

PRINCIPLES AND METHODS OF IMPLEMENTING ENERGY EFFICIENCY OF INDUSTRIAL ENTERPRISES

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Annotation

This article discusses fundamental approaches to the rational management of energy use at production facilities, where the principles of economics, management standards and characteristics of real energy consumption are integrated. These approaches provide a framework for the actions of management structures and employees, taking into account the socio-economic context and the elements that determine energy consumption. Therefore, the development of such key principles becomes critically important and requires a responsible approach at the initial stage of the development of an energy management system at the enterprise.

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Introduction

Fundamental approaches to the rational management of energy use at production facilities integrate the principles of economics, management standards and characteristics of real energy consumption. These approaches provide a framework for the actions of management structures and employees, taking into account the socio-economic context and the elements that determine energy consumption. A deep understanding and versatility of these fundamental principles directly affect the success in achieving goals and the effectiveness of energy initiatives. Therefore, the development of such key principles becomes critically important and requires a responsible approach at the initial stage of the development of an energy management system at the enterprise.

Methodology

The research work was based on scientific publications by domestic and foreign authors concerning the classification of principles and methods of energy consumption management in industrial enterprises, as well as legislative and other regulatory documents. The data of scientific and practical events organized on this topic also played an important role in the formation of the methodological base. A systematic approach and methods of logical, comparative and statistical analysis were used to analyze and solve research problems.

Result and discussion

The main problem of current energy management methods is their dispersion, insufficient structuring and limited application, both in theoretical aspect and in practical application.

The first set of principles is related to organizational and economic factors.

1.1. The principle of regulation at the state level provides a two-way influence, primarily serving as an organizational foundation for the stable operation of the market system of energy resources.[1]

Classification of the principles of energy management in an industrial enterprise.¹

Principles	Under the principles
1.The Group of Organizational and Economic Principles:	1.1. The principle of state regulation in energy consumption management; 1.2. The principle of full consideration of energy needs, the state and dynamics of demand and energy market conditions; 1.3. The principle of optimal combination of centralization and decentralization; 1.4. The principle of purpose in energy management; 1.5. The principle of dominance of strategic aspects in energy consumption planning; 1.6. The principle of opportunity costs; 1.7. The principle of energy efficiency; 1.8. The principle of proportionality of energy consumption; 1.9. The principle of ranking management objects according to their priority in the formation of TEB; 1.10. The principle of preserving and developing competitive advantages; 1.11. The principle of comparability of management decision options.
2. Group of Financial Principles:	2.1. The principle of budget balance of targeted energy programs; 2.2. The principle of flexibility and elasticity of energy consumption planning.
3.The Group of Ecological and Technological Principles:	3.1. The principle of environmental safety of production and consumption of fuel and energy resources in the formation of a balance; 3.2. The principle of systematic application of energy-saving technologies; 3.3. The principle of interchangeability of energy resources.
4. A group of methodological principles:	4.1. The principle of a systematic approach to management; 4.2. The principle of scientific validity of energy consumption planning; 4.3. The principle of integrated energy consumption planning; 4.4. The principle of respect for economic interests; 4.5. The principle of eliminating negative processes.

To ensure regulation of market activity, government agencies establish rules and restrictions, monitor their updating and compliance. It is important to note the role of the government in integrating market principles into the social sphere, which is critically necessary for their successful application. Public administration plays a significant role in shaping and supporting the functioning of a market economy, going beyond the simple assignment of rules and including the management of various economic processes. The regulatory intervention of the state in economic relations is key, interacting with other aspects and forming the basis of the market system.

Determining the ideal balance between market freedom and government control is a difficult task for which there are no generally accepted methodologies or standards yet. In the context of a liberalized market, it is considered preferable for companies to have a certain degree of competition due to adequate regulation of the balance between supply and demand of energy resources in the fuel and

¹Compiled by the author on the basis of theoretical materials

electricity market. This model can be described as a regulated competition structure. A set of tools for state regulation of the economy is aimed at realizing such an ideal state.[1]

1.2. The use of an approach that includes comprehensive consideration of energy needs, assessment of the current state and changes in consumption, as well as consideration of the characteristics of the energy resources market, is key in the development of production and management strategies. These strategies are aimed at improving energy efficiency at the enterprise level, which is in harmony with the fundamental principles of marketing.[2]

1.3. In the context of the implementation of the energy program, the principle aimed at achieving an ideal balance between centralized and decentralized distribution of decision-making powers is actively applied. In order to achieve the highest efficiency, preference is given to maintaining centralized management of strategic planning and the definition of the main objectives of the program. At the same time, it is proposed to transfer the implementation and application of managerial functions to a decentralized level, which allows for flexibility and efficiency in management.

1.4. Energy consumption management at the enterprise level is closely linked to the goal setting process, which is key to developing a strategy and implementing an energy program. The lack of clearly defined goals and expected outcomes can lead to inefficiency or failure of the implementation of an energy saving program due to ambiguity in orientation and lack of adequate control - the main control element.

1.5. Energy consumption planning is based on an emphasis on strategic factors, which follows from an awareness of the importance of long-term effects of rational use of energy resources and their role in strengthening the company's position in the commodity market.

1.6. In the context of energy consumption and the development of various approaches to the use of energy resources and their balancing, the concept of opportunity costs is used. This concept plays a key role in conditions of limited energy resources, where the choice of methods of their application is determined by the need to achieve maximum economic benefits. According to this principle, making a decision in favor of using a certain energy source should ensure efficiency comparable or higher than that which could be achieved by choosing other alternatives. Opportunity costs mean the value of opportunities that have to be abandoned when a certain way of using limited energy resources is chosen, instead of using them for other purposes, for example, in the production of various goods and services.[1]

1.7. The principle of economical energy consumption implies achieving a certain level of energy efficiency with minimal costs — this is the principle of minimization, or the maximum level of energy saving at certain costs — this is the principle of maximization. Thus, the main idea of the principle of economical energy consumption is the efficient use of fuel and energy by all consumers.

Energy efficiency is estimated through the ratio of investments to benefits achieved. Investments are understood here as the monetary expression of the resources spent on energy consumption (expressed in natural terms or their equivalents), while the benefit is estimated through the monetary equivalent of the efficiency obtained from energy consumption.

1.8. The application of the principle of proportionality in energy consumption management is to determine the appropriate relationships between key indicators that reflect the efficiency of energy resources use. These relationships serve as a mechanism for monitoring compliance with established energy efficiency standards. Indicators representing these proportions become fundamental elements for evaluating energy efficiency. The development of such proportional relations is directly related to improving production efficiency at the enterprise, which includes reducing the cost of materials for products, increasing labor productivity, using energy saving methods and contributes to scientific and technical development.

Given the multilevel links with different sectors of the economy, it is impossible to accurately determine the balance of energy consumption using a single criterion. At the moment, certain patterns are observed that together give a clear idea of these proportions, including optimization of the structure of energy consumption, an increase in the share of recycled energy in total consumption, an increase in the level of electrification and automation of processes, as well as changes in the overall efficiency of the energy industry over time.

The development of balanced proportions for the fuel and energy balance (TEB) is a key task, since an imbalance can cause an inappropriate increase in energy and resource costs. These ratios are directly related to the current trends and pace of innovation in technological development, both in the industrial and energy sectors, which in turn shapes the energy needs of enterprises. When calculating the optimal proportions in the TEB, special attention is paid to energy pricing, which is a fundamental element in the economic system that affects the structure of the TEB and the efficiency of production processes. Thus, changes in prices and their ratios are of significant importance in the development of strategies for balancing and optimizing the use of energy resources.[3]

1.9. The application of the element prioritization method in the process of creating a fuel and energy balance (TEB) allows you to identify the most significant and critical management objects based on parameters such as productivity, compliance with current needs, the amount of influence and potential risks. Given the limited investment funds, it is important to focus on the most important aspects related to improving the efficiency of energy resources use in enterprises.

1.10. The strategy of maintaining and strengthening the competitive advantage of an enterprise is to analyze its advantages and disadvantages. This strategy allows the company to form an effective energy consumption management policy based on the anticipation of these competitive advantages and their active application in the processes of product production or service provision. This approach helps to increase the competitiveness of goods or services by optimizing energy costs.

1.11. The principle of choosing management decisions in the field of energy consumption is based on their mutual comparison in several key aspects, such as the duration of implementation, qualitative characteristics, the amount of impact, the degree of familiarity with the process, available sources of information, the specifics of use in certain conditions, the impact of inflation, as well as associated risks and the level of uncertainty.

2. Group of Financial Principles:

2.1. To achieve a balance within the framework of targeted energy saving programs, a methodology based on a balanced approach to planning energy initiatives is used. This includes the formation of various types of balances - material, labor, financial and others - that are necessary to ensure pre-established goals to reduce energy consumption in the enterprise.

2.2. The principle of adaptability and flexibility in energy consumption management implies the ability to adjust energy saving plans in response to changing internal and external business conditions. Adaptability allows you to effectively respond to unexpected changes during the implementation of energy-saving projects. At the same time, elasticity is reflected in the ability to maintain the availability of the necessary financial resources to adapt to current needs, even when choosing the best strategies, as well as taking into account alternative ways of developing the situation.

3. The Group of Ecological and Technological Principles:

3.1. The principle of compliance with environmental standards in the extraction, production and consumption of energy resources affects all links in this chain. He emphasizes the implementation of best environmental practices, which are becoming key for both producers and end users. The strengthening of environmental requirements and the application of new international standards in the field of environmental regulation emphasize its importance for improving energy efficiency. There is an

increasing emphasis on changes in public attitudes, the development of environmental awareness and the creation of a more restrained approach to the use of energy resources in the context of a market economy.

3.2. The use of the principle of continuous implementation of energy-efficient technologies implies giving preference to energy consumption methods that are most effective and at the same time minimize the impact on the environment. This contributes to the improvement of environmental safety within the processes of extraction, production and use of energy, as well as in the process of balancing energy resources. The focus is on improving the efficiency of resource and energy use at the enterprise level through cooperation in the production segment of the market.

3.3. The concept of the possibility of replacing some energy resources with others was implemented for the first time with the transition from the monopoly use of coal to the use of diverse and interchangeable energy sources. This range includes sources such as coal, natural gas, oil and its derivatives, hydropower and nuclear energy, and various types of converted energy, including electricity, steam and hot water, produced using both centralized and decentralized approaches. This concept provides an opportunity to achieve harmony between different types of primary energy resources, different methods of their transportation and a variety of forms of energy at the stage of creating an energy balance.[1]

An important aspect for improving the energy balance in the enterprise is the application of the concept of interchangeability of energy sources. This concept allows a variety of methods to be used to meet the energy needs of various production processes. However, there are certain restrictions on this process, including specific fuel requirements for specific technological installations, limited investment opportunities for upgrading to more efficient energy sources in the long term, and economically feasible energy consumption rates within the energy balance of the enterprise. These aspects set the framework for the implementation of the concept of interchangeability of energy sources.

4. A group of methodological principles:

4.1. The concept of an integrated approach in management involves the analysis of economic entities as multidimensional systems, including elements such as input and output parameters, connections with the external environment and feedback. This approach provides a comprehensive account of all important relationships and influences in the management system, facilitating an in-depth analysis of influencing factors in the formation of strategic goals and the development of management solutions to achieve the tasks set in the field of energy conservation. The principle of consistency integrates other principles into itself, forming a common integrated approach. It organizes knowledge, tools and methodological principles for research, which promotes the use of a scientifically proven method in regulating energy use.[4]

4.2. The basis for scientifically based energy consumption planning is the application of the latest developments in the field of information technology, advanced methods and innovative solutions in the control of energy consumption processes, as well as the use of effective strategies to optimize plans.

4.3. An integrated approach to energy use planning is implemented through a multi-level structure of the projects being created and ways to ensure their coordination.[5]

In the context of energy consumption management, two main strategies are distinguished: the strategy of balancing economic benefits and the strategy of minimizing negative effects.

The strategy of balancing economic benefits is to create economic relations between different levels of government and between actors in the energy and technology market, which ensures mutually beneficial cooperation between regional structures, enterprises and other market participants. This strategy is aimed at achieving harmony of interests of all parties in order to optimize the processes of production and consumption of energy resources.

A striking example of the disagreement between economic interests in the field of energy efficiency and energy conservation, ignored by state regulatory authorities and not reflected in the policies of wholesale and retail electricity markets, is the situation in which any change in the volume of electricity consumption by agreement immediately entails financial losses for the supplier obligated under the contract to ensure supply, and as a result, imposes fines on the consumer.

When one consumer consumes less energy than expected, his savings are offset by the increased consumption of other users, thus ensuring balance in the overall level of electricity consumption. As a result, the energy supplier responsible for the supply benefits by applying penalties to consumers for underconsumption and for exceeding the stipulated limits, thus contributing to balancing electricity consumption within its service region.

The principle of eliminating undesirable trends in energy consumption management is critically important for identifying and monitoring those aspects where performance growth is disproportionately high in relation to creating an effective balance between fuel and energy. This approach prescribes the definition and impact on key elements through the introduction of optimization in the processes of energy use in order to normalize the growth of these indicators at the enterprise level. A distinctive feature of these principles is their specificity, due to the unique technical and organizational and technological features in the energy sector, which makes their application in the energy market special in comparison with other market sectors.

Conclusion

Thus, the proposed systematization of the principles of energy consumption management at industrial enterprises reflects the specific characteristics of energy consumption as a complex economic system. The effective functioning of such a system is possible through finding the ideal balance between energy needs and its supply over a certain period. We are convinced that each of these principles has equal importance for the energy management process and should be implemented and analyzed synchronously.

The analytical review demonstrates that the principles of energy management are interrelated and mutually complementary. The integration and interaction of various principles in the process of energy consumption management at the enterprise are determined by their general requirements for the structure and management mechanisms. Failure to apply any of them can lead to inconsistency and inefficiency of management decisions.

These principles underlie the effective management of energy consumption in the enterprise, defining strategies and directions for the implementation of energy programs. The first nine of them are especially important for the successful operation of the management system, and their failure to comply can seriously complicate or even make it impossible to implement the overall energy strategy of the enterprise. Thus, these principles are the cornerstone of the energy management system and determine its effectiveness.

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