

# TECHNOLOGY PLATFORMS AS A FACTOR IN INCREASING THE ECONOMIC EFFICIENCY OF DISTRIBUTED ENERGY IN RUSSIA

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***Abstract:** In article features of formation and development of technological platforms in the sphere of the distributed power are considered. Results of their activity are analyzed. The characteristics inherent in the domestic technological platforms operating in the sphere of the distributed power come to light. The prospects of development of technological platforms for the purpose of increase in energy efficiency are shown. As basic methods of research, in article used a systematic approach, comparative and statistical analysis of data showing the state of the electricity industry. The author considers the specifics of the creation and operation of technological platforms, the activities of which are aimed at improving the economic efficiency of distributed energy in the Russian Federation. As the results of technological platforms show, there is a structural shift in energy in favor of more diverse, flexible and "energy-efficient" solutions, including those aimed at more fully meeting the needs of consumers and intensifying the search for modern technological and management solutions based on the development of small forms of energy.*

***Key words:** technological platforms, the distributed power, technological development.*

***JEL codes:** P18, Q42, Q48.*

## **1. Introduction**

In the current conditions of transformation of global economies, the formation of new organizational structures contributing to the efficiency of the economy is becoming increasingly important in Russia and foreign countries. Such structures include technology platforms, which are a communication tool aimed at intensifying efforts to create promising commercial technologies, new products or services, attracting additional resources for research and

development based on the participation of all stakeholders (business, science, state, civil society), improving the legal and regulatory framework in the field of scientific and technological, innovative development.

To date, 35 technology platforms operate in the Russian Federation in accordance with the List approved by the decisions of the Government Commission on High Technologies and Innovation (2011), the decision of the Presidium of the Government Commission on High Technologies and Innovation (2012), the decision of the Presidium of the Council under the President of the Russian Federation on economic modernization and innovative development of Russia (2014).

Since April 2011, Russia has had four technological platforms created as innovative platforms consolidating the efforts of the state, business, science and civil society for the development of distributed energy: "Small distributed energy", "Intelligent electric power system of Russia", "Environmentally friendly thermal energy of high efficiency", "Promising renewable energy technologies". All technology platforms are voluntary, self-funded, self-governing organizations without the formation of a legal entity.

The purpose of the article is to analyze the results of the activities of technological platforms created to increase the economic efficiency of distributed energy in the Russian Federation.

## **2. Methodology and Data**

As basic methods of research, we used a systematic approach, comparative and statistical analysis of data showing the state of the electricity industry. Thus, the systematic approach was reflected in the consideration of a set of elections, innovative platforms consolidating the efforts of the state, business, science and civil society for the development of distributed energy. This allows not only to identify the features of technological platforms, but also to consider the relationship and interaction of their components.

Investigating the problems of creating and developing technological platforms, the author analyses both statistics and the legislative base, which is the cornerstone of the formation of the national electricity system, improving its efficiency. Methods of the comparative and statistical analysis of data are for this purpose applied.

### **3. Results and Discussion**

The creation and operation of technological platforms is aimed at improving the economic efficiency of distributed energy in the Russian Federation. Each of these platforms has its own specificity, an area of activity in which certain results have been achieved. Let 's look at each of them in more detail.

#### **3.1. Technological platform "Intelligent electric power system of Russia"**

In recent years, quite active work has been carried out to transform the conditions, mechanisms and technological principles of the operation of the electric power industry by increasing its intelligency on the basis of large-scale innovation, especially digital and information and communication technologies. According to the draft Energy Strategy of Russia until 2035, it is expected to step-by-step transition of industries to the principles of best available technologies (BAT) and introduction of promising technologies that reduce specific resource consumption and negative impact on the environment. In this regard, "it will be necessary to develop and introduce a wide range of promising technologies in all sectors of fuel and energy sector, development of infrastructure of engineering centers and industry experimental sites (polygons) and certification centers"(Draft Energy Strategy of the Russian Federation for the period up to 2035, 2019).

The creation of the technological platform "Intelligent Energy System of Russia" (TP IES) is aimed at determining: the main requirements and functional properties of the Russian electric power industry on the basis of the IES concept; Key directions of development of all elements of the energy system - generation, transmission and distribution, marketing, consumption and management; Main components, technologies, information and management solutions in all the above-mentioned areas. In addition, the activities of TP IES include the formation of a strategic vision for the implementation of the concept of IES of Russia and coordination of modernization and innovative development in the Russian electric power industry.

According to the Report on the execution of the Project of Implementation of the Technological Platform "Intelligent Energy System of Russia" in 2018 and the Action Plan of the TP IES for 2019 (Report on the execution of the Project of Implementation..., 2019), as of February 1, 2019 the number of organizations that joined the technological platform "Intelligent Energy System of Russia" amounted to 215 organizations (at the stage of creation of technological platform of companies interested in participation in TP IES, there were 61).

The coordinating organization of the Platform ("Russian Energy Agency" of the Ministry of Energy of Russia), in order to ensure scientific, analytical, expert and legal activities of the Platform, formed expert councils in such areas as: Generation, Networks, Consumption and Management.

Representatives of the technological platform included in the corresponding collegial bodies under the Ministry of Energy of the Russian Federation (working groups, project committees) took an active part in the formation of the list of national projects. "In 2015 - 2018, the working group on the selection of national projects on the introduction of innovative technologies and modern materials in the energy sector approved 20 such projects, including 11 projects in the electricity sector" (Report on the execution of the Project of Implementation..., 2019).

The key task facing the representatives of the TP IES is the formation of a target vision for the development of intellectual technologies in Russia, as well as the conduct of research and development on the Platform.

In 2018, a group of organizations participating in TP IES (PJSC "Rosseti," JSC " Unified Energy System Operator," PJSC "INTER RAO," State Corporation "Rosatom,") formed and submitted to the Ministry of Energy of Russia proposals for participation in the departmental project "Digital Energy" within the framework of the federal program "Digital Economy." Application of digital technologies throughout the chain of management of subjects and assets of the fuel and energy sector of the Russian Federation will allow to build an end-to-end industry system of accounting and planning, will increase competitiveness in the international market of both the fuel and energy sector of the Russian Federation as a whole and its individual subjects.

As the experience of foreign countries shows, "digital transformation of electric networks allows to significantly reduce operational and investment expenses of network companies, reduce power losses, increase reliability, availability of electricity supply and create a set of additional services for clients" (Draft Energy Strategy of the Russian Federation for the period up to 2035, 2019).

In April 2018, the Federal Network Company of the Unified Energy System put into operation the first in Russia energy object of ultra-high voltage class, in which digital technologies - 500 kW substation "Tobol" in the Tyumen region are integrated. "This is the first high-voltage-class facility in the country, where digital substation technologies, mainly

Russian-made, are used in a comprehensive manner. By 2025 it is planned to build more than 30 such facilities "(Report on the execution of the Project of Implementation..., 2019).

In Moscow in 2018, the first digital substation in the country was put into operation, which is the only substation in Russia fully equipped with equipment of domestic production - Digital Substation 110 kW "Medvedevskaya" (PJSC "MOESK"). The substation is designed to serve consumers of the innovation center Skolkovo. In terms of automation and energy saving it exceeds European analogues.

In 2018, the complex reconstruction of one of the largest feeding centers of the Moscow region - 220 kV substation "Luch" began. At the site it is planned to introduce a complex of digital technologies, and its capacity will triple - to 700 KVA. The company invests more than 3.4 billion 16 rubles in the project. On substation of 220 kW " Luch" essentially new control system, control of the mode and operation of the equipment with use of digital terminals of relay protection and automatic equipment, fiber-optic communication links and the automated process control system taking into account requirements of the international standard IEC 61850 will be realized.

Within the framework of the project "Creation of an integrated system of automation of 15kW distribution electric networks of JSC "Yantaryenergo" (2014-2021)" (Kaliningrad region), aimed at developing the main technological and methodological approaches to the introduction of innovative solutions, it is planned to develop an intelligent energy system - digital substations and digital active-adaptive networks with distributed automation and control system. For its development, the main Center for Management of Networks and Small Generation was opened in JSC "Yantaryenergo".

The project to build a digital network in the Kaliningrad region is unique in its performance for Russia. "The steps taken have made it possible to increase the observability, controllability and, accordingly, efficiency of the electric grid complex and already exceed in the main indicators many international analogues: indicators of reliability (quantity (SAIDI) and duration (SAIFI) of technological violations) in the digital area of electric networks have improved by 60%; on average, power losses have been reduced by almost 10%; specific operating costs reduced by almost 20% " (Report on the execution of the Project of Implementation..., 2019).

TP IES together with both domestic and foreign (CIS, Germany, USA, UK, Japan, Italy, France, China, Vietnam, South Korea, Bulgaria, Finland, Serbia, Iran, India) partners have

created a number of successfully functioning research and educational programs, scientific and educational centers, technopark structures, research and training laboratories.

### **3.2. Technology platform "Clean thermal energy of high efficiency"**

The formation of the technological platform "Clean thermal energy of high efficiency" is based on the task of preserving and developing the competences of domestic industries (energy, power and electric machinery), eliminating the lag in these industries in the development and development of high-efficiency technologies and equipment for the production of electricity and heat from organic fuel in recent decades.

The technology platform "Clean thermal energy of high efficiency" includes the following technologies: "Domestic CCGT (Combined Cycle Gas Turbine), and GTP (Gas Turbine Plant) on their basis with capacity of up to 1000 MW with efficiency up to 60% and promising technologies using fuel cells, providing efficiency up to 70%; Coal power units for super-critical steam parameters with unit capacity of 330 - 660 - 800 MW with efficiency of 44-46%, promising technologies for ultra-critical steam parameters (35 MPa, 700/720 ° C), providing efficiency of 51-53% and coal CHP with new generation with single capacity of 100 - 200 - 300 MW; Generation of electric power and heat using SGP with internal gasification of solid fuel with unit capacity of 200-400 MW with efficiency up to 50% and promising technologies using fuel cells, providing efficiency up to 60%; The technologies of environmentally friendly use of solid fuel and gas purification providing the minimum emissions of SO<sub>2</sub>, NO<sub>x</sub>, the coated particle fuel, etc. ingredients, including catching from a cycle, compression and the subsequent burial of CO<sub>2</sub>; Highly efficient modular heating steam-gas plants with single capacity of 100 and 170 MW for construction of new and reconstruction of operating combined heat and power plants and promising technological complexes based on them with the use of heat pump plants, providing a fuel heat utilization factor close to 95-98% taking into account the use of sources of low-potential heat; Turbine generators with a capacity of 60-1000 MW based on modern electrical insulation materials and technologies, which allow to increase the service life up to 50 years and provide inter-repair life up to 7 years" (Technology platform "Clean thermal energy of high efficiency", 2019).

As the results to which the participants of the technological platform are aimed, we will highlight, first of all, the implementation of priority directions of innovative and scientific and technical development in energy and mechanical engineering, defined in the Energy Strategy of the Russian Federation for the period up to 2030.

The activities of the participants of the technology platform are aimed at "creating new highly efficient environmentally friendly technologies for the production of electric and thermal energy; modernization of technologies and equipment for power and heat generation to the world level; the development of "breakthrough" technologies to create the energy of the future; development of unified equipment and model projects to reduce the time required to upgrade the electricity industry and save financial resources for its implementation; development of an effective management system for the creation and introduction of innovative technologies in the implementation of the technological platform on the basis of effective use of public-private partnership mechanisms, use of effective forms of financing, use of scientific and technical potential of domestic energy engineering; training of specialists on the profile of the technological platform with modern competences, organization of an effective system of advanced training of existing specialists" (Technology platform "Clean thermal energy of high efficiency", 2019).

### **3.3. Technology Platform "Promising Renewable Energy Technologies"**

The initiator and coordinator of the technological platform is PJSC "RusHydro".

The stated goal of the Platform is "to unite the efforts of the state, business, financial institutions and development institutions, scientific and project communities, educational institutions in creating conditions for the development of renewable energy, introduction of high-efficiency generation technologies based on renewable energy sources (RES), increasing the competitiveness of renewable energy services and products in the Russian and world markets" (Platform "Promising Renewable Energy Technologies", 2019).

Participants of the Platform include 139 Russian and foreign legal entities, whose activities are aimed at solving a number of tasks. One of the main ones is market monitoring and analysis, assessment of the technical level of renewable energy equipment and problems of renewable energy use both in Russia and at the world level. Another task facing TP participants is the development, adjustment and implementation of the Strategic Research Program, which correlates and guides the actions of developers of promising technologies, coordination of the actions of TP participants and other organizations cooperating with TP (educational, scientific, production, financial and investment), in accordance with the goals and time horizon of the Strategic Research Program.

TP activities are aimed at finding and bringing to the project stage promising projects related to the creation and implementation of the main equipment in the field of renewable

energy. Participants in the technology platform promote public and private investment in R & D under the Strategic Research Programme. Assisting in the development of norms and standards for the implementation of the development, design, construction and operation of generating facilities based on new renewable energy technologies is also a task for TP participants.

At the same time, the technological platform carries out its activities in the following technological areas: Hydropower (including large ones); Wind power; Energy of tides, waves and currents; Solar energy; Geothermal energy; Energy Storage Devices; Hydrogen Energy; Other RE technologies; Power supply systems based on the integrated use of renewable energy.

### **3.4. Technology Platform "Small Distributed Energy" (TP SDE)**

Distributed Energy, a non-profit partnership, is the platform 's coordinator.

As a key activity of the platform, it is necessary to mention the coordination of efforts of all participants of the process (representatives of science, education, production, state structures, financial institutions) for the development of distributed energy as an innovative sector of Russian energy. Small Distributed Energy (SDE) helps to promote the best domestic technologies and projects in the field of small distributed energy, helps to interact with financial structures and development institutions (Rosnano, Industrial Development Fund, Skolkovo, etc.). Among the priority areas of the platform, we will highlight "assistance to interested organizations in promoting complex projects in the field of distributed energy at the federal and regional levels, including within the framework of the Working Group of the Ministry of Energy on the Introduction of Intelligent Energy Systems and the Government Initiative "EnergyNet," As well as organization of interaction of TP member organizations with companies with state participation (PJSC "InterRAO," PJSC "Rushydro," PJSC "Rosseti", "Energy Systems of the East") on promotion of the most promising developments within the framework of innovative programs of state-owned companies " (Technology Platform "Small Distributed Energy", 2019).

According to Memorandum "On Creation and Operation of Technology Platform" Small Distributed Energy " (hereinafter - Memorandum), the participants of the technology platform join their efforts to move from the traditional development of energy as a strictly centralized system with the prevalence of large sources of generation to a variety of types and forms of energy development in accordance with the peculiarities of demand of specific consumers,



specific local development conditions and the requirements of the state policy to increase the energy efficiency of Russia.

Highlight the key areas of technological development supported within the technology platform:

1. Technologies of generation of electric and thermal energy, including: engines for power plants (microturbines, gas piston, new power plants based on external combustion engines, etc.); fluidized bed solid fuel combustion power plants; fuel cells, hydrogen power.

2. Technologies of efficient use of energy in local power systems, including: energy accumulators (chemical, inertial, gravitational, etc.); power control automation systems ("micro-grid"); new technologies for building local electric networks.

3. Resource-saving technologies in local networks of resource supply, including: heat pumps; energy saving and heat recovery in heating, ventilation and air conditioning systems, water supply and water disposal, other resource-supplying local networks; local gas supply systems, liquefied gas fuel storage systems (gasholders).

4. Technologies for the use of local energy resources, renewable energy and bioenergy, including: modern technologies for the use of peat as a fuel resource; gasification of local fuel resources, production waste and household waste using synthesis gas to generate energy; use of renewable energy in complex local power systems, including modular power plants combining generation of solar energy (photovoltaic, solar collectors, etc.), wind (wind power stations), small rivers with energy of fuel sources.

5. Related energy-saving building technologies, including low heat loss technologies (houses with "zero" heat consumption); complex construction, energy, engineering and architectural and planning solutions of settlements, cities.

The main goal of the TP in the Memorandum is "innovative and technological support of diversification of energy development taking into account the peculiarities of consumer demand in specific local conditions"(Technology Platform "Small Distributed Energy", 2019).

From the overall goal, a system of TP SDE goals is derived and formed. Thus, one of the systems of goals is the formation of a national scientific, technological and production and engineering base, the activities of which will allow to create effective systems of distributed energy based on advanced technologies.

The operation of the TP SDE is aimed at achieving technological leadership and competitiveness in selected directions and developing the activities of the platform participants in global markets.

The systemic goal of the platform is also to create domestic demand for innovative solutions in the field of local energy and small distributed energy.

In order to create favorable conditions for the development of small distributed energy in Russian conditions, the necessary systemic goal of the TP was the development of the regulatory and legal framework.

In order to achieve these goals, the Memorandum of the TP SDE defines the following tasks: "formation of a target vision for innovative technological development of small distributed energy of Russia; elaboration of proposals to improve the regulatory and legal framework of small distributed energy in Russia; development of long-term R&D plans and activities to promote innovation in small distributed energy; supporting pilot projects of small distributed energy in order to form market, institutional, scientific, technical and other conditions for the development of small distributed energy in Russia; formation of expert and consulting network and development of information and analytical service for platform participants; creating an Internet TP portal based on openness and accessibility of information" (Technology Platform "Small Distributed Energy", 2019).

#### **4. Conclusions**

Based on the analysis of the activities of technological platforms created for the development of distributed energy, we note a number of characteristics inherent in all the platforms considered.

First of all, the activities of the platforms are aimed at coordinating the efforts of business, science, education, state structures, financial institutions for the development of the innovative sector of Russian energy - distribution energy.

Technology platforms assist interested organizations, companies and groups of companies in cooperation with federal and regional authorities, development institutions to promote the most promising developments and projects in the field of distributed energy.

The activities of the platforms are aimed at identifying and bringing to the stage of credit financing or subsidizing highly effective investment projects, facilitating interaction with Russian and international financial institutions (Industrial Development Fund, Skolkovo, etc.), finding interested strategic investors, forming sustainable business structures, performing functions of integrator of complex projects.

As the results of technological platforms show, there is a structural shift in energy in favor of more diverse, flexible and "energy-efficient" solutions, including those aimed at more fully

meeting the needs of consumers and intensifying the search for modern technological and management solutions based on the development of small forms of energy (Khokhlov A. et al., 2018).

On the basis of technological platforms, issues of low availability of investment projects in energy for small and medium-sized private business, local self-government can be solved. Within the framework of the TP it is possible to eliminate the high investment threshold of the industry, as well as the complicated regulatory system that inhibits the development of both the energy industry and projects in other industries. As a result, in strategically important technological directions of energy the lag of the Russian scientific and technological base will be overcome, technological leadership and access to target foreign markets will be ensured.

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