ECONOMIC THEMES (2024) 62(4): 447-456

DOI 10.2478/ethemes-2024-0024

IMPLEMENTATION OF GOVERNMENT POLICY AND INTERNATIONAL ECONOMIC COOPERATION IN THE RENEWABLE ENERGY SECTOR OF THE REPUBLIC OF SAKHA (YAKUTIA)

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UDC 620.92:339.5(470.23 Yakutia)

Review paper

Received: 25.10.2024
Accepted: 25.12.2024

Abstract: The research analyzes the specifics of implementing regional programs to underpin the development of renewable energy sources in the Republic of Sakha (Yakutia) and the experience of foreign economic cooperation in this field. The law of the Republic of Sakha (Yakutia) on renewable energy sources is considered. The analysis of the directions of state support provided to energy producers on the basis of renewable energy sources in accordance with the above-mentioned law was performed. Also the economic evaluation of generating facilities for renewable energy was carried out. A scheme for the state authorities' competence of the Republic of Sakha (Yakutia) in the renewable energy sector has been developed, as well as a scheme of supporting measures likely to increase the investment activity of energy efficiency projects in the field of renewable energy. A conclusion is made on the progressive development of the renewable energy sector in the region and increasing the energy security of small settlements in the decentralized energy supply sector.

Keywords: renewable energy sources, renewable energy sector, law on renewable energy sources, energy efficiency, foreign economic cooperation.

JEL classification: F53, Q48, Q42

Introduction

The state policy in the field of renewable energy sources in the Arctic zone of Russia is implemented within the framework of a set of programs for direct and indirect support of renewable energy sources. In particular, it is formed in the field of regional and national economic directions, structures and legislative measures of an infrastructural nature, as well as in the form of foreign economic cooperation. Renewable energy development support programs, implemented by the regional

authorities in the Arctic zone of Russia, have their own specifics. Due to harsh natural conditions and high energy intensity of the economy, the Republic of Sakha (Yakutia) belongs to the regions showing interest in self-maintenance of a decentralized energy system. At the same time, the local energy market tends to expand, while the cost of imported fuel increases. The task of the article is to examine the mechanism for optimizing local energy, which provides certain resources for the design of renewable energy facilities and interaction with federal authorities for the purpose of co–financing, as well as foreign economic cooperation.

The main contents

In the Republic of Sakha (Yakutia), the following renewable energy development programs were approved by the regional authorities:

"Energy saving and energy efficiency improvement for 2024-2027 and for the period up to 2032" — with a total budget of 22 billion rubles ($220 million), of which more than 13 billion rubles are financed from extra-budgetary sources, the state budget of the Republic of Sakha (Yakutia) and local budgets account for 3.6 billion and 298 million rubles, respectively; "Energy Efficient Economy for 2024 - 2027 and for the period up to 2032" — with a budget of 12.9 billion rubles for 2024-2032. Of these, 294 million rubles are allocated from the federal budget, the state budget of the Republic of Sakha (Yakutia) and local budgets account for 3.5 billion and 339 million rubles, respectively, the amount of financing from extra-budgetary sources is 8.8 billion rubles. The purpose of these programs is to reduce the energy intensity of the gross regional product of the Republic of Sakha (Yakutia) by 50 percent by 2032 and to form an energy-efficient society in the region.

The subprogram of the above-mentioned programs "Development of renewable energy sources and alternative fuels, innovative energy-saving technologies and projects" provides for the implementation of such directions and activities as the use of energy-saving technologies, partial transfer of local energy to alternative, renewable energy sources; reducing the cost of generating electric energy by diesel power plants due to a reduction in diesel fuel costs at the expense of the gradual replacement of diesel fuel production with renewable energy sources and giving small nomadic consumers opportunities to utilize electricity from the usage of renewable energy sources. In accordance with the specified subprogram, by 2032 It is expected to reduce diesel fuel consumption through the agency of implementing the above measures by 1,738 tons (for the entire duration of the subprogram), as well as ensuring the production of electricity using renewable energy in the amount of 5,100 MWh (during the entire duration of the subprogram).

According to this subprogram, by 2032, in the Arctic regions of the Republic of Sakha (Yakutia), it is planned to build wind power plants with a total capacity of 1,350 kW to meet the electricity needs at agricultural facilities remote from the grid

in the settlements: Bykovsky, Pokhodsk, Chokurdy, Nizhneyansk, Saskylakh. The total capital costs of the construction of wind power plants in these settlements will amount to 3 million rubles. In addition, the above-mentioned program during its implementation period includes the commissioning of a mini-hydroelectric power plant in the village of Yuryung-Khaya of Anabar ulus with a design capacity of 250 kW and capital investments in the amount of 39.5 million rubles ($395 thousand) (Morgunova and Kovalenko, 2021).

It should be emphasized that financing of measures for the construction of wind power plants in the settlements of Bykovsky, Pokhodsk, Chokurdy, Nizhneyansk, Saskylakh within the framework of this subprogram is planned in the amount of 534 million rubles ($5.34 million) from extra-budgetary sources (Sergeeva and Monich, 2017).

In addition, within the framework of the above-mentioned programs and foreign economic cooperation, a project is currently underway to build a wind-diesel energy system in the village of Tiksi. This system will include three wind power plants with a total capacity of 900 kW, as well as diesel generators with a capacity of 3 MW. The capacity of the wind diesel system will be 3.9 MW. The contractor of the facility is "PJSC Mobile Energy", which carries out the design, construction and commissioning of a wind diesel system. This project is implemented with the participation of the Japanese company *Komaihaltec inc.*, which has developed its feasibility study. The capital costs for the construction of this energy system, which is scheduled to be completed in 2030, will amount to 600 million rubles ($6 million). As a result of the project, diesel fuel savings will amount to 227 tons annually (RAWI, 2024). The operating costs of the generating facility g in the i calendar year (OC_g^i) are calculated using the following formula:

$$OC_g^i = OC_g^{2030} \times \sum_{j=2030}^{i-1} CPI_j \ , \qquad (1)$$

where OC_g^{2030} is the value of specific operating costs, assumed for 2030 to be equal to 741 thousand rubles per 1 MW per month (Resolution of the Government, 2013);

The CPI is the value of the consumer price index in December of the j year by December of the year j-1, determined and published by the federal executive authority that performs the functions of forming official statistical information.

Therefore, based on formula (1), the value of the specific operating costs of this wind diesel system is:

OC_g^i = (741000 × 2.5%) × 4 MW = 74100 rubles per month = 74100 × 12 = 889,200 rubles per year

The economic assessment of the operation of the wind diesel energy system is carried out using the net present value (NPV) indicator, which is determined by the formula:

$$NPV = \left[\frac{W_1}{1+r} + \frac{W_2}{(1+r)^2} + \cdots + \frac{W_n}{(1+r)^n}\right] - I_0\,, \qquad (2)$$

where W_1, W_2,... W_n is the annual effect obtained from the total operation of wind turbines and diesel power plants;

n is the service life of wind turbines;

r is the real interest rate;

I_0 is investments in wind power plants and a diesel power plant.

Then, using expression (2), the NPV of the wind diesel system will be:

$$NPV = \left[\frac{13\,638\,800}{1+0{,}215} + \frac{13\,638\,800}{(1+0{,}215)^2} + \cdots + \frac{13\,638\,800}{(1+0{,}215)^{10}}\right] - 600\,000\,000 = 17\,394\,239\ rubles$$

Accordingly, the NPV of this project for 2030-2040 will amount to 17.39 million rubles ($170 thousand), and the discounted payback period is 10 years.

Among the implemented renewable energy projects in recent years in the Arctic zone of Russia within the framework of the designated regional programs and the development of foreign economic cooperation, it is worth to mention the Batagai solar power plant, launched in the late 2010s, which is the largest photovoltaics facility beyond the Arctic circle. The construction of a solar power plant in Batagai was the result of the Agreement on cooperation in the field of renewable energy development signed by Energy System Vostok Holding and the Government of the Republic of Sakha (Yakutia), as well as the cooperation with the Russian-French company Helios Strategia. The objectives of this project include reducing the dependence of the village's energy supply on expensive imported fuel, replacing the reconstructed capacities of the only source of electricity – Batagayskaya diesel power station. The relevance of the project is due to the fact that Batagai is one of the leading centers of industrial development in the northern part of the Sakha Republic (Yakutia), but at the same time it has a low level of transport infrastructure development — normal traffic along the highway to Yakutsk is possible only in winter, most of the goods are delivered by river transport in summer, although this route is 2,800 km from the capital of the Republic of Sakha (Yakutia). In addition, the construction of the solar power plant in Batagai will ensure a continuous supply of electricity to consumers in the industrial and residential sectors, as well as create the required reserve of electrical

power. Thus it will increase the safety of power supply to the Batagai power station during the autumn-winter peak loads (Pilyasov and Goncharov, 2023).

The Batagai solar power plant includes 3,472 polycrystalline panels with a capacity of 300 watts each. It is important to note that the station's equipment meets the increased work requirements imposed by the extreme climate of this region: it can be operated at temperatures of +40 °C in summer and -45°C in winter, taking into account that the cloudless winter in Batagai lasts eight months a year, and in the spring and summer months the level of insolation here is approximately the same as in the southern regions of Russia. The power of the solar station is 1000 kW. The first stage of the solar plant generates approximately 1.2 million kWh per year, as a result of which the Batagai energy industry can reduce purchases of diesel fuel for the village by 300 tons per year and therefore save 16 million rubles. This project provides an increase in the installed capacity of the station to 4 MW. The solar power plant is integrated into the existing power supply system of the village and, together with the existing diesel power station in Batagai, is a single energy complex. The capital costs for the construction of this solar power plant amounted to 156.7 million rubles ($1.56 million).

Thus, based on formula (1), the value of the specific operating costs of the Batagai solar power plant is:

$$OC_g^i = (741000 \times 2{,}5\%) \times 1\text{MW} = 18525 \text{ rubles per month} = 18525 \times 12 = 222\,300 \text{ rubles per year}$$

Then, using expression (2), the NPV of the Batagai solar power plant will be:

$$NPV = \left[\frac{15\,777\,700}{1+0{,}215} + \frac{15\,777\,700}{(1+0{,}215)^2} + \cdots + \frac{15\,777\,700}{(1+0{,}215)^5}\right] - 156\,700\,000 = 38\,086\,420 \text{ rubles}$$

Accordingly, the NPV for this project for 2020-2025 will amount to 38 million rubles ($380 thousand), and the discounted payback period is 5 years.

It is worth mentioning one of the first projects of *Energy System Vostok Holding* in the Arctic part of the Republic of Sakha (Yakutia), implemented in 2010s with the participation of the German component manufacturer *SMA Solar Technology AG* in the village of Batamai. The first pilot solar station was launched in this locality. The experimental solar station included 52 solar panels with a total capacity of 10 kW. After the completion of the first year of use, taking into account the economic benefits from the operation of the station, the *Holding* carried out its modernization. Currently, there is a multifunctional autonomous energy complex in the village, including a 160 kW diesel power plant, a 60 kW solar power plant and 86.4 kWh electricity storage systems. The implementation of this pilot project has led to a reduction in Batamai's dependence on seasonal diesel fuel supplies and increased energy security.

Also, it is worth to point out about the positive experience provided by the "cluster" construction method used for the first time during the implementation of the project: in the process of the solar station launch in Batagai, several more projects were built geographically close to each other, which made it possible for *Energy System Vostok Holding* to reduce the cost of building small power stations in the villages of Betenkes and Stolby located near Batagai.

In 2017-2023, solar power plants were commissioned in the village of Yunkur of Verkhoyansky ulus (40 kW), the village of Betenkes (40 kW), the village of Stolby (10 kW) and the village of Ulu of Aldansky ulus (20 kW). These solar power plants have been combined with the existing diesel power plants in the villages and partially replace their generation.

The conducted economic assessment of the operation of renewable energy generating facilities indicates that in decentralized energy districts with high cost of electricity generated at diesel power plants, renewable energy projects that increase energy efficiency, have a noticeable economic effect in terms of reducing energy supply costs to consumers.

In addition to these programs, in 2014 the Republic of Sakha (Yakutia) adopted a law on renewable energy sources aimed at:

- formation of a legal, economic and organizational framework for stimulating energy conservation and energy efficiency in the Republic of Sakha (Yakutia) by increasing the share of energy generated using renewable energy sources in the energy balance of the Republic of Sakha (Yakutia);
- Improving energy security through the use of renewable energy sources;
- reducing the negative impact on the environment through the application of renewable energy technologies;
- reduction of non-renewable energy sources consumption within the Republic of Sakha (Yakutia) (Law of the Republic of Sakha, 2014).

Materials and methods

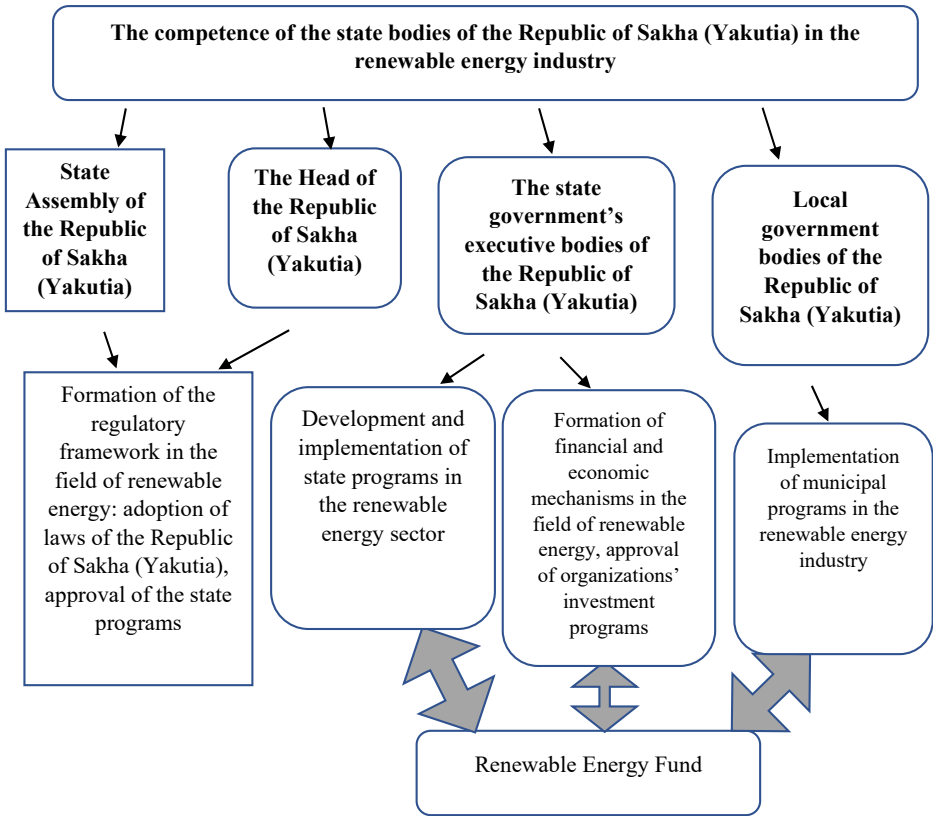
The research materials were the regulatory framework of the Republic of Sakha (Yakutia) and analytical information provided by the Government of the Arkhangelsk region. As part of the research, the author used the method of complex economic analysis, the method of system analysis, the method of multifactor analysis, the use of which, together with the modeling method, allowed building of several graphical models.

Research results and discussion

Tee analysis of publications in the field of renewable energy development in the Arctic zone of Russia has shown that there is limited information about the

specifics of the implementation of regional programs to support the development of renewable energy sources in the Republic of Sakha (Yakutia), published in the works of Popel, Kiseleva, Morgunova (Popel et al., 2015), Gabderakhmanova, Tarasenko (Gabderakhmanova et al., 2016), Pilyasov (Pilyasov, 2011), Nefedova (Nefedova et al., 2022). Figure 1 shows a diagram of the state authorities' competence in the renewable energy sector.

Figure 1. The scheme of the state authorities' competence in the renewable energy industry



Based on the examined literature, the following measures of state support, provided to renewable energy producers in accordance with the above-mentioned law, are proposed:

- implementation of a tariff policy aimed at stimulating the use of energy generated from renewable sources, including ways of long-term (at least ten years) use of savings obtained through the consumption of renewable energy, in accordance with the federal regulatory legal acts and normative legal acts of the Republic of Sakha (Yakutia);

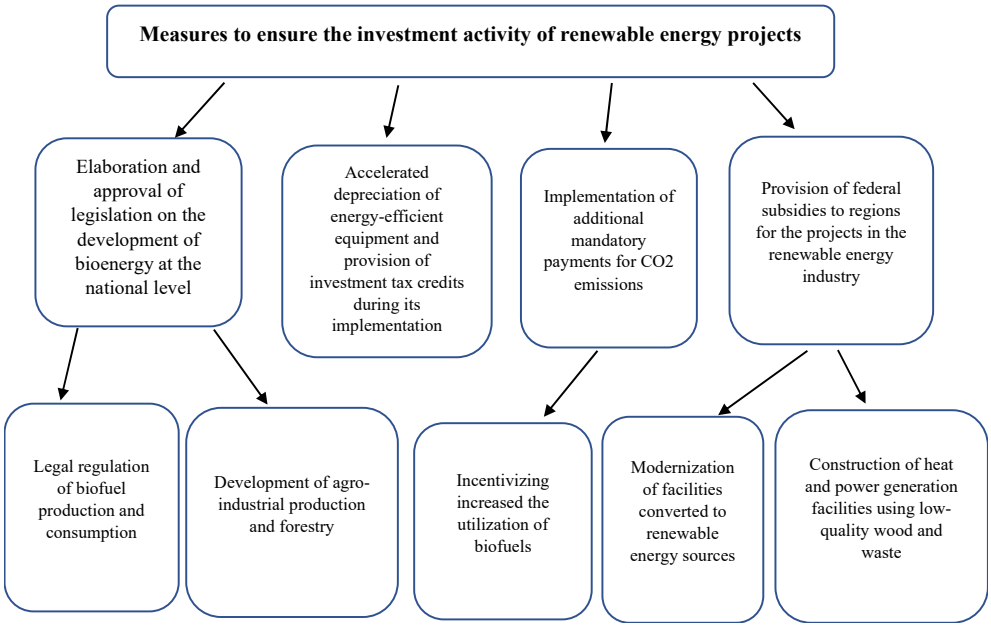
- creation of mechanisms to stimulate the investment activity in a favorable investment climate, with the attraction of credit resources for the implementation of renewable energy projects;
- support for the implementation of efficient technologies and installations for the usage of renewable energy sources;
- application of tax benefits according to the legislation on taxes and fees;
- the use of incentive methods for conducting the research and development work in the field of renewable energy sources;
- support for legal entities, individuals, and individual entrepreneurs engaged in the design, construction, production and operation of installations for the use of renewable energy sources within the Republic of Sakha (Yakutia);
- creating favorable conditions for attracting extra-budgetary funds to investment projects involving the use and development of renewable energy sources, as well as at the expense of the state budget of the Republic of Sakha (Yakutia) and through the use of public-private partnership mechanisms;
- creation of favorable conditions for the conclusion of energy service agreements, the subject of which is the fulfillment by the contractor, the actions aimed at improving the efficiency of energy resources usage on behalf of a customer by replacing non-renewable energy sources with renewable ones;
- Creation of a renewable energy fund to financially support the policy of the Republic of Sakha (Yakutia) in the field of renewable energy development.

The financing resources of the aforementioned renewable energy fund may include:

- savings resulting from the implementation of measures to replace the used non-renewable energy sources with renewable ones (The government of the Arkhangelsk region, 2015);
- Appropriations allocated from the budget of the Republic of Sakha (Yakutia), including the funds corresponding to cost savings resulting from the measures to replace used non-renewable energy sources with renewable ones;
- federal budget funds received for the implementation of regional energy saving programs in accordance with the Rules for Granting subsidies from the Federal budget to the budgets of the constituent entities of Russia for the implementation of regional programs in the field of energy saving and energy efficiency improvement, approved by the decree of the Federal Government (Law of the Republic of Sakha, 2014).

In addition, according to the author, the increase in investment activity of energy efficiency projects based on renewable energy sources in the Republic of Sakha (Yakutia) will be facilitated by the adoption of a number of additional measures at the federal level. Figure 2 shows a scheme of auxiliary measures that may increase the investment activity of energy efficiency projects in the renewable energy sector.

Figure 2. Scheme of auxiliary measures aimed at increasing the investment activity of energy efficiency projects in the renewable energy industry



Conclusion

Thus, summarizing the above analysis of renewable energy development programs in the Republic of Sakha (Yakutia), we can conclude that in recent years the region has seen progressive development of the renewable energy sector in the form of regional projects and within the framework of foreign economic cooperation. This, in turn, will lead to a decrease in the dependence of the Arctic region on the purchase of expensive energy resources, along with the reduction of subsidies from regional budgets for local energy and increase the energy security of small settlements of the decentralized energy supply sector due to the continuous supply of electricity to consumers in the industrial and residential sectors, as well as the creation of the necessary reserve of electric power.

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SPROVOĐENJE DRŽAVNE POLITIKE I MEĐUNARODNE EKONOMSKE SARADNJE U SEKTORU OBNOVLJIVIH IZVORA ENERGIJE REPUBLIKE SAHA (JAKUTIJA)

Apstrakt: Istraživanje analizira specifičnosti sprovođenja regionalnih programa za podršku razvoju obnovljivih izvora energije u Republici Saha (Jakutija), kao i iskustva međunarodne ekonomske saradnje u ovoj oblasti. Razmatran je zakon Republike Saha (Jakutija) o obnovljivim izvorima energije. Izvršena je analiza pravaca državne podrške proizvođačima energije na bazi obnovljivih izvora, u skladu sa pomenutim zakonom. Takođe je sprovedena ekonomska procena proizvodnih postrojenja za obnovljive izvore energije. Razvijena je šema nadležnosti državnih organa Republike Saha (Jakutija) u sektoru obnovljive energije, kao i šema mera podrške koje bi mogle da povećaju investicionu aktivnost u projektima energetske efikasnosti u oblasti obnovljivih izvora energije. Donet je zaključak o progresivnom razvoju sektora obnovljive energije u regionu i povećanju energetske sigurnosti malih naselja u sistemu decentralizovanog snabdevanja energijom.

Ključne reči: obnovljivi izvori energije, sektor obnovljive energije, zakon o obnovljivim izvorima energije, energetska efikasnost, međunarodna ekonomska saradnja

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Oleg Dubinskii is a scientific fellow at the Faculty of Business, Management and Economics at the University of Latvia in Riga. His research focuses on the economic impact of the renewable energy sector.