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***SCIENTIFIC ARTICLE***

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# Actual issues of Russian energy sector development

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**Abstract:** The article is devoted to the consideration of the most pressing issues related to the development of the modern energy sector of Russia. Among them there are the technical obsolescence of energy production facilities, a huge amount of unused energy equipment, serious disruption of the innovation cycle in the energy industry, and inefficient management. The authors pay special attention to the difficulties associated with the ever-accelerating process of digitalization of economy in general and the energy industry in particular. The article also predicts the most probable possibilities for the emergence of environmental problems initiated by the development of renewable energy. The priority tasks for the development of the energy sector are determined. The list of the mentions tasks includes domestic power equipment competitiveness increasing; ensuring full utilization of energy capacities; restoration of the innovation process; improving the quality of strategic decisions; solving the problem of negative impacts of digitalisation.
**Key words:** energetics; energy transition; technical obsolescence of equipment; underutilization of production capacities; innovation cycle; inefficient management; digitalization of the economy; renewable energy; environmental damage.
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***НАУЧНАЯ СТАТЬЯ***

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# Актуальные проблемы развития российской энергетики

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**Аннотация:** Статья посвящена рассмотрению наиболее актуальных вопросов, связанных с развитием современной энергетики России. В их числе технически устаревшие энергетические промышленные объекты, недозагрузка производственных энергетических мощностей, нарушение инновационного цикла в энергетике, неэффективное управление. Особое внимание авторы уделяют проблемам, связанным со все ускоряющимся процессом цифровизации экономики в целом и энергетики в частности. Также в статье спрогнозированы наиболее вероятные возможности возникновения экологических проблем, инициированных развитием возобновляемой энергетики, определены приоритетные задачи развития энергетики. В перечень названных задач входят повышение конкурентоспособности отечественного энергетического оборудования; обеспечение полной загрузки энергетических мощностей; восстановление инновационного процесса; повышение качества стратегических решений; решение проблемы негативных последствий цифровизации.
**Ключевые слова:** энергетика; энергетический переход; техническое устаревание оборудования; недозагрузка производственных мощностей; инновационный цикл; неэффективное управление; цифровизация экономики; возобновляемая энергия; ущерб окружающей среде.
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## Introduction

At present the problem of the effective development of the energy sector of the economy is gaining increasing importance. However, there are a number of problems that are significantly complicated. Lack of analysis of Russian specifics in the energy transition, lack of consideration of the real interests of Russia in this process; energy production facilities technical obsolescence; large amount of unused energy equipment; crucial innovation cycle disruption in the energy industry; inefficient management; unemployment increasing and demand for highly skilled labour reduction as the inevitable results of the energy sector digitalization; serious threat of environmental pollution and other kinds of the environmental damage due to solar and wind energy production can be named here. All these problems require the urgent development of tools and ways to solve them.

## Methods

The article used methods of analysis, synthesis, comparison and generalization, which made it possible to identify the fundamental changes of the energy role in the general system of ensuring economic security, taking into account the environmental factor, and based on the analysis of the obtained results, formulate proposals for improving the efficiency of the Russian energy sector development.

The informational basis of the study was formed by regulatory legal acts, scientific works of domestic and foreign scientists and practitioners in the field of economic and environmental security, energetics, digital economy.

## Results and Discussion

The electric power industry is undoubtedly one of the basic sectors of the national economy, which accounts for about 10 % of Gross Domestic Product (GDP) [1, p. 8].

The upcoming changes in the world energy system seem to be so fundamental that they allow us to speak of an energy transition, similar to civilizational changes in generations. They are associated with the application of nanotechnology in energetics, expanding opportunities for energy storage, increasing trends (especially in Europe) to decisively replace carbon with renewable energy sources (RES), etc.

The term «energy transition» refers to increasing the sustainability of the energy sector by rising the use of RES, the so-called transition to «green energetics».

The expected energy transition is justified by the need for a widespread rejection of traditional energy sources in favour of renewable «low-carbon» ones.

The predictions of the inevitable depletion of natural resources, including energy resources, which are periodically published in scientific and popular literature, have not yet been justified. Probably because the world scientific community invariably finds opportunities to use constantly improving institutional instruments based on the optimization of organization and management processes. The steady development of these innovative tools leads, in particular, to the constant replacement of some priority-used energy resources with others.

The problem is that when making decisions on the advisability of switching to renewable energy sources, the fact which is often not taken into account is that corresponding scenarios often turn out to be unsuitable for Russia, as opposed to western countries, since it does not experience any problems with traditional energy resources [2].

«Experiencing an acute shortage of energy resources, Europe is forced to use expensive alternative energy sources, which seriously undermines its competitiveness and economic position in the world market. To maintain their economic position, Europeans need to force potential competitors to switch to the same expensive energy sources, even if they do not have any need for this. It makes no sense to take these requirements into account when planning the directions for the development of domestic energetics» [3, p. 60–61].

Therefore, first of all, it is necessary to answer the question about the necessity and advisability of the energy transition for Russia, and then develop a practical mechanism for such a transition [4].

According to the forecasts of the McKinsey Global Institute, the availability of energy resources in the context of the digitalization of the economy will steadily and significantly expand. For example, thanks to the processing of a huge amount of data, geological modelling, mining automation, robotization of the fuel preparation process, mining companies will be able to use deposits that were previously considered unprofitable [5].

The world energy industry is undergoing drastic changes [6]. The growth rate of energy consumption is decreasing, and there are clear trends in the structure of the energy balance: the use of fossil fuels is decreasing, while renewable energy sources are growing rapidly.

In the next British Petroleum Review, published in 2020, which is a forecast for the development of the world energy up to 2050, three scenarios for the world energetics development up to 2050 are presented: the first is radical carbon-free (Net Zero); the second is a fast energy transition (Rapid); the third is inertial (Business-as-usual).

The share of renewable energy sources (RES) will grow in all three scenarios. Namely, from 5 % in 2018 up to 2050: up to 60 % – in radical; up to 45 % – in rapid; up to 20 % – in inertial [7, p. 6].

So far the claims of renewable energetic for 100 % dominance look utopian [5].

A long «era of gas» awaits us – the dominance of natural gas in the energy sector of the country and the world, despite the projected high growth rates of the use of renewable energy sources. Gas turbines are science-intensive and high-tech products, without exaggeration, the pinnacle of scientific and engineering thought in the energy sector [8, p. 423]. Only a few countries, including Russia, have the relevant competencies [9].

The problems accumulated in the Russian energy sector are of a systemic nature and require serious scientific analysis [10; 11].

The priority tasks of the new energy strategy of the Russian Federation are as follows.

Firstly, increasing the competitiveness of domestic power equipment. The opening of the domestic market for imported power equipment in the early 1990s led to a sharp decline in demand for domestic equipment and the subsequent degradation of power engineering in the country. It turned out to be not ready to work in

market conditions – to compete with the world's leading corporations with huge financial and intellectual resources. In the context of the economic downturn, domestic enterprises did not have such resources and therefore could not quickly re-equip their technological base and start developing new competitive equipment. The collapse of the innovation process in the industry, the self-elimination of the state from it only deepened the situation.

The General Scheme for the Placement of Electric Power Facilities adopted in 2017 provides for the decommissioning by 2035 of a number of old thermal power plants (TPP) capacities and the commissioning of new capacities to replace them, as well as the modernization of some of the operated power generating equipment by 2030.

The problem of modernization should be discussed in more detail.

Modernization, where it is technically and economically justified, should be carried out on the basis of new technologies and should aim at a significant increase in the energy and economic efficiency of the reconstructed installations at reasonable capital costs.

The analysis of the results of the preliminary selection of modernization projects showed absolutely unsatisfactory results. At many sites, only a few steam turbines and not a single boiler unit will be replaced. No innovative system solutions using the latest equipment are provided. The replacement of several power generators can hardly be considered an innovative solution.

Efficiency improvements are not mentioned, but the main requirement – limiting the level of specific capital costs – has been met.

This is not a modernization. Without the decommissioning of morally and physically obsolete equipment, such tools will be a list of capital repairs and will not be able to claim the status of a program for the modernization of the country's electricity industry.

Secondly, when planning measures to improve the efficiency of the energy sector it should be born in mind that at present there is a huge reserve of unused thermal power plant capacities in Russia. This circumstance could be regarded well as a great advantage of the unified energy system of the country, if not for the significant (50 % or more) wear of fixed assets [1, p. 16]. Physically worn out and obsolete equipment continues to be in operation, significantly reducing its already low economic efficiency, as well as increasing the risk of man-made industrial accidents.

Thirdly, the restoration of the innovative process in the energy sector (scientific research – R&D – construction and development of head units – production of serial equipment). Such a scheme could ensure the creation of competitive domestic energy equipment and, thanks to this, the scientific and technological independence of the country's energy sector.

One of the reasons for making the wrong decisions in the development of the Russian energy sector is due to the collapse of the industry's innovation environment. The links between science, power engineering and power companies have been destroyed. Science does not have the resources to carry out the costly research needed to develop new energy technologies. Mechanical engineering, in the absence of orders, does not have the funds to modernize the production base and create prototypes of new technology. Electricity companies are not interested in testing and implementing them, as this requires increased operating costs. It is easier and cheaper for them to purchase well-tested imported equipment, albeit not the most advanced. This explains the uncompetitiveness of the products of many domestic power engineering enterprises.

Great hopes for the restoration of the innovation process in the energy sector are associated with the implementation of the main provisions of the Strategy for Scientific and Technological Development of the Russian Federation adopted in 2016 [12]. Special attention is paid to regional aspects of innovation processes.

Fourthly, improving the quality of preparation of strategic decisions for the development of the energy sector. The solution to this problem will require, first of all, the improvement of the state forecasting system in the energy sector in conjunction with the development of the country's economy, world scientific and technological trends and the emerging geopolitical situation [8, p. 416].

When developing measures to improve the efficiency of the energy sector, it is necessary to take into consideration the fact that the reform of the sector that has taken place in recent years has significantly increased the complexity of managing the newly formed system. Due to the liquidation of RAO «Unified Energy Sys-

tem of Russia» (UES), the sectoral centre for unified coordination of the work and development of the industry was lost, because numerous complexly structured subsystems were created [1, p. 19].

Fifthly, problems related to digitalization. Today digitalization is commonly supposed to be the integrated use of computer interfaces (API technologies – Application Programming Interface). It is becoming an increasingly comprehensive and diverse phenomenon in all areas of the socio-economic system. The terms «digital ecology» and «digital ecosystem» are becoming ubiquitous and apply to all areas of sustainable development – economic, social and environmental. The infrastructure of data transmission, storage and processing is steadily developing [13, p. 36].

The fusion of material and digital elements taking place within the framework of the digitalization of the economy is revolutionizing the work of the electric power sector [14; 15]. These transformations are associated primarily with two factors.

Firstly, the digitalization of energetic leads to a significant reduction in energy prices. Thus, according to available estimates, the annual global savings in capital and operating costs of working power plants may amount to about $ 80 billion up to 2040 [5].

Secondly, due to the automation of energy flow control in real time, the infrastructural availability of electricity is significantly increasing [5]. For example, a promising experimental blockchain technology can be used to institutionalize the renewable energy market and carbon dioxide emissions, which will allow balance between supply and demand of electricity.

Currently, the most important element of the digitalization of the energy sector is object monitoring of the subsoil state, which allows for a comprehensive analysis and systematization of annual reports of enterprises, as well as inspection and control testing of observation wells, to assess the state of groundwater and surface waters interconnected with them [13, p. 40].

Despite significant achievements in the development of the digital economy [16], it is still prematurely to talk about the radical impact of digital technologies on socio-economic development in general and on the efficiency of the energy sector in particular. One of the reasons for this state of affairs is the fact that the digitalization of energy not only allows solving many problems, but also initiates new ones.

For example, the development of gas and renewable energetics leads to the fact that traditional energetics is becoming a sector with a small number of employees and a small number of highly qualified specialists in the field of information technology. This, in turn, causes significant changes in both the structure of employment and the level of unemployment. Thus, the recently seemed high potential of renewable energy sources to create «green» jobs is being reduced due to automation and robotization [5].

Separately, it should be said about the problems associated with RES. But they do not have «Russian singularities», being able equally affect all countries of the world community.

First difficult problem is the serious threat of environmental pollution due to the dissipation of various elements in it during the production and subsequent disposal of panels for solar energy production [17, p. 211].

In the mass consciousness, an idea has developed about the environmental cleanliness of renewable energy sources, which does not correspond to reality at all. For example, the production, regular replacement and subsequent disposal of solar panels leads to the release of a huge amount of various highly toxic compounds into the environment [3, p. 61].

The statements that there is no need to consume additional natural resources associated with the operation of solar panels are equally unfounded. For example, solar power plants located in a desert area require a large amount of scarce clean water to regularly wash the surface of solar panels and mirrors concentrating solar radiation [3, p. 61].

No less problems are associated with wind energetics. Degradation of soil ecosystems under the influence of acoustic vibrations, change in the volume and direction of transported precipitation, death of birds, appearance of huge landfills of blades made of non-decomposing and incombustible composite materials are among them [18].

Second problem is the fact that the scope of effective use of renewable solar and wind energy is significantly narrowing due to the increasing demand for rare earth metals required for the production of solar and wind installations, as well as the need for their utilization [5].

The fundamental disadvantage of solar energy is the low energy flow density, which predetermines the need to use huge areas for the «collection» of solar radiation. For engineering equipment of such areas in the earth's crust there may simply not be enough raw materials for the production of solar panels [17, p. 211].

All types of RES use «low-potential energy», the density of which in the energy carrier is extremely low. Therefore, it is the problem of concentrating and using dissipated low-potential energy, which is used by all renewable sources without exception, that is the main obstacle to their industrial use [3, p. 54].

Thus, the transition to low-carbon energetics imposed on the country, which is fraught with many uncertainties and potential dangers, requires careful analysis. The planned rapid development of renewable energy without taking into account the negative systemic effects caused by it can have significant negative technical and economic consequences.

And although, according to available estimates, Russia today lags far behind the leading countries of the world in the development of renewable energy sources [19, p. 32; 20], the described problems cannot be disregarded.

**Conclusions**

In modern conditions, it is very important not to blindly focus on the participation of other countries of the world community in any energy projects of a global scale, but to plan measures for the development of the domestic energy sector based on national interests.

In order to digitally transform the fuel and energy sector (FES), create conditions for the introduction of digital technologies and platform solutions in them, taking into account the priorities identified by the President of the Russian Federation, and the provisions of the national program «Digital Economy of the Russian Federation» approved in 2017, the Ministry of Energy of Russia with the active participation of fuel and energy companies formed a departmental project «Digital Energetics» [21]. This project is aimed at transforming the energy infrastructure of the Russian Federation through the introduction of digital technologies and platform solutions to improve its efficiency and safety.

When making decisions on the transition to «green energy», it is necessary to be guided by Russian realities. The primary task here is to justify the expediency of the energy transition for Russia.

The priority tasks for the energy sector development are increasing of domestic power equipment competitiveness; ensuring full utilization of energy capacities; restoration of the innovation process; improving the quality of strategic decisions; solving the problem of negative impacts of digitalisation (increasing the number of employees, decreasing the demand for highly qualified specialists).

Special attention should be paid to the problems related to permanently increasing scales of renewable energy sources use. The paramount problem here is the huge environmental damage.

The key problems of the country's modern electric power industry are of a systemic nature and require serious scientific analysis.

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