M.B. Koshumbaev, P.A. Kvasov

ENERGY SAVING AND RENEWABLE ENERGY

Кошумбаев М.Б. Квасов П.А.

ЭНЕРГОСБЕРЕЖЕНИЕ И ВОЗОБНОВЛЯЕМЫЕ ИСТОЧНИКИ ЭНЕРГИИ

Кошумбаев М.Б. Квасов П.А.

ЭНЕРГИЯНЫ ҮНӨМДӨӨ ЖАНА ЭНЕРГИЯНЫ КАЛЫБЫНА КЕЛТИРҮҮЧҮ БУЛАКТАР

УДК:512.9/225

The power savings allow to save expenses for manufacturing of the goods and services. In the conditions of Kazakhstan the economy can make about 30%. The given parameter can be raised at the expense of introduction of innovative decisions under power savings and renewable energy sources.

Key words: *renewable energy, low energy efficiency, high energy intensity.*

Экономия энергии позволяют экономить затраты на производство товаров и услуг. В условиях Казахстана экономия может составить около 30%. Данный параметр может быть повышена за счет внедрения инновационных решений по энергосбережению и возобновляемым источникам энергии.

Ключевые слова: *возобновляемые источники энергии, низкая энергоэффективность, высокая энергоемкость.*

Энергияны үнөмдөө товарларды жана кызматтарды өндүрүүгө сарпталуучу каражаттарды үнөмдөөгө мүмкүнчүлүк берет. Казакстандын шарттарында үнөмдөө 30%га жакын болуусу мүмкүн. Бул параметр энергия үнөмдөө жана энергиянын калыбына келүүчү булактары боюнча инновациялык чечимдерди жайылтуунун эсебинен жогорулоосу мүмкүн.

Негизги сөздөр: *энергиянын калыбына келүүчү булактары, төмөнкү энергия эффективдүүлүк, жогорку энергия эффективдүүлүк.*

Introduction

The development of science, innovation and technological modernization are aimed at sustainable development of the economy through the introduction of domestic developments and transfer of technologies, creation of effective system of generation and use of knowledge for the economy.

The resolution of these problems is seen in the conception of a system of scientific knowledge, creating a new system of science financing, creation of the advanced infrastructure of the innovation system, organization of the complex of measures on stimulation of commercialization of national developments projects and due to the transfer of technologies, the enhancement of the status of a research worker, a large-scale modernization of the economy, promoting financial institutions in lending to the scientific-research programs and projects, development of financial instruments to attract investments to the projects with the scientific content, the improvement of the legislative base, the elimination of state control in the scientific researches, creation of conditions for generation, distribution and commercialization of knowledge in Higher Education Institutions and Scientific-Research Institutes of Kazakhstan.

The most energy-related are the scientific topics of energy saving and the introduction of domestic developments in the renewable energy sources, the analysis of a modern condition and prospects of scientific and technical development in the field of development of the state system of energy saving and use of renewable energy sources, assessment of prospects for energy saving in different branches of industry, housing and communal services, the budgetary sphere, the role of alternative energy sources in the energy strategy of the Republic of Kazakhstan.

The high energy intensity of the economy compared with the developed international countries leads to the unsustainable use of fuel and energy sources, reduces the competitiveness of the economy, and, as a consequence, leads to significant pollution of the environment, including the greenhouse gases that influence the global climate warming. Kazakhstan is the largest producer of anthropogenic greenhouse gas in Central Asia and the third largest emitter among the former Soviet republics. The energy sector emitted around 95% of the total volume, including about 35 % of the power plants running on fossil fuels [1]. The modernization of industry and the application of modern energy-saving technologies are the solution for reducing emissions of greenhouse gases per unit of output.

Current state of the issue. The analysis of the existing world data on energy intensity of various sectors of the economy indicates the presence of a vast reserve of potential energy savings from the use of outdated technologies, as well as the low technological discipline at the enterprises of the Republic, which, at the same time, from year to year increases rapidly [2, 3].

According to the international Energy Agency, energy consumption per unit of GDP in the Republic of Kazakhstan and other countries and indicators of energy intensity in the different countries of the world shows that in our country it is used almost about 2.8 kW-hour per 1 dollar of GDP, while in such countries as great Britain, Germany, Italy and Japan it is 0.22 - 0.3 kW-hour, and the United States, France, Turkey and Korea

spend 0.4-0.6 kW-hour, Canada and China spend 0.8-1.2 kW-hour.

Limiting factors of socio-economic growth in the Republic of Kazakhstan are [1]:

- high depreciation of fixed funds, and in certain branches of the industrial sector of physical deterioration reaches more than 60%, the lack of own financial resources for the modernization and technical re-equipment;
- low energy efficiency of a number of energy-intensive production;
- significant losses in energy distribution and heating systems;
- General technical and technological backwardness of enterprises, the lack of efficient communication of science to production, low expenses for scientific-research and experimental-design works;
- lack or total absence of domestic enterprises, producing an in-depth processing raw materials, the use of new advanced technologies, which, in turn, puts Kazakhstan manufacturers in dependence on the conjuncture of the world market for imported materials, the prices for which are subject to significant fluctuations;
- high transport costs, in particular, the high railway tariffs, increasing the cost of finished products;
- high rates of taxation;
- the imbalance of customs tariff regulation: customs duties on imported raw materials for the production of separate kinds of building materials exceed the import duties on finished products.

The analysis of the country's economy and its energy sector suggests that the potential for energy saving in the Republic of Kazakhstan may reach 30 % of the total volume of energy consumption. Energy efficiency can significantly reduce fuel consumption to increase in the demand for electric and thermal energy [1-4].

To increase the competitiveness of the domestic economy there was developed «Strategy of industrial-innovative development of the Republic of Kazakhstan» and the State program «Efficient use of energy and renewable resources of the Republic of Kazakhstan to sustainable development for the period up to the year 2024» [5, 6]. Expected results of realization of the «Strategy of industrial-innovative development»:

- reduction of energy intensity of GDP in two times, the growth of labour productivity in 3-3.5 times, the doubling of GDP by 2015;
- «triple» doubling the GDP in the period 2018 to 2024 years. The targeted GDP growth should be guaranteed due to the preservation of the annual growth rate of production is below 10 % until 2012, 12 % until 2018, and 14 % up to the year 2024;
- effective use of resources (efficiency of the economy of the country as a whole for 2012-2018 years should rise to 43 %, and by 2024 year to reach 53 %.

The Ministry of energy and mineral resources of the Republic of Kazakhstan has developed a Program on energy saving for the period of 2005-2015 (phase I - 2005-2007). [7] and the Program of development of electric power industry till 2015 [8], which determine the development prospects of power industry of the country and the main objectives in the field of energy saving, and in particular, it is planned to solve the following priority tasks:

- rehabilitation and replacement of the generating equipment, which exhausted the normative service life of the existing power plants;
- expansion of the existing power plants through the commissioning of new generating capacities, on the first place - entering the 500 MW at the Ekibastuz GRES-2;
- involvement in the balance of renewable energy sources (small hydro and wind farm) at the South of the Republic;
- construction of new power plants using natural and associated gas of oil deposits in Western Kazakhstan, which play positive role in achieving energy independence of the region;
- modernization of electric networks 220-500-1150 quarter of the Unified Energy System of Kazakhstan by way of re-equipment of modern switching equipment, devices of relay protection, automatics, control for increase of reliability of operation of electric networks and guaranteed power for consumers.

Accumulation of problems in the energy sector has led to the formation of a significant gap between the installed and available capacity of energy sources, which by the beginning of 2007 amounted to 4.3 thousand MW or 23 % of the installed capacity, and the losses in the heating networks twice regulatory data. It should be noted that the normative term of operation of many of thermal power stations built in the 30 - 40-ies, will be exhausted already by 2010-2015 (about 11,000 MW). In the long term, the growing demand for electric power will be compensated for residual capacity of these stations, as well as new capacities, which are planned to be commissioned to replace obsolete and developed the resource.

At the present time in many developed countries in the world the active introduction of new non-traditional energy sources is accepted as one of the priority tasks of the development of the economies of these countries [4]. It is predicted that the share of alternative energy (solar, wind, tidal, solar power, etc.) in the world energy consumption will increase annually and by the year 2030 will reach 30%, by 2050 - 50%.

For the financing of scientific researches and innovative processes for the integration of alternative sources of energy in developed countries allocated funds: in the United States in 2005 from the Federal budget of $275 million, in Japan every year 30 billion yen (about us $273 million), and the European budget research into renewable sources of energy exceeds 2 billion Euros (2002-2006 years).

The solution of the problems of energy saving in developed countries. Energy problems of any developed country in the world, including the countries

of the Union of Independent States can be divided into the energy supply and energy efficiency [2, 3, 9]. Issues of energy supply and energy saving are concern of the world community; the different countries, of course, have their own approaches and possibilities in solving these problems.

The problem is particularly important for the countries of the Union of Independent States with economies in transition, including the Republic of Kazakhstan, because in these countries the energy intensity of industrial production and social services is many times more global indicators [1,2,9].

The energy intensity of production is also connected with a permanent increase in our country the cost of energy resources: oil, natural gas, coal, electric power, etc. In the cost of production in the Republic of Kazakhstan component of the energy costs becomes dominant, and therefore the competitiveness of the domestic products increasingly depends on the economical consumption of fuel and energy resources.

Energy resources at the present time are non-renewable sources of energy in the form of organic mineral fuels: natural gas, oil, coal, peat and other fuels. The use of these fuels as energy sources leads to significant emissions of both greenhouse gases and harmful substances (dust, oxides of sulphur, nitrogen, etc.). Therefore, the problem of energy saving is closely connected to the decision of a number of important environmental issues and the protection of the environment.

The impetus for the solution of problems of energy saving for the majority of Western countries served as the energy crisis of 1973 [2, 4, 9]. The solution of these problems was possible due to scientific and technical development and introduction of energy saving technologies in all developed countries in the world, and implementation of the state energy-saving policy in 24 countries of the world in the framework of the International energy Agency.

In the U.S. back in the 70-ies [2] the problems of realization of energy saving programs were raised because of the loss of the energy consumed at that time in the United States, accounted for nearly 50%. Increase in fuel prices, instability of supplies, the restrictions proposed in the future forced to focus on the need for a full revision of attitude to the consumption of fuel and energy, with particular emphasis on energy saving, which in this case means the reduction of losses and increase of the coefficient of energy use. The saving was not in any way connected with the reduction of the consumption of the energy resources.

Energy analysis showed that less than 50% of all the energy consumed in the world is used effectively, and the remainder is the energy loss during the conversion, the thermal radiation, with the cooling water, etc. About 55% of the energy used in ferrous metallurgy is spent effectively, and 45% are losses. Energy uses about 30% of the energy contained in the original fuel (loss - 70%). Transport only 25% coming this customer energy is used efficiently, while 75% will be lost.

Forecast of the Western specialists showed that the General improvement of the use of energy per unit of output could reach 25-35 % of the whole industry, and the separate industries could have a more significant savings than others.

In the United States, the problem of energy saving is directly associated with the growth of labor productivity. In Germany [3] only one third of the primary fuel comes to productive use. The EU countries, primarily Germany, are interested in the restructuring of the energy sector, in particular, the gradual withdrawal of nuclear power plants with the increase of the share of renewable energy sources and organic fuels.

An interesting feature of the energy saving policy is the introduction of ecological tax (Ecological Tax) [3] proposed for the countries of the European Union on emissions of greenhouse gases (since 1999). This tax, on the one hand, stimulates the reduction of emissions of greenhouse gases (CO_2, CH_4, etc.) in accordance with the resolution of the Kyoto conference, December 1997), and on the other hand, has a direct impact on the policy of energy-saving, increase of efficiency of use of fuel, as well as the use of less-greenhouse-gas-emitting fuels (gases).

The German government has agreed to reduce greenhouse gas emissions by 25% between 1990 and 2010. This environmental reform with the introduction of ecological tax proposed EU countries. It is considered, that it is also acceptable for the USA, Canada and Japan, moreover, that in a number of countries CO_2 emissions exceed emissions in Germany (10 tones). For example, in Belgium the issue of 12 tones, in the Netherlands - 11.8 t, etc. It is also believed that these regimens will contribute to the increase of competitiveness in the conditions of the period of the new globalization of the economy.

In 2005, France expressed the need for further reduction of energy intensity of production (up to 40%) and wider use of natural gas for cogeneration technologies (use of gas turbines), the wider use of biogas, solar, wind energy. The focus of the French transport is not only a car, but also passenger bus, operating at the energy of the fuel elements (so-called hydrogen vehicles).

In early 1996, entered into force in Russia the Federal law «On energy saving». Problems of energy supply in Russia, as well as global problems of energy saving for the current period and for the next 20 years is critical described in work [10].

Russian specialists have developed the «Energy strategy of Russia up to 2020», where with the optimistic scenarios of energy development plans to increase the production of electricity from 870 to 1125 billion кВт-hours in 2010 i.e. by 30%, and by 2020 - 1585 billion кВт-h, i.e. 1.8 times.

The adoption of legislative acts and new programs on energy saving and energy efficiency is not reflected

in the real sector of the Russian economy. It is already known that in 1998 - 2000, the country had experienced actual growth of the GDP energy intensity by 3.7 % instead of the planned reduction of 5.3%, which at the present day in 3 times higher energy intensity of the global economy, 7 times more, than in Japan, 4.5 times more, than in the United States [10].

Excess energy intensity of Russian products on the world average indicators in 1,5 - 4 times defines directly the significant growth of the value of the products of Russian industry in comparison with the world prices, which predetermines the low competitive level of Russian goods and services.

Today the design and use of new alternative sources of energy in many developed countries of the world adopted as vitally important, strategically necessary resources to ensure long-term development of the economies of these countries [11,12].

In the concept of alternative energy are devices that generate electricity and heat, which differ from those of fixed assets of the energy of the day, working on the hydrocarbon raw materials and nuclear fuel that use other sources of energy (for example, wind power, solar energy, etc.)

The renewable energy sources can include the following:

- solar energy;
- wind energy;
- biomass energy;
- wave - power of the World ocean;
- gradient-thermal energy;
- energy received different ways of household and industrial waste;
- tidal energy;
- geothermal energy;
- small hydropower plants (with capacity up to 30 MW in the capacity of a single unit is not more than 10 MW), which differ from traditional large - HPP territory of the flooding and the volume of the reservoir.

Small and renewable energy - energy of the future. Its inexhaustible, autonomy, security, economy serve as the guarantee of the future development of the energy sector, the basic resource of its development in the developed countries in the world.

At the present time it should be noted some general trends in the field of energy in the world:

- forecast of lack and high cost of "traditional" types of material and energy;
- damage to the environment of modern energy is substantial. This can threaten the existence of human civilization, impede its development;
- attempts to improve the existing industrial methods, means of obtaining energy are poorly financed, and there are not specific decisions;
- the most common solar, wind and tidal power plants are not efficient enough;
- a number of States and of the world's largest Corporation carries out scientific-research work and focus on our own developments in the field of renewable energy [12].

In recent years, the protection of the ecology and environmental protection have become the main trend of practically all States, under public pressure, the leaders of countries to take measures to change the traditional power structure in which dominated the resources such as oil and coal. Today, the most promising is natural gas and uranium. If the widespread use of the gas is connected to problems of the environment, the generation of electricity and heat at the expense of a thermonuclear reaction linked to the overall security. This confirms an accident at a nuclear power plant in Japan. Until you have worked out the General rules for the risk assessment of hazardous objects, and prone to natural and man-made emergencies, developed a system of preventive measures to eliminate the causes of potential accidents, developed safe reactor design, you cannot design the new NPP.

However, all countries in the world are interested in the increase of non-hazardous energy sources, which are not harmful to the environment and does not pollute the environment. Therefore, many of them signed the Kyoto Protocol. Measures taken in the international scales provide technical assistance of developed countries to the developing States, to which also belongs and Kazakhstan. One of the important directions is nanotechnologies for creation of new types of fuel and energy sources, which the Kazakh Research Institute of Power engineering regards as strategic scientific program. At the same time to examine other areas, which may lead to development of new materials and the means to generate energy.

Analysis of the legislative database on energy saving and renewable energy. In Kazakhstan there are number of legislative and normative acts and orders, the main of which is the Law of the Republic of Kazakhstan "On energy saving", as well as the Law of the Republic of Kazakhstan «About support of use of renewable sources of energy», which is aimed at regulation of public relations arising in the organization of production, transmission and sale of heat and electric energy, produced with the use of renewable sources of energy and the Law of the Republic of Kazakhstan «On the ratification of the Kyoto Protocol to the United Nations framework Convention on climate change», which promotes the application of new environmentally friendly technologies with the use of alternative sources of energy.

The importance of the use of renewable energy in the Republic of Kazakhstan is not only a need to diversify sources of fuel, but also facing the country objectives in the field of environment protection. Development of the production of electric power and heat on the basis of decentralized renewable energy sources will reduce the load on the environment posed by centralized power generation based on fossil fuels.

Unfortunately, the adopted laws are not enforced, there are a number of circumstances, which hinder the

action of the legislation on introduction of energy saving measures, as well as not developed mechanisms for the regulation of the tariff rates for electric energy generation from alternative sources of energy. Nevertheless, the analysis of the legislative basis for energy saving and use of renewable sources of energy shows that the main disadvantage is the abstraction of the majority of articles of the laws, which cannot be applied in practice because of the lack of normative-regulatory rules of its execution.

According to the obligations taken by the Ministry of the environment has initiated the project of changes in the legislation. This document contains a positive experience of other countries, which approved a plan to reduce emissions and adopted a number of measures to tighten against violators of - pollutants of the environment. At the same time, the study of the project reveals its shortcomings, which include the lack of its content with the current legislation. Apparently the staff of the Ministry of environmental protection of the surface comes to a discussion of this project with other ministries and authorities, designated to Finance and taxes. During the discussion of this issue many economists and financial experts believe that after the adoption of this project, it will be possible to adopt legislative acts in coordination of its actions with some norms of the current legislation. This approach explains much of the inaction of our laws that have been developed by "raw" laws, and are then made numerous amendments, which will also require additional changes.

To improve the legislative framework required a permanent audit. As every law has a specific action, in the auditors ' report must include, in addition to lawyers of experts on the main profile of the complex of normative acts. Apparently, to improve the interaction between the different departments and structures it is necessary to develop the General form of a legislative act, which will contain the mandatory articles in the form of objectives, tasks, means of attaining the objective, outcome, and also the norms of tax, accounting, and economic incentives. With this approach in one law will be connected all the necessary grounds for the regulation of certain activities.

Research methods the introduction of innovative solutions. As the practice indicates, energy saving and renewable energy development requires implementation of innovations and transfer of new technologies. The decision requires the analysis of the proposed new decision. In market conditions the proposed methods of analysis should also include the market elements and provide a simple procedure of payments. There are various methods of analysis, but for the analysis of innovative decision there are usually used morphological analysis and non-analytical methods.

The essence of the method of morphological analysis [13] lies in a combination of a unified system of methods for the identification, designation, counting and classification of all the selected options of any of the features of this innovation. All of the innovation is connected with the desire to reduce the volume of capital investments and reduce the degree of risk, which is always accompanied by innovation. And these two characteristics of innovation are in direct dependence on the number of required changes.

Morphological analysis is carried out according to the following scheme:

1) formulation of the problem;

2) formulation of the problem;

3) drawing up a list of all the characteristics of the study of (alleged) of the product or the operation;

4) drawing up a list of possible solutions for each characteristic. This list is in the table, called the morphological matrix;

5) analysis of combinations;

6) select the best combination.

The result of morphological analysis in the form of morphological matrix is shown in table 1. In the problem of allocated 3 aspects: A, B, C. Suppose that aspect A can be resolved in three ways, B - two, and C - four. Each combination represents a potential solution to the Total number of possible solutions to the problem, therefore, is: 3*2*4=24.

Table 1. Morphological matrix

Parameters	Variants of the decision of problems
A	A1, A2, A3
B	B1, B2
C	C1, C2, C3, C4

From the received twenty-four possible options is selected only one. The choice is usually made by the miscalculation of all the options without exception. Therefore, it is quite a time-consuming work. In full morphological analysis can be implemented with the help of means of computer technology.

Addition of morphological analysis can serve as a functional-cost analysis is a method of system analysis of the functions of the object (a new product), directed on minimization of the cost in the areas of marketing, design, production, operation while maintaining (improving) the quality of the facility. It is based on the examination of the object through the prism of the discharge of its functions and relations between them.

Assessment of options of the object's construction (new product development) is made according to criteria, which takes account of the extent and importance of the functions, as well as the costs associated with their implementation at all stages of the life cycle. The theoretical basis of such a study are principles the functional organization of the systems:

1) updating of functions means the acquisition of expediency (functionality) of each element and its properties. Ideally, the new product should not be non-functional, unnecessary elements;

2) the concentration of functions means that fewer resources will be necessary for the implementation of the basic functions, the closer to the ideal would be the decision;

3) compatibility of functions is one of the conditions of opposing the occurrence of harmful functions. Elements of an object should not contradict each other and must be interrelated;

4) the flexibility of the functions of the ratio of the stability of the structure of object and mobility functions.

Functional cost analysis allows you to modify the existing scientific and technical decisions, change their scope of application and to find new solutions.

Not analytical methods [13] allow you to move away from the formal procedures and encourage creative problem-solving. They should give the answers to four key questions:

- correct the problem we solve?
- is it possible to break the stereotypes of logical thinking?
- can you become more receptive to new ideas?
- how can help the other?

The most common not analytical methods include brainstorming (collective generation of ideas) - the strategy of group problem solution. This method, also known as the «brain storm», «the conference of ideas», was proposed by the American scientist Alex Osborn in 1955.

Brainstorming process is based on the following principles.

1. In solving the set task involves two groups of people: the generators of ideas and experts. Generators of ideas unite people with creative thinking and imagination and with the knowledge in the field of science, technology and economy. Experts are usually people with a large amount of knowledge and a critical mind.

2. When generating there are no restrictions. Ideas are expressed any, including the clearly erroneous, humorous, without any proof and feasibility study. The expressed ideas are usually recorded in a Protocol, in the computer, etc. Thus, the basis of the method is the separation of the process of integration of ideas from the process of their evaluation. The generation of ideas is conducted in the conditions, when the criticism is prohibited and even, on the contrary, encouraged any clearly a ridiculous idea.

3. The philosophical basis of the brainstorming - theory 3. Freud, according to which the consciousness of man is a delicate and precarious layering over the abyss of the subconscious. In normal conditions of thinking and human behavior is determined mainly by the consciousness, in which exercise authority over the control and procedures for: - consciousness «programmed» the usual ideas and prohibitions. But through the thin crust of consciousness, and then it burst dark natural forces and instincts, the turmoil in the subconscious.

These forces are pushing the man to illogical actions, in violation of the prohibitions on all sorts of irrational thought. The inventor has to overcome all sorts of psychological complexes, all sorts of prohibitions, due to the usual ideas about the possible and the impossible.

The method of brainstorming can be of various modifications. In solving the problems of the number of people, as generators, and experts, are usually no more than six persons, the duration of the storming of not more than 20 minutes. Brainstorming ideas can be implemented in a written form, it can be individual, pair (the discussion of one of the ideas of two experts), double (discussion of ideas is made in two stages) and phase (discussion of ideas is made in stages). There is also a «reverse storm». Inverse Sturm means that participants of the attack are looking for defects of any new product or operations, eliminate these deficiencies and put forward new tasks.

Brainstorming is used, when it is necessary to obtain a large number of original solutions in a relatively short period of time. While brainstorming, and does not allow coming to a decision, he is important in the innovation management as a method of generating ideas for new products, especially consumer goods, as well as in the development of new proposals on marketing, advertisement, marketing, etc.

References

1. Dukenbayev K.D. Energy Sector Of Kazakhstan. Conditions and mechanisms for its sustainable development. - Almaty, 2004. – 604 p.
2. Chardjoy M. H. energy efficiency in the industry. - Moscow: Metallurgiya, 1982. -272 with.
3. P.J.J. Welfens,Meyer B. Energy Policies in the European Union Germanys Ecological Tax Reform.- Berlin, New Jork Springer, 2001.- 143 p.
4. World Energy Outlook, 2006, publishing house of the IEA, str. Paris
5. «Strategy of industrial - innovative development of the Republic of Kazakhstan for 2004 - 2015г.г.» (determined by the decree of the President of RK от17 may 2003. № 1096).
6. «A Comprehensive energy saving plan in 2009 - 2010). (1 stage)», approved by the Decree of the Government of the Republic of Kazakhstan from February 26, 2009 №221.
7. «The Energy strategy of the Republic of Kazakhstan for the period 2004 - 2015» (determined by the decree of the President of RK от17 may 2003. № 1096).
8. «On the program of development of electric power industry till 2030» - Resolution of the Government of the Republic of Kazakhstan dated April 9, 1999. № 384.
9. Lisienko V.G., Shelokov I.M., Ladygichev M.G. A reader of energy saving: a reference book: In 2 books/Under ed. V.G. Lisienko. - M.: Heating engineer, 2005.
10. Favorsky O.N. The power supply of Russia for the next 20 years// the Bulletin of the Russian Academy of Science.2001.71. No.1. P.3-9.
11. «A Comprehensive energy saving plan for 2009 – 2010 (1 stage)», approved by the Decree of the Government of the Republic of Kazakhstan from February 26, 2009 № 221.
12. The Website of the Ministry of energy and mineral resources of the Republic of Kazakhstan, www.memr. gov.kz.
13. Vorob'ev V.P., Platonov V.V., Rogova EM. Innovation management: textbook. - 2-e Izd./ Edited by Dr. of economic Sciences, prof. S.YU. Shevchenko. - SPb.: Publishing house of GOU VPO «Saint-Petersburg state University of Economics and Finance, 2005. - 115 p.

Рецензент: