Assessment of factors ensuring sustainable development of the electric power industry in the context of transition to renewable energy sources of the national economy

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Abstract. The article is devoted to the issues of the transition of the electric power industry to renewable energy sources. The study analyzed the total consumption of electric energy and the installed capacity of Russian power plants, as a result, it was concluded that the increase in energy consumption. At the same time, the study found that the share of renewable energy sources does not exceed 1 GW of installed capacity and there are no quantitative changes in the volume of electricity production from renewable energy sources. The work identified factors that impede the development of renewable energy sources, which are grouped into technical, technological and economic factors, according to the level of state support and the presence of systemic problems in the electric power industry. The study proposed mechanisms aimed at developing renewable energy sources. In conclusion, the study presents the main findings and results of the work.

1. Introduction
The issues of ensuring sustainable development in the framework of world economic policy were voiced as far back as the middle of the last century and then at the United Nations level the issues of preserving the environment for future generations and the efficient use of natural resources in accordance with the needs of man and society were posed [1]. In the Russian Federation, issues of increasing production efficiency, in order to comply with the ratios of economic, environmental and social systems, come to the fore during the transition of the state to innovative and digital technologies, reducing the use of minerals and improving production processes [2, 3].

Within the framework of certain types of economic activity, concepts are developed for the transition to sustainable development, which include measures to reduce production costs, switch to new technologies, reduce the use of energy resources, etc. [4, 5]. For example, in the electric power industry, the issues of transition to renewable energy sources (RES) are being updated, which will
allow not only the introduction of highly efficient technologies in the industry, but also reduce the raw material dependence of the electric power industry, increase environmental efficiency, reduce production costs and increase the overall efficiency of the electric power complex.

At the same time, despite the need to switch to renewable energy sources, today there are no prerequisites for commissioning renewable energy capacities, which is associated not only with the lack of necessary financial resources, but also with other problems [6]. Thus, the relevance of the study is to assess the factors that ensure the transition of the electric power industry to renewable energy sources.

2. Materials and methods
The purpose of this study is to analyze and evaluate the factors that ensure the development of renewable energy sources and develop recommendations for the transition of the electric power industry to renewable energy. To achieve this goal, the following tasks:

- analyze the level of use of renewable energy sources in the electric power industry;
- identify the factors that ensure the transition of the electric power industry to renewable energy sources.

The study used methods of descriptive, historical, factorial, statistical, logical, comparative, economic and system analysis, a method of expert assessments that allowed the authors to solve the tasks.

3. Results
Consider the volume of electricity and power consumption over the past 10 years (figure 1) [7].

From the presented figure it can be seen that the volumes of consumption of electric energy and power are increasing every year, which indicates an increase in consumption by various categories of consumers, as a result, the level of capacities involved increases during the period under review. It is worth noting that in the Russian Federation on January 1, 2019, the installed capacity was about 246.8 GW, however, about 155 GW of installed capacity was involved in peak periods. This fact indicates the availability of free capacities that are not used for the production of electric energy, but at the same time, are in working condition and can be used at any time [8, 9].
Next, we analyze the share of renewable energy in the total installed capacity of the electric power complex of Russia (figure 2) [7].

![Diagram showing the structure of the installed capacity of power plants of the Unified Energy System of Russia for 2019, in percent.]

The diagram shows that two-thirds of the installed capacity relates to thermal power plants that generate electrical and thermal energy from gas or coal, 19.94% and 11.98% relate to hydroelectric power stations and nuclear power plants, respectively, and only 0.34% comes to solar energy and 0.08% for wind power plants. A similar gap between traditional and non-traditional power plants is due to the large reserve of capacities, cheap hydrocarbons that are used as the main fuel in power plants, the lack of significant quantitative and qualitative prerequisites for the development of renewable energy, low utilization of installed capacity of renewable energy and other.

Let us imagine the volumes of electric energy production from renewable energy sources and the share of renewable energy sources in the structure of the installed capacities of the electric power industry in Russia (figure 3) [7].

It can be seen from the figure that the share of electric energy production from renewable energy sources and their installed capacity has been increasing in recent years. At the same time, it is worth noting that the installed capacity of 150 MW is introduced annually, and the production of electric energy does not exceed a quarter percent.

Thus, the analysis showed that renewable energy in the structure of the electricity industry occupies a fraction of a percent. At the same time, it can be noted that in the Russian Federation the issues of transition to renewable energy sources are included in the development programs not only of the electric power industry, but also in state programs for environmental protection, transition to innovative technologies, energy efficiency and energy saving, development of processing and mining industries [10, 11]. At the corporate level, strategies are being developed that are aimed at consuming resources produced on renewable energy sources, reducing production costs and improving energy conservation policies. All these programs and strategies have a common goal and objectives, namely, to ensure the sustainable development of the national economy.
The capacity of generating facilities operating on the basis of the use of renewable energy sources (excluding hydroelectric power plants with an installed capacity of over 25 MW), MW

The share of electricity production by generating facilities operating on the basis of the use of renewable energy sources in the total volume of electric energy production (excluding hydroelectric power plants with installed capacity of over 25 MW),%

Figure 3. Volumes of renewable energy sources in the general structure of electric energy consumption and maximum power consumption.

4. Discussion
However, the analysis showed that there are no prerequisites for the transition of the electric power industry to renewable energy sources, in this regard, it seems necessary to identify factors ensuring the development of renewable energy sources in the Russian electric power complex (figure 4).

Figure 4. Renewable Energy Development Model.
From the presented figure it can be seen that the factors affecting the development of renewable energy sources can be distinguished into four large groups, among which:

- technical and technological factors, including the features of renewable energy sources and the electric power industry of the Russian Federation;
- economic factors reflecting economic incentives and barriers to switching to renewable energy sources;
- the level of state support, including areas related to and ensuring the transition to renewable energy from state and regional authorities;
- systemic problems containing factors that generally limit the development of this field of activity [12, 13, 14].

Thus, the identified factors ensure the development of renewable energy sources; in this regard, it seems relevant to describe the mechanisms for managing these factors in order to achieve the transition of the electric power industry to renewable energy sources [15].

In the opinion of the authors of the article, the following mechanisms should be envisaged at the state and industry levels to ensure the transition to renewable energy sources:

- a systematic refusal to modernize energy and wasteful facilities and pursuing a policy to eliminate the capacities of coal fired;
- creation of state preferences for enterprises and stations involved in the construction of power plants based on renewable energy sources;
- increasing the investment attractiveness of the electricity sector;
- the development of cheap and similar technologies for renewable energy;
- tightening environmental policies for thermal power plants;
- development of quotas for green energy based on the experience of the countries of the European Union.

As a result, the transition to renewable energy sources must be carried out exclusively with the support of the state, which should not only set a restrictive framework, but also provide all kinds of preferences for business entities that switch to renewable energy sources.

5. Conclusion
Thus, as a result of the analysis, it was revealed that in the Russian Federation, fractions of a percent of electric energy are generated on the basis of renewable energy sources and about 1 GW of installed RES capacity is functioning. At the same time, over the past few years there have been no significant quantitative changes in the volume of electricity production on renewable energy sources and the share of installed capacity of renewable energy sources in the electric power industry. In the work, factors were identified that ensure the development of renewable energy sources, which were grouped into technical, technological and economic factors, according to the level of state support and the presence of systemic problems in the electric power industry. At the end of the study, the authors presented mechanisms that ensure the transition of the electric power industry to renewable energy sources.

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