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Factors affecting the efficiency of energy-saving projects in market conditions

The article discusses the factors affecting energy-saving projects including administrative, legislative, economic, social and environmental, scientific and technical and other processes. The authors of the article note that the introduction of energy-saving projects is associated with significant capital costs, which include the replacement of technologies and reconstruction of existing production, the introduction of less energy-intensive materials, reduction of the material and electrical capacity of products due to innovations. The article classifies the factors affecting energy-saving projects by the degree of influence and the nature of the impact. All factors influencing the efficiency of energy saving regime implementation in real life are divided into two groups: subjective (psychological, motivational, and informational) and objective (social, investment, technological). The article indicates the tax (decrease or increase of the general level of taxation; tax discounts on investment projects; a variety of special tax incentives) and economic (introduction of a system of loans, grants, instalment payments, concessional and interest-free energy efficiency loans; promoting energy efficiency through environmental mechanisms of influence; attraction of investments into development of energy saving potential due to saving resources for the future) tools to encourage energy conservation. The authors of the article classify the factors by the nature of the impact on energy-saving projects: technical and technological factors; organizational factors (legislative and regulatory, informational and analytical); socio-economic factors (financial and economic, motivational and stimulating).

Keywords: energy saving project, energy saving, energy saving measures, factors, subjective factors, objective factors.

In modern conditions, all production and non-production systems operate on the basis of the use of energy resources. The level of consumption, which largely determines the development of all economic systems and the costs of society as a whole for the maintenance of production and non-production funds. The demand of such systems for energy resources is determined along with other factors by energy saving, the dynamics of which, in turn, is influenced by general economic conditions and factors due to administrative, legislative, economic, social, environmental, scientific, technical and other processes.

Considering energy-saving projects as a large open system with internal (at the enterprise level) and external (at the world, state and regional levels) links, it is possible to formulate the main factors, that is, particularly important elements or significant circumstances that affect the possibility and results of energy-saving measures.

Currently, experts identify three main areas of energy saving implementation [1]:

1. Implementation of organizational and economic measures for energy saving. Experts attribute this mainly to the improvement of accounting and rationing of fuel and energy resources, the establishment of technological order, the strengthening of production discipline, the increasing role of economic incentives and the elimination of elementary losses.

2. The second direction involves the implementation of technological measures, the content of which is technological reconstruction of the production rationalization, replacement and modernization of outdated energy and manufacturing equipment, improving the quality of supply. This direction is recognized by experts as low-cost and can be financed from the company's own funds.

3. The third direction is associated with the introduction of energy-saving projects, which include the replacement of technologies and reconstruction of existing production, the introduction of less energy-intensive materials, reducing the material and electrical capacity of products due to innovations. This direction, of course, is associated with significant capital costs.

Thus, each of these areas of energy conservation provides for the results from the elimination of the causes of irrational use and losses at each stage of the life cycle of the energy resource.

By functionality, energy-saving measures can be classified as follows [2]:

– «passive» — measures to reduce the required design capacity of engineering systems of lighting, heating, ventilation, air conditioning;

- «active» — measures to reduce energy consumption during operation by regulating heat, electricity or water consumption;
- additional technical measures to ensure energy savings through the use of waste, secondary, renewable energy resources;
- organizational, informational and non-technical measures to stimulate energy and resource saving.

Meanwhile, the objective nature of energy saving and the presence of conditions that increase the importance of this process, as studies show, are not a guarantee of its implementation. A necessary condition for this is the activation of a complex of factors that affect the conservation of energy resources. The diversity and ambiguity of these factors determine the need for a systematic approach to their analysis. However, some authors in their studies do not adhere to a certain classification of factors affecting energy saving, while highlighting the most significant aspects of energy saving and characteristics in certain economic conditions. Therefore, we consider different classifications of factors affecting energy-saving projects by different authors (Table).

Table

Classification of factors affecting energy-saving projects by different authors

Authors	Type of factors	Content
Bashmakov I.A., Habibrakhmanov R.R., Ryzhkova L.V.	–climatic; –technical and technological; –economic; –structural; –standard of living.	The value of a comprehensive classification of factors is that it can be used to model economic activity, to carry out a comprehensive search for farm reserves in order to improve production efficiency.
Golovanova L.A.	–climatic; –technical and technological; –economic; –financial; –structural; –political; –environmental.	
Pavlova A.S., Sergienko O.I.	–economic; –social; –political; –related to technology and science; –environmental.	This classification is based on external factors associated with the integration of the state and several industries to solve the problems of rational use of energy resources on the basis of the implementation of reserves of every industry, the development of cooperation between them and obtaining a synergetic effect on this basis.
Sergeyev N.N.	–technical and technological; –legislative and regulatory; –information and analytical; –financial and economic; –motivational and stimulating.	

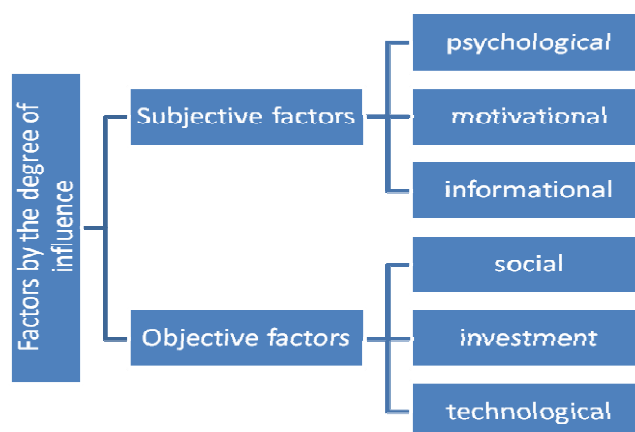
Note. Compiled by the authors [3–7].

The analysis of factors showed that economic, structural, climatic, technological conditions are presented in almost all analyzed authors. Individual authors (Pavlova A.S., Sergienko O.I., Golovanova L.A.) also take into account the influence of political and environmental factors. Bashmakov I.A., Habibrakhmanov R.R. and Ryzhkova L.V. additionally include the structure factor and the standard of living of the population. Sergeyev N.N. – legislative and regulatory factors, analytical factors, financial and economic factors, motivational and stimulating factors.

Modern approaches to energy saving and energy efficiency allow not only to reduce energy losses, but also to ensure environmental safety through the rational use of energy resources, reducing emissions into the environment, the use of alternative and renewable energy sources. Environmental factors are often not considered in the development of energy efficiency strategies in companies, and energy efficiency is not recognized as a component of corporate social and environmental responsibility.

Despite the grouping of factors that affect energy-saving projects, energy sales companies are primarily interested in increasing profits. As a result, the interest in energy saving is quite low. Also, the lack of motivation in the development of energy efficiency is due to the ability to shift the growth of costs to the consumer. A complex system of electricity pricing, non-transparency of tariffs, sale of electricity at contractual prices agreed with the consumer, and not at prices (tariffs) set by the regulatory authorities, the increase in prices in the supply chain (from the generating company to the consumer) are barriers to energy efficiency.

The company's priorities in energy saving are set depending on the share of energy costs. Apparently, energy-intensive production is primarily interested in the introduction of energy-efficient technologies as it reduces the cost of production. However, for companies energy costs of which are insignificant, or which have a number of other more pressing problems, the issue of energy saving development is relegated to the background. Therefore, we have identified subjective and objective factors affecting energy-saving projects (Fig. 1).



Note. Compiled by the authors.

Figure 1. Classification of factors by the degree of influence on energy-saving projects

All factors affecting the efficiency of the implementation of the energy saving regime in life can be divided into two groups: subjective and objective.

Subjective factors reflect the psychological and motivational features of the individual to innovation. Under the subjective factors resistant should be taken to the desire of the people to keep wasteful attitude to the consumption of fuel and energy due to lack of skills, not of knowledge and culture.

Objective factors can be used to achieve success or to ensure efficient management of energy-saving projects. Objective factors affecting the efficiency of energy use are: investment costs and fuel costs; production costs and costs of maintenance and repair; reliability of equipment; social factors (environmental protection, labour protection, etc.).

In the system of state, motivation of energy saving is necessary to distinguish between incentive measures and measures aimed at ensuring responsibility for the achievement of regulated results of activity. One of the tools to stimulate energy saving is tax regulation which includes the following elements:

- reduction or increase of the general level of taxation;
- tax discounts on investment projects;

– variety of special tax benefits that encourage business activity of the enterprise in the field of energy saving or increasing the interest of economic entities in energy-saving measures.

In addition, economic measures to promote energy conservation should include:

– introduction of a system of loans, grants, instalment payments, preferential and interest-free lending of energy saving measures;

– realization of privileges, including tax, for the enterprises which are turning out production conforming to the international standards on indicators of energy consumption, depreciation privileges, privileges on the income tax, privileges on customs duties on the energy saving equipment, tax credits on energy saving projects, including with participation of the foreign capital;

- promotion of energy saving through environmental impact mechanisms;

- attracting investment in the development of energy saving potential through future resource savings and reinvestment, the gradual inclusion of state subsidies;
- organization of bonus funds in the state organizations for achievement of the set indicators of energy saving.

Responsibility for the implementation of measures aimed at energy conservation and energy efficiency should be not only encouraging, but also punitive. These measures should be applied to economic entities both for the irrational use of energy resources and for the incomplete use of the contractual volume of energy supply.

According to Moruleva, L.A. [8] it is possible to allocate the so-called factors — the reasons that in one way or another have an impact on energy conservation. These factors influencing energy saving and energy efficiency include: the size and structure of GDP, the level of physical and moral deterioration of equipment, the state of the legislative framework in the field of energy saving and energy efficiency, the potential for energy saving in various sectors of the economy, the use of various tools and methods in the field of energy saving, the level of awareness and interest of personnel in the field of energy saving and efficient use of energy resources. It is important to note that the importance of efficient energy consumption is very high. It is necessary to properly manage these factors, which will be accompanied by movement towards a more sustainable energy future and energy-efficient economy.

A.M. Nevelev, V.A. Sirenko [9] distinguish the following factors of resource saving:

- structural factor due to the optimization of the structure of consumed resources (the use of new resources – effective substitutes for traditional resources, the use of local fuels, materials and raw materials);
- the design factor causing creation of essentially new types of production with certain consumer properties and low material consumption and also decrease in weight characteristics of products;
- the technological factor causing full use of primary raw materials, decrease in production waste and losses, involvement in production of secondary resources on the basis of their preliminary preparation for production consumption according to requirements of technological process;
- organizational factor that causes the involvement in the production of available but unused resources and the mobilization of internal reserves (involvement in the production process of excess reserves, illiquid balances).

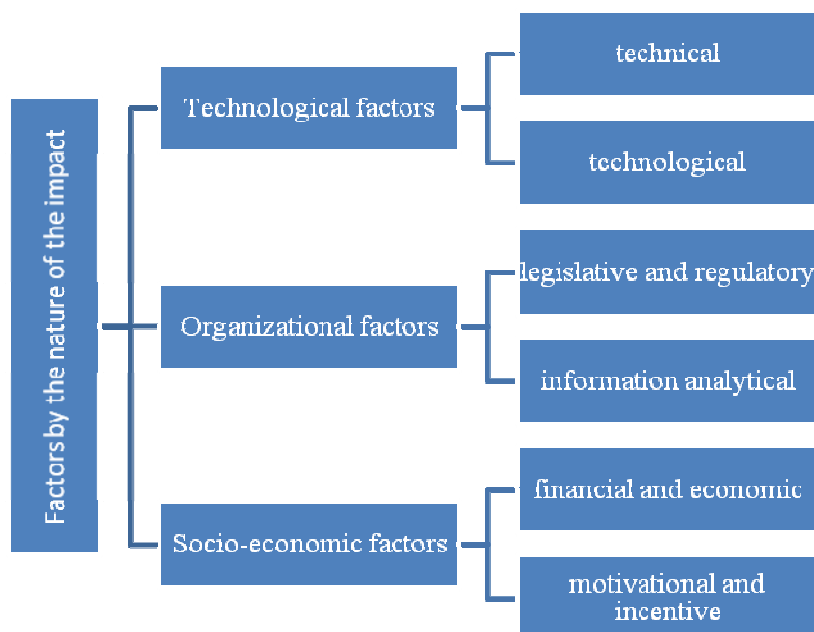
Based on the classification of the factors of energy saving (Bondarev V.A. and Semenov A.S. [10]) the factors of efficiency of the enlarged region are divided into the work of the external and internal conditions. External conditions are formed outside the region, but have an impact on the energy efficiency of the subject. Internal ones are components that are controlled by local authorities.

Sokolovskaya G.A., Sigareva T.S., isolated groups of factors of resource as the scope of environmental, social, foreign, and function factors to improve the economic mechanism and the factors of infrastructure development [11].

All of these factors, to some extent, have a direct impact on the formation of the energy saving potential of industrial enterprises. In addition, there are several classifications of energy saving factors.

In any classification adopted by a gradation of characteristics. Based on this, at the first level of the classification there are two groups of factors: regulatory due to public administration and regulation of the process of saving energy resources; resulting, allowing to obtain a certain economic, social, environmental and other results in the implementation of energy saving policies. At the second level of classification, based on the special organizational and economic role of energy saving, the following groups of factors are identified: market, administrative, economic, socio-environmental, organizational, scientific and technical, information and psychological [5].

In this regard, it is possible to identify factors by the nature of the impact on energy-saving projects (Fig. 2).



Note. Compiled by the authors on [5, 7, 8].

Figure 2. Classification of factors by the nature of the impact on energy-saving projects

The first group of factors is associated with technical and technological methods of energy saving and is expressed in the state of technical and technological bases of the industrial enterprise. For example, the material and technical base of many industrial enterprises is outdated equipment, which greatly complicates the process of implementing energy saving. These methods are related to technological energy saving and can be quantified. The market of energy-saving equipment and technologies is limited today. Taking into account the characteristics and specifics of production, the pace of energy efficiency development in companies is reduced due to the lack of own structures that would work on the modernization of equipment and improvement of the technological process. The most environmentally responsible companies work closely with equipment suppliers to optimize energy consumption. The possibilities of technical re-equipment are often limited because of the high wear and tear of technological equipment and power supply systems.

The second group of factors relate to organizational methods. For assess the legal factors, it is necessary to analyze the existing legal framework of energy saving. Such a base should exist not only at the state and regional levels, but also at the municipal level. Information support of energy saving is necessary for making adequate management decisions aimed at improving the energy efficiency of industrial enterprises. The importance of education and information in the field of energy conservation cannot be underestimated. Legislative, self-regulatory and evaluation measures will not be effective without understanding and justification. To date, the information support of energy saving is not sufficiently developed. There are no information and analytical centers to provide consulting on the world and advanced domestic experience in the field of energy efficiency. There is a weak level of training of energy auditors.

The third group of factors is socio-economic. These factors depend primarily upon the amount of the company's own funds, the possibility of borrowing. For these groups, it is not always possible to give an unambiguous assessment of the effectiveness. The lack of own funds of the organizations, as well as the lack of opportunities to attract budget resources makes it difficult to implement projects in the field of energy saving. At the same time, financial institutions are unable to provide the necessary financial support. However, even if there is a budget, the management of companies is not always ready to finance energy efficiency projects because of the long payback period and the lack of mass examples of the practical application of energy-efficient technologies, as well as the use of energy services. This is one of the reasons for the identified insufficiency of their development and application in industrial enterprises. Simultaneously, the factors that determine the organizational and socio-economic methods of energy saving largely affect the feasibility of technical and technological methods and are low and medium-cost measures.

Thus, the definition of the main directions of improving the efficiency of energy-saving projects, the classification of factors of this activity will allow for further research to fully identify opportunities for improving energy management in enterprises implementing energy projects.

References

- 1 Жуков Ю.П. Энергоёмкость – критерий эффективности хозяйствования / Ю.П. Жуков, В.Ф. Воронин // Энергосбережение. — 2004. — № 3. — С. 10–13.
- 2 Фрейдкина Е.М. Оценка эффективности энергосберегающих мероприятий: учеб. пос. / Е.М.Фрейдкина — СПб.: ВШТЭ СПбГУПТД, 2018. — 80 с.
- 3 Башмаков И.А. Региональная политика повышения энергетической эффективности: от проблем к решениям. / И.А.Башмаков – М.: ЦЭНЭФ, 1996. — 245 с.
- 4 Хабибрахманов Р.Р. Факторы, определяющие энергоёмкость отечественной экономики [Электронный ресурс] / Р.Р.Хабибрахманов, Л.В. Рыжкова // Управление экономическими системами: электрон. науч. журн. — 2012. — №12. Режим доступа: <http://www.uecs.ru/marketing/item/1802-2012-12-14-08-08-27>.
- 5 Голованова Л.А. Управление энергосбережением при проектировании и строительстве зданий (на примере Хабаровского края). — Хабаровск, 2000. — 205 с.
- 6 Павлова А.С. Анализ факторов, влияющих на повышение энергоэффективности и развитие корпоративной социально-экологической ответственности российских компаний на основе метода обратного прогнозирования с участием заинтересованных сторон [Электронный ресурс] / А.С. Павлова, О.И. Сергиенко. Режим доступа: <https://cyberleninka.ru/article/n/analiz-faktorov-vliyayuschih-na-povyshenie-energoeffektivnosti-i-razvitie-korporativnoy-sotsialno-ekologicheskoy-otvetstvennosti>
- 7 Сергеев Н.Н. Методологические аспекты энергосбережения и повышения энергетической эффективности промышленных предприятий: моногр. / Н.Н.Сергеев — Ижевск: Изд-во «Удмуртский университет», 2013. — 116 с.
- 8 Моралева Л.А. Анализ факторов, оказывающих влияние на энергоэффективность экономики //Международ. науч. исслед. журн. — 2015. — № 6 (37). — С. 75-77.
- 9 Невелев А.М. Экономика ресурсосбережения / А.М. Невелев, В.А. Сиренко, В.И. Габ и др.; под ред. А.М. Невелева. — Киев: Наук. думка, 1989. — 247 с.
- 10 Бондарев В.А. Оценка основных факторов энергосбережения / В.А. Бондарев, А.С. Семёнов // Современные наукоемкие технологии. — 2014. — №5-1. — С. 228,229.
- 11 Соколовская Г.А. Ресурсосбережение на предприятиях / Г.А. Соколовская, Т.С. Сигарева. — М.: Экономика, 1990. — 156 с.

Ф. Курбанов, Л. Тылл

Нарық жағдайындағы энергия үнемдеу жобаларының тиімділігіне әсер ететін факторлар

Мақалада әкімшілік, заңнамалық, экономикалық, әлеуметтік-экологиялық, ғылыми-техникалық және өзге де үдерістерге негізделген энергия үнемдеу жобаларына әсер ететін факторлар қарастырылды. Мақала авторларының айтуынша, энергия үнемдейтін жобаларды енгізу технологияларды ауыстыру мен жұмыс істеп тұрған өндірістерді қайта құру, энергияны аз қажет ететін материалдарды енгізу, жаңа енгізілімдер есебінен өнімнің материалсыйымдылығын және электрсыйымдылығын төмендету сияқты елеулі күрделі шығындармен байланысты. Мақалада энергия үнемдеу жобаларына әсер ететін факторлар әсер ету дәрежесі және әсер ету сипаты бойынша жіктелген. Энергия үнемдеу режимін өмірге енгізудің тиімділігіне әсер ететін барлық факторларды авторлар екі топқа бөлген: субъективті (психологиялық, мотивациялық, ақпараттық) және объективті (әлеуметтік, инвестициялық, технологиялық). Мақалада салық (төмендету немесе көтеру, салық салудың жалпы деңгейі; инвестициялық жобаларға салық жеңілдіктері көрсетілген; түрлі арнайы салық жеңілдіктері) және экономикалық (қарыз, дотация, төлемдерді кейінге қалдыру, энергия үнемдеуші іс-шараларға жеңілдік және пайызсыз несие беру жүйесін енгізу; экологиялық ықпал ету тетіктері арқылы энергия үнемдеуді ынталандыру; ресурстарды болашақ үнемдеу есебінен энергия үнемдеу әлеуетін игеруге инвестициялар тарту) энергия үнемдеуді ынталандыру құралдары. Мақала авторларымен энергия үнемдеу жобаларына әсер ету сипаты бойынша факторлар жіктелген: техникалық-технологиялық факторлар (техникалық, технологиялық); ұйымдастыру факторлары (заңнамалық және нормативтік, ақпараттық және сараптамалық); әлеуметтік-экономикалық факторлар (қаржылық-экономикалық, мотивациялық және ынталандырушы).

Кілт сөздер: энергия үнемдейтін жоба, энергия үнемдеу, энергия үнемдейтін іс-шаралар, факторлар, субъективті факторлар, объективті факторлар.

Ф. Курбанов, Л. Тылл

Факторы, влияющие на эффективность энергосберегающих проектов в рыночных условиях

В статье рассмотрены факторы, влияющие на энергосберегающие проекты, обусловленные административными, законодательными, экономическими, социально-экологическими, научно-техническими и иными процессами. Авторы отмечают, что внедрение энергосберегающих проектов связано со значительными капитальными затратами, которые включают в себя замену технологий и реконструкцию действующих производств, внедрение менее энергоемких материалов, снижение материалоемкости и электроемкости продукции за счет нововведений. В статье классифицированы факторы, влияющие на энергосберегающие проекты: по степени влияния и по характеру воздействия. Все факторы, влияющие на эффективность внедрения режима энергосбережения в жизнь, разделены на две группы: субъективные (психологические, мотивационные, информационные) и объективные (социальные, инвестиционные, технологические). В статье указаны налоговые (понижение, или повышение, общего уровня налогообложения; налоговые скидки на инвестиционные проекты; разнообразные специальные налоговые льготы) и экономические (введение системы ссуд, дотаций, рассрочек платежей, льготного и беспроцентного кредитования энергосберегающих мероприятий; стимулирование энергосбережения через экологические механизмы воздействия; привлечение инвестиций в освоение потенциала энергосбережения за счет будущей экономии ресурсов) инструменты стимулирования энергосбережения. Авторами статьи классифицированы факторы по характеру воздействия на энергосберегающие проекты: технико-технологические (технические, технологические); организационные (законодательные и нормативные, информационные и аналитические) и социально-экономические факторы (финансово-экономические, мотивационные и стимулирующие).

Ключевые слова: энергосберегающий проект, энергосбережение, энергосберегающие мероприятия, факторы, субъективные факторы, объективные факторы.

References

- 1 Zhukov, Ju. P., & Voronin, V. F. (2004). Enerhoiomkost – kriterii effektivnosti hoziaistvovaniia [Energy intensity – a criterion of economic efficiency]. *Enerhosberezhnie – Energy saving*, No. 3, 10-13. [in Russian].
- 2 Frejdkina, E.M. (2018). Otsenka effektivnosti enerhosberehaiushchikh meropriiatii [Evaluating the effectiveness of energy-saving measures]. Saint-Petersburg: VShTJeSPbGUPTD. 80 s. [in Russian].
- 3 Bashmakov, I.A. (1996). Rehionalnaia politika povysheniia enerheticheskoi effektivnosti: ot problem k resheniiam [Regional energy efficiency policy: from problems to solutions]. Moscow: CJeNJeF. 245 s. [in Russian].
- 4 Habibrahmanov, R.R., & Ryzhkova, L.V. (2012). Faktory, opredeliaiushchie enerhoemkost otechestvennoi ekonomiki [Factors determining the energy intensity of the domestic economy]. *Upravlenie ekonomicheskimi sistemami - Economic systems management*, No. 12. Retrieved from <http://www.uecs.ru/marketing/item/1802-2012-12-14-08-08-27>. [in Russian].
- 5 Golovanova, L.A. (2000). Upravlenie enerhosberezheniem pri proektirovanii i stroitelstve zdanii (na primere Habarovskogo kraia) [Energy saving management in the design and construction of buildings (on the example of the Khabarovsk territory)]. Habarovsk. 205 s. [in Russian].
- 6 Pavlova, A.S., & Sergienko, O.I., Analiz faktorov, vliiaushchikh na povyshenie enerhoeffektivnosti i razvitie korporativnoi socialno-ekologicheskoi otvetstvennosti rossiiskikh kompanii na osnove metoda obratnoho prohozirovaniia s uchastiem zainteresovannykh storon [Analysis of factors affecting energy efficiency and development of corporate social and environmental responsibility of Russian companies based on the method of reverse forecasting with the participation of stakeholders]. Retrieved from <https://cyberleninka.ru/article/n/analiz-faktorov-vliyayushchikh-na-povyshenie-energoeffektivnosti-i-razvitie-korporativnoy-sotsialno-ekologicheskoy-otvetstvennosti>. [in Russian].
- 7 Sergeev, N.N. (2013). Metodologicheskie aspekty enerhosberezheniia i povysheniia enerheticheskoi effektivnosti promyshlennykh predpriiatii [Methodological aspects of energy saving and energy efficiency of industrial enterprises]. Izhevsk: Izdatelstvo «Udmurtskii universitet». 116 s. [in Russian].
- 8 Moruleva, L.A. (2015). Analiz faktorov, okazyvaiushchikh vliianie na enerhoeffektivnost ekonomiki [Analysis of factors influencing the energy efficiency of the economy]. *Mezhdunarodnyi nauchno-issledovatel'skii zhurnal*, No. 6 (37), 75-77.
- 9 Nevelev, A.M., Sirenko, V.A., Gab, V.I., & et al. (Ed.). (1989). Ekonomika resursosberezheniia [Resource-saving economy]. Kiev: Nauk. Dumka, 247 s. [in Russian].
- 10 Bondarev, V.A., & Semenov A.S. (2014). Otsenka osnovnykh faktorov enerhosberezheniia [Assessment of the main energy saving factors]. *Sovremennye naukoiomkie tekhnologii*, No. 5-1, 228-229. [in Russian].
- 11 Sokolovskaya G.A., & Sigareva T.S. (1990). Resursosberezhnie na predpriiatiiakh [Resource saving in enterprises]. Moscow: Ekonomika. 156 s. [in Russian].