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Controlling System as a Key Factor Energy Management of an Industrial Enterprise

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ABSTRACT

In this article the methodological elements of the energy management of an industrial enterprise; reveal the organizational aspects of the formation of industrial plants for energy management, energy auditing and controlling; the proposed organizational and functional structure of the analytical laboratory for energy efficiency. In order to create energy-saving systems in any enterprise in its activity it is necessary to introduce energy management, which provides an integrated approach to structural savings of various kinds of energy. Energy management from a broad perspective can be seen as an instrument of general management with a universal set of controls energy consumption and costs to obtain it. With a narrow point of view of energy management - is planned system control and accounting of energy flows in order to minimize energy costs. An important aspect of the implementation of energy management issues are consulting on energy efficiency in the work of sound methodological framework for the management of energy resources, which should be consistently implemented at two levels - technical and managerial.

Keywords: Energy, Industry, Controlling, Management
JEL Classifications: M11, P28

1. INTRODUCTION

Experience in industrialized countries has defined conceptual approaches to the management of energy resources with a view to their optimization. These approaches combine both the legal, organizational, economic, geographic, demographic and other aspects. We believe that these aspects depends on the database management tool, including energy management, energy audits and monitoring. The effectiveness of any socio-economic system, the solution of many problems of social development in a period of restructuring of the economy is directly linked to the extensive, detailed assessment procedure to mobilize resources and, in particular, the results of human activity. And it is important to note that the analysis of the impact of the production system depends on two interrelated positions - objective and subjective. The objective reflects the possibility of the system itself, and a subjective stance characterizes a person's ability to use these features. Thus, the effect of the current system is determined by the degree of utilization of its total capacity and effectiveness is dependent on the value of the use of the existing potential (Shatalova et al., 2014).

2. RESEARCH METHODOLOGY

The study used an integrated methodological approach to the problem of combining classical instrumentation system, resources and effective approaches. Resource-based approach that involves the totality of the available resources of an economic entity, in the direction of their integration is the goal - the choice of resources; interconnection of resources, that is, resource-based approach does not exist without a targeted approach. Effective approach, as well as at the stage of resource potential, and at the stage of its use, it involves target setting (this selection of key resources, and identifying the most appropriate forms of the pooling of resources, and the identification of possible rational and efficient

use of resources, etc. (Algina and Bodnar, 2011; Chebykina et al., 2013; Shatalova et al., 2014 and Shatalova, 2014). The very same productive approach, which is treated as an opportunity, the ability of the economic entity to engage in the manufacturing process resources, factors of production, to a greater extent reflect the administrative aspect in the study of the economic category of resource potential (Shatalova, 2014). Thus, efficient approach takes into account the total resources as a system, and all the factors of production, which can ensure the efficient functioning of the system. In identifying the key feature of sample resources, the authors identify the immanent and the transcendent property resources. Immanent property resources is manifested in them in an objective ability to complex and interrelated to cooperate in the framework of the material conditions of the resource potential. Transcendent resource properties manifested in the fact that they act as the subjective sources, coordinating and organizing the inherent quality resources. Transcendental resources in its subjective form of sample organizational conditions of the resource potential. Category "resource potential" is considered by the authors as the material conditions for the reproduction quality of its basic structural elements of a complex and dynamically interacting with the organizational conditions for the purpose of stable operation of the enterprise in market conditions (Shatalova, 2014).

His essential characteristic of selected methodological tools manifested in such management practices as a system, process, integrated, economic, adaptive, situational (Table 1).

3. MAIN PART

In order to create energy-saving systems in any enterprise, its activity is necessary to introduce energy management, which provides an integrated approach to structural savings of various kinds of energy. Energy management from a broad perspective can be seen as an instrument of general management with a universal set of controls energy consumption and costs to obtain it. With a narrow point of view of energy management - is planned system control and accounting of energy flows in order to minimize energy costs.

At the heart of the energy management system approach should be used, which includes seven consecutive stages: The system (dynamics) analysis of the general situation of energy consumption in the company; monitoring and assessment of the situation at the present time (in fact); decision-making process on the implementation of energy management; recording of energy consumption; monitoring and evaluation of energy consumption; informing about the results of the management and staff; development of measures for the organization, technology, and behavior.

An important aspect of the implementation of energy management issues are consulting on energy saving (Chebykina and Bobkova, 2013). Such counseling should include the steps of the first two stages and provide a deep understanding of the situation and the purpose of stimulation of workers and businesses on the effective implementation of energy management.

When advising on energy saving must be the ability to convince people suspicious of the very idea of rational use of energy; attract employees, supports the introduction of energy management, prioritizing correctly and keep a job for the collection of energy consumption, monitoring and evaluation of energy consumption.

The key point for the majority of energy saving projects are competent consulting (Chebykina and Bobkova, 2014). Initial conditions and the possibility of introducing energy saving programs differ in every company. The main goal that the organization wants to achieve, is to limit the emissions into the atmosphere CO_2, SO_2i NO_2. One way to accomplish this is to urge consumers to reduce energy consumption. The purpose of energy management can be defined as the rational use of energy. And this goal should not be limited only to the adoption of energy-saving measures, a systematic approach is needed for energy management.

In the process of implementing an energy management plan included our goals, tools (the need to collect information). This process is an exemplary model and available for further development.

1. System (dynamics) analysis of the general situation of energy consumption in the company. Ego goal - to provide in the form of tables and diagrams the situation of energy consumption and the cost of its consumption.

To do this, you must collect information on consumption and energy costs over the last 5 years: Data counters, vendor accounts and administrative data. What follows is an analysis of consumption and costs of energy consumption with the existing calculations so that demonstrate cost savings or cost overruns.

In order to obtain results of analysis required to bring the ratio of energy to the volume and number of residents of the building, thus it is possible to receive indicators of comparison. Then you should compare energy consumption of a particular building with national figures in similar conditions. Then, the data on energy consumption for heating to adjust according to climate data, this method can be used degree-days, giving the chance to compare data for a number of years. After that need analysis of monthly energy consumption of suppliers' invoices for the full year.

The structure and content of the contracts of suppliers of energy, you can define the parameters for the analysis and assessment of the situation at the current time. If you have multiple sites that need to estimate energy consumption, we should define the priorities.

The data needed for this process: Consumption of gas, electricity and oil products per year and compare them over the past 5 years, the data on the electricity needs, according to the meter reading for the previous calendar year, the data on the volume of buildings, total area, number of users, operating expenses and incomes.

In order to obtain these data, it is advisable to use the request form, which is filled on the basis of the accounting of energy companies. However, there are rare cases of misreporting.

Table 1: The relationship of methodological approaches in the study area

Methodological approaches	Brief characteristics
Economic	It determines the most economical management of the organization The effective approach manifests itself in the definition of a rational structure of the resource potential (i.e., To reduce the proportion of the cost of the building blocks of capacity; to improve the efficiency of their use)
Complex	It involves consideration of all components of the control system - goals, objectives, operating conditions, management strategy and development The effective approach is manifested in the quantitative estimates of the efficiency of integrated management of the resource potential of the system
Adaptive	It involves the construction (organization) of the mobile control system, which, with changing internal and external conditions, the flexibility to change and capable of determining, in turn, prompt adaptability to business instability of the environment The effective approach manifests itself in the modified building blocks of the resource potential, production factors affecting its formation as a function of changes in the external and internal conditions
Process	It assumes control of the system considered as a series of interrelated activities (functions) each of which by itself is a process The effective approach manifests itself in the target setting for the pooling of resources for the optimal use of resource potential, which implies functional actions of managers to plan, organize resource base of economic entity, as well as the implementation of the organizational and economic processes efficient use of the resource potential
System	Suggests to consider the organization as an integrated system, all elements of which are interrelated. Each indivisible (as part of) brings its own characteristics into the overall system. Any system has inputs and outputs The effective approach manifests itself in the target system settings at the entrance (the identification of the resource base of the subject), which in a functioning system can be taken as a result of (fact) and in targeted results at the output of the system (effective use of resource potential)
Situation	Assumes the specific situation, the conditions of the internal environment and the external environment in which the system operates. This approach reflects the quality of management of the organization, i.e., It is an essential part of the system approach The effective approach is manifested in the regrouping of the resource base, production factors influencing the resource potential for the realization of the possibility of providing flexibility in the development of a changing market environment

During the initial phase it is necessary to establish a list of data on the consumption of energy provided by the accounting organization, as well as to assess the reliability of the information obtained, to develop a form of inquiry and reporting system.

It is important stakeholder organizations in providing reliable information. Join energy consumption calculations and accounting - basic conditions for implementation of energy management at this stage.

2. Monitoring and assessment of the situation at the present time (in fact);

3. The decision making process on the implementation of energy management. The purpose of this step - the introduction of energy management; achieving cooperation with the management policy and the organization of energy management; increasing the responsibility of employees for the implementation of management.

To achieve the goal you want to convince workers of the need for energy management on the basis of the analysis of energy consumption. This can be achieved by using reports and assessment of the situation by the staff. The following is to propose measures to reduce costs and justify the benefits obtained.

Management must decide how to implement energy management in the activity of the enterprise, it is tasked with the implementation and realization of the plan. Consideration should be given a clear policy with specific objectives. This approach contributes to the popularization of the idea of energy management.

Energy management should start with the definition of priorities. Why do you need information about the absolute and relative level of energy consumption in comparison with national indicators; of previously adopted measures to save energy; and the impact of these measures; the technical condition of the buildings.

In cases where the detected high levels of energy consumption for individual production processes, the solution of these issues must first be addressed.

It is obvious that the solution of a single problem leads to other changes. Thus, after the insulation of the building there is a problem with the calculation of new power heating network, etc.

Foreign experience shows that the introduction of energy management enough 3-5% annual cost of overall energy consumption (Algina and Bodnar, 2011). The costs of 3-5% is acceptable, since the regulation of power allows you to save only 10% through the introduction of energy management. The payback period is around 6 months.

In general terms, the main responsibilities of the manager of the electricity needs are to establish the accounting system of electricity consumption, the analysis of energy flows, calculating

and monitoring standards of energy consumption, reporting on energy consumption, the development of proposals for new technologies, according to the investment policy, the calculations of capital investments, the analysis of energy consumption position of power saving, the development of measures to improve the process, maintenance and equipment operation modes.

The manager can work on energy consumption at the company part-time or full-time, however, if the work is 20 h a week, it is advisable to have a specialist qualification, corresponding to the profile of energy management. In such case the manager for energy consumption must meet certain requirements: Possess communication skills, be capable of organizational and individual performance, be able to analyze, to have a technical background.

4. Fixing energy consumption: Management together with the manager on energy solves the problem of what data is needed. The goal - to collect information on energy consumption to get an idea about the ongoing situation in the enterprise and evaluate the effectiveness of interventions.

As a result of constant registration of data on the energy consumption can be determined with the frequency of consumption, compare the data with the same period last year and with the rules on energy consumption.

5. Monitoring and evaluating the energy consumption in practice means that the actual level of energy consumption is monitored on the basis of norms. The easiest method for determining the standard is to take a decision for the standard level of consumption during the same month last year. Define standards on energy consumption required to consider certain aspects: It is impossible to set a low level of the standard, as this can lead to frustration and subsequent adjustments. Standard for the month should be set no lower than 10% of the level of the previous year. After the implementation of energy-saving measures should be made taking into account the adjustment to the standard economy.

6. Reporting: The data resulting from the previous steps, you must submit a report to the board, management, users of the building. However, management should not receive unrelated information. Therefore, it is advisable to provide information in the following forms.

Monthly Bulletin of energy consumption: By means of this report on energy manager reports the results for the month, analysis, changes in the level of energy consumption, measures to reduce this level. The bulletin can be used to inform employees or tenants. The newsletter can find ways to save energy.

Quarterly reports: With their help, the manager on energy management reports on the status of implementation of energy-saving measures.

The annual report includes a reflection of the results and targets. The report is the group management and energy management. This form of reporting is an effective tool for tracking feedback on the measures taken to save energy. This report should be focused on different groups of consumers of information. They can be classified into the following report users: Top management, accounting, middle management, and various workers' councils.

The annual report includes the following sections: Analysis of the rational use of energy, indicating the reasons for the increase or decrease in the level of electricity consumption, baseline energy consumption for existing equipment, adjusted the fuel and energy balance, the list of priority policy of energy conservation, long-term energy-saving measures. The annual report cannot be made in abbreviated form, as to prepare it requires information and experience on energy management.

7. The development activities for the organization, technology, and behavior. Energy management studies and regulates the organization, technology, and behavior. The realization of events occurs in one of these areas. High result can be achieved if the measures carefully thought out and balanced. Organizational measures include: The organization of activities, cleaning, rational use of contracts, signing requests, demanding reports on the measures taken, monitoring of maintenance by monitoring on the basis of data on the consumption of energy, methods of setting up the equipment, to attract employees to register complaints.

The second element in the conceptual approach to energy management system controlling the activities of an industrial enterprise is an energy audit. Controlling provides the ability to perform and analyze energy use and its cost, to determine the place of their irrational use and on this basis, the company offers energy-saving program (Galkina et al., 2015; Shatalova and Zhirnova, 2014). The objectives of the energy audit include assessment of energy consumption in the organization and development of measures to promote energy-saving projects. On the basis of this information should be compared with the various companies belonging to the same industry.

The methodology of the energy audit includes six stages:

1. Calculation of energy consumption and costs: The examination of the enterprise carried out by analysis of information on energy consumption, drawing up an action plan.
2. Calculation of energy flows: The formation of the balance of energy, determination of the main consumer areas and possible energy savings.
3. The study of energy flows and the proposal of measures to reduce energy consumption.
4. Development of energy saving projects - study of proposals for reduction of energy costs, a comparison of alternatives and selection of the best deals.
5. Analysis of energy-saving projects by assessing the effects of the implementation of projects, their appropriateness, cost and payback.
6. Presentation of the results: The formation of the written report on the results of the energy audit of the administration.

Energy audits should not be seen as an exclusively technical problem. It should contain the legal and economic justification. "Rules of conducting energy audits of organizations" regulate

energy audits organizations to determine the effectiveness of the use of resources and should be subjected to such surveys all companies where energy consumption is more than 6 thousand tons of standard per year, with a periodicity of inspections not less than once every 5 years (Shatalova, 2014).

The energy problem is the lack of organizational structure, which is responsible for energy efficiency at the company. Position refers to the energy manager managerial positions and can not find an understanding without the presence of management thinking (Shatalova and Grachova, 2014).

Energy conservation measures require investment, but it can be cost-free, requires no investment in new equipment, but allow to change working methods. The cause of long-term projects may be not only a decrease in energy consumption, but also new products, production growth, reduction of environmental pollution. The introduction of low-cost measures is not possible without an understanding of energy use in the organization, and without the control of the process.

Thus, the instrumental framework for energy management should be consistently implemented at two levels - technical and managerial. The purpose of the technical - the creation of an information system. Here we include energy audits and monitoring. The purpose of the management level - the creation of management structure that is responsible for information security and the development of necessary actions, again on the basis of monitoring. i.e. controlling is an intermediate element in the conceptual approaches to energy management, which we define as a kind of remedy (method, mechanism) provides a comparison of the results (information) with the tasks (activities).

It should be noted that at the present time, the current law provides that a program of regional and municipal levels in the field of energy saving and energy efficiency should include a list of target indicators in the field of energy efficiency. We propose to classify them according to seven groups: The complex indicators in the field of energy conservation and energy efficiency in view of targets; Indicators in the area of energy savings and energy efficiency, allowing to determine the savings for each type of energy, taking into account the target systems; Indicators in the area of energy conservation and energy efficiency in the public sector in view of targets; Indicators in the area of energy savings and increased energy efficiency in the housing sector in view of targets; Indicators in the area of energy conservation and energy efficiency in municipal infrastructure to the target systems; Indicators in the field of energy saving and energy efficiency in the transport sector; Other target indicators.

We believe that a certain set of methodological presented figures may be included in the controlling and accounting functions of energy management tools. But for more in-depth analysis of the current and strategic tasks of managing energy resources, as well as to assess the effectiveness and quality of the energy management required more complex indicators, which may be included in the monitoring and in the energy audit.

In this regard, we agree with the view of a number of researchers (Algina and Bodnar, 2011; Chebykina et al., 2013; Chebykina and Bobkova, 2013; Chebykina and Bobkova, 2014) which proves that generalizes the criterion of efficiency of the energy enterprise is - maximum energy efficiency (Formula 1):

$$TF = C0-\Delta PE + R (EIT + OST + nn + and (Rn + Dr)) \quad (1)$$

where the kilowatt-hour (Gcal)/RUB

Rn - revenues from sales on the energy power technology services;

Dr - proceeds from the sale of energy generated at its own facilities;

and - other costs associated with violations of reliability and quality of the external power supply;

Poise - the full cost of maintenance and energy management;

PTA - purchase costs of energy fuels;

EPZs - the cost of purchasing power;

Ex - supply power to external markets;

ΔPE - loss of energy generating installations, transforming plants, electrical and heating systems of energy facilities;

C0 - the amount of the purchase price and the volume produced at its own facilities of electricity and heat (for personal customers).

In the presence of enterprises combined heat and power plants cogeneration amounts of heat and electricity in the index Eph legitimately measured in the same units. In particular used in practice 1 kW/H = 680 kcal. Energy efficiency should be analyzed over time.

So Formula 1 in the complex takes into account such factors that determine the effectiveness of energy management - it is energy efficient, economic exploitation of power facilities, fuel suppliers optimal output and energy, the energy potential (own). But for analysis may need additional parameters. The coefficient of efficiency of the energy business (Formula 2):

$$Keff = De + DR/Ip \quad (2)$$

where,

De - the income from sales of electricity. (Thermal power) received from its own generation;

DR - income from sale of technological services;

Ip - enegosnabzheniya full costs (the cost of products- in the calculation of the period)

Coefficient of independence of electricity and heat (Formula 3):

KH Su =/(Su + Bn) (3)

where

Su - the amount of own electricity generation (heat) for the accounting period;

Bn - the amount of the purchase of electric or thermal energy;

The participation rate of secondary energy resources in the energy supply company (Formula 4):

Ku = BB/(Su + Bn), (4)

where

BB - volume production of electric (thermal) energy on the basis of secondary energy companies.

4. CONCLUDING REMARKS

New strategies of enterprises in the energy markets require restructuring of the energy, and therefore the problem becomes particularly relevant design and implementation of appropriate institutional frameworks. We consider it expedient to electricity, the formation of specialized industrial enterprises of power management and its structural analytical division - namely, the analytical laboratory. The main functions of the analytical laboratory are: Overall management of energy supply in the factory; organization of work for the implementation of progressive technical solutions in terms of energy savings in the introduction of new and operation of existing power plants and systems, as well as to improve the utilization of secondary energy resources; the implementation of heads of departments of the plant monitor the performance of all elements of the management system of energy saving; organizational and methodical work on the preparation of administrative decisions regarding energy efficiency and control over their implementation; development of regulations, guidelines, procedures, and other regulations in relation to work on energy saving; organization of development and feasibility study of the current, medium and long term plans to reduce the cost of fuel and energy resources.

In general, the study conceptual approaches to energy management, we can conclude that they are reduced to three interconnected elements - energy management, energy audits and monitoring. In this work, these elements were considered by us to a greater extent on the level of the enterprise, as the company is, in our opinion is a kind of "catalyst," which reveals the desirability and feasibility of implementation of various mechanisms at the regional level.

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