

Advantages Of Applying Digital Technologies For Energy Security Of Energy Enterprises In Uzbekistan

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Abstract: The article explores the main advantages of applying digital technologies to enhance energy security in Uzbekistan's energy enterprises. It outlines theoretical aspects of digitalization, including the use of IoT, big data, artificial intelligence, and blockchain. The paper presents examples of improved infrastructure reliability, energy efficiency, personnel safety, and management practices. It also addresses key challenges such as the shortage of qualified personnel, the need for infrastructure modernization, and cybersecurity threats. Strategic recommendations are proposed for phased digital integration in the national energy sector.

Keywords: Digitalization of energy sector, energy security, energy efficiency.

Introduction: Modern energy systems are undergoing an era of global change driven by the implementation of digital technologies. These transformations affect not only methods of energy production and distribution, but also issues of risk management, safety, and resilience of energy infrastructures. Uzbekistan, as a country with a developing energy infrastructure, faces a number of challenges in ensuring energy security that require the adoption of innovative solutions. In recent years, many countries have actively implemented digital technologies to enhance energy efficiency and the security of energy facilities, representing an important step toward the sustainable development of the energy sector.

The digitalization of energy enterprises is a key element in ensuring energy security, as it enables effective process control, improved monitoring and resource management, as well as reduction of risks associated with accidents and failures. The application of digital technologies contributes to strengthening energy security, improving the reliability of energy supply, and enhancing the environmental situation in the country. The purpose of this article is to analyze the benefits of applying digital technologies for the energy security of enterprises in Uzbekistan, as well as to identify potential challenges and future prospects in this area.

Digitalization of the energy industry: Theoretical aspects

Digitalization in the energy sector encompasses a wide range of technologies, including process automation, the Internet of Things (IoT), big data, cloud computing, artificial intelligence (AI), and blockchain technologies. All these tools significantly improve the efficiency of energy enterprises and help create a system capable of responding promptly to any security threats. A monitoring and control system based on digital technologies ensures not only improved efficiency but also better quality of services, reduction of losses, and more rational use of resources.

One of the key factors is the use of big data and analytics in energy system management. The collection and analysis of data through sensors and detectors provide a comprehensive view of the condition of equipment, consumption levels, and possible deviations, helping to identify potential threats in advance and prevent accidents. Furthermore, the integration of all data into a single platform improves coordination between different departments of energy companies and increases their ability to respond quickly to changes in operating conditions.

Advantages of using digital technologies for energy security

For Uzbekistan, the introduction of digital technologies in energy enterprises represents not only a challenge, but also an opportunity to ensure the sustainable development of the energy sector. The main advantages of such technologies for enhancing energy security include, the following.

1. Reliability Enhancement and Risk Minimization

Digital technologies significantly improve monitoring and control systems, which form the basis for enhancing the reliability of energy infrastructure. The implementation of predictive diagnostics based on big data analysis enables early detection of potential equipment failures and prevention of accidents. For example, through sensors and machine learning algorithms, it is possible to monitor the condition of transformers, turbines, pumping stations, and other critical system elements, thus preventing breakdowns and minimizing downtime.

In Uzbekistan, where the energy infrastructure is one of the key factors of economic development, such technologies can substantially reduce the probability of large-scale accidents that could disrupt energy supply in both major cities and remote regions.

2. Energy efficiency and cost reduction

Digitalization makes it possible to significantly increase energy efficiency, which is one of the most important aspects of energy security. With the help of digital technologies, processes of energy generation and distribution can be optimized, reducing losses and improving resource utilization rates. Automatic control systems enable the optimization of operating modes of power facilities, which reduces costs for fuel, electricity, and other resources.

For Uzbekistan, where energy efficiency remains a pressing issue, the adoption of digital technologies can become a decisive step toward the rational use of energy resources. Such solutions will not only lower the cost of energy production but also significantly reduce environmental impact, which is particularly important in the context of global climate change.

3. Improving workforce safety

Digitalization contributes to the safety of employees in energy enterprises. The introduction of automated monitoring and control systems minimizes human involvement in hazardous processes, thereby reducing the likelihood of errors and accidents. Digital technologies also enhance staff training by providing access to simulators and digital tools that replicate real working conditions. This allows employees to gain the skills necessary to act in emergency situations without putting their health or lives at risk.

In Uzbekistan, where many energy facilities are located

in remote and hard-to-access areas, these technologies represent an important step toward improving worker safety and overall labor conditions.

4. Improving the level of management and control

Digitalization enables the creation of more transparent and efficient management systems, which improves oversight of energy enterprises. Real-time monitoring systems support rapid decision-making in the face of security threats, while the use of blockchain technologies helps ensure data transparency and security. These technologies also strengthen cooperation between state and private structures responsible for energy supply, while building higher levels of trust among consumers and investors.

Challenges in applying digital technologies in Uzbekistan

Despite the clear benefits, the implementation of digital technologies in Uzbekistan's energy sector faces several challenges. One of the main barriers is the need for substantial investment in infrastructure modernization and staff training. Successful digitalization requires a highly skilled workforce capable of working with advanced technologies and effectively applying them in practice. This necessitates the development of specialized educational programs and professional training courses for energy sector employees.

Another critical issue is cybersecurity. With the growing number of digital solutions, the risk of cyberattacks increases, potentially leading to the collapse of information systems and severe consequences for the country's energy security. Therefore, it is essential to develop and implement robust data protection systems and maintain a high level of cybersecurity at all levels of energy infrastructure operations.

Suggestions and recommendations

The adoption of digital technologies to enhance the energy security of enterprises in Uzbekistan represents an important step toward the sustainable development of the energy sector. Digitalization improves supply reliability, reduces accident risks, strengthens management and control, while also increasing energy efficiency and workforce safety. The introduction of advanced technologies into Uzbekistan's energy industry creates new opportunities for optimizing enterprise performance and enhancing competitiveness.

However, for these solutions to be implemented successfully, several challenges must be addressed, including workforce shortages, infrastructure modernization needs, and ensuring cybersecurity. Ultimately, the successful deployment of digital

technologies will not only strengthen Uzbekistan's energy security but also contribute to building a sustainable, resilient, and efficient energy system.

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