

ENERGY SAVING AS A KEY FACTOR FOR SUSTAINABLE DEVELOPMENT OF ENERGY-INTENSIVE ENTERPRISES

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Abstract

This article examines the issues of improving energy efficiency and energy conservation in various countries of the world, where research is aimed at evaluating the efficiency of using energy resources to support management decision-making and methods for evaluating energy efficiency vary depending on the tasks set, the depth of analysis of energy efficiency, as well as the sphere of economic activity or industry. This leads to the need for additional study of current approaches to energy saving analysis.

Keywords

factor, methodology, energy efficiency, energy, strategy, sustainable development, energy conservation, modernization, industry.

Introduction. Nowadays, the importance of addressing the challenges of sustainable development has become more acute, which is associated with an increase in the pace of change and an increase in the level of uncertainty both within economic systems and in the external environment. The use of performance indicators to measure progressive changes in the enterprise is an important tool that provides the ability to reliably measure and evaluate these changes.

Within the framework of the company's sustainable development strategy, it is possible to identify tools aimed at improving the efficiency of the use of production resources - such as tools and objects of labor, as well as labor resources. In modern conditions, the importance of energy saving as a key factor in the sustainable development of energy-intensive enterprises is increasing.

Formulation. In order to better understand the meaning of the terms «energy saving» and «energy efficiency», it is necessary to provide clear definitions and highlight the main differences between them.

Traditional definitions of these concepts were considered in the works of scientists such as Bushuev V. V., Belogoryev A.M., Borgolov E. A., Timatkov V. V.

In their opinion, energy efficiency is defined as a reasonable use of energy resources, which includes achieving economically profitable use of energy with existing technical and technological capabilities, taking into account the requirements for environmental protection. Energy saving, according to these definitions, is a set of measures aimed at improving energy efficiency, which leads to lower costs for achieving the desired result.

Any changes that lead to a reduction in energy consumption per unit of a company's output should be considered as part of an energy efficiency strategy, even if these changes are not related to energy technologies. [2]

Positive results from energy efficiency improvements include:

- reduction of the cost of manufactured products;
- reduction of utility costs for a company or individual;
- increase the profitability of production;
- reduction of emissions of harmful substances into the atmosphere;
- conservation of natural resources.

It should be noted that energy saving covers fewer aspects than energy efficiency improvement, since it usually involves changes that can be standard and regular in the production process, without contributing to the qualitative development of the company. Instead, increasing energy efficiency becomes a key strategic factor for the enterprise, as it contributes to stimulating innovative development.

The new amendments to the Law of the Republic of Uzbekistan «On Rational use of Energy», adopted on July 14, 2020 under the number ZRU-628, define the concept of «energy saving». This includes implementing a variety of measures, such as legal, organizational, economic, technological, technical and other measures, aimed at reducing the use of energy resources, while maintaining the appropriate level of beneficial effects from their use, including the work done, products produced or services provided. [3]

According to N. I. Suslov, energy efficiency is defined as the amount of income or output received from the use of one unit of energy in various forms. However, experience demonstrates that the definition of «energy saving» does not fully cover the essence of energy conservation actions, since energy savings can occur by reducing the useful effect, even if the volume of energy consumption is reduced. Energy efficiency is achieved when the specific energy consumption for the production of one unit of useful product, service or work decreases, or when the useful result increases with a decrease in energy consumption.

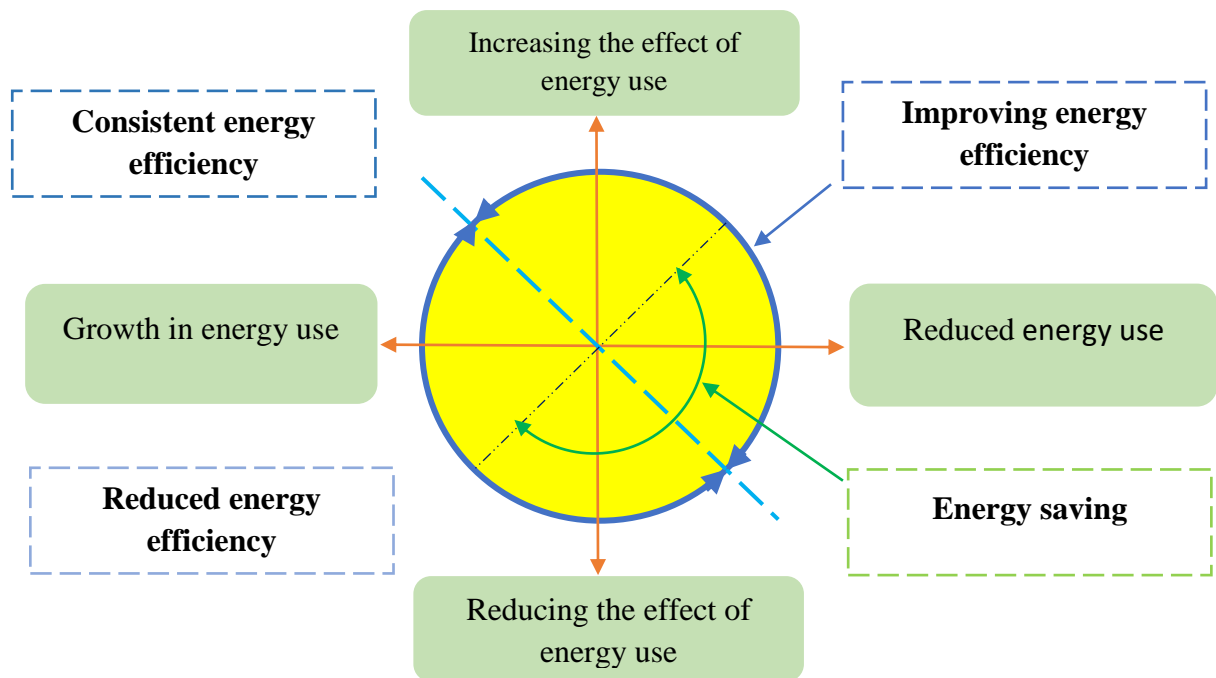


Figure. Defining the difference between energy efficiency improvements and energy savings.⁸⁰

Efficient use of energy plays a significant role in the development of industrial enterprises, as it is aimed at optimizing the consumption of energy resources. This leads to an increase in the positive impact on the environment and social significance.

Among the factors that contribute to energy saving, as well as its results that affect the prerequisites for saving energy resources, we can distinguish general economic ones, such as improving technologies and updating fixed assets, as well as organizational and methodological ones, including legislative acts, regulatory regulations, and specific measures aimed at reducing costs while maintaining the production process, i.e. energy saving measures. Effective actions should include reducing energy requirements and making the most efficient use of primary energy resources, as well as reducing energy costs.

It is important to note that energy conservation should be implemented as part of a system that consistently and consistently monitors all changes in energy consumption during the implementation of energy conservation measures. These figures are essential for objective monitoring and play an essential role in the strategic decision-making process. Of particular importance are aspects related to the correct selection of equipment and knowledge of the technical and economic

⁸⁰ Compiled by the author

characteristics of equipment, devices and mechanisms. When implementing energy conservation measures, these aspects are of key importance.[4]

According to L. D. Gitelman and B. E. Ratnikov, for the majority of energy enterprises, a decrease in specific costs for thermal energy leads to an increase in the overall financial efficiency of the enterprise and can indirectly contribute to the growth of production. For various industrial enterprises, including oil producers, the cost of production is one of the key indicators of the efficiency of production and economic activities. This indicator is closely related to the price of products, reflecting the efficiency of the use of material and labor resources, fixed assets, as well as the organization of production and labor. Thus, the introduction of energy conservation measures, as an important means of reducing production costs, is an integral part of the sustainable development of any industrial enterprise.[4]

Currently, there are developments in determining the level of energy efficiency in the industrial sector, which have been developed by experts from the International Energy Agency.

K. Tanaka's initiatives to assess the efficiency of energy consumption in industrial enterprises and in various industries involve the use of the following criteria:

- the efficiency of using thermal energy by the equipment, which is the ratio between the generated and used energy;
- energy intensity, measured as the ratio between energy consumption and the volume of products produced or a certain volume of a physical unit;
- the total amount of energy consumed and indicators of the use of energy-efficient equipment/technologies.

The combined arguments emphasize the importance of an energy efficiency assessment methodology that takes into account various factors and performance indicators in this area. The application of this methodology will not only allow assessing current energy efficiency, but also develop sound regulatory measures aimed at both direct and indirect aspects of energy efficiency factors. This approach will also make it possible to assess the effectiveness of their practical implementation in the long term.

Assessment of energy efficiency in the thermal power industry is based on a combination of system-hierarchical and process approaches in the methodology. Applying a system-hierarchical approach has several advantages. First of all, this approach makes it possible to identify a range of criteria associated with energy efficiency at various levels of the hierarchy - from technological processes and equipment to the level of enterprises in the field of thermal energy, their

associations, regional heat supply systems and the energy sector on the scale of the whole economy. Secondly, by taking into account the links with the environment, this method allows analyzing not only the overall energy efficiency indicators, but also various aspects that contribute to their changes over time, focusing on both internal and external factors that affect the level of efficiency.[5]

Analysis of energy efficiency in the thermal power sector is based on the integration of systematic and hierarchical approaches with process analysis. Applying a system-hierarchical strategy provides a number of advantages. First of all, this strategy allows defining and describing a set of key energy efficiency indicators at different levels - from individual technologies and equipment to the level of enterprises in the field of thermal energy, their associations, regional thermal energy systems, and to the energy industry as a whole at the macroeconomic level. Second, by taking into account the link to the environmental context, this approach provides the opportunity to assess not only aggregate performance indicators, but also analyze the impact of various factors on their change over time, including both internal and external aspects that affect the level of energy efficiency.

The use of the process approach is a response to the unique features of the heat power industry, which is characterized by simultaneous production and consumption of energy. This highlights the importance of efficiency analysis at every step-from production to distribution and end-use of energy, and also covers all processes of creating added value in enterprises of the heat and power sector.

When selecting indicators to measure energy efficiency, the results of both domestic and foreign studies in the field of energy efficiency assessment in industry were taken into account.

This includes recommendations from the International Energy Agency (IEA), as well as official indicators set out in the program and regulatory documents for monitoring and evaluating energy efficiency. This approach allows us to take into account the best practices of the world and confirms the complexity of our own energy efficiency assessment method, as it takes into account the impact of energy saving measures as a factor contributing to improving energy efficiency.

It is also worth noting that this research paper analyzes both economic and technical-economic parameters. This is due to the fact that modern technological solutions are closely related to the economic benefits of their implementation. For example, in the production of thermal energy, the cogeneration process plays an important role in improving energy efficiency, which must be taken into account when evaluating the efficiency of the production segment of energy enterprises.

Table 1 shows the main energy efficiency indicators that are of current use in the energy sector and are detailed for the business entity. The definition of these criteria is based on criteria of validity, consistency, and verifiability. In the process of compiling this list, the complex nature of the activities of enterprises in the field of thermal energy, covering both aspects of production and distribution in the value chain, is taken into account.[5] When changing the level of analysis of energy efficiency, it is necessary to make appropriate adjustments to the list of indicators used.

For a more detailed analysis of energy efficiency indicators and the transition to the level of units, processes and equipment in the field of thermal energy, where the result of the process is energy production, it is recommended to use the efficiency of the installation as an indicator of energy efficiency.

Indicators of specific energy consumption simultaneously reflect two aspects - both the production and consumer aspects of energy in enterprises engaged in thermal energy.

To assess energy efficiency, you can use both general and more specialized indicators that describe various aspects of energy efficiency. [5]

Using these specific indicators, can be created an energy efficiency index by summing up the weighted values of such indicators (1), or standardize them by industry averages for enterprises in the energy sector (2).

$$И_{эф} = \sum_{i=1}^n \bar{И}_i a_i \quad (1)$$

where - energy efficiency index of the energy system - - normalized value of the *i*-th indicator, - weight of the *i*-th indicator

$$\bar{И}_{ij} = \left(\frac{И_{ij}}{И_{icp}} \right) * 100\% \quad (2)$$

where - the normalized value; - the value of the *i*-th indicator for the *j*th enterprise; - the average value of the *i*-th indicator, the reference value in the observed sample of values of enterprises in the region. [5]

In order to develop an information base for management decision-making, it is necessary to simultaneously evaluate both the resulting energy efficiency indicators and the factors affecting the use of energy resources in order to determine their impact and significance. The analysis of such factors contributing to growth or limiting energy efficiency can be carried out at different levels, but it is most appropriate to study them in the context of the heat and power complex of the region. In addition, it is important to consider both internal and external factors.

Results and discussion.

Analysis of the proposed methodological approaches and tools for assessing energy efficiency at various levels of the economy allows us to draw a number of conclusions. Although the issue of energy efficiency assessment has attracted considerable attention both in practice and in research, no universally accepted method for measuring industrial energy use has yet been developed, nor is there a standardized set of criteria.

In addition, the assessment of energy efficiency significantly depends on the availability of information and the specifics of statistical data. In addition to the national aspect, the characteristics of industries and regions have an important impact on the assessment.

Additionally, it should be noted that some researchers focus on indicators and their components, while others analyze factors that affect energy efficiency, which makes it difficult to compare the results obtained.

Numerous studies are also devoted to identifying relative energy efficiency at the national or regional level. Special attention is paid to the importance of innovative and technological aspects in assessing the energy efficiency of industrial enterprises, which is confirmed by both theoretical and empirical data from various countries around the world.

Conclusion. In this way, the assessments represent an analysis of the effectiveness of various factors and resulting energy efficiency indicators, allowing to determine both the relative level of energy efficiency and the impact of factors that contribute to or hinder the efficient use of energy resources.

Even in companies with a high level of energy efficiency, there may be indicators that are on the verge of optimal for a particular decision-making system. Additional calculations for different time periods and analysis of changes in estimates allow to identify the reasons for decreasing or increasing energy efficiency indicators in specific systems. The results of the assessment show that a significant potential for energy efficiency of an enterprise can be realized through encouraging innovation, increasing the level of technological equipment and expanding the use of information technologies.

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