International Journal of Education, Social Science & Humanities.
Finland Academic Research Science Publishers
ISSN: 2945-4492 (online) | (SJIF) = 7.502 Impact factor
Volume-11| Issue-9| 2023 Published: |22-09-2023|

# INNOVATIVE SOLUTIONS FOR ENERGY DEVELOPMENT IN UZBEKISTAN

https://doi.org/10.5281/zenodo.8365407

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**Annotation**

*In the electric power industry, an innovative path of development is an objective necessity. Without modern IT systems, it is increasingly difficult to solve the problems of industry development today, and in the future it will become completely impossible. The article discusses modern directions of innovative technologies that are being introduced in the world.*

**Keywords**

*energy, digital technologies, IoT, artificial intelligence, electrical grid, substation*

According to the Center for Strategic Research (CSR), the technological structure in the electric power industry has currently reached the limit of its effectiveness. In the next five years, in those areas where increased demands are placed on the availability, reliability and quality of energy supply, digitalization will become an absolute necessity.

At the same time, innovation in the energy sector is not only and not so much the possibility of using (with an increasing discount) renewable energy sources, but also a huge and highly relevant layer for solving problems of resource saving, energy efficiency, new technologies in traditional energy, spatial development, and the environmental situation. Innovations in traditional energy for the environment are currently no less, and perhaps more significant, than the development and implementation of "alternative" energy.

According to experts, switching to gas instead of coal and oil can reduce emissions into the atmosphere by half. The use of associated gas and the preparation of traditional fuels (fluidized bed technology) not only increases energy efficiency, but also sharply reduces pollution. The use of digital technologies in the energy sector can reduce energy losses several times and increase the overall efficiency of power grids.

The current large-scale crisis that has engulfed all sectors of the economy makes it necessary not only to find optimal ways out of the current situation, but also to identify promising areas of development that will allow us to overcome

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contradictions and problems. This fully applies to the fuel and energy complex, the immediate and long-term prospects of which are associated with innovative development. Many experts note the need to use the current situation to "retool" the energy sector, both technically and conceptually, including the introduction of renewable energy technologies and energy efficiency, because the future lies with them anyway.

Accordingly, the topic of innovation in the energy sector is extremely relevant today. It is so extensive and multifaceted that just the classification of problems can take dozens of publications. Among the many issues, the environmental and legal "emptiness" should be noted, including the imperfection of the system of environmental and energy legislation, the debatable nature of the concept of innovation as a legal category, the lack of mechanisms for adaptation to modern requirements, and a holistic vision of energy and environmental problems. As follows from the legal concept of "innovation", it is not simply and not only an innovation, a new achievement, an invention, know-how, etc. This is, first of all, new product quality and process efficiency aimed at meeting consumer demand for market-demanded goods and services.

Digital solutions in the electric power industry make it possible to both optimize the use of existing infrastructure and include in the generation and distribution process the latest energy storage systems, solutions with controlled consumption, as well as systems used to organize energy services in close proximity to consumers and based on the infrastructure of distribution networks 110 kw and below.

Let's consider the main trends in innovation in the energy sector, the impact of which is either already noticeable in the industry or will appear in the near future.

1. IoT improves the efficiency of power plants

According to PwC, when implementing the Internet of Things in the power industry network complex, the focus should be on improving the controllability of substations, power lines and other network elements through remote monitoring. Such projects will help reduce operating and repair costs, while simultaneously preventing technological and commercial losses. As for the electricity production sector, the use of IoT will reduce fuel consumption, the purchase of which currently accounts for more than half of the operating costs of stations. The total economic effect from the introduction of IoT in the electric power industry until 2025, according to experts, will reach 532 billion, of which 180 billion will be prevented energy losses. IoT – based solutions in the energy sector are increasingly being combined with artificial intelligence (AI) and machine learning functionality to

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process and analyze large data arrays generated during equipment operation. Technologies help to identify non-obvious patterns in the operation of objects, literally "hear" the enterprise and build a dialogue on a new level based on this information. In world practice, power plants are already appearing that can effectively monitor and manage basic work processes in a completely autonomous mode using data collection and analysis tools. For example, the capabilities of AI and machine learning are quite enough to cope with the monitoring and adjustment of gas turbines - these tasks are already automated in one way or another in thousands of enterprises around the world.

Examples of successful IoT projects in the global power industry include the project at Inter RAO Electric Power Plants . The company 's system for collecting, transmitting and calculating technological information (SSPRTI) helps reduce fuel burnouts and increases operational reliability. The payback period of the project is estimated at 5–7 years, taking into account the fact that the system allows saving 130 billion rubles on fuel. annually. Where it is not technically possible to install sensors, the problem is solved by equipping personnel with eSOMS systems (electronic Shift Operations Management System).

The Rosenergoatom Corporation has implemented such solutions at the Smolensk and Voronezh nuclear power plants, where with their help it was possible to optimize the tasks of inspecting facilities, compiling reports and reconciling historical data with the ability to create predictive models.

2. Robotics creates a safe environment

In the power industry, investments are growing to create a new level of safe working environment for power plant personnel, and one of the leading trends here is the commercial introduction of robots that are resistant to extreme working conditions and controlled remotely. Such solutions are also based on AI/ IoT technologies , and recently augmented reality (AR) functionality has been added to their capabilities, with the help of which the image from the cameras on the robot receives an interactive component. A popular application of robots is infrastructure monitoring using drones. In the West, robots are being developed and implemented to perform the functions of diagnosing and servicing high-voltage power lines. Such mechanisms are suspended from the line wires, and their actions are controlled from the ground using a controller by the operator. The robots are equipped with sensors and video cameras that allow them to identify problem areas on the wires. In areas with long winter periods, cleaning robots are used to remove snow and ice from power lines, and some models are capable of

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unscrewing and tightening bolts and nuts, and removing foreign objects from wires. Nuclear power plants are also being robotized: for example, robots are given the task of checking the primary circuits of reactors using ultrasound.

3. Power grids and substations are getting smarter

The problem of continuous operation of power grids remains unresolved throughout the world: even in countries that are relatively prosperous in this sense, 100% fault-tolerance of networks cannot be achieved. In the USA, this figure is 99.97%; just a few failures in a year can lead to losses of $100–150 billion. To solve this problem, technologies from the Smart Grid family are used. Essentially, it is a less centralized, more manageable automated infrastructure built on several concepts that are actively being developed today.

These include an advanced infrastructure for consumption metering (Advanced metering infrastructure, AMI) and various solutions for visualizing load distribution and available network resources in real time. The first concept involves instant calculation of the cost of the energy resource consumed by an enterprise or household, up to the output of the exact cost of daily consumption on a special panel or on consumer mobile devices. The second is to create and use an interactive network resource management panel that optimizes load distribution in real time to prevent blackouts. Smart Grid technology is being implemented by Rosseti as part of 10 pilot projects: this is the company's own solution, which is expected to reduce electricity losses by 225.3 million kWh and achieve a level of optimization of repairs worth 35.8 billion rubles. One of the first "digital" substations (SS) 110 kV was opened by IDGC of Siberia in Krasnoyarsk in 2018. The substation is based on the iSAS software ¬and hardware complex - an integrated substation protection and control system for providing relay protection, emergency automation and automated control systems. Thanks to digitalization, it was possible to reduce the amount of cable for various purposes by 10 times: from 150–160 km to approximately 15 km. In general, the substation was 5% cheaper than analogs of the previous generation, and in the future, taking into account the increased reliability of its operation due to a high degree of automation, new quality of monitoring and controllability, as well as due to the absence of operational personnel, over 30 years of operation the substation should provide an economic effect of about 75 million rub.

4. MRO automation is in full swing

Repair work and maintenance of facilities ( MRO ) is one of the basic components of business processes of the largest backbone companies in the energy segment. The FSA area (field service automation systems) today can be called one

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of the most dynamically developing in the electric power industry - IT solutions in this area allow you to quickly receive data on the status of a task after the team has visited the site, avoid duplication of tasks when fixing network defects, and strengthen control over the execution of work and remove typical shortcomings from the work processes of service engineers and repair teams.

Modern solutions in this area have broad scalability and integration with other industrial information systems: ERP, EAM and CMMS, support compatibility with mobile platforms ( Android , Windows 8.1/10), are NFC compatible and provide rapid data exchange via any wireless communication channels in real time.

5. Monitoring becomes centralized

In the segment of thermal power plants and hydroelectric power plants, there is a high demand and relevance for solutions for centralized monitoring of the technical condition of power units, compliance with industrial safety rules and monitoring of personnel work.

It is clear that control rooms at such facilities have always existed, but the real embodiment of the concept of centralized monitoring became possible relatively recently thanks to the development of data exchange protocols (FC, iSCSI , etc.), which together made it possible to reliably connect geographically remote monitoring systems with a central point. Virtualization technologies have also played an important role in the development of centralized monitoring, which makes it possible to reduce the load on local IT resources of the facility, and solve critical tasks of working with data in a remote data center .

A significant increase in the performance of monitoring systems has also been achieved by the development of software in this direction: software solutions for such systems today include modern knowledge management tools, MDM, AR and other components that allow you to effectively monitor, identify emerging incidents and respond to them.

Artificial intelligence, IoT and other digitalization technologies, combined with the computing power of modern IT platforms, have enormous potential to release hidden and wasted resources across a wide range of parts of the energy industry’s production cycle. At the production stage, the most modern IT solutions are already being used today (for example, “digital twins” of wells and fields); the evolution in the same direction in the field of electricity generation and distribution follows from the general logic of the process and complements it. I would like to hope that the above innovations will help the industry avoid new global shocks.

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