Economic Indicators Improvement due to the Introduction of Energy-Efficient Technologies

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Abstract. The paper describes issues concerning energy efficiency improving in the Russian power engineering economics. The energy efficiency applicability, the technical and the economic energy efficiency potential, the government energy efficiency tools are substantiated. The results of energy efficiency program implementation are presented.

1 Introduction

In the last 10 years energy efficiency is considered as a central factor in ensuring competitiveness of both individual companies and the industry as the whole, as well as the national economy. The energy efficiency can be described as a unique potential [1], which helps the economic growth, long-term energy security and even human well-being and health improvement. Decreased energy consumption was provided by the investments in energy efficiency that exceeded the other energy resources production in many countries. But at the same time, the experts note a significant lag in the field of energy efficiency of the Russian national economy compared to other countries. Russia takes the fourth place in the world in regards to energy consumption. However, it consumes more energy per unit of GDP than other countries among the ten largest energy consumers. By analysing the data from International Energy Agency (IEA), it can be concluded that the Russian rating is raising. According to these data, Russia was on the 12th place among the 121 countries in terms of energy volume of economics in 2009. It was moved to the 15th place in 2017. The World Bank showed that Russia can save about 45% of the total consumption of primary energy every year, if the energy efficiency measures are taken. The \$ 320 billion investments by private and public organizations are necessary to realize the energy efficiency potential. Energy efficiency investments will be paid off in 3 years at the national economics level [2,3]. Russia will be able to save 340 billion kWh of electricity, 240 billion cubic meters of natural gas, 89 million tons of coal, 43 million tons of oil products in terms of crude oil after realization of its potential for energy efficiency increasing [4-6]. According to the practice, the energy efficiency is 3 times cheaper than the energy resources production increasing [7].

2 Improving energy efficiency in Russia

The fearsome argument that influences the urgency of the task of improving energy efficiency is the climate change. The International Energy Agency and the Organization for Economic Cooperation and Development (OECD) identified challenges in the structure and energy efficiency of energy in the following way: "At the global level, energy intensity of GDP and the carbon intensity of primary energy consumption should be reduced by about 60% by 2050 compared to the today's level". The International Energy Agency proposed three possible options for further development of energy for the period until 2050:

1. A scenario that leads to disastrous consequences. Unfortunately, at present the world is moving precisely towards it. According to forecasts, the ambient temperature can rise by 6 °C (6DS).

2. A scenario that reflects the initiatives that many countries have announced with regard to reducing emissions and improving energy efficiency. In this scenario the outlook is not so sad and presumably the ambient temperature will rise by 4 °C (4DS).

3. A scenario that offers the latest concept of developing a balanced energy system with a reduction of greenhouse gas emissions, including carbon dioxide (CO₂). As a result, the ambient temperature will rise by 2 °C (2DS) [7].

The goal of many countries in the world is to reduce the absolute consumption of energy that is obtained from fossil carbon fuels. This goal is related both to ensuring energy security (exhaustion of cheap hydrocarbon reserves and uneven distribution of those reserves) and the consequences of burning carbon fuels for the climate.

The Russian economy is characterized by a high level of energy intensity and is the fourth largest in the world in terms of total energy consumption. In Russia the manufacturing industry holds the first place in

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regards to energy consumption and the second place is occupied by the housing sector.

Special attention was paid to five strategic areas at one of the annual meetings of the commission on modernization and technological development of the Russian economy. These strategic areas include energy efficiency and energy saving which have priority technological development.

According to the Russian Minister of Power Engineering A. Novak, development of energy efficiency and energy conservation is an important point in the development of the entire Russian economy and increasing its competitiveness in the world. Figuratively, the increase in energy efficiency can be compared with the fifth type of fuel. In 2008 the president of Russia set a goal by his decree - to reduce by 2020 the energy intensity of the gross domestic product by at least 40% of the 2007 level. In the recent years experts have been observing the rate of energy intensity decrease, but in general, for period from 2008 to the present, the decrease is about 13%, which is much lower than the planned one. What could affect this significantly? Let us note several objective reasons:

1. The understated growth of gross domestic product over the period under review.
2. Structural changes in the economy which have not finally reached their goals.

We can say that the goal designation and the beginning of the system work was laid [8].

In 2009, the Federal Law on energy conservation and energy efficiency was enacted (Federal Law No. 261-FZ of November 23, 2009 "On energy conservation and on improving energy efficiency and on amending certain legislative acts of the Russian Federation") [9]. Virtually all sectors of the Russian economy have the potential to increase energy efficiency, but fuel and energy complex, industry, housing and communal services, transport and the public sector have the best ones. By now, 55 regional energy supply centers were created and 78 regional energy laws were adopted by the subjects of the Russian Federation. To comply with the world practice in the field of energy efficiency, a regulatory and legal framework has been created, which was proved quite successful in recent years. This is confirmed by the 17th place of Russia according to the rating of state regulation in the field of energy efficiency of the World Bank. Russia was able to enter the list of leaders which is a breakthrough and gives prerequisites for further development.

Nowadays there are several main areas for the implementation of the state policy in the field of energy efficiency and energy saving.

The first direction is the introduction of energy management at the state level, which will allow to form a public energy management system and which will contribute to an increase in energy efficiency up to 5%. Key points of this direction are energy efficiency indicators and sectoral responsibility. There is a need to add indicators to government programs. Despite the fact that not all changes have been accepted, most state programs do have them. As for the fuel and energy complex, it already includes 7 sectoral indicators of

energy efficiency. For example, these are the specific consumption of electricity for oil transportation and gas transportation, specific consumption of fuel equivalent for electricity production (five-year observations showed a 9% decrease in this indicator); the useful use of associated petroleum gas. Here we can draw an unambiguous conclusion about the positive dynamics.

Similar work can be observed in other large industries and companies. According to statistics, about 2/3 of the largest companies have implemented energy management long ago [10]. In accordance with the Federal Law, state and regulated companies implement special programs for energy conservation and energy efficiency necessarily. The boards of directors periodically review these programs. The program realization constitutes in significant savings of heat and electric energy and in introduction of modern technologies.

The second direction can be considered as the issue of the policy inclusion of information on the achievement of energy efficiency indicators in the public corporate reports of the largest state-owned companies. In autumn 2017 the government supported and submitted a Federal Law project to the State Duma, which provides the transition to the sectoral principle of forming requirements for energy efficiency programs. This Federal Law was introduced to improve work in this area and improve energy efficiency.

Thus, all sectoral departments form their own requirements for energy saving programs of state companies in their industries. The state program of the regions also includes the necessary indicators. At the moment, energy efficiency indicators are included in 63% of regional sectoral government programs. To this end, a tremendous effort was made to train 40,000 municipal and state employees.

The annual Federal State report confirms the energy efficiency of enterprises and regions with public ratings. This technique allows benchmarking and highlighting best practices. For example, in several regions LEDs were introduced into the public sector. In the city of Vladimir over the past 3 years the traditional street lighting has been replaced with LED lighting, it is about 44% if compared to a percentage. This resulted in economy of more than 30% of power. The illumination of Moscow was increased by 40%. In Kazan a project for the modernization of heating was implemented, according to which 1.4 thousand individual heat points with automatic control was installed. This project in turn allowed decreasing the population total payments for heating. The work on the preparation and implementation of standards for the openness of government bodies (which necessarily includes energy saving [8]) is in full progress within the framework of the open government in 60 regions of Russia.

The functioning public sector monitoring information system is aimed to increase the number of buildings that have reached the permissible energy efficiency class in the process of overhaul. By means of such a system we can identify the potential savings. The Moscow region was the first to implement such practice of control and planning. 80% of the total number of state and municipal

institutions in the country is already included in the system. The main goal is to provide annual information to the system, and the information provision is planned to be made mandatory. This bill passed the second reading and was submitted to the State Duma.

The third direction of state policy is to introduce technological and environmental regulation concerning energy saving issues. The main points in this direction are the use of the latest available technologies, energy-efficient requirements and standards. The Ministry of Power Engineering has prepared projects of guidelines for the best available technology (BAT) with respect to energy efficiency for the fuel and energy complex. Innovative technologies occupy the main positions here. They can claim the role of a new industry standard. We can take "smart" electrical networks and digital substations as an example. After introduction of such technologies in the Kaliningrad region a reduction in energy loss of 45% was recorded. In technical regulation the use of LEDs for lighting gives us a good example.

Since 2017 there is a ban on the purchase of non-energy-efficient light sources for state and municipal institutions. The goal by 2020 was to demand bringing the share of LED lighting to 75% as an additional responsibility of regulated organizations [11,12]. Compiled and approved set of rules obliges the use of LED light sources when designing street lighting. The use of LEDs in the public sector has made significant savings in cash per year. If we roughly calculate the size and potential savings then according to the most conservative estimates it can be about 200 billion rubles a year while consumption is at least 12% of the total electricity consumption. Obviously it is quite real to save 40% of consumption. If we study the international practice, every month there is new measures aimed to ban incandescent lamps. More than 100 countries have taken such measures. In Russia measures to reduce the permitted threshold for incandescent lamps from 100 to 75 or 50 W is planned to introduce in the next two or three years. An obligatory condition for taking such measures should be the introduction of a minimum warranty period for the product and the introduction of certification. Our industry's readiness to replace the most sold lamps with energy-efficient lamps [9] is high.

The formation of an economic stimulus can be highlighted as the fourth direction of state policy. The funding will accelerate the growth of energy efficiency projects. As international practice has shown, the most significant points are the set prices of energy resources in our region, investment surcharges, excises and fees for harmful emissions.

We have all the socio-economic opportunities for carrying out and implementing such events [9]. For example, this includes a new model of the heat market, fines for associated petroleum gas, stimulating the withdrawal of inefficient generation and its modernization. Moreover, there are promising proposals for new modernization projects.

Since 2016 a mechanism of tax incentives for energy efficient equipment has been developed and successfully put into operation together with the Ministry of Industry and Trade. The list is approved by a government decree

and gives the right to use property tax concessions and accelerated depreciation. This is the essence of economic recoupment and economic stimulus, which can become the driver of investment. There is a positive experience with the extension of subsidies distributed from 2011 to 2018 (about 10 billion) [13]. The projects in the subjects of the Russian Federation were co-financed and extrabudgetary funds and subject funds were raised thanks to them. The attraction of additional investments is in the range of 10 to 20 rubles per each ruble. As a result of the calculations the Ministry of Economic Development plans to consider extending and improving such an incentive system [8].

The fifth direction is the promotion of energy saving. Our regions have been actively involved in the implementation of this direction [14] and have done a great job. Undoubtedly, this is a step forward. Of course, we have considerable potential and much remains to be done.

The energy efficiency and energy saving is an interdisciplinary task which affects all areas of activity. In order to intensify the work and increase efficiency in the field of power engineering, the Ministry of Economic Development has developed and approved a comprehensive plan to increase the economy, which in turn affects all sectors of the economics. For today the project is undergoing an approval procedure. The state policy of Russia is intersectoral, the indicator of energy efficiency and energy intensity of the economy is included in the state program "Economic development and innovative economy" [15].

Also, work on inclusion of our federal sectoral ministries in all government programs and assigning an annual report on the state of energy conservation on the Ministry of Economic Development continues and improves.

3 Conclusions

The structure of the energy balance of any country can be viewed both from the point of view of commercial interests of specific energy producers, the state, and from the point of view of the interests of final consumers [1]. The development of the economy, especially in the part of energy-intensive industries, is directly related to the cost of energy resources [7]. It becomes important to understand the influence of the generation structure on the formation of the price of electricity. The strategy for the development of energy capacities should take into account the interests of all consumer groups, including the population.

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