Introduction of a Modern Management Model of Energy-saving Technologies at Enterprises

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Abstract: The article examines global trends in the energy sector in the information society. 4 stages of the formation of the concept of energy saving as a global trend in the historical concept are highlighted. The architectonics of the formation of models of energy development of the 4th investment cycle is defined as the interrelation of two models of the development of energy-efficient technologies "Energy Efficiency +" and "New Paradigm". The directions of implementation of these models as ensuring sustainable socio-economic development at all hierarchical levels of the economy are determined: consumers, enterprises, countries, the whole world. The drivers of the development of the "Energy Efficiency +" technology are: the dominance of centralized energy; the development of trigeneration; the development of dispersed generation; economically sound innovations; the development of smart energy models in individual clusters (Smart Grid). The definition of the energy efficiency criterion is proposed based on the Best-in-Class methodology and an attributive approach in order to realize the potential.

1 INTRODUCTION

The introduction of new engineering and design solutions in energy supply systems, which provide for the integrated use of renewable energy sources, will solve an important economic and scientific and technical problem of reducing the consumption of traditional fuel and energy resources for domestic enterprises. This corresponds to the Energy Strategy of Russia for the period up to 2035 (Order ..., 2020) and other legislative documents. However, a complex of issues related to the definition of the domestic specifics of the introduction of a modern model of energy-saving technologies among economic agents requires in-depth analysis and methodological clarification. It is becoming increasingly difficult for energy companies to determine which set of communication tools is effective for creating long-term relationships in the market and achieving optimal influence on the consumer.

It should be noted that recently there has been an increasing interest among scientists and practitioners in the existing problems of the development of the energy sector, as evidenced by the appearance of numerous publications. In modern conditions, the problem of rational use of energy resources is becoming increasingly important at all hierarchical levels: consumers; enterprises; countries; the whole world.

The need to introduce the concept of energy conservation as a factor of social development is considered in the literature from different angles: saving natural resources (Mady, 2020), environmental pollution (Di Somma, 2015), competitiveness of individual companies (Griffiths, 2015), industries and states (Lieder, 2018), the welfare of society (MacElroy, 2016), Energy security (Zolotukhin, 2017). Despite numerous studies and the practical significance of the results obtained, it should be noted that such issues remain insufficiently studied: global trends of the fourth investment cycle

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in the energy sector; formation of energy development models; conditions for building an energy-efficient society as conditions for sustainable development of the national economy, etc.

The purpose of the article is to study the introduction of a modern management model of energy-saving technologies at enterprises in an information society.

The methodological and theoretical basis of this work is the methods of analogy, expert evaluation, comparison, research of domestic and foreign authors in the field of modern management model of energy-saving technologies at enterprises.

2 MANUSCRIPT PREPARATION

The balanced development of the economy, the environment and society is at the heart of the problem field of sustainable development. "Solving this problem requires thoughtful actions that must be carried out taking into account the interrelationship of environmental, economic and social aspects" (Bekmurzaev, 2021). If we consider the stages of the formation of the concept of energy saving as a global trend in the historical concept, we can distinguish four stages.

Stage 1. The invention of accounting devices for monitoring the volume of consumption of resources, in particular energy. In developed countries, this falls in the second half of the XIX century. The introduction of scientific and technological achievements in the activities of industrial enterprises (in particular, steam-based technologies), as the latest round of the industrial revolution, led to the need to reduce production costs in order to maximize profits.

Stage 2. The first half of the XX century. The creation of industrial giants, the active development of transport and telecommunications networks has led to a significant increase in the energy intensity of products. The era of energy and industry of this historical period can be divided into 2 stages: Fordism and post-Fordism. Henry Ford is mainly credited with the development of a modern mass production system, as a result of the creation of a conveyor. Mass production has significantly increased the energy consumption of industrial enterprises.

Stage 3. The second half of the XX century. The first global crisis in the energy sector in the 70s of the XX century led to the "oil war", which has been constantly happening for more than 30 years. The United States began to create an alliance of oil-importing countries like the "Anti-OPEC". In December 1974, a conference was held in Washington, at which the "International Energy Agency" (IEA) was created. Formally, the IEA was formed in order to determine joint actions by participants in the event of a new energy crisis, as well as to coordinate plans for better long-term provision of energy sources (Tetreault, 1981).

The economy needed new cheap types of energy – the emergence of nuclear power allowed to significantly reduce energy costs, but raised the issue of energy security to a new level. This issue is particularly acute after the tragedy at the Chernobyl Nuclear Power Plant in 1986. This was the second shock in the sphere of the use of the atom, when the problem of the survival of humanity as a whole arises.

The emergence of the last, 4th stage, was additionally influenced by many other factors, but, first of all, these are factors of global economic transformations: the emergence of the Internet, the achievements of industry 4.0, increased labor migration, the expansion of the activities of multinational companies, etc. In the global energy sector, a new 4th investment cycle is being launched these days, in which, according to the International Energy Agency, such global trends will operate (Fig. 1).

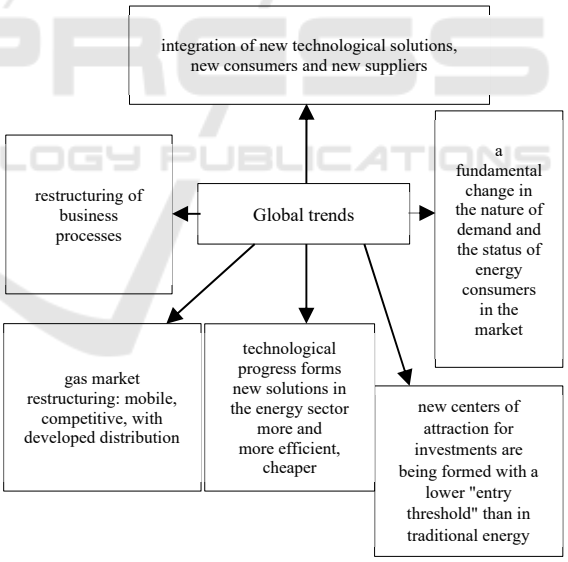

Figure 1: Global trends of the 4th investment cycle in the energy sector (Safe...).

Today, a new energy civilization is being formed in the leading countries, the main features of which are: energy efficiency; intelligent energy systems built according to the Smart Grid concept; decentralization of energy; new energy sources, etc. The development of energy of the 4th investment cycle is implemented within the framework of such models (Fig. 2).

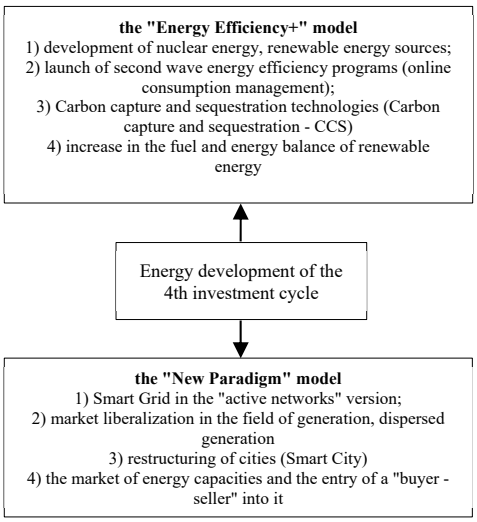

Figure 2: Architectonics of the formation of energy development models of the 4th investment cycle (Azzuni, 2018).

The components of the activation of the "Energy Efficiency+" development model in the medium term are: the dominance of centralized energy; the development of trigeneration; the development of dispersed generation; economically sound innovations; the development of smart energy models in individual clusters (Smart Grid). There is no doubt that the sustainable socio-economic development of any country largely depends on the growth of energy efficiency of the national economy.

Based on the conducted content analysis regarding the definition of existing approaches to the definition of the terms "energy saving" and "energy efficiency", within the framework of this study, the following definition of the term "energy saving is a set of actions aimed at obtaining progressive results regarding the rational and efficient use of energy resources in order to save energy, reduce energy costs and losses associated with the reduction of the negative impact on the environment, the achievement of a beneficial socio-economic effect" is proposed.

"Progressive results" means focusing on the samples (countries, companies) with the highest energy efficiency. This is possible by comparing these indicators with estimates of the best and advanced technologies (Best-in-Class) in the study area based on determining the distance between the studied result and the efficiency limit. Thus, it is possible to determine energy efficiency categories based on the Best-in-Class methodology in order to realize the potential (Fig. 3).

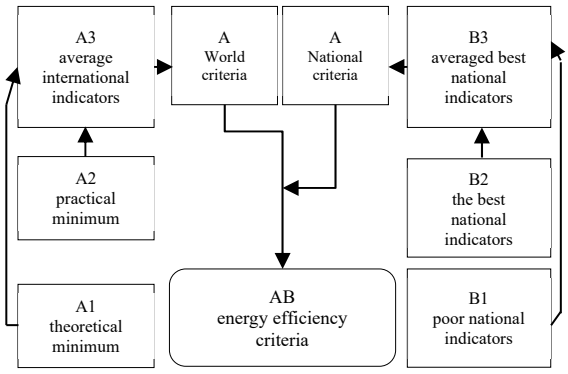

Figure 3: Determination of the energy efficiency criterion based on the Best-in-Class methodology in order to realize the potential.

AB as a set of energy efficiency criteria is the general set of world criteria (A) and national criteria (B): AB = AΔB. At the same time, it should be noted that in order to ensure the competitiveness of national enterprises in world markets based on the energy saving factor, national criteria should approach the world ones: the covariant functor displays the function f: B→A.

Each block of the subset A and B is a Boolean of local exponents: 2^A, respectively = {A1, A2}; 2^B = {B1, B2}. A subset of the second type under the assumption of induction 2^A or 2^B, a subset of the first type defines a subset of this type obtained from some single subset of the second type by adding the element a0, hence: 2A = A1 ∪ A2 and A1 ∩ A2 = ⊕. Each of the minimums are the minimum criteria for energy efficiency. So, if we define the criteria of technological equipment as a technological basis for ensuring the energy efficiency of an enterprise, we can thus characterize this minimum. A1 "Theoretical minimum" is the specific energy consumption required to perform certain work or transform materials in accordance with the laws of electro– and thermodynamics; A2 "Practical minimum" is the best in world practice indicators of specific energy consumption when using commercially technologies with a certain efficiency. Decomposition analysis can be used to study the influence of factors affecting the energy intensity of GDP (Table 1). This method is recommended to be applied by the International Energy Agency in the practical activities of enterprises (Energy..., 2016).

The considered decomposition analysis is used for a more detailed analysis of energy efficiency and requires additional input data. In order to overcome this disadvantage of the considered methodology, it is necessary to determine the aggregated energy efficiency, consisting of individual indicators: energy

intensity, electrical capacity and fuel capacity of GDP.

The indicator of the energy intensity of GDP reflects the trends in the development of the economy at the macro level from the standpoint of energy consumption with the definition of the appropriate type of economic activity: intensive (energy-saving) or extensive (energy-consuming). Energy-efficient societies can successfully solve the problem of efficient provision of energy resources for the purpose of socio-economic development of the country. At the same time, appropriate measures are used in the state regulatory policy in order to increase the influence of energy factors of stimulants on the vector of social development based on the optimization of energy costs.

Table 1: A logical-structural model of the influence of factors leading to changes in the volume of final energy consumption.

Factors	Economic sector		
	Industry	Household	Transport
Activity	added value of the total output of goods	population size	passenger traffic or cargo volume
Structure	the share of output of various types of products	number of square meters per person	passenger traffic or cargo volume for transport
Performance	the amount of energy used per unit of activity in each of the sectors of final energy consumption		

In the XXI century, it is possible to solve the problem of increasing the efficient use of energy resources only by introducing the latest energy-efficient technologies and equipment that meet the appropriate stage of scientific and technological progress. Unfortunately, in our country, only some sectors of the economy are gradually switching to the principles of Industry 4.0. At the same time, developed countries began to discuss the specifics of the entry of national economies already to Industry 5.0. Today, business efforts should be focused on innovative development, especially in the field of overcoming technical and technological backwardness.

Energy efficiency is characterized by constant changes that entail an increase in its level due to economic, environmental and social components, ensuring harmonious development at the micro, meso and macro levels of any system. Increasing energy efficiency ensures the achievement of energy independence of the state and business entities, which is defined as the use of fuel and energy resources simultaneously with energy-saving production technologies in order to meet the energy needs of various entities in different spheres of functioning without outside interference. At the same time, it is advisable to cooperate at all levels: national, private, public. Effective development of the domestic economy requires public awareness that energy efficiency is not just a condition for sustainable development, but an indicator of the self-sufficiency of the state, a marker of its readiness to be at the forefront of innovative development, to attract modern innovative technologies that will ensure economic and energy independence.

4 CONCLUSIONS

Of all technically possible measures to ensure energy efficiency, only some are economically feasible and economically attractive for a certain period of time. In order to determine the best way to achieve savings as a result of investments in energy efficiency projects, it is important to separate economically sound and financially attractive projects. The difference between economically sound investments and economically attractive investments can be explained by different discount rates between public and private investments, the indirect impact of energy savings and the impact of external factors.

When analyzing the transformation of scientific approaches to determining the content of energy saving and energy efficiency in enterprises, certain features of development are highlighted. It is necessary to consider in more detail the issue of the development of the energy platform as a basis for enterprise management based on the concept of energy conservation. At the same time, it is necessary to take into account the trends of the current stage of development of an energy-efficient society, especially the concept of Smart Grid.

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