Modern problems of digitalization in energy

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Abstract. The formation of the technological progress of the Russian economy is inextricably linked with the development of the industry. And one of the key industries is energy. It is she who largely determines the socio-economic and industrial development of the country. Without a doubt, with digitization, business becomes more efficient and products become more accessible. At this stage, the digitalization of postal systems in the Russian Federation makes it possible to process more than a billion e-mail messages every day. This leads to an increase in the growth rate of labor productivity and a decrease in costs. Therefore, there is reason to say that the digitalization of the electric power industry will allow not only achieving similar results, but also surpassing them.

1. Introduction
The digitalization of an energy company is, first of all, an approach aimed at adapting digital resources to the production process and the realities of the modern-day, increasing competitiveness in the market.

Digitalization is based not only on the desire to modernize production but also on the ability to distribute and transmit energy using digital power plants. They are systems consisting of several objects with the possibility of remote maintenance using Big Data.

For example, Siemens is implementing in Russia, together with the Ministry of Industry and Trade, a program to create a new digital space.

The transition to digital devices for power management will improve the parameters of electrical systems, as well as their loading and management of electricity flows. In addition, when the possibility of simultaneous power supply and data transmission is realized, it will be possible to search for services for consumers in real-time. And now it becomes possible thanks to the development of the Internet of Things "Industrial Internet of Things" (IIoT) [1].

2. Digitalization and the Future of Energy
At the current stage of the development of the electric power industry, the industrial Internet of Things opens up a wide overview of applications, as well as provides potential for the operation of power grids and their optimization. As a result, it is possible to digitize industrial processes that include infrastructures such as power distribution.
Nevertheless, already at this stage of digitalization in Russia, some problems arise. Since Russia is at the very beginning of the road, and the development of the electric power industry is fraught with enormous difficulties and risks, the lack of skills in this area can lead to serious obstacles to digitalization. Also, do not forget that internal barriers of a person, which are associated with the structure of thinking, habits, and cultural views, can play a role [2].

An example is the report of the DNV GL group “Digitalization and the Future of Energy”. During the report, more than 2,000 engineers and CEOs of various companies, from startups to corporations, were interviewed. All companies were from the energy sector, and about 71% of organizations needed employees with digital experience. Research by the DNV GL group found that 91% of respondents believe that digital education is a critical skill when applying for a job in their organization. In addition, the respondents acknowledge the fact that it is necessary to invest significant funds, both material and intellectual, in order to learn digitalization [3].

Among other things, it should be emphasized that the digitalization of the energy sector is also a mandatory program for replacing outdated equipment with new skills related to digital technologies [4–9].

The digitalization of the electric power industry in the Russian Federation is based on the following documents:

1. Decree of the Government of the Russian Federation of April 18, 2016 No. 317 "On the implementation of the National Technology Initiative" with amendments and additions as of August 31, 2019.
2. Decree of May 7, 2018 No. 204 "On national goals and strategic objectives for the development of the Russian Federation for the period up to 2024".
3. Decree of the Government of the Russian Federation of November 16, 2015 No. 1236 "On the establishment of a ban on the admission of software originating from foreign states for the purpose of making purchases to meet state and municipal needs" with amendments and additions as of March 30, 2019.
4. Decree of the President of the Russian Federation of May 9, 2017 No. 203 "On the Strategy for the Development of the Information Society in the Russian Federation for 2017 – 2030".

In order to develop the service of intellectual energy on the territory of Russia and help in solving problems that are involved in the implementation of software, since 2016, the Ministry of Energy has been carrying out a set of works in the direction of the National Initiative "Energy". The purpose of the work is the possibility of the subjects of the electric power industry entering the market using modern tools of entrepreneurial activity. Within the framework of this strategic management, there is an opportunity to modernize the processes of operation of energy systems using business models.

All these documents pursue one goal - the digitalization of the electric power industry with the help of innovative solutions based on modern technologies. At the same time, one should also take into account the provision of stable operation of networks, flexibility and adaptability to new market participants and high-tech facilities [10-13].

For example, in [12], an algorithm for the development of a block circuit for controlling injection motors of an AC electric locomotive is given. The block diagram of the developed technical solution is shown in Figure 1 [12].
Figure 1. Block diagram of a technical solution that allows you to control the injection motors of an electric locomotive [12].

In works [14–17] it is said that digitalization in electronics is not just a promising opportunity to bring modernization to a new level, but a necessity dictated by the development of science.

So, for example, the author of work [16] is sure that by 2050 renewable energy sources will become the main energy sources on the territory of the European Union. Factories that do not consume energy and networks are able to analyze their work on their own - this is the future and it is impossible without digitalization.

It is worth noting that it is necessary to correlate cause-and-effect relationships and look for patterns describing the influence of some systems on others. This approach will make the development more visual and will allow you to predict possible problems of the system in the future. An example of a block diagram of the dependence of Internet development and electricity consumption in China is shown in Figure 2 [17].
Figure 2. Block diagram of the dependence of the development of the Internet and electricity consumption [17].

Referring to the experience of other countries, it is also possible to cite Germany as an example, which has become one of the leaders of the international market of electric vehicles. In order to analyze data on electric vehicles in the country, they are structured into systems similar to the one shown in Figure 3[18].

Figure 3. Characteristics of the cars in a structured form [18].
This allows you to significantly reduce the time and make the result of operations more visible and understandable to the layman. Thus, the simplicity and accessibility of the presentation in many ways allows us to solve the energy problems associated with the lack of structured data.

The digitalization of smart grids is also discussed in articles [19-20]. Numerous studies and analysis of control systems show the importance of intelligent energy management systems. Meanwhile, the authors of work [21], who modeled an autonomous smart grid based on the available data, came to the conclusion that building such a network in the realities of modern energy is a real and quite feasible task, although it is a very difficult task. The diagram of the analyzed network is shown in Figure 4 [21].

![Figure 4. Scheme of an autonomous smart grid [21].](image)

Today, it is possible to formulate the main tasks facing the scientific community and the electric power industry during digitalization [22]:

1. Building a system that in the future will be able to self-recover, distribute automated cable lines and automatically use backup lines in case of failure of the main ones.
2. Creation of digital high-tech substations.
3. Construction of intelligent metering systems for electric power resources, which will combine the functionality of a dispatcher and track the centers of technical and economic losses.
4. Creation on the basis of territorial networks of a modern Network Management Center (NCC), which will ensure the functioning of power grid management using digitalization.
5. Building digital systems taking into account Big Data and Artificial Intelligence.

3. Conclusion

Thus, the use of digital technologies acts as a key driver of changes in the Russian energy complex, allows automating the electric power industry and creating tools for building the so-called "smart" energy in the territory of the Russian Federation.

In addition, it should be added that in today's market it is impossible to achieve technological progress without the use of digital technologies. It is digitalization that helps maintain competition in the energy industry, manage processes, thereby reducing the cost of energy.

However, when moving along the path of digital progress, one should not forget about traditional methods of working with information. Proper data preparation will not only help to reduce the processing time and make the result more visual, but will also help to avoid serious errors. When conducting experimental studies, it is not always possible to quickly deduce the dependence of the quality of rail steel on the content of impurities. To optimize the process of creating new standards, it
was proposed to use modeling. It is digital technologies that will be useful in studying the number, shape, and size of non-metallic inclusions that may be present in a particular grade of rail steel.

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