

# Digital Transformation of Management of Russian Energy Companies

Soldatova N.F.<sup>1</sup> Ilyashenko S.B.<sup>2</sup> Rebrikova N.V.<sup>3</sup>

<sup>1</sup>Financial University under the Government of the Russian Federation, Moscow 125993, Russia

<sup>2</sup>Plekhanov Russian University of Economics, Moscow 115054, Russia

<sup>3</sup>Financial University under the Government of the Russian Federation

\*Corresponding author. Email: ilyashenko.sb@rea.ru

## ABSTRACT

It is quite obvious that qualitative changes are being formed in all areas of the fuel and energy complex, which are the core of the new technological order and the basis for the innovative renewal of the Russian economy. Energy companies are in the process of creating a higher quality of economic and managerial relations, which allows them to provide consumers with a high quality of life and adaptability to new economic conditions. The digitalization of the country's energy sector is based on the level of science and technology development, the scientific and technical potential of companies that ensure competitiveness in the world market of goods (services) and technologies. The digitalization of energy becomes the most important factor in the implementation of the state's economic interests in the period of Industry 4.0.

**Keywords:** energy sector, digitalization, digital energy, Industry 4.0, digital energy tools

## 1. INTRODUCTION

Rapid development in digital technology has brought a new phenomenon of the industrial revolution, generally called by Industry 4.0. This revolution introduces modern technologies that support the connectivity of the entire components within the industries. However, connectivity is not the only advantage that will follow – the concerns aim to support sustainability in the industry [6].

Over the past 12 years, Russia has remained one of the main participants in the international energy market: it accounts for 10% of world energy production at the end of 2019 and 5% of energy consumption [1]. A decrease in demand for hydrocarbons in the world market and tougher inter-fuel competition will inevitably lead to the stabilization of Russian energy exports and increase risks to ensure the sustainability of the country's economic development. The global fuel and energy industry market have entered a period of “energy transition”: the rapid development of new technologies in the energy sector, the slowdown in global energy consumption and the change in the vector of state energy policy in leading countries.

During recent decades, the energy sector has undergone thoughtful structural changes, getting towards a more competitive environment, a process that is highly controlled and monitored by regulatory authorities. The differences in the pace and extent of market reforms are mainly related to the starting point of each reform and the problems associated with the internal environment of the market [9].

The Russian energy market is transforming, but the rate of change is associated with high uncertainty.

The digitalization of the Russian energy sector as part of the digital economy can stimulate the development of the country's economy and ensure GDP growth, partly due to the great potential for energy conservation and the development of demand for innovative products of the fuel and energy complex. To ensure the implementation of the decrees of the Russian Federation's president V.V. Putin dated May 09, 2017 No. 203 “On the Strategy for the Development of the Information Society in the Russian Federation for 2017 - 2030” and dated May 7, 2018 No. 204 “On National Goals and Strategic Tasks of the Development of the Russian Federation for the Period until 2024”, the Government of the Russian Federation forms and approves the program “Digital Economy of the Russian Federation”, which is based on the development of high-tech companies through the formation of new principles of interactions between various market entities and the expansion of enterprises' digital capabilities. The transformation of the Russian energy market dictates the need for implementation of the digital business models' introduction by leading energy companies that are ready to offer alternative digital solutions to maintain their market position.

The period of “energy transfer” in the Russian market and the possibility of reducing uncertainty in the energy market are associated with the creation of a digital system (horizontal and vertical cross-cutting - managerial and operational processes), integration with digital systems of partners, suppliers and the formation of a higher level - the digital ecosystem.

The functioning of digital ecosystems should ensure the growth of consumer value at each level of management and production. So, in [7] and [8], the features of energy production under decentralized production conditions and the application of effective strategies for the development of the energy sector were considered.

The energy market is being transformed in the direction of decentralized generation, the search for technological solutions in terms of energy storage and improving the efficiency of communication with customers through the digitalization of multi-level interaction with the consumer and personalized marketing by customer profile.

Detailed discussions are provided on the integration of temporally refined energy demand, based on thermodynamic processes and socio-technical effects [10].

## 2. RESEARCH METHODOLOGY

The instrumental and methodological apparatus is based on the following representative scientific methods: scientific knowledge, system analysis of managerial processes and phenomena in the field of energy, induction, deduction, and others; graphic, statistical and economic methods, methods of groupings and classifications.

The information and empirical base of the research are made up of the previous works of the authors on this topic, as well as the Internet resource Diesel & Gas Turbine Worldwide, which annually publishes open statistics on the structure of energy product orders. This study is conducted in a dynamic retrospective (for the analysis of the world and Russian energy markets, the period was chosen: 2007-2019).

The methodology for researching the electric power market and the phenomena occurring on them is a complex model of processes simulation that describes the state, factors, and prospects for the development of the energy market. Methodological aspects of the energy market analysis include the principles and methods of conducting a comprehensive study such as environmental monitoring and sounding of the internal environment, which allows to identify the research problems and generate a target. The algorithm of complex market research during the “energy transition”, which is part of the general research methodology, is to implement the following sequence of actions:

1. Determination of the information and empirical basis of the study and the time intervals for considering the digitalization of companies operating in the energy market.

2. Classification of digital tools for managing a company in the energy sector and within the digital ecosystem.

3. Obtaining, processing, grouping, and interpretation of the original statistical data, obtained during the author’s research.

4. Identification of the main trends, cause-effect relationships and factors influencing the situation on the market, forecasting its further development [1].

The author’s algorithm has limitations in analyzing the global energy market, identified by the authors in comparison of this study results and the one obtained in the analysis of the Russian energy market [1], where implemented various approaches to the digitalization of management, operational activities, and the practice of using digital tools, therefore It is almost impossible to describe the variety of approaches and digital tools.

Difficulties arise when studying the Russian practice of using digital platforms, programs, and tools, used by energy companies due to the lack of information that is publicly available by leading state corporations. Limitations in the study are due to the analysis of world market trends during the “transition” period, the practice of digitalization of Russian non-state companies, in which it is not possible to analyze in details some aspects of digitalization. In this regard, the forecast for the digital development of energy companies and digital tools is approximate.

The category “digital energy” is complex and can be discussed from various perspectives. First, digital energy is considered as a new system for managing a company, industry, digitalization of the country’s economy, which forms the optimization of business processes for solving strategic problems (national level). Secondly, “digital energy” is understood as the digitalization of enterprise processes within the value chain, the digitalization of processes with other energy entities and other markets (macro-level).

Thirdly, “digital energy” is understood as the digitalization of enterprise processes within the value chain (micro-level).

The fourth industrial revolution and the underlying digital transformation, known as Industry 4.0, is progressing exponentially. The digital revolution is reshaping the way individuals live and work fundamentally, and the public remains optimistic regarding the opportunities Industry 4.0 may offer for sustainability [5]

**Table 1 Digital energy market size, billion dollars**

Applied Technologies	2017	2018	2019	2020	2021	2022	2023	2024
Total, including:	52	52	54	54	53	54	56	60
Distribution Network Automation	4	5	6	6	7	7	8	9
Smart Meters	18	19	21	21	21	21	21	24
Operation and maintenance of TES	24	22	20	19	17	15	14	12
Other	6	6	7	8	8	11	13	15

**Table 2 Strategic directions of digitalization of ROSATOM Corporation**

Internal digitalization	Digital Products	Participation in the digitalization of the Russian Federation
<ul style="list-style-type: none"> <li>* Digitalization of NPP construction processes</li> <li>* Digital twin and breakthrough technology</li> <li>* Digitalization of core processes and corporate functions. The Unified Industry Quality Management System of ROSATOM State Corporation - EOS-Quality (stage 1) was developed and implemented;</li> <li>* Architecture, infrastructure; * User experience</li> <li>* Information security</li> <li>* Digital import substitution;</li> </ul>	<ul style="list-style-type: none"> <li>* Digital products, ecosystems of developers and partners</li> <li>* Marketing and image of «Digital Rosatom»</li> <li>* In nuclear energy, a project is being implemented to create a network of atomic energy information centers (ICAE) in the regions of presence. The network includes more than 17 ICAE centers and a center in Minsk and Astana;</li> </ul>	Digital economy of the Russian Federation
<b>ORGANIZATIONAL CHANGES</b>	<b>DIGITAL CULTURE</b>	
Organizational Changes in Digital Transformation	Digital Competencies and Corporate Culture * Joint digitalization program with NRNU MEPhI;	

**Table 3 Strategic directions of digitalization of ROSSETI corporation [3]**

Internal digitalization	Digital Products	Participation in the digitalization of the Russian Federation
<ul style="list-style-type: none"> <li>* Digitalization of NPP construction processes</li> <li>* Digital twin and breakthrough technology</li> <li>* Digitalization of core processes and corporate functions. The Unified Industry Quality Management System of ROSATOM State Corporation - EOS-Quality (stage 1) was developed and implemented;</li> <li>* Architecture, infrastructure; * User experience</li> <li>* Information security</li> <li>* Digital import substitution;</li> </ul>	<ul style="list-style-type: none"> <li>* Digital products, ecosystems of developers and partners</li> <li>* Marketing and image of Digital Rosatom</li> <li>* In nuclear energy, a project is being implemented to create a network of atomic energy information centers (ICAE) in the regions of presence. The network includes more than 17 ICAE centers and a center in Minsk and Astana;</li> </ul>	Digital economy of the Russian Federation
<b>Organizational changes</b>	<b>Digital culture</b>	
Organizational Change in Digital Transformation	Digital Competencies and Corporate Culture * Joint digitalization program with NRNU MEPhI;	

The transformation of the global energy market has led to the understanding of digital energy as a distributed architecture of energy systems based on the digital technology platform. Market infrastructure is developing in the direction of “smart grids”, and consumers are actively involved in the production of goods and services consumed by themselves.

### 3. RESEARCH RESULTS

Russian energy companies are faced with the need to transform existing business models, and the acceleration of scientific and technological progress in the energy sector necessitates the introduction of new technologies.

According to the data of Navigant Research and Bloomberg New Energy Finance, which the Ministry of Energy of the Russian Federation cites in its report, according to the results of 2019, the size of the digital technology market in the energy sector amounted to 54 billion dollars, of which 41 billion dollars are accounted for by smart electricity meters, as well as operation and maintenance of thermal power plants (table 1).

We also note that according to the forecasts of Navigant Research and Bloomberg New Energy Finance, the volume of the market for home energy management systems amounted to \$ 11 billion by 2025.

The digitalization of ROSATOM strategically involves development in the following areas, presented in Table 2.

The digitalization of the state corporation ROSATOM is based on the implementation of the digitalization strategy, which structurally includes 11 programs [2]. ROSATOM Corporation actively participates in the state program Digital Economy in the following areas:

- “Formation of research competencies and technological groundwork”;
- “Atlas of “cross-cutting” technologies of the Russian digital economy”;
- “Industry 4: 0”.

The unified digital strategy of ROSATOM Corporation is based on the development of the industry 3.0 transformation program for the IT period. Three basic principles signify the foundation of the digital strategy of the corporation:

1. Systematic;
2. Business orientation;
3. Customer focus [2].

As a key participant in the Digital Economy of the Russian Federation program, the company is positioned as a leading developer of digital solutions and a partner in horizontal digital partnerships with state corporations in terms of import substitution, procurement, etc. The scale of nuclear energy and the diversification of business pushed the corporation not only to internal digital transformation but also to the active production of digital products and turnkey solutions [2].

The state corporation PJSC “ROSSETI” has developed and is implementing the “Digital Transformation 2030” strategy, where the strategic objective is the introduction of intelligent control systems based on digital technologies [3].

The goal of the strategy is a global change in the logic of all management processes, including operational ones: provision of integrated information flow (cloud technology) for all departments of the corporation on the basis of research (CAC), using digital technologies for big data analysis.

The main directions of the corporation's digital transformation are implemented by participation in the digitalization of the Russian Federation and the internal digitalization of processes. The main directions of internal digital transformation are determined by the specifics of the largest network company's operation engaged in the transmission and distribution of electricity. The modernization of digital technologies will affect the management and operational processes:

- services for the transmission of e-energy (intelligent metering of e-e, Internet of things IoT, Big Data, Artificial Intelligence, Blockchain);
- technological connection (Digital Shadows, IoT, Business Ontology, Big Data, Artificial Intelligence);
- technological and operational management (Digital Shadows, Business Ontology, Big Data, Artificial Intelligence);
- technological maintenance, repairs, reconstructions (Digital Shadows, Big Data, VR-reality);
- investment activity (Big Data);
- capital construction (Digital Shadows, Big Data, VR-reality);

- economic processes (Big Data);
- procurement management (Big Data, Artificial Intelligence);
- risk management (Big Data, Artificial Intelligence);
- knowledge and personnel management (Digital Shadows, Big Data, VR-reality);
- corporate property management (Big Data, Artificial Intelligence);
- management of legal aspects of activity (Big Data, Artificial Intelligence);
- logistics (Big Data, Artificial Intelligence, Blockchain);
- management of services provided (Big Data, Artificial Intelligence, Blockchain);
- production asset management (Digital Shadows, Big Data, Artificial Intelligence).

The transformation of digital technologies, computer chains, and equipment of “ROSSETI” Corporation into a CIS allows you to receive information about the state of the system as a whole and individual units (business units) in particular. Huge amounts of information require a qualitative approach to the analysis of the collected information to optimize the decision support system.

#### 4. THE DISCUSSION OF THE RESULTS

The strategy of the world electric power industry is aimed at creating an “intelligent” electric power industry, with the intensive transition to digitalization based on digital technological competencies that will ensure the global competitiveness of the industry. Digitalization of energy is considered from the following approaches:

- digital control over the functioning of energy systems aimed at optimizing technological and business processes;
- the formation of digital technologies for the interaction of market participants.

The period of the “energy transition” modernizes the existing electric power systems in the direction of the distributed generation and accumulations of energy. Energy markets are formed as decentralized, infrastructure - artificial intelligence technologies, consumers (wholesale and retail) demonstrate prosumer models of behavior.

BCC Research estimates the global distributed generation market growth at 10% annually.

The Russian electricity market has its specifics, which leaves imprints on its transformation in the “energy transition”. Distributed energy in Russia amounted to 23–24 GW, or 9–9.5% of the installed capacity of the unified energy system (2017). The increase in electricity tariffs for consumers (primarily industrial), low density of electricity consumption, a significant amount of reserve capacity, socially-oriented policies of state corporations, high cost of investments, and inefficient management are factors that impede the development of the national economy and energy industry.

The digitalization of the Russian energy sector is based on such legal documents as: “Forecast of the scientific and technological development of the fuels' sectors and energy complex of Russia for the period up to 2035”, roadmap “Introduction of innovative technologies and modern

materials in the fuel and energy sectors”, state program “Energy Efficiency and Development energy”. The national project “Development and implementation of digital electrical substations and stations at newly constructed and reconstructed energy facilities” and “Energy-efficient substation” has been approved and is being implemented. Work is continuing to improve the EnergyNet roadmap of the National Technology Initiative. The general vision of the transformation of the energy market in the context of the “energy transition” has not yet developed into a digital energy strategy in Russia.

Digital energy management is being upgraded in the following ways:

- introduction of risk-based management;
- development of digital customer services;
- Improving the system of price-dependent consumption reduction – Demand-Response in the wholesale market;
- introduction of demand management aggregators in the retail market;
- formation of a unified information platform in the industry;
- change in the functionality of aggregators as participants in the energy market, etc.

World practice of the energy markets functioning indicates the active use of the “demand management” tool in energy systems. Moreover, this tool is used both in the wholesale market and in the retail market, where medium and small companies and household consumers are present.

Large Russian companies operating in the energy market are already engaged in the production of digital products (services) and are introducing digital technologies. As a rule, these are the flagships of Russian business, state corporations. PJSC “ROSSETI” is implementing a digitalization program worth 1.3 billion rubles. “ROSATOM” announced a new business unit: Digital Energy. Medium-sized companies generating products (services) for Russian state-owned corporations are not actively involved in the digitalization of goods or services during the “Industry 4.0” period. The surveyed private companies executing orders for “ROSATOM” (the survey collected information from 11 companies) responded that the use of digital tools is hindered by:

- lack of own financial resources for the creation of digital platforms;
- lack of confidence that soon (2 years) the information platform will become an asset, i.e. will create “consumer value”;
- targeting a large consumer of the company, rather than creating and promoting products and services, does not stimulate an increase in the effectiveness of campaign communications;
- the corporate strategy of the companies studied is aimed at “maintaining a market position” or even “survival”. Therefore, the creation of digital business models is not considered, etc.

## 5. CONCLUSIONS

A transformation is taking place on the Russian energy market but in terms and directions different from global trends. The main changes are taking place in the direction of transmission, processing, and analysis of information, exchange and creation of digital models for managing energy systems. When considering digitalization from a management perspective, it should be noted that the goal of transformation is to optimize management decisions based on ICT. The main areas of digitalization include the following large blocks:

1. Creation of a unified information platform, wherein a single chain of creating consumer value is constantly located - information from generating and switching equipment, information from transformer substations and distribution networks, as well as information from the consumer. Companies faced the need to intensify horizontal and vertical digitalization of information flows for constant adaptation to market requirements.
2. Improving informatization due to the speed of data transfer on the basis of a digital platform increases the efficiency of energy system management in general, reduces risks and improves the quality of management decisions.
3. The introduction of artificial intelligence technology will improve the quality of predictive analytics and calculations, as well as improve the organization and control not only of the internal environment of the company but also of contractors and suppliers.
4. In solving energy problems, the digitalization of technological and managerial processes, where Russia has its specifics, is of great importance. State-owned energy corporations are ahead of the commercial energy sector in terms of investments in digitalization of the industry, as well as the range of digital tools and technologies much wider among state-owned companies.
5. The radical transformation of the energy sector - the transition to a digital economy and management, horizontal and vertical digitalization into a market economy, will become the basis of digital management's state at all levels. First of all, we mean advanced state corporations that retain their potential at the global level.

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