Formation of a mechanism to ensure the stability of the electric power complex

A A Gibadullin¹,², V N Pulyaeva³, E N Kharitonova³, Yu V Erygin⁴ and N A Kharitonova³

¹ State University of Management, 99, Ryazan Avenue, Moscow, 109542, Russia
² Moscow Open Institute, 80, Leningradsky prospect, Moscow, 125190, Russia
³ Financial University under the Government of the Russian Federation, 49, Leningradsky Prospekt, Moscow, 125993, Russia,
⁴ Reshetnev Siberian State University of Science and Technology, 31, Krasnoyarsky Rabochy Avenue, Krasnoyarsk, 660037, Russia

E-mail: 11117899@mail.ru

Abstract. The paper deals with issues of stable functioning and development of the electric power complex of the Russian Federation. The analysis carried out in the study revealed a number of factors that adversely affect the electric power complex, including the creation of completely new conditions for the functioning of electric power companies, the formation of competition and the electric power market, an increase in equipment service life and a fall in the financial stability of the electric power complex. It was found in the work that such changes occur not only the first year, but over a long period of time, the analyzed indicators do not improve, but, on the contrary, they are worsened in terms of qualitative and quantitative indicators. It was substantiated in the work that the solution of emerging problems is possible through the merger of energy companies, making it possible to reduce the use of inefficient and wasteful energy, improve the financial situation and monitor all business processes involved in the production of the energy company. Creating a unified corporate integrated structure will increase the investment attractiveness of the industry and concentrate financial resources on the most popular and highly efficient projects. In conclusion, the study presents the main findings and results of the work.

1. Introduction
The electric power complex of the Russian Federation is a complex of interconnected production elements, working in parallel with each other, and connected into a single structural mechanism - the generation, transmission, distribution and sale of electric energy. The electric power industry is not only capable of providing energy to all interested consumers, but is also one of the main elements with the help of which the value added of the gross domestic product of the country is formed [1]. Thus, the electric power complex is not only an integral part of the national economy, but also creates the main potential for the development of society and the economy as a whole.

In recent decades, the power industry has undergone structural and technical changes, a transition to market relations and the development of competition in the industry. In this regard, there is a need for the formation of mechanisms to preserve the complex in an unchanged state and give it a sustainable development [2].
2. Materials and methods

The aim of the research is the formation of mechanisms to stabilize the conditions for the operation of the electric power complex and to ensure its sustainable development. To achieve this goal the following tasks:

- analyze the structure and condition of the electric power complex of the Russian Federation;
- to form a mechanism allowing to increase the efficiency of the conditions for the functioning and development of the electric power industry in Russia.

Further, based on the use of economic-statistical, comparative and logical methods, we will conduct a study and present recommendations for improving the sustainability of the electric power complex of the Russian Federation.

3. Results

Consider each of the factors affecting the country's electric power complex.

During the existence of the Soviet Union, the electric power industry of the USSR, owned by the state [3], was managed by a specialized ministry, under which policy-making development plans were adopted, basic principles of management and control were formed, and the general supervision of the state of the power industry in the Soviet Union was carried out [4]. In addition, at the national level, the entire potential of the industry was formed, the new equipment and technology were developed and designed, the production and consumption resources were redistributed, and the basic principles of functioning of the industry both isolated from the outside world and the unified system within the state were adopted [5]. At the same time, today in the territory of the countries of the former Soviet Union, power stations and facilities of the grid complex function almost unchanged, the Russian Federation is no exception [6; 7; 8]. Consider the indicators of the technical condition of fixed assets of the electric power complex (figure 1 and figure 2).

![Graph showing technical condition](image)

**Figure 1.** The service life of the main equipment, years.
From Figure 1, it can be seen that the life of the main equipment for some type of equipment exceeds the standard period and the period specified in the state-of-the-art technologically sophisticated equipment, while the share of equipment operated outside the park resource is almost 50% of the equipment. In addition, Figure 2 indicates a significant increase in the degree of depreciation of fixed assets and almost zero renewal of the production capacity of the power industry.

Thus, one of the factors affecting the stability of the electric power complex is its technical condition and, as a result, the moral and physical obsolescence of the main equipment.

Further, it seems necessary to analyze the operating conditions of the electric power industry and determine the structural factors affecting the stability of the electric power complex.

Since 1991, the power industry of the Russian Federation began the process of separating from the power system of the Soviet Union and by 1993 fully gained independence [9], as a result, the power system of Russia began to independently develop plans for the development of the power industry [10; 11]. Until 2008, the industry was wholly owned by the state, and RAO UES of Russia was involved in management, which developed national programs for development, transition to innovative technologies, equipment upgrades, searched for investment resources, carried out economic justification for tariffs and considered expanding the existing potential of the electric power industry.

Since 2000, a Resolution of the Government of the Russian Federation was adopted, which regulated the reform of the power industry of Russia and the transition to market relations in the industry. In 2008, the restructuring of the electric power complex was completed, as a result, the industry underwent significant changes not only in the principles of managing the electric power complex, but also the ownership structure of energy facilities was changed. Thus, a significant change in the industry after the reform was the formation of competition and the electric power market, on the one hand, and the preservation of monopoly activities, on the other [12; 13]. The companies of the generating and distribution complex were completely transferred to private management, with the exception of the hydro technical and nuclear complex, and the grid and distribution complex remained completely under the control of state-owned companies. It was assumed that as a result of the reform, the investment attractiveness of the industry would increase, programs for modernization and innovative development of the industry would be implemented, quality indicators of technological processes would change, the use of inefficient and worn-out production capacities would be reduced, etc [14]. However, the conceived plans were not implemented, and today, the industry has a quasi concurrent market of electric energy, whose functions are limited by taking into account the technological features of the power industry associated with the impossibility of transmitting electricity over long distances and storing it, as well as the lack of competition in the power industry network [15].

The next factor affecting the sustainability of the electric power complex is financial sustainability. In recent years, there has been not only a change in the forms of ownership of electric power industry organizations, but also the fundamentals of budget planning for the next period, the formation of
investment and innovation programs, policies in the field of environmental and social sustainability, marketing and other business processes of energy companies. Such actions impose on the enterprises of electric power industry not only the need to maintain equipment in working condition, but also to increase its competitiveness, to finance projects and programs in the field of electric power industry development, to preserve the organization’s workability, which is impossible without stable financial condition of the organization. Of course, the mechanisms of financing various programs in the electric power industry are the organization’s own sources, loans and investment resources. Any development cannot be imagined without attracting investments, in this regard, we consider the indicators of investments in the power industry of Russia (figure 3).

The figure indicates that until 2014 there was an increase in investment in the electric power complex, but then there was a drop in investment resources in the electric power industry, which, of course, negatively affects the innovative and technological potential of the electric power industry.

Thus, the analysis showed that the electric power industry is influenced by both institutional and structural factors, including increased wear and service life of equipment, market transformations in the industry and operating conditions for technologically unified equipment, financial instability and a fall in the investment attractiveness of the electric power industry.

4. Discussion
Ensuring the sustainability of the electric power complex is possible only through the cumulative consideration of factors affecting the electric power industry and the formation of a mechanism for changing the conditions of operation and development of the energy sector.

In our opinion, increasing the stability of the industry should be based on the mechanisms of integration and centralization of production processes, reducing duplicate functions and tasks, optimizing and concentrating financial resources on the most highly efficient and sought-after projects of the electric power complex, ensuring interchangeability and complementarily of individual business processes and business units. The mechanism for forming the conditions for the stable functioning and development of the electric power complex is shown in the figure 4.
Figure 4. Formation of the mechanism of stable functioning and development of the electric power complex of the Russian Federation.

The figure shows that in order to ensure the stable functioning and development of the electric power complex, it is advisable to integrate the chain of generation, transmission, distribution and sale of electric energy into a single corporate structure of the electric power industry, within which the centralized control of electric power facilities will be carried out. The advantage of creating a corporate structure is the development of joint plans for the development of the complex, ensuring the flow of electric energy within the framework of the Unified Energy System of the Russian Federation, reducing the use of inefficient and energy-wasteful production capacities, increasing the level of investment attractiveness of the energy sector, preserving the financial stability of the established structure and others.

Thus the proposed mechanism will not only ensure the stability of the equipment and the rational utilization of production capacity, but also allow companies to develop consistently taking into account the pace of development of territories, the level of territorial energy deficit, the socio-economic development of the region and the innovative development of the electric power complex.

5. Conclusion
The study made it possible to identify factors affecting the stable state of the electric power complex, including the state of the fixed assets of the electric power industry, structural changes that have occurred in the electric power complex and the level of financial stability. The paper proposed a mechanism based on the convergence of electric power companies into a single corporate structure, within which it is advisable to consider issues of efficient use of production capacity and the development of a unified program to ensure the sustainable functioning and development of the electric power complex.

References
[1] Alferova T, Shilova E and Tretiakova E 2015 Methodical approaches to sustainable development of industrial enterprises. European Research Studies J. 3 115-28
[2] Gibadullin A A and Pulyaeva V N 2016 Modern mechanisms of innovative development of Russian industry (Moscow: State University of Management) p 159
[3] Demidovich B P 1998 Lectures on the mathematical theory of stability: Proc. allowance. (Moscow: Publishing House of Moscow University) p 480
[4] Veselovsky M Y, Menshikova M A, Gnezdova J V, Izmailova M A and Romanova J A 2015 Formation of management system for sustainable development of enterprises in the various industries International J. of Applied Engineering Research 20(10) 41172-7
[5] Biryukov V V and Romanenko E V 2016 The formation of territorial innovation models Indian J. of Science and Technology 12(9) 89534
[6] Gibadullin A A, Pulyaeva V N and Yerygin Y V 2018 The need for a digital substation during the digitalization of energy International Youth Scientific and Technical Conference Relay Protection and Automation 8537223
[7] Gibadullin A A 2012 Mechanisms of stable industry development. The international scientific J 4 23-7
[8] Linnik Yu N, Linnik V Yu and Garifullin F F 2018 Loading and durability of cutter holders in case of wear of coal production combine cutter slots Ugol’ 11(112) 24-30
[9] Loginov E L and Bortalevich S I 2016 System-dynamic approaches to increasing sustainability and reducing risks in the energy supply of large urban agglomerations Problems of security and emergency situations 4 56-63
[10] Chuprov S V 2005 Monitoring the sustainability of production systems. (Irkutsk: Publishing house BGUEP)
[11] Linnik Yu N and Linnik V Yu 2015 The hypothesis on the energy assenement as for operational safety of function elements in coal mining machines Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu 3 51-5
[12] Biryukov V V, Romanenko E V, Khairova S M and Khairov B G 2015 Cyclic-Temporal Competitive Advantages of the National Economy and Entrepreneurship Development Mediterranean J. of Social Sciences 4(6) 64-71
[13] Kasymova N B and Kharitonova N A 2014 Features of the organization of the controlling system as an instrument of anti-crisis management in the electric power complex of the Kyrgyz Republic Management of economic systems: electronic scientific journal 6 (66) 28
[14] Linnik Yu N, Sherstkin V V and Linnik V Yu 2015 Integral criterion of coal seam breakability Gornyi Zhurnal 8 37-41
[15] Pulyaev V N 2018 Technological development of the power industry of Russia. Economy of industrial markets: formation, practice and development Fuel and energy complex: legal and economic regulation Proceedings of materials of the inter-university scientific conference and round table pp 151-5
[16] Gibadullin A A, Bortalevich S I and Yerygin Y V 2019 Dynamic Invariance of the Electric Power System Advances in Economics, Business and Management Research 47 299-302