Renewable and small energy development management

D S Lopatkin¹, T N Shushunova¹, G E Shaldina¹, A A Gibadullin² and I L Smirnova³

¹ Mendeleev University of Chemical Technology of Russia, 125047, Russian Federation, Moscow, Miusskaya sq. 9,
² State University of Management, 109542, Russian Federation, Moscow, Ryazan Avenue, 99
³ Financial University under the Government of the Russian Federation (Financial University), 125993, Russian Federation, Moscow, Leningradskiy Avenue, 49

E-mail: 11117899@mail.ru

Abstract. The article is devoted to the issues of transition of the Russian electric power industry to renewable energy sources. The analysis carried out in the work showed that in the electric power industry there has been a tendency to intensify activities to switch to innovative and renewable technologies in the production of electric energy. The main goal of the transition is to reduce the use of depleted natural resources and reduce the environmental burden. A similar trend is associated with the need to increase the competitiveness of the Russian electric power industry, since in some countries of the world up to 25% of electric energy is generated from renewable energy sources. In addition, in recent years, state programs have been adopted in which by 2024 it is planned to increase installed capacity based on renewable sources to 11 GW. At the end of the work, a structural-logical scheme was proposed that allows for the transition from traditional energy to renewable energy sources. In conclusion, the study presents the main findings and results of the work.

1. Introduction

The Government of the Russian Federation together with the Ministry of Energy of the Russian Federation adopted the state program of the Russian Federation “Development of Energy”, which envisages increasing the installed capacity of power plants operating on renewable energy sources to 11 GW, which is comparable to 4,5% of the installed capacity of the Unified Energy System of Russia. To date, the share of electricity generation at thermal power plants is 64,7%, at hydroelectric power plants and nuclear power plants at 17,14% and 18,06% respectively, and at renewable energy sources it does not exceed 0,1% [1; 2].

The transition of energy to renewable sources will solve the following problems:

- reduce the use of non-renewable energy sources;
- reduce the environmental burden on the environment from power plants operating on combustible substances;
- develop new areas of activity and increase the competitiveness of Russian energy in the world market [3; 4].
At the same time, the problems associated with the increase in the cost of electric energy, which is paid by all consumers, and the additional costs for industrial enterprises related to the payment of the cost of providing power and technological connection, actualize the transition of energy from centralized to decentralized electricity supply. In this regard, renewable or small energy can be used [5-7].

2. Materials and methods
The aim of the article is to search for the prerequisites for the development of renewable and small energy in modern conditions of functioning of the electric power complex of the Russian Federation. To achieve this goal, the following tasks:

- analyze the volume of electricity production based on renewable energy in the countries of the world and determine the cost of installed capacity of renewable energy in Russia;
- propose a structural-logical diagram of the transition of Russian energy to renewable energy sources.

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

3. Results
In developed countries, the share of electricity production from renewable energy sources is more than 25%. In Russia, this indicator is much lower and does not exceed 1%, but by 2024 it is planned to increase production volumes to 4.5%. Consider the volume of electricity consumed in the countries of the world in 2010 and 2016 (figure 1) [8].

![Figure 1. Volumes of electric energy consumption in the countries of the world, billion kW*h.](image-url)

From the presented figure it is seen that in the countries of the European Union and the USA, the volumes of consumption of electric energy are reduced, this indicates the introduction of energy-saving technologies. At the same time, in the Russian Federation, India and China, there is an increase in the consumption of electric energy, and, as a result, there is a need for the construction of new power plants that will satisfy the demand for electric energy.

Next, we consider the volumes of electric energy production in the countries of the world based on renewable energy sources (figure 2) [8].
Figure 2. Volumes of electric energy production on renewable energy sources in 2016, billion kW*h.

The figure shows that in Germany and England, the volume of electricity produced on the basis of renewable energy sources reaches 20%, in the USA and France this indicator is 10%, and in India and China 7% and 6%, respectively. Thus, we can conclude that in the Russian Federation the volumes of electric energy produced on the basis of renewable energy sources do not exceed 0.1% and indicates the absence of development of renewable energy.

In recent years, there has been a trend towards a sharp reduction in the use of non-renewable resources. Currently, 80% of energy is provided by minerals, but scientists and economists predict that by 2025 the use of fuel energy in the world will be reduced to 40-45%.

One of the options for the development of renewable sources may be wind turbines, as they can be located almost anywhere in the country, and their efficiency is much higher, for example, than solar generation. At the same time, there is a growth in the wind energy market in the world, the indicator of which reaches 31% [9-11]. Currently, the world uses the new and old type of wind turbines, the latter of which are mainly located in the densely populated areas, while new installations are made taking into account the terrain. The amount of electricity generated depends on wind speed. Russia by wind speed can be divided into three zones, the first - the average annual wind speed of less than 3 m/s - these are the central regions where there is no large river flow, the second - from 3 to 5 m/s, the regions where the rivers are located in the free territory, the third - more than 5 m/s, regions adjacent to the oceans [12].

Wind turbines can be divided into 4 types:

- Micro-wind farm in the form of domestic installations from 1 to 30 kW of power, located on the roofs of cottages, high-rise buildings and balloons;
- Installations for farmers, small enterprises and large buildings, as well as remote outposts, military units, with a capacity of 30 to 300 kW;
- Large mini-wind farms for large enterprises and urban settlements. They are located on technical floors or on the roofs of high-rise buildings, power up to 600 kW;
- Wind farm with a capacity of 1000 kW or more. They can be placed on a hill and in the mountains, carried out to sea on metal or reinforced concrete platforms.

In Germany, Italy, and Denmark, wind farms are actively using wind power to produce industrial electricity. In Belarus and Ukraine, they began to introduce medium-sized wind turbines for the needs of farms.
Solar energy ranks second among renewable energy sources. Today it is widespread in countries such as India, Italy, Greece, where a large number of sunny days prevail, while in Russia, solar energy practically does not develop due to climatic conditions [13].

In many countries of the world energy from biological substances is developed. Energy from biological substances in Russia occupies one of the leading places in the generation of electricity from renewable energy sources. Energy from biological substances is the production of electrical energy through the use of raw materials of biological origin.

Despite the availability of traditional energy sources, Russia is interested in using renewable energy sources, which today can have several areas of application, for example, using renewable energy sources; it is possible to provide energy to hard-to-reach areas that are not connected to common networks. The cost of transporting oil, gas or coal to these areas amounts to millions of rubles, thus the cost of electricity is several times higher than the average tariffs in the country [14].

The most promising direction in the development of the electric power industry was the construction of small power plants that satisfy the needs of individual consumers. Due to the construction of small power plants, the consumer refuses to pay for network and marketing services, thereby reducing the cost of electric energy. At the same time, due to the proximity of the location of small power plants to sources of consumption, the reliability and uninterrupted power supply increases [15].

4. Discussion

Thus, the transition of the Russian electric power industry to renewable and small-scale energy will solve not only environmental issues and the conservation of natural resources for future generations, but will also help solve systemic problems associated with equipment wear, the lack of innovative technologies to modernize existing capacities and increase the industry’s efficiency, how today depreciation of generating equipment exceeds 60%, and a number of production capacities are used beyond the useful life use.

The development of renewable and small energy needs to be carried out not only at the state expense or of large consumers, but also with the direct participation of large consumers who are actual consumers of this electric energy. According to experts, 1 kW of installed capacity for the construction of wind generation is 64,900 rubles, and solar is 49,800 rubles. At the same time, small generation is not a cheap type, its advantage is the possibility of combined generation of electric energy and 100% capacity utilization, while solar energy can be used mainly in sunny areas, and wind energy in areas with increased wind speed, and, as a result, the level of renewable energy use does not exceed 15% [16].

The development of renewable and small generation is possible due to the gradual displacement of traditional power plants and the transition to new technologies [17]. We will formulate a scheme for the transition of energy to renewable energy (figure 3).

The presented scheme reflects the logical process of the transition of the Russian electric power industry to renewable energy sources, which consists in determining the volume of electricity consumption and the gradual abandonment of the construction of traditional energy in exchange for stations based on renewable energy sources.

5. Conclusion

Thus, the presented study allowed the authors to formulate the prerequisites for the development of renewable and small generation in the Russian Federation. The analysis of the development of renewable energy sources in the world shows that the Russian electric power industry can begin a gradual transition to renewable or small energy, which will give stability and reliability to the electric power industry. Based on the analysis, a scheme was proposed for the transition of Russian energy to renewable energy sources.
Figure 3. Structural-logical scheme of the transition of Russian energy to renewable energy sources.

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