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ENERGY EFFICIENCY IN THE INDUSTRIAL SECTOR: CONCEPTUAL FOUNDATIONS AND EMPIRICAL RESEARCH

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ABSTRACT

This article discusses the issues of industrial energy efficiency in modern conditions. Conceptualization of the concept and empirical analysis are carried out. The necessity of improving energy efficiency in the domestic industrial sector is substantiated, which requires a thorough theoretical analysis of the meaning and interrelation of the relevant concepts, as well as studying the current state and forecasting changes in the field of energy efficiency.

KEYWORDS

Efficiency, energy efficiency, industrial energy efficiency, analysis, forecast, sector, economy, technological progress.

Introduction

In today's world, where the competitive environment is becoming increasingly tense, the importance of energy efficiency and energy-saving technologies for various sectors of the economy and industry is growing. One of the key tasks today remains to improve the energy efficiency of industrial enterprises using economical, high-quality and relatively affordable technologies that allow efficient use of energy resources. In modern conditions, increasing the energy efficiency of industrial enterprises is an important factor contributing to productivity growth, the development of the national economy and the strengthening of companies' positions in the international arena. Optimization of energy consumption helps to reduce production costs for both individual organizations and their associations, which entails a reduction in production costs and an increase in production volumes without increasing the level of resource use. In addition, improving energy efficiency frees up financial resources previously spent on energy payments and reduces the dependence of enterprises on fluctuations in energy prices. Energy efficiency encompasses all aspects of economic activity, including manufacturing and non-manufacturing sectors, and is based on the rational use of various resources to achieve competitive advantages. This approach is considered as a key driver of economic growth, an alternative path based on increased consumption of energy and fuel resources, which is a less sustainable strategy. In this context, energy efficiency can be considered as an important element of energy assets. To increase energy efficiency in the country's industrial sector, a comprehensive theoretical analysis of the meanings and interrelationships of key concepts related to this area is required. It is important to investigate the current state of energy efficiency, as well as to assess future

changes and trends. Special attention should be paid to identifying the factors influencing the rational use of energy resources, as well as studying modern methods, technologies and tools that can contribute to improving energy efficiency in the current environment.

Methodology

The methodological basis of the research was the works of domestic and foreign experts devoted to the introduction of innovative approaches in the field of energy efficiency and increasing the competitiveness of enterprises. In the course of the analysis, legislative and regulatory acts were used, as well as materials from scientific and practical conferences covering these topics. The research was based on a systematic approach, and methods such as logical, comparative, and statistical analysis were used to achieve its goals.

Result and Discussion

Increasing energy efficiency in industry plays a key role for the development of the national economy, especially given the significant amount of energy consumption in this sector. This is due to several important factors. First of all, it ensures the reliability and sustainability of the country's energy supply. In addition, increasing energy efficiency contributes to improving the environmental situation. It also accelerates the transition to a development model focused on innovative and high-tech industries, which reduces dependence on raw materials industries and stimulates technological progress. In recent years, this approach has become one of the priorities of modernizing the Uzbek economy.

To improve energy efficiency in the domestic industrial sector, a deep theoretical analysis of the essence and interrelation of key concepts is required. This includes the identification of factors influencing the rational use of energy resources, as well as the study of methods, technologies and tools that can contribute to increasing energy efficiency in the modern conditions of the country.

Special attention is paid to the study of the relationship and differences between the terms “energy efficiency” and “energy conservation”. The analysis shows that the concept of energy efficiency is interpreted in different ways. Modern theoretical approaches in this field are mainly based on concepts that focus on the rational use of resources, the achievement of results and the principles of sustainable development. This approach makes it possible to assess the balance between economic indicators and the energy resources needed to achieve them, taking into account environmental and social factors.

A number of studies emphasize the importance of resource efficiency, defined as “minimizing energy consumption to achieve a given useful result” or “reducing energy consumption while maintaining the volume of services provided”. [9]

A number of researchers consider energy efficiency as an indicator of the performance of industrial enterprises in a socio-economic context, defining it as a “qualitative characteristic of the economy” or as a process aimed at optimizing “energy parameters of activities, taking into account environmental safety and expanding the capabilities of production systems”. [2]

In economics, efficiency is often determined through the ratio of results achieved and resources expended, which makes the resource-based approach one of the key ones in the study of energy efficiency.

At the same time, domestic and foreign scientists approach the issues of energy efficiency and energy conservation from different points of view. However, their importance for solving the main socio-economic problems remains indisputable. Research in this field covers both the macroeconomic level

and the level of individual enterprises and technological processes, paying attention to the interaction of various economic entities in solving relevant tasks.[3]

The adoption in 2020 of the Law of the Republic of Uzbekistan No. ZRU-628 “On Amendments and Additions to the Law of the Republic of Uzbekistan on the Rational Use of Energy” was an important step in creating an institutional framework for improving energy efficiency in the country. State standards in this area have been established, and regional strategies and specialized programs have been developed and implemented to address key energy conservation and efficiency issues in the use of energy resources. [1]

According to these documents, energy efficiency is defined as the ratio of the effect of using energy resources to their costs, whereas energy conservation implies the use of various measures to reduce their consumption for the purpose of rational use. Experts emphasize that government agencies and policy initiatives play a crucial role in regulating and improving energy efficiency.

Although national legislation enshrines the basic concepts of energy efficiency and energy conservation, further development of theoretical and methodological foundations in this area is necessary to create effective mechanisms for their implementation in the industrial sector.

It is advisable to use a system-synergetic approach to manage and regulate energy efficiency. It is important to consider increasing energy efficiency from different angles: as a factor stimulating economic development, and at the same time as a result of this process.

We propose to complement approaches to understanding energy efficiency by presenting it as a complex property of industries. This approach reflects the specifics of industries and their ability to function effectively in a competitive market, as measured by results per unit of output.

This perspective is conditioned by the need to take into account the specifics of the economy at the current stage of its development when studying energy efficiency and finding ways to improve it. Energy consumption and efficiency depend on a variety of factors that vary depending on the economic system. In addition, the level of energy efficiency in industry is closely related to the state of the fuel and energy complex (fuel and energy complex), its potential and the needs of energy consumers. This highlights the importance of the relationship between energy efficiency, fuel and energy complex and other key industries.

Empirical studies conducted in ten countries that are the largest consumers of energy demonstrate the existence of a relationship between economic growth and energy consumption. [4] Similar results have been obtained in additional studies covering data from multiple countries that confirm the link between economic development and energy consumption. [5]

In the context of the domestic economy, the macroeconomic perspective is represented by regional and sectoral systems, while at the micro level the focus is on the activities of individual business entities. In this regard, energy efficiency assessment is carried out taking into account regional and industry specifics, and also requires analysis at the level of specific enterprises and organizations.

The management of energy saving processes is distributed among all levels of the economic system, which implies the use of a variety of general and specialized indicators to assess energy efficiency at each of them.

One of the key indicators of energy efficiency is the energy intensity of GDP. Uzbekistan's economy is currently characterized by high energy dependence, which is associated with the peculiarities of industrial production and the use of outdated technologies in energy-intensive industries, including

equipment that has long needed modernization. Researchers, both domestic and foreign, unanimously note that increasing energy efficiency plays a significant role in stimulating economic growth.

In the countries of the European Union, energy efficiency is seen as a tool for achieving various goals, including meeting national and international economic and political objectives. These goals include reducing carbon dioxide emissions, ensuring reliable energy supply, and reducing costs. [9] Experts note that improving energy efficiency is one of the main ways to reduce fuel costs, and investments in energy-saving technologies quickly pay off due to reduced operating costs. [11]

The economic state and features of the chosen economic model of the country have a significant impact on the level of energy efficiency. Factors such as the structure of industries, high depreciation of fixed assets, low level of innovation activity of industrial enterprises, as well as the predominance of sectors with low technological equipment, negatively affect the energy efficiency of industry. As noted by I.A. Bashmakov, increasing energy efficiency and reducing energy consumption are important results of economic modernization.[6] L.Y. Bogachkova emphasizes that the growth of energy efficiency is becoming a key element of the global competitiveness of the national economy. [7]

A systematic approach to the study and improvement of industrial energy efficiency covers several areas:

-reduction of energy consumption and rational use of basic energy resources, which includes energy conservation measures;

-changing the structure of energy production and consumption by increasing the share of renewable energy, which has a positive impact on both the economy and the environment;

-increasing the efficiency of energy processes, resulting in a higher level of return on resources used.[8]

In our opinion, the development of effective solutions for each of these areas requires a transition to a new technological level, which is becoming accessible thanks to the achievements of the third and fourth industrial revolutions. This process involves a large-scale modernization of production processes and economic structure in accordance with the principles of neoindustrialization.

Foreign experts are actively studying the impact of new industrialization on economic development, which is explained both by the importance of a theoretical understanding of modern models of economic growth in the context of industrial innovation, and the high practical value of such research. [8]. Jeremy Rifkin highlights a key feature of the third industrial revolution — the integration of the latest communication technologies, such as the Internet, with modern energy systems, including the use of renewable energy sources.

Klaus Schwab emphasizes that the idea of “smart factories” is becoming more relevant in our time and will play a key role in the future. This phenomenon is the result of the fourth Industrial revolution, which is leading to the creation of a global environment where digital and real production systems interact effectively on the international stage.

One of the promising directions in this context is a significant reduction in energy consumption due to the transfer of part of the production processes from the physical environment to the digital one. However, increasing energy efficiency alone is not enough to ensure the competitiveness of the national industry. Achieving significant success requires the innovative development of both traditional and new industries, which will become the basis for a large-scale technological breakthrough.

The main idea is to move to a new technological paradigm that involves a profound transformation of the industrial sector of the economy, including its structure and principles of functioning.

Conclusion

The need to study improving the energy efficiency of domestic industry in the context of neoindustrialization is due to the fact that at the micro level it covers the efficiency of equipment and technologies used, as well as the organization of production processes at the enterprise level as an integrated system. At the national economic level, energy efficiency indicators are formed on the basis of aggregate data on energy efficiency by individual enterprises. The introduction of innovative technologies into the production processes of factories can significantly reduce energy consumption.

In the process of updating the management system, the focus is on creating innovative industrial clusters that ensure the dissemination of successful energy management practices among participants, using the experience of leading enterprises. This contributes to a more efficient use of energy through the integration of production processes and the introduction of advanced technologies.

Key areas include the introduction of innovative approaches such as a closed production cycle, the creation of environmentally oriented industrial parks and cooperation models based on the principles of resource conservation. The implementation of such initiatives has become possible due to significant progress in digital technologies, which is stimulated by the processes of neoindustrialization.

The analysis allows us to conclude that improving the energy efficiency of the industrial sector in the context of neo-industrialization is possible through an integrated approach to solving a number of interrelated tasks at various levels of its functioning. These tasks include:

-changing the industry structure with an emphasis on the development of industries characterized by high energy efficiency;

-modernization of industry through the introduction of advanced technological developments;

-creation and development of new industries focused on energy reduction technologies;

-active use of renewable energy sources; [8]

- implementation of the Industry 4.0 concept through the introduction of innovative solutions such as cyber-physical systems and smart enterprise technologies.

In our opinion, the improvement of energy efficiency both at the level of individual enterprises and throughout the country's industry is directly related to the active introduction of innovations and the creation of high-tech production processes. This approach requires the implementation of comprehensive measures affecting various sectors of the economy, as well as coordinated efforts by the government and the management of enterprises to achieve significant results in improving the energy efficiency of the industrial sector.

References

1. The Law of the Republic of Uzbekistan “On Amendments and additions to the Law of the Republic of Uzbekistan “On Rational Use of Energy” dated 07/14/2020, No. ZRU-628.

2.Страхова Н.А., Горлова Н.Ю. Концепция энергоресурсо-сберегающей деятельности в промышленности. URL: http://flatik.ru/koncepciyaenergoresurso sberegayushej-deyatelenosti-v-promishl

3.Журавлев В.М., Кулагина Т.А., Писарева Е.Н., Чернявская Е.Н., Клименков С.И. Взаимоотношения в области энергосбережения между научными, производственными, общественными организациями, властью и бизнесом // Сервис в России и за рубежом. 2011. №5. С.108-113.

4.Shahbaz M., Zakaria M., Shahzad S. J. H., Mahalik M.K. The energy consumption and economic growth nexus in top ten energy-consuming countries: Fresh evidence from using the quantile-on-quantile approach// Energy Economics. 2018. 71.P. 282–301.
5. Faisal, Tursoy, T., Resatoglu, N.G., 2016. Energy consumption, electricity, and GDP causality: the case of Russia, 1990–2011. Procedia Econ. Finance 39, P. 653–659. Zhang Y.-J. Interpreting the dynamic nexus between energy consumption and economic growth: empirical evidence from Russia// Energy Policy. 2011. 39. P. 2265–2272.
6. Башмаков И.А. Сколько, кто и где тратит на повышение энергоэффективности? Анализ зарубежного опыта и рекомендации для России //Академия энергетики. №1 [57] февраль 2014. URL: http://www.cenef. ru/file/Bashmakov%2007.pdf
7.Богачкова Л.Ю. Повышение энергетической эффективности как драйвер глобальной конкурентоспособности национальной экономики// Экономика и управление: теория и практика. 2018. Т. 4. № 1. С. 22-31.
8.Подгайнов, Денис Викторович Механизмы повышения энергоэффективности компаний в рамках реализации промышленной политики: диссертация ... кандидата экономических наук: 08.00.05 Ростов-на-Дону 2019. http://dlib.rsl.ru/rsl01010000000/rsl01010176000/rsl01010176355/rsl01010176355.pdf
9.Показатели энергоэффективности: основы статистики. OECD/IEA, International Energy Agency. 2014. С 18.
10.Справочный документ по наилучшим доступным технологиям обеспечения энергоэффективности. European Commission, 2009. 489 с.
11.Energy efficiency – the fast track to a sustainable energy future. ABB. 2015. URL: http://new.abb.com/docs/default-source/better-world/abb-energy-efficiencyaper.pdf.
12. Хамдамова Г.А. Классификация политики в области энергетики и энергоэффективности и ее реализация. Молия. Научный журнал. ТФИ. Ташкент. 2023. № 5.
13.Gavhar Khamdamova. INDUSTRY AND ITS ROLE IN THE SOCIO-ECONOMIC DEVELOPMENT OF SOCIETY. Scientific Journal of “International Finance & Accounting” Issue 2, April 2023. ISSN: 2181-1016.
14.Хамдамова Г.А. Новый этап развития национальной промышленности и её роль в современной экономике страны. Журнал. Молия. 2023. – №1. – С.86-94.