

Energy management and audit

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Abstract. In modern conditions of managing important task is to increase energy efficiency and energy efficiency as one of the priorities of economic policy. Energy management and energy audit is the first steps in improving energy efficiency. The purpose of this paper is to develop theoretical and methodological approaches and scientific and practical recommendations aimed at improving energy management and energy audits. In this paper authors gives definition of the concepts of energy management and energy audit, the stages of the energy audit, energy efficiency standards for the Republic of Kazakhstan. Implementation of the proposals for the development of energy management and energy audit will improve the management efficiency, the optimal interconnection between strategic and tactical goals, to bring to an optimum level of productivity.

Keywords: energy efficiency, energy management, energy audit, energy consumption and energy savings.

I. INTRODUCTION

To achieve the goals of sustainable development is necessary to ensure the improvement of energy efficiency of enterprises. Energy efficiency - one of the most important areas in the complex of measures to stimulate economic growth and strengthen the international position of the companies. In modern conditions, energy conservation and energy efficiency is one of the priorities of the economic policy of many private companies and government agencies, focused on the rapid development, both in terms of reducing the cost of production of goods and services, and in accordance with the general thrust of government programs aimed at reducing energy intensity of the economy. World practice shows that energy efficiency is achieved largely due to organizational changes in the system of energy management, by improving energy management system. Therefore, energy efficiency as the energy management system is introduced in the enterprises.

Positive developments in the energy efficiency of the economy possibly in obtaining objective data that can be obtained with the help of an energy audit, which to be conducted properly and in accordance with international standards. Kazakhstan has implemented concrete steps to improve the energy efficiency. Government adopted the Law "On energy saving and energy efficiency" (2014), which establishes certain requirements for businesses such as mandatory energy audit, the introduction of energy managers, development of strategies for energy efficiency. The main instrument of state policy in the field of rational and efficient use of energy in the Republic of Kazakhstan is a comprehensive plan to improve energy efficiency of Kazakhstan for 2012-2015. The practical stage of implementation of energy saving policy in Kazakhstan

started in 2013: more than 3000 standards of energy consumption, requirements for energy efficiency for buildings and design documentation, transportation and electric motors, adopted by more than 200 technical standards for energy efficiency.

The energy intensity of industry in Kazakhstan is 4-5 times higher than in European countries. Kazakhstan's GDP energy intensity varies 1.5-1.8, while, in Japan, for example, 0.1 and 0.16 in Germany.

Energy facilities and infrastructure in Kazakhstan require speedy modernization. It is estimated that over 90% of the gas turbines, nearly 60% of the steam turbine and steam boiler 33% have worked at least twenty years. Investments are needed not only for the producers of electricity, but also for its end-users: the lion's share of Kazakhstan's industry consumes a great deal more energy to produce (five times) than similar enterprises in European Union.

There are many studies worldwide identifying a wide variety of sector-specific and cross-cutting energy efficiency improvement opportunities for industry. Significant numbers of energy efficiency measures is discussed in various studies (DeCanio 1998; Golove and Eto 1996; de Groot et al. 2001; Jaffe and Stavins 1994; Thollander and Ottosson 2008; Rohdin and Thollander 2006; Rohdin et al. 2007). Questions of energy management and energy audit is discussed in Kazakhstan (Zeinolla and Tleppayev 2015).

This paper aims to develop theoretical and methodological approaches and scientific and practical recommendations aimed at improving energy management and energy audits.

In accordance with this purpose we had the following research objectives:

- 1) practice of the concept of "energy management" and "energy audit";
- 2) identify the stages of the audit and specific features;
- 3) develop a model of energy management;
- 4) develop a standard of energy audit .

Results

The concepts of "energy management" and "energy audit"

The main tool for reducing energy consumption and improve energy efficiency in enterprises is energy management. Energy Management System - an innovative solution aimed at reducing specific consumption rates of energy resources and the optimum use of scarce financial resources for the implementation of projects on energy efficiency. An energy management system - a management system based on standardized measuring and testing,

providing a mode of operation in which only consumes energy needed to produce.

An energy management system - a set of interrelated and interacting elements of the enterprise aimed at the formation of the energy policy of the company, setting goals, developing activities to achieve these goals.

Energy management and control of the energy economy of the company is a complex process that requires the ability to conduct a analysis and make the right decisions to ensure effective energy savings in the company.

Energy management in the enterprise can be implemented independently or in conjunction with other management systems in quality, environment, occupational health and safety, finance, risk management in organizations of all types and sizes.

Energy management recommends special benchmark tests for estimation of current state. As results, the enterprise can estimate sufficient "reserve" for implementation of effective energy management.

The main instrument of energy management is an energy audit. Energy audit is a necessary tool for the assessment of the actual state, identifying the main causes of the loss and the development of recommendations aimed at reducing energy consumption.

Thus, an energy audit is necessary in the event that management of the company or institution has taken a course to reduce energy costs, improve product quality and enhance the energy security of the enterprise. As a result of the energy audit is compiled opinion on energy conservation and efficiency. The main purpose of the energy audit is energy-saving recommendations and assistance to business entities in determining the areas of energy efficiency. The main tasks of the energy audit:

- identification of reserves and potential energy savings;
- development of a program of energy saving measures, energy-saving technologies;
- determination of the economic effect of the introduction of energy-saving measures;
- definition of the payback period of energy-saving measures and the costs of their implementation;
- improving the system of control and metering of energy resources;
- energy passport of the enterprise.

We allow to clarify that an energy audit conducted to assess the effectiveness of the use of fuel and energy resources (electric and thermal energy, natural and associated gas, solid fuel, oil and processed products) to identify opportunities to conserve resources and to develop a set of energy saving measures. This definition is more fully and clearly reflect the concept of energy audits.

Currently, there are many techniques for energy audits, which are designed for individual systems, types of equipment, technological and power plants in various industries. They regulate the audit process, and the need to prioritize those or other measurements.

In Kazakhstan the procedure of energy audit are determined by "Rules of the audit" (2012).

In accordance with these Rules, an energy audit consists of 4 main steps:

I stage. Preparatory: a program of energy auditing, including a program of instrumental examination.

Stage II. Measuring (Test).

Phase III. Analytical: a technical report on energy audit.

Stage IV. Final: an action plan for energy conservation and efficiency.

According to other researchers, energy audit consist from the following activities:

1. Analysis of the state of power supply systems, heating, water supply, the technical equipment of the park industrial enterprise.
2. Assessment of the systems and measuring instruments.
3. Identification of unreasonable losses.
4. Assessment of the system of regulation of energy consumption and energy use.
5. Checking the energy balances of the enterprise.
6. Calculation of the specific energy consumption standards for manufactured products or types of work.
7. The evaluation of the major energy-saving measures.

In our opinion, the main stages of the energy audit can be shows in figure 3.

The result of the energy audit may be:

- conclusion about the quality of produced energy, particularly electricity;
- recommendations for an energy-saving measures and technologies;
- recommendations for the steps (including changes in technology), aimed at improving the energy efficiency of products.

Standards of energy management.

Currently, standards for energy management systems already exist in certain countries (such as Denmark, Ireland, Sweden, the USA, Spain, South Korea) or under development (China, Europe through CEN (CEN) and CENELEC (CENELEC), South Africa, Brazil). The experience of these countries shows that standards can achieve sustainable energy savings in the industry. In July 2009, European standard EN 16001: 2009 "Energy management systems - Requirements with guidance for use" (Energy Management Systems - Requirements with guidance for use) has been issued, which has received national status in 30 European countries:

- UK (BS EN 16001: 2009),
- German (DIN EN 16001: 2009),
- France (NF EN 16001: 2009),
- Sweden (SS EN 16001: 2009),
- Italy (UNI EN 16001: 2009).

The International Organization for Standardization (ISO) approved the most innovative standard in the field of energy management: "ISO 50001: 2011 Energy management systems - Requirements with guidance for use" by June 15, 2011.

ISO 50001 includes the requirements for the development and implementation of energy policy, objectives, targets and action plans in the field of energy management, taking into account the legislative regulatory acts.

The benefits of the energy management system based on ISO 50001:

1. The ability to identify and minimize risks associated with your future energy supply system.
2. Measurements and monitoring energy use to determine ways to increase its effectiveness.
3. Increase the overall efficiency and reduction of energy consumption and the related costs.
4. Reduce carbon emissions and compliance with the relevant government targets.
5. Demonstration of the achievements in the field of ecology and empower effective participation in tenders.

Companies that have implemented an energy management system according to ISO 50001, can reduce the costs of consumption of energy resources and to reduce carbon dioxide emissions into the environment.

There are several standards related ISO 50000:

- ISO / CD 50002 Energy audit;
- ISO / CD 50003 Energy management system audits and competence of auditors;
- ISO / CD 50004 Guidelines for the implementation, maintenance and improvement of the energy management system;
- ISO / CD 50006 Basic use of energy and energy efficiency (EnPIs) - General Principles and Guidelines;
- ISO / CD 50015 Monitoring, measurement, analysis and verification of the organizational level of energy efficiency.

The Japanese company Toyota, after the implementation of ISO 50001 in 2002, has reduced energy consumption by 23% per unit of the product.

In the CIS countries such as major companies as "Lukoil", "Severstal", "Gazprom" implemented this standard.

Kazakhstan has not a national standard of energy efficiency. Although the actual standard allows doing the following:

- 1) to estimate the energy management system of the company;
- 2) to identify the mutual influence of the energy management system and operations at each other;
- 3) to assess and manage the risks;

The implementation of the standard should reduce the financial costs of greenhouse gas emissions and other environmental impacts through systematic management of energy. Successful implementation depends on commitment from all levels and functions of the organization, and especially from top management. The standard will enable organizations to develop a strategy to improve energy efficiency, reduce costs and improve the environmental aspect of operations.

CONCLUSION

Energy management is becoming an integral part of the modernization of the enterprise. The successful introduction of energy management to a large extent depends on the attitude towards him the company's management. Tangible results can be achieved only if management takes the initiative.

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