Improvement of the energy saving management system in the housing and utilities sector

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Abstract. The article aims to analyze the issues of energy-saving policies in the housing and utilities sector. The article studies the nature of energy saving measures. In the housing and utilities sector, energy saving depends on the efficiency of the energy saving management system. The article is aimed at 1) systematization of legal acts regulating energy saving at the federal, regional and municipal levels; 2) analysis of factors, principles, directions, objectives, mechanisms of energy saving policies. The control mechanism is an impact of the control subject on the control object. Energy saving subjects, objects and factors were identified. Energy saving factors were classified. Technological improvement of production, investing in production facilities should be a basis for energy saving policies. To search for new ways of rational use of energy resources and implement energy saving solutions, it is necessary to take into account capabilities of each participant in the energy saving management system of the housing and utilities sector. Energy saving is an interrelated set of scientific, methodological, technological, engineering, organizational, and economic measures. The energy saving program is a result of joint efforts of regional and local governments, businesses, experts engaged in solving ecological, housing and utilities problems.

1. Introduction

Our country has rich energy resources, but the climatic conditions of Russia require increased consumption of energy resources to create comfortable conditions for the population. In Russia, the total area of buildings is more than 5.0 billion square meters. According to the averaged data, almost 30 percent of the national annual energy resources are consumed for heating. About 40 percent of all energy resources are consumed for heating, electricity and water supply [1]. Therefore, when implementing energy saving programs, it is necessary to address the issue of efficient energy consumption.

In Russia, until the mid-1990s, energy saving policies were not regulated by the legislation. Over the last years, a number of Federal laws, Presidential decrees, Government resolutions, the energy strategy of Russia for the period up to 2030 were adopted. They declare principles, strategic guidelines, establish main components and mechanisms for implementing government policies and targeted programs at the federal, regional, and municipal levels.

The Russian energy sector has a lot of resources for internal sustainability, which allows it to shape the strategic course of its development on the basis of targets, rather than changing forecasts of external and internal conditions. The development of a new energy saving strategy is an obligatory condition for strategic planning in order to take into account new trends in economic and energy development, new technologies contributing to the development of the national energy sector [2].
The legal acts contributed to changes that determined conditions and significance of the factors influencing energy saving.

2. Materials and methods

The main incentive for energy saving is the price of energy resources. In Russia, rising prices of energy resources generated a need for developing energy-saving technologies in the construction, housing and utilities sectors. These objective conditions contribute to the awareness of significance of energy saving policies.

Federal Law N 261-ФЗ “On Energy Saving, Improving Energy Efficiency and Amending Legislative Acts of the Russian Federation” of 23.11.2009 regulates the issues of energy saving and energy efficiency. The act consists of 50 articles establishing organizational, economic, financial, legislative, and informational principles and mechanisms for energy saving and energy efficiency improving. Its goal is to create legal, economic and organizational fundamentals for stimulating energy saving and energy efficiency.

The act defines energy saving as a system of legal, organizational, scientific, industrial, technical and economic measures aimed at the rational use of energy resources and involvement of renewable energy sources in the economic turnover. Rational energy saving is economically viable efficiency of the use of energy resources in compliance with the requirements for environmental protection [3].

In the housing and utilities sector, the energy management system is a combination of subjects (federal, regional and municipal authorities, enterprises of the housing and utilities sector, consumers) and objects (laws, methodological, organizational, economic, economic, technological and engineering components). The control mechanism is an impact of the control subject on the control object using effective methods.

According to the “Strategy for Innovative Development of Russia up to 2030”, one of the indicators is the share of enterprises engaged in technological innovation activities [4, 5], including energy saving.

In implementing the strategy, enterprises should implement energy saving principles of (Fig. 1).

![Figure 1. Basic energy saving principles](image)

Figure 1. Basic energy saving principles

To solve the problem of energy conservation, it is necessary:
- to save material and financial resources by attracting external (extrabudgetary) funds (investing) in energy-efficient facilities and programs;
- to improve the economic and technical examination of construction and reconstruction projects;
- to develop financial maneuverability by using the most efficient forms of activities of energy-saving enterprises;
- to control energy consumption, since all these components are interrelated elements of the system of energy saving management in the housing and utilities sector [6].

Currently, energy saving factors are crucial. Due to the multiplicity of these factors, it is necessary to classify them by the main areas:
1. Regulatory factors are determined by public administration and regulation of energy saving processes aimed at achieving economic, environmental, social, political results in implementing energy conservation policies;

2. Resulting factors are determined by the organizational and economic role of the energy and utilities sectors in all spheres of life.

The classification allows for analysis of energy saving effects on production activities of enterprises taking into account market economic parameters: demand and supply, pricing mechanisms, and competition. These factors influence the implementation of energy-saving measures in the energy markets. Market mechanisms are a good lever. However, weak competition in energy markets and shortcomings of the pricing system do not contribute to the energy conservation.

The energy saving level is improved with the help of information support (Articles 17 and 18 of the Federal Law “On Energy Saving...” and in the Resolution of the Government of the Russian Federation N 391 “On the procedure for creating the state information system in the field of energy conservation and energy efficiency and conditions for its operation” of 01.06.2010” which involves accumulating information on modern organizational and technical technologies, financial methods, environmental protection, reducing energy intensity of products, implementing educational programs on energy conservation. The decree approved the rules aimed at determining the procedure for creating a federal system aimed at the energy conservation and energy consumption efficiency improvement[7].

Economic, organizational, scientific, technical, behavioral, and socio-environmental factors were referred to the resulting factors.

All the factors contributing to energy saving are important. The economic factors are prices, taxes, incentive mechanisms, penalties for energy wasting, financing resources.

Energy conservation is based on technical and technological improvement of production, investing in technological development. Energy saving projects can be funded by enterprises and governments. Bank loans, federal and regional subsidies and loans can become financial sources.

The significance of the economic factor is due to the fact that it influences both demand and supply of energy resources, scientific, technical and technological production contributing to energy conservation.

Organizational factors play a special role in energy saving. These are control over energy consumption, monitoring of large consumers of energy resources, creation of organizational structures and energy saving management systems. Organizational factors are regulated by the federal law “On Energy Saving” and a number of decrees of the Government of the Russian Federation.

Scientific and technical factors (research and development) are also very important.

Energy saving can be achieved by reducing energy wasting. With rising prices of energy resources, the demand for energy decreases.

Social, environmental and political factors also influence the energy saving policies. All these factors are combined because the demand for energy resources is always determined by economic growth, welfare of society, penalties for environmental pollution, and the federal export strategy.

We believe that this classification allows for monitoring of energy saving effects on production and identification of relations between energy saving factors.

To improve the energy conservation management process, it is necessary to change relations at the federal, regional and municipal levels.

3. Results

The direction “Energy Saving Management” has found a wide application in the regions of Russia. It involves control over the use of energy resources. Installation of metering devices speaks for the direct relationship between these devices and the demand for energy, as well as their results and quick pay-back [2].
In order to find new ways for the rational use of energy resources and implementation of energy saving solutions, it is necessary to take into account capabilities of each participant in the energy saving management process in the housing and utilities sector.

Energy saving management measures are as follows:
- reduction of need for energy resources;
- substitution of one resource for another one;
- reduction of energy consumption by industrial sectors.

The tasks arising in each direction complement each other.

The development of an energy saving management mechanism involves identification of levels and types of control, basic principles and methods for obtaining, processing and analyzing initial information. Impacts on the energy saving process are based on rational interaction of federal, regional and municipal governments.

The regional energy saving program is aimed at:
- creation of organizational, legal, economic, scientific, technical and technological conditions ensuring reduction of energy intensity of production;
- involvement of unused energy sources in the regional economy;
- coordination of interests of municipalities, producers and consumers of energy;
- improvement of the living standards of the population.

Development of regional regulatory acts makes it possible to improve the efficiency of energy saving policies. On May 5, 2014, the Government of Irkutsk Region adopted Resolution No. 234 “On Approval of the List of Mandatory Measures for Energy Saving and Increasing Energy Efficiency in Relation to the Property of Room Owners in Apartment Blocks Located in Irkutsk Region”. On December 2010, the Government approved “The Long-Term Target Program “Energy Saving and Improving Energy Efficiency in Irkutsk Region for 2011-2015 and until 2020”.

The program is aimed at reducing energy intensity of the gross regional product by increasing the efficiency of energy consumption; involving unused secondary fuel and energy resources into the fuel and energy balance of renewable energy sources; reducing expenses of the population and budget funds on energy resources and water; reducing expenses of budgets on reimbursement of incomes to power supply organizations; regulating utility rates [8]. To achieve these goals, the Program involves formation of energy efficient zones in Irkutsk region; creation of conditions for energy saving and energy efficiency in the public sector, housing stock, municipal infrastructure systems, economic sectors; creation of monitoring and information support systems.

At the municipal level, the energy saving policy is based on regional and local energy conservation programs. The municipal energy saving measures are short-term low-cost activities, medium-term projects contributing to the economic efficiency.

On June 28, 2016, the Administration of Irkutsk approved the municipal program “Energy Saving and Improving Energy Efficiency in Irkutsk for 2016-2021”.

The program is aimed to stimulate energy conservation and improve energy efficiency of the economy of Irkutsk [9].

The implementation of the program involves organizational, legal, technical, economic mechanisms aimed at improving energy efficiency in Irkutsk. The basis for energy-saving measures is a program-target method which determines target mechanisms for implementation of energy-saving measures.

The objectives of municipal energy conservation programs are as follows:
- encouragement of efficient production, transformation, delivery and consumption of energy resources;
- the use of energy-saving technologies, materials and equipment;
- equipment of real estate objects with energy consumption metering devices;
- energy audit;
- examination of design documentation in terms of energy saving issues;
- implementation of demonstration projects;
- economic, informational and educational activities.

Organizational and regulatory factors have the greatest impact on energy saving activities.

The energy saving efficiency level is determined by the level of consumption of fuel, materials, electric, thermal energy and water resources. These measures release part of energy. It is like a new energy source that does not require additional fuel combustion. Each unit of energy obtained through energy conservation is environmentally friendly.

According to statistics, in residential buildings, actual heat losses exceed the design values by 20–30. The level of thermal protection does not meet regulatory requirements. Old residential buildings require much heat and hot water supply which increases maintenance costs. Heat is lost through external wall fences (42% for 5-storey and 49% for 9-storey buildings). High specific heat consumption increases consumption of thermal energy which is 3.3 million Gcal per year. This can be seen from Table 1 [10].

Table 1. Comparative calculated assessment of large-panel housing construction in comparison with regulatory requirements for energy consumption and heat consumption.

| No | Indicator | Series |
|----|-----------|--------|
|    |           | 1–335 | 1–528 | 1–507 | ОД | ГИ |
| 1  | Average heat transfer resistance, sq. m°C/W, (actual) | 0,62 | 0,61 | 0,63 | 0,5 | 0,57 |
| 2  | Average heat transfer resistance, sq. m°C/W, (required) | 1,85 | 1,85 | 1,85 | 1,8 | 1,85 |
| 3  | Specific annual heat consumption per 1 square. m of the building (actual) | 237 | 256 | 271 | 284 | 367 |
| 4  | Specific annual heat consumption per 1 square. m of the building calculated after insulation | 132 | 133 | 134 | 136 | 202 |

The analysis of cost of energy resources consumed by the buildings showed that improvement of performance characteristics of buildings is of great importance for the Russian economy. It is one of the directions of the energy saving policy.

4. Discussion

As part of the energy saving strategy, federal targeted programs for improving the energy efficiency of buildings have been developed and are being implemented, but at the regional and municipal levels, their efficiency is not high. The analysis shows that energy saving programs have to be connected with capital repair programs based on the results of mandatory and voluntary energy examinations of buildings [11].

The urgency of measures aimed at modernizing the utilities using innovative forms is due to the fact that depreciation of fixed assets is more than 60% [12]. Implementation of energy saving programs and measures is hampered by a number of technical factors, building design features. Thermal unit slack regulators that would reduce the heat supply when the outside temperature rises. There are no thermostat radiators that would reduce heat consumption. Most apartments lack radiator faucets that would reduce heat consumption. To save water resources, we have installed individual metering devices. To save heat, we need these devices as well.

Innovation policies are designed to increase production efficiency, reduce resource-intensity of industries, implement resource-saving technologies [13-15]. For successful implementation of energy-efficient technologies and technical solutions, the following regulatory measures are used:
- energy passports of municipalities, enterprises, civil buildings and structures;
- heat, electricity, hot and cold water, gas consumption limits, increasing cost of overconsumption;
- rational heat supply management schemes taking into account the integration of small and medium-sized centralized heat supply facilities in order to create a corporate management system;
- public conditions regulating civil law relations between public utility companies and consumers of public services;
- adoption of documents that establish requirements for the quality of water and heat supply; order of hot, cold water and heat energy consumption accounting; order of housing and utilities pricing; thermal requirements for buildings.

The main directions of price and tariff regulation in the system of energy saving factors are as follows:
- direct state regulation of prices (tariffs) of products of the natural monopolies;
- indirect government control over the dynamics and ratio of free prices in other economic sectors;
- improvement of competitiveness of domestic enterprises producing energy-intensive products, reducing the energy component which will ensure the rise in prices of energy resources;
- reasonable increase in unitalties costs [5].

The administrative components of the energy saving policy are as follows:
- revision of existing norms, rules and regulations aimed at tightening the requirements for energy saving;
- improvement of the rules for control over energy consumption;
- development of energy standards, penalties for their violation, including higher fees for inefficient energy consumption;
- compulsory certification of energy-using devices and equipment for compliance with the specified level of energy consumption;
- regular energy audit of enterprises;
- encouragement of energy saving.

Standardization and certification measures in the field of energy consumption and energy saving are as follows:
- development of technical standards for energy saving;
- revision and development of state standards for energy-using products, fuel and energy resources and materials;
- development of federal standards for energy consumption measurement devices and measurement accuracy standards;
- development of standard procedures for certification of energy-consuming products.

5. Conclusion

Energy saving is an interrelated set of scientific, methodological, technological, engineering, organisational, economic and business activities.

The priority directions of the energy saving policy are as follows:
1) conservation and rational use of natural resources in manufacturing products (or providing services);
2) a significant increase in the degree of processing and reduction of losses of material resources;
3) full use of secondary material resources and waste, improvement of the economic efficiency of industrial production and prevention of its harmful effects on the environment.

Energy saving is a significant factor of the balanced economic development taking into account interests of the present and future generations.

The energy saving program is a result of joint efforts of regional and local administrations, business and experts engaged in solving problems of the energy, housing and utilities sectors as well as environmental problems.
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