complex to private management, while the facilities of the electric grid complex remained under the control of state companies. The last stage of the reform of the electric power industry was caused by a drop in the volume of renewal of production capacities, a decrease in investment attractiveness and innovative activity of the industry, an increase in the use of morally and physically worn-out capacities, an increase in the level of raw material dependence, a violation of the financial stability of electric power enterprises, etc [2]. As a result of the reform of the industry, competitive types of activity were identified - generation and marketing of electric energy, and monopolistic ones - transmission and distribution of electric energy.

With the transition to a new stage of development, it was expected to receive additional incentives for the development of the electric power industry due to the formation of competition in the industry,
however, after more than a decade, this did not happen and additional problems related to the lack of uniform rules for the management and development of electric power companies were revealed in the electric complex, and a decrease reliability and uninterrupted operation of equipment, a reduction in the introduction of innovative designs, and the absence of a single policy for modernization and replacements s equipment. Such a situation leads to a violation of the stability of the electric power industry and a violation of the integrity of the created unified energy system [3-5].

2. Materials and methods
The aim of the article is to analyze the development of the electric power industry and develop proposals for the convergence of Russian energy enterprises during a period of declining reliability and stability of the industry. To achieve this goal, the following tasks:

- to analyze the reasons for the violation of the reliability and stability of the electric power complex;
- form mechanisms aimed at convergence of energy enterprises, ensuring the reliability and sustainability of the electricity complex.

The study used statistical, comparative, economic and statistical and logical methods.

3. Results
In the electric power industry, reliability and sustainability issues come to the fore, as the electric power industry has a direct impact on industrial production, the livelihoods of the population and the economy as a whole. A generally accepted term that reflects the stable operation of a power system is reliability, which includes properties such as persistence, uninterrupted operation, durability, reliability, maintainability, and is understood as the property of an object to function in predetermined modes and maintain its initial state for a long period of time [6; 7]. Another property that reflects the safety of an object is its stability, which contains requirements for both the reliability of the equipment and its long-term development.

It is possible to achieve reliability and sustainable development through a set of measures carried out as part of the functioning of the electric power complex, which are as follows:

- maintenance, repair and modernization of equipment;
- replacement and liquidation of worn-out facilities;
- updating and commissioning of new production capacities, including using innovative and renewable technologies for generating electric energy;
- ensuring the flow of electric energy from energy waste to economically and technically rational facilities [8].

All the above measures not only contribute to the development of the electric power industry, but also ensure its stable functioning in the conditions of changing external and internal environment. However, it is worth noting that the above measures affect about 2% of production capacity and do not contribute to the qualitative transition of the industry to a new path of functioning and development. So, for example, we consider the indicators of commissioning generating capacities in Russia for 2018 (figure 1) [9; 10].
Hydro power plants
Thermal power plants under the power contract
Thermal power plants outside the capacity contract
Nuclear power plants
Renewable energy stations

Figure 1. The structure of the actual input of capacity of generating facilities in Russia for 2018, MW.

It can be seen from the figure that in 2018 a total of 5 087 MW of installed capacity was commissioned, which is about 2% of the total installed capacity of energy facilities in the Russian Federation. It is worth noting that about 2 033 MW was removed from the composition of the main production assets of the electric power industry of the Russian Federation, which is 40% of all commissioned capacity in 2018. A similar picture indicates that about 3 thousand MW of those commissioned in 2018 were not aimed at replacing the installed capacities, but at covering the load of new consumers formed due to the development of territories or industrial production. Thus, it can be said that about 2 000 MW of commissioned production capacities were aimed at updating existing fixed production assets, which, respectively, makes up about 0.8% of the installed capacity of the electric power industry in Russia [11].

Analysis of other indicators reflecting reliability and stability shows that repair and modernization of power equipment occurs according to the actual state of production capacities, and not according to the standards according to which fixed assets were built and put into operation. Most of the equipment has already served its normative period of use; however, they continue to be used further without significant updating and modernization. There is practically no policy on the withdrawal or elimination of worn-out facilities, which is associated with the inability to replace retired equipment. The innovative technologies used in the industry are not capable of ensuring a high-quality transition of the electric power industry to a new development path; this is due to both the lack of necessary technologies and financial resources. There is no policy on switching to renewable energy sources, for example, today the installed capacity of wind and solar power plants is 184 MW and 843 MW, respectively, which does not exceed 0.4% of the total installed capacity of the Russian energy system [12; 13].

A number of problems are solved through intersystem cooperation and the interchangeability of energy capacities, but only in those cases when it becomes necessary to cover the load of energy-deficient regions and in emergency situations. Ensuring the interchangeability of generating facilities, the rejection of energy-wasting and inefficient capacities would solve the problems associated with maintaining the reliability and uninterrupted power supply and the transition of the electric power industry to a qualitatively new level of development, however, it is rather difficult to implement such experience in market conditions, since generating capacities belong to different to the owners.

Of course, this situation is due to a drop in the investment attractiveness of the industry and a reduction in funding. In this regard, there is an increasing need to develop a model for ensuring the sustainability of the electricity industry in the context of the disintegration of a single national energy system and the search for mechanisms to solve these problems.
4. Discussion

In the opinion of the authors of the article, it is possible to achieve sustainability through the convergence of electric power complexes into a single organizational and structural complex, which would ensure the reliability of power supply and sustainable development of the electric power industry, while not violating the rights of owners of energy facilities. One of the options for creating an integration company can be a form of association - a holding [14].

Within the framework of the holding structure, an agreement is concluded between all members of the association, while companies and electric power companies remain legal entities, but their shares are owned by the parent company, income distribution is carried out between all members of the association. The advantages of this form are the creation of a single technological cycle and the management of the entire association, which today does not occur in the electric power industry, despite the fact that its development was based on the principles of centralized management. In addition, within the framework of the merger, energy companies still have partial economic independence, despite the fact that there is a centralized management of all business processes of the merger. It seems possible to integrate companies by transferring shares of energy companies to the parent company, and it is worth noting that today the ultimate beneficiary of shares of energy companies is the state, in this regard, through legal mechanisms, it is possible to ensure their transfer to the management of a single national energy holding [15].

Thus, in the opinion of the authors of the article, the mechanisms for ensuring the sustainability of the electric power complex should be based on the convergence of energy enterprises and the development of measures aimed at maintaining the functioning and development of the electric power industry (figure 2).

From the presented figure it is clear that the stages of convergence and sustainability should consist of several mechanisms:

- convergence of electric power enterprises, within the framework of which the prerequisites for the merger are determined, mechanisms for the integration of companies are formed, and a common infrastructure is created for joint industrial and economic activities;
- development of a strategy for the development of the electric power complex, which is being developed as part of the activities of an integrated company and includes areas for innovative development, improving energy efficiency and modernization of fixed assets of the electric power complex;
- monitoring the technical condition of the equipment, which will be aimed at the technical assessment of power equipment, identifying points of stability loss and preventing negative consequences for the electric power industry and the economy as a whole, consisting of developing a system of indicators and methods for assessing the condition of equipment, assessing the technical condition of equipment and analyzing stability management electric power complex.

5. Conclusion

Thus, the presented study allowed the authors to identify problems in the electric power industry related to a decrease in the efficiency of business processes, a decrease in the volume of modernization and updating of fixed assets, which leads to a violation of the reliability and stability of the electric power complex. Based on the analysis, mechanisms were proposed for combining energy companies into a single industry complex in the form of a holding and activities aimed at the strategic development of the electric power industry and assessment of the technical condition of the electric power complex.
Figure 2. Formation of the mechanism of convergence of energy enterprises and the development of the electricity sector.

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