Innovative Energy-Saving Technology Management Model in the Company Sustainable Development System

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Abstract. The development of innovative activity conditions an increase in the level of awareness of the enterprise employees about organizational goals, strategic and tactical development plans, industry trends, and the problem of engineering and management nature. The study’s purpose consists of substantiating the theoretical-methodological principles and developing practical recommendations for creating a company energy-saving innovation activity management model. The methodological platform of the study is the set theory for building a model for determining the effectiveness of the management system of innovation activities of the enterprise. As a result, a model for monitoring parameters characterizing the effectiveness of enterprise innovation activity management system is proposed. In conclusion, the developed analytical-process model allows managers to quickly assess the current state of the enterprise innovation activity management system and reasonably make regulatory decisions concerning its improvement.

1. Introduction
The evolution of innovations determines the level of awareness of the company employees about organizational goals, strategic and tactical development plans, industry trends, and issues of engineering and management nature.

Thus, there appears a need to develop theoretical principles and practical recommendations for forming the concept of management of energy-saving technologies because of compliance with the conceptual principles of sustainable development, namely focusing on carbon-free energy technologies. All this requires a radical restructuring of the methodological platform for managing energy-saving technologies, a set of functions in management (planning, organization, marketing, motivation, control, accounting, audit, etc.) at all hierarchical levels of the Ukrainian economy, especially for industrial enterprises.

A scientifically sound strategy for innovative development of energy-saving should be the conceptual basis for ensuring the stability of industrial enterprises in a dynamic economic environment. The need for constant updating of technology forces to introduce scientific and design solutions in the system of enterprise activities focusing them on acceleration of innovative processes and implementation of innovative energy saving projects.

Activing strategic, innovative development of energy saving in the economic system is a necessary process that requires interrelated and coordinated work of all its subdivisions at each stage of an innovative energy-saving project.
In order to intensify innovative solutions in the energy saving sector as a component of resource saving, enterprises need to carry out transformation processes of all components of the management system. Thus, it is necessary to implement an effective system of incentives and motivation of staff for the introduction of energy saving technologies: material, social and mental measures [1]. They include improvement of information and analytical support for management decisions on energy saving projects, namely, the development of rational document management, the use of modern software products for business processes, the formation of structural units in accordance with the needs of the organizational structure, etc. [2]. The introduction of a system for planning of all business processes at enterprises and the application of the latest forecasting methods will allow the company to carry out constant monitoring and control of energy saving measures [4]. Review of structural changes in the ratio of own and borrowed capital, science-based choice of credit line and other instruments of financial internal control will ensure the implementation of the strategy of implementation of innovative energy saving technologies at enterprises.

The need for new technologies of processing and use of energy is because, during the combustion of traditional hydrocarbons energy losses are up to 80–90 %. This conditioned the development of new technologies for their conversion, reducing losses and being more environmentally friendly. These are electrochemical conversion technologies artificial liquid fuel production by thermal decomposition of coal and oil shale, and gasification of solid fuel. The main obstacle is that these technologies are in the process of development and improvement and are not suitable for industrial use.

Energy saving is the essential factor in improving energy efficiency, economic efficiency, and economic security of business [5].

Issues of energy savings due to rising energy prices, shortages, the need to import energy resources, their mindless consumption remain in the spotlight at the present stage of development of society [6-7]. The negative factor is the high energy intensity of the Ukrainian economic system. This is especially true of economic sectors such as metallurgy, chemical industry, coal mining, etc. The energy consumption of industrial companies does not meet the conditions of an energy-efficient society.

High spendings on fuel and energy resources limit the competitiveness of national production, in particular in conditions of external energy dependence [8]. A significant share of energy consumption does not allow companies to obtain the necessary profit values, which slows down development. As a result, the high share of fuel and energy spendings companies’ production costs does not lead to increasing the competitiveness of national products [9].

The theoretical and methodological, and practical significance and insufficient development of problematic issues are to ensure the effectiveness of management decisions on introducing energy-saving technologies in industrial enterprises in the absence of a generally accepted scientifically grounded paradigm basis for management of resource conservation of industrial enterprises.

2. Method
For achieving the above goal, set theory is used in building a model for determining the effectiveness of the enterprise innovation activity management system.

The algorithm for monitoring the management system of innovative activities of the enterprise in the field of energy-saving has the main stages: the purpose of monitoring and identification of parameters (X); accumulation of information about the object of monitoring (financial and economic characteristics, the success of the system operation, staffing, information, and analytical support); processing of information regarding the object of monitoring; structuring information for development and making management decisions. These parameters are determined based on expert analysis with the involvement of experts from among top managers (direct assessment based on competencies).

Considering that the analytical information is a set of systematized features of the objects of classification of data on the object of monitoring, the elimination of uncertainty requires identifying the degree of confidence in the data. It is based on the identification of the degree of confidence that data is structured. It is impossible to define all the features of any information, so when identifying the
degree of confidence in the object, it is most realistic to use only its limiting (most significant) features \((X_1^*, X_2^*, X_3^*, X_4^*)\).

The use of knowledge creation algorithms involves the classification of monitoring objects, in this case, the parameters characterizing the effectiveness of the enterprise innovation activity management system. The performance of this task is based on building classification functions. The study was conducted at industrial enterprises of Ukraine during 2018–2020.

3. Results and discussion

Fuel and energy resources of own production are not enough to meet the needs of industry and households in Ukraine, which requires the import of energy at a reasonably high price. Assessing the prospects for the development of energy industry in Ukraine, it should be noted that it is advisable to introduce renewable energy sources as an alternative to outdated resource-intensive technologies for sustainable development.

Due to the depletion of non-renewable energy sources, their high cost and low efficiency in use, and harmful effects on the environment, alternative and renewable energy sources are increasingly used globally. Recently, a tendency of the growing share of energy supply from renewable sources in Ukraine has been observed.

This hierarchical model classification of factors characterizing industrial enterprises’ innovation activity management system in the energy-saving system is presented in Figure 1.

![Figure 1. Hierarchical classification of factors characterizing the innovation activity management system of industrial enterprises in the energy saving system (projected by authors).](image-url)

Given the factor dependence between several coefficients and the fact that the monitoring of these systems based on factor analysis, which characterizes the effectiveness of corporate innovation management systems, requires building a hierarchical structure based on structural similarity of efficiency parameters of the systems under study the interdependencies between all factor and performance indicators are determined.

Thus, the indicators of level 1 include the factors \(X_i\): feasibility of expenses for innovation activities; efficiency of work; implementation of the goals of the management system; effectiveness of decisions; employment of personnel in the management apparatus; the work efficiency of the management staff of the system; education and qualification level of employees; usefulness of the information used; the success of proposed and implemented innovative ideas; the effectiveness of research and production cooperation in the management system of innovation activities.
Due to the significant impact of price and other aspects of fuel and energy consumption on the company activities, more attention is paid to the energy efficiency system: introduction of energy-saving programs, an incentive mechanism for energy saving, energy audit, etc.

The priority goal of developing of energy-saving programs at enterprises is to reduce energy consumption and increase the share of additional renewable energy sources. Implementation of energy-saving programs involves increasing energy efficiency, reducing its share in the cost structure, promoting energy savings, and comprehensive analyzing of approaches to optimizing business costs.

The first step in solving any problem is to understand the problem. First of all, most companies’ primary motive for organizational change is the economic motive — a significant increase in energy prices is the impetus for using energy-saving measures for top management.

The introduction of energy-saving technologies aims to improve energy efficiency. That is, a high economic effect is achieved by reducing the specific energy consumption [10]. In general, this can increase the total cost of energy resources, as they have become cheaper per unit of output, so the released money can be used to purchase more energy resources or invested in other business areas [11-12]. The issue of efficiency management is an integral part of the management of an enterprise which activities are aimed at making a profit.

4. Conclusion
There arises a problem of identifying specific criteria based on which one can assess the level of effectiveness of management systems, determine specific criteria for effectiveness. For example, the goal of management is the object of management achieving the desired state, so the content of the management effect is to achieve management goals. Thus, the criterion of management efficiency can be formulated as the level of achievement of management goals, the degree of achievement of the desired state by the object of management.

Prospects for further studies in this field include building an algorithm for the development and implementation of management decisions to improve the management system of innovative activities of the enterprise in the area of energy-saving, namely: decision preparation, decision making, implementation of the decision.

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