
Innovational Management of Industrial Enterprises in the Energy Sector

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Abstract:

Issues of energy conservation and energy efficiency are always on the agenda in the context of both economic growth and recession, and today becomes one of the priority guidelines in the development of industrial enterprises in Russia. The implementation of contemporary management technologies and measures related to power supply allows reducing significantly energy costs, thereby increasing the real profit of the company.

The article deals with the development of mechanisms for the implementation of an energy management system in industrial enterprises. The authors substantiate urgency of an energy management system formation at the enterprise that creates the framework for the integration of energy efficiency issues into the overall concept of enterprise management. Moreover, the authors suggest several recommendations for the practical implementation of energy management.

The article also analyzes successful examples of implementation of contemporary energy management technologies such as benchmarking, outsourcing, monitoring, crowdsourcing, and coaching.

Keywords: *Industrial enterprise, energy conservation, energy efficiency, energy management, standards, energy recourses, energy benchmarking, energy outsourcing, energy monitoring, energy coaching.*

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1. Introduction

The energy consumption process at industrial enterprises can be represented as an independent business process with certain input resources (energy components) and end output product (energy component in the production cost). Russian industrial enterprises, as a rule, pay special attention to the needs of energy carriers production, while do not attach much importance to the efficiency of their use. The recognition of the fact that energy is a resource that requires the same management as any other resource is the basis for improving energy efficiency and reducing energy consumption (Sysoeva, 2012). Energy management is a tool to achieve efficient use of energy resources. This term integrates a combination of organizational, technical, analytical, and regulatory measures aimed at efficient production and rational consumption of fuel and energy resources (Antunes *et al.*, 2014).

According to Andrizhievsky (2005), energy management is an activity aimed at ensuring the rational use of energy resources, which is based on obtaining information on energy consumption through metering, energy audits, monitoring and performance analysis of energy use, as well as implementing energy-saving technologies. Implementing a systematic approach to energy efficiency of industrial enterprise, energy management allows developing an energy policy, identifying goals and implementing processes to achieve them, monitoring effectiveness, as well as making changes to improve energy consumption management system (Sa *et al.*, 2017).

The major task of the energy management is forming a balanced connection between "energy demand" and "energy supply" in accordance with the needs of the economy at the macro- and microlevel. Practical implementation of the energy management functions in the context of controlling energy flows is based on information data bank about the energy flow dynamics at industrial enterprise. Thus, the science of energy flow management, that is, energy management becomes of paramount importance. Despite the wide enough scope of problems reflected in various studies (Gangolells *et al.*, 2016; Korobov, 2007; Burlakova, 2011; Kmet and Mayzner, 2017) there is a need for further analysis of the theoretical and applied aspects of energy conservation management in terms of structural and substantive analysis of the issues related to providing energy resources to industrial enterprises (Pociovalisteanu *et al.*, 2010; Thalassinis and Politis, 2012).

During economic activity, the cost of energy resource becomes part of the cost of production. Since the cost of production is the basis for competitiveness, it will affect the performance of an industrial enterprise on the market, especially in terms of tough competition. Thus, efficient use of energy becomes one of the main issues, which requires special attention from the corporate management of industrial enterprises, the technological processes of which are usually energy-consuming (Kuznetsova *et al.*, 2008).

Historically, Russian industrial enterprises pay special attention to the needs of the production processes in energy while almost do not call attention to the efficiency of energy transfer and use. In the last decade, the CEOs of several Russian industrial holdings and enterprises (e.g., Evrazkholding, SIBUR Holding, etc.) had been trying to develop reliable organizational and technical facilities (systems) to manage the efficient use of energy resources, i.e., implement energy management system (Eremeeva *et al.*, 2011). Energy management is a purposeful activity of administrative structures, aimed at saving energy and improving energy efficiency of the enterprise. According to researchers, an essential component in energy management consists in motivation of employees to save energy (Richert, 2017).

According to the world experience and Russian practice, the efficiency of energy use can be achieved and maintained on a long-term basis and at a sufficiently high level only in case of employees' motivation (incentives) and interest that significantly affect energy consumption and energy efficiency of the enterprise (Sucic *et al.*, 2016; Chekudaev *et al.*, 2015; Novikova and Shadrin, 2014; Bibarso *et al.*, 2017). Unfortunately, the incentive policies that have been previously adopted at industrial enterprises, were eliminated during the 1990s, and only now such systems, in one form or another, are applied again in some companies. Organization of personnel motivation is a very complex process, which needs to be addressed at each enterprise considering the specifics of the management structure and staff characteristics. Foreign companies use different methods to motivate their employees to save energy. Along with the financial support used to involve employees in energy management processes, these companies also use other "non-monetary" types of incentives. They focus on the correct definition of goals, motivating their employees to achieve them. This motivation is based on factors that either motivate employees to action or activate these actions.

2. Methodology

This work aims at developing proposals on implementation of energy management system (EMS) at industrial enterprises of Russia to reduce the cost of production through efficient use of energy resources. To achieve the desired results in the field of energy conservation, is not enough just to take certain measures, it is also necessary to systematically carry out energy management, the main task of which is reducing energy costs in consideration of energy quantity and quality. As is known from foreign practices, to this end, any industrial enterprise creates the EMS, the main operational purpose of which is systematic and targeted enhancement of energy efficiency of economic management with rational use of all other resources.

To achieve effective cost reduction in energy resources, the industrial enterprises should pay attention to measures contributing to improvement of energy efficiency. In contrast to energy conservation, which is focused mainly on reducing energy consumption, energy efficiency is efficient use of energy, i.e. use of less amount of

energy to provide the same level of energy supply to technological processes at production. Since the main consumers of energy resources are industrial enterprises of different industries, it is necessary to create perfect energy efficiency and energy conservation management system at each industrial enterprise. The solution of this problem can be achieved through implementation of EMS that brings to enterprise several direct and indirect benefits and effects of organizational, financial, and reputational nature.

3. Results

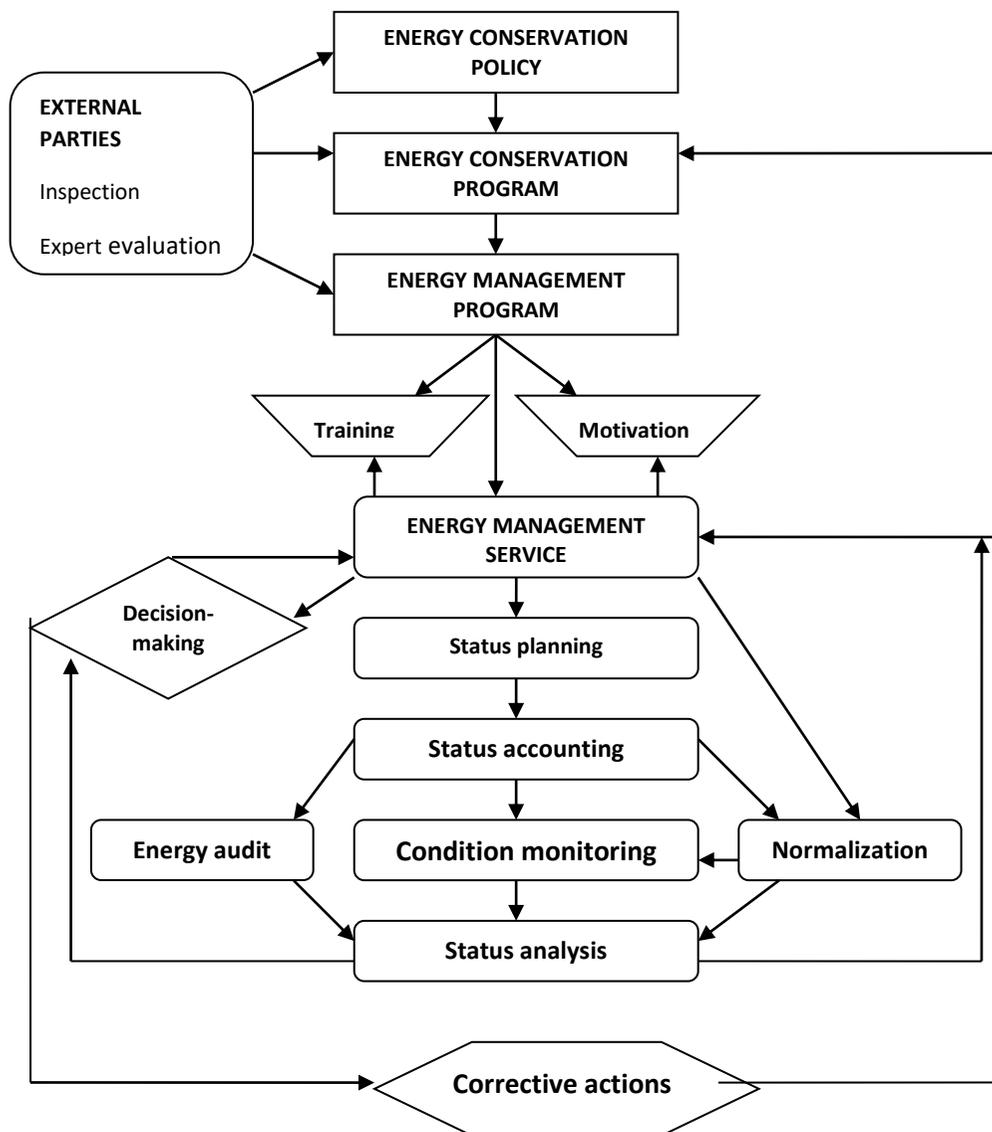
Creation of energy monitoring system at an industrial enterprise should begin with filing documents concerning the corporate establishment's decision about the creation of EMS (Prokhorova, 2015). This requires the following:

- to issue an order on creation of EMS specifying its goals and the immediate tasks;
- to appoint person responsible for energy management, putting him in charge the definition of the basic management processes in the use of energy resources, implementation of set tasks, organization of works and maintenance of operational management processes, as well as coordination in the activities of the work group on energy efficiency.

Figure 1 shows EMS organization model, which is recommended for implementation at the industrial enterprise. The presented EMS model shows the whole sequence of EMS organization at an industrial enterprise. Successful results can be achieved only when executing all phases of this model. According to the authors, the most appropriate sequence of EMS development and implementation at an industrial enterprise should consist in several characteristic stages, the implementation of which is mandatory for further effective functioning of the EMS. According to recommendations (Lee and Cheng, 2016; Bondarenko *et al.*, 2017), the sequence looks like the following:

- 1) developing energy conservation policy;
- 2) developing energy conservation program;
- 3) developing energy management program;
- 4) forming energy management service structure;
- 5) implementing energy monitoring;
- 6) creating enterprise's internal standards regulating the EMS functioning;
- 7) developing motivation, awareness, and training programs in the field of energy conservation;
- 8) filing EMS documentation;
- 9) carrying out EMS audit;
- 10) carrying out energy management and its certification.

Figure 1. The recommended EMS organization model at the industrial enterprise



According to the researchers, efficiently operating EMS reduces energy costs at least by 6-7% (as shown by domestic experience), and in general – by up to 20% (as shown by foreign experience) already within the first year (Letichevskaya, 2016). Thus, the implementation of an EMS at an industrial enterprise will give the following advantages:

- more efficient use of energy resources;

- ability to appreciate the priority of energy conservation technologies' implementation;
- creation of a basis for the implementation of energy efficiency criteria into managerial practices;
- operational management of energy consumption and costs;
- ability to attract best practices and competent management in the EMS.

4. Discussion

The implementation of an effective energy consumption management system at Russian enterprises is possible in the case of active use of achievements in domestic and foreign management science. High quality corporate energy system should be based on modern energy efficiency and energy conservation technologies. Such technologies include energy benchmarking, energy outsourcing, energy monitoring, and energy coaching. Consider the use of these technologies at Russian industrial enterprises.

Energy benchmarking: Nowadays, energy conservation involves a wide range of methods, tools, and practices. One such relatively new management tool is benchmarking, i.e., the process of comparing company's key performance indicators with those of other market participants involved in the same business to identify opportunities for further improvement. The use of such a tool makes it possible to carry out specific strategic planning to improve energy efficiency and select the optimal application points for the corresponding energy saving measures. The Energy management standards EN 16001 and ISO 50001 do not require benchmarking. However, the Annex to ISO 50001 emphasizes that benchmarking is one of the tools to maintain and continuously improve energy efficiency, being part of such energy management element as energy planning.

Benchmarking can be of two types, namely external and internal. External benchmarking is focused on the achievement of energy efficiency of the equipment, product, and the best service in the industry. Internal benchmarking is focused on the search for differences in the efficiency of energy use within a single organization to select the best option. Benchmarking can provide answers to the following important questions: "To what extent the ratio of manufacturer's material costs per unit of output is better or worse compared to other enterprises in the industry?", "How much energy is consumed by industry leaders to produce one unit of product?" as well as define "at what level is the analyzed enterprise in comparison with them?". The experience of "SIBUR Holding" can serve a practical example of implementation of the energy benchmarking technologies (Kazantsev, 2012; Dudin *et al.*, 2017; Dudin *et al.*, 2016; Bruskin *et al.*, 2017).

Corporate energy benchmarking project on exchange of experience in the field of energy conservation and energy efficiency is implemented at the enterprises of "Tobolsk-Neftekhim" (leading company in EMS implementation in the framework

of a comprehensive energy audit) and "Tomskneftekhim" (leading company in energy efficiency in the framework of the project on implementing the production system of "SIBUR" at support from DuPont).

During benchmarking at "SIBUR Holding", the following results of comparative analysis were obtained when implementing EMS:

- a total system to approach energy conservation was developed;
- advanced practices in the field of energy conservation and energy efficiency had been adopted;
- new targets were set for a 5% energy saving;
- the development of EMS was conducted with involvement of corporate top management.

Energy outsourcing: Outsourcing means the transfer of specific business processes or business management functions to external company specializing in the provision of services in an area. As for energy management at industrial enterprise, there are the following types of outsourcing:

- outsourcing in the production of energy resources at the expense of the particular company;
- outsourcing in the transportation of energy resources;
- outsourcing in repair (maintenance) of power equipment;
- other types of outsourcing.

Depending on amount of work to be done, outsourcing can be of two types:

- maximum or complete outsourcing, in which employees or assets associated with the core business processes of the company are passed on to the vendor during the validity period of the outsourcing contract;
- partial or selective outsourcing, in which most functions of the company are still carried out under the responsibility of the customer.

Collaborative outsourcing is a term, which describes one of the outsourcing options, in which the contracting parties are partners. Some experts use this term to define subcontracts, which include several suppliers. Outsourcing can be reasonable if the company receives certain competitive advantages and reaches its goals. The efficiency of outsourcing depends on many factors that must be considered and accurately assessed. As a successful example of energy outsourcing, the experience of the "Pipe Metallurgical Company OJSC" can be cited. Outsourcing activities led to the reorganization of the company's service structure, including its mechanical, electrical, and energy services. The reorganization measures of the maintenance and repairs management included the following 3 stages:

- the first stage consisted in the creation of centralized maintenance services at the enterprise;
- the second stage included development and regulation of appropriate cooperation among the central repair services of the company and its technical, economic, commercial, and other services;
- the third stage consisted in the creation of legally independent repair and service centers in relation to the different types of activities based on centralized repair services (Dvorkin, 2012).

The outsourcing of some repair and service functions of the centralized management structure leads to lowering levels of management from 4 to 2. Beneficial effects of the implemented energy outsourcing include the follows:

- improved manageability;
- elimination of dual and inefficient functions;
- increased order execution speed;
- reduction of staff;
- specification of managers' responsibilities;
- lower maintenance costs;
- higher safety of equipment (Dvorkin, 2012).

Energy monitoring: Energy monitoring, as incentive system of energy conservation, is widely used, for example, by the British industrial enterprises. The British authorities pay special attention to the development of energy conservation, many publications and wide dissemination of information on best practices in this area. So, in 1990s the experience of successful energy conservation at the enterprises of the Rover Company (Longbridge Plant) became widely known through numerous publications (Berner *et al.*, 2010).

Longbridge Plant subdivision produces mini and medium-sized cars, as well as Land Rover engines and gear boxes. Due to effectively organized motivation and promotion of energy conservation system, the company managed to save 1.5 million dollars in one year, having spent just 10 thousand dollars, with a total annual cost of energy (natural gas, fuel oil, electricity, and water) for the enterprise equal to 20 million dollars. Managers of Longbridge Plant traditionally pay much attention to energy conservation and energy management issues in general. The company has implemented and successfully operates the Target Energy Monitoring System (TEMS).

Information on energy consumers is reflected in weekly reports of each subsidiary as well as the enterprise in general. These reports contain not only data on energy consumption, but also the deviations from target values during the reporting week and savings from the beginning of the financial year. The target values of energy consumption are calculated using regression analysis of statistical data on energy

consumption and target parameters. Target parameters, which are used by TEMS are quite simple and obvious:

- the number of cars produced;
- the number of engines produced;
- the number of gear boxes produced;
- the number of working hours;
- the amount of energy consumed for facility heating and air-conditioning systems.

Although these measures allowed increasing energy conservation, enterprise's energy management believes that there are more opportunities for additional energy conservation through improved operation of EMS by the corporate personnel. In this connection, the company has developed a special program to raise both personnel motivation and its awareness; in addition, to achieve the maximum economic effect of the program, it was decided to minimize the cost of its implementation. This has led to a system that consisted only of organizational measures, and certain work with plant personnel that did not require any additional costs of labor and material resources.

One of the program key objectives was not only providing energy consumption monitoring but also decreasing energy consumption for a short period of time. This was achieved in less than six months. These improvements were associated with some simple technical and organizational measures with zero cost, as well as with more strict control over the use of energy-intensive equipment. In normal practice, most of the subsidiaries carry out weekly inspections to identify cases of inefficient energy consumption.

Energy coaching: Coaching refers to the traditional training methods. According the Chartered Institute of Personnel and Development (CIPD, UK), coaching has become one of the most popular methods for employees' development (Chartered Institute of Personnel and Development, 2014). In the framework of consulting projects, training is defined as a form of individual work on a professional basis, vocational development, and socio-cultural adaptation of newly hired employees or those, who are reassigned to another position. In this case the coach is an experienced specialist, who shares knowledge and experience with other employees at the workplace, provides an overview of the production process, as well as promotes proper relationships between the employees.

Coaching is widely used at large Russian industrial enterprises. This is particularly important for energy conservation and improving energy efficiency. Coaching has successfully established itself as a form of work with young employees within the framework of the "Human resources support and development program" of the PJSC "Interregional Distribution Grid Company of Center and Volga Region" at the "Tulenergo" company.

The "Lenenergo" company also has a special regulation concerning coaching, which has been developed and come into force at the enterprise to implement a systematic approach to adaptation and vocational training of newly hired employees, applicants for post, and those who are reassigned to another position. Coaching is used also to prepare students for practical work in "Lenenergo". One of the main goals of energy coaching is attracting skilled employees and young professionals to search for and develop innovative projects related to energy conservation and energy efficiency. Coaches are appointed among skilled professionals, who consistently demonstrate high performance, are willing and able to share their experience, have visions of their job responsibilities and enterprise operation process, as well as possess communication skills.

5. Conclusion

Achievement of real improvements in energy efficiency in present-day conditions must be based not only on technical solutions but also practicing more advanced management. Enhancement of energy efficiency should not be a one-time measure with limited duration. It is necessary to determine long-term system of measures based on the EMS at the enterprise.

The recognition of the fact that energy is a resource that requires the same management as any other resource is the first step towards improving energy efficiency and reducing energy consumption at industrial enterprises. To achieve real improvement in energy efficiency of industrial enterprise, it is necessary to improve the whole management system. It is therefore necessary to create perfect management system of energy efficiency and energy conservation. One of the instruments to solve this problem is the implementation of an EMS.

Effective management of industrial enterprise should be based on contemporary management technologies in the field of energy efficiency and energy conservation, such as energy benchmarking, energy outsourcing, energy monitoring, and energy coaching. The successful implementation of EMS depends especially on the attitude of managers to this challenge. Real results can be achieved if top management comprehends this and makes every effort to improve energy efficiency as part of measures to reduce corporate financing costs, to support and develop energy management by implementing the most advanced energy conservation and energy efficiency management technologies.

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