Prospects of the use of alternative energy sources in an ecological economy

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Abstract. The use of alternative energy sources in Russia should be considered as an important factor in the modernization of the productive forces, contributing to the solution of a number of important economic, social and environmental problems. One of these energy sources is biogas, which is used to produce two types of energy simultaneously: heat and electricity. The article substantiates the need for the introduction of biogas technologies, primarily in livestock complexes, and in the agro-industrial complex as a whole, for the processing of agricultural waste and the production of highly effective organic fertilizers. It is possible to use waste-free production technologies not only at large, but also at medium and small enterprises, and above all in eco-farms of various types. On the example of the farm “Lily of the Valley” of the campaign of JSC Green Valley of the Belgorod region, the cost and economic efficiency of a biogas plant for a year were calculated and its payback period was established. Conclusions are drawn that for faster implementation of biogas plants, it is necessary to pay attention to the experience of Western countries in the issues of state support for the development of dairy farming in terms of the use of administrative resources. So, as an example, to oblige the nearest enterprises to buy surplus electricity produced with the help of renewable energy sources at a reduced rate; to give a subsidy for each installation in the amount of 50% of the average cost; at times to increase fines for violating environmental legislation; develop tax incentives for those organizations that will comply with the technology of waste-free production.

1. Introduction
In 2020, humanity faced an unprecedented global economic crisis, caused by the coronavirus pandemic, which, without exaggeration, engulfed:

- all countries of the world,
- all regions of the world,
- all farms in each of the regions – and therefore, without exaggeration, became the first truly global crisis.

Many countries are currently actively conducting foresight studies, which analyze all possible scenarios for both future crises and long-term development of technology and other forms of innovation at the national and international levels. This methodology, which has been used since the 1970s, allows for complex integrated forecasts of changes in the field of innovation, regional economy, and science.
At the same time, the Russian government takes a very active position on this issue, in particular, on an ongoing basis, encouraging the progress of innovative technologies that allow creating an environmentally safe economy and, more broadly, the environment of human habitation.

At the same time, as world economic practice has repeatedly shown, the foresight-long – term forecast in this situation again did not work—there was not a single serious study that provides for such a scenario for the development of the world and regional economies in the near future.

The global crisis has also shown the urgent need for:

- maximum self-sufficiency of each national and regional economy with both energy sources and goods and services;
- development of "green" technologies, energy resources, production of goods and services that have a minimal harmful impact on both consumers and the environment;
- maximize the savings of resources and energy sources and the progress of renewable energy sources.

After 2020, humanity must reach a fundamentally new level of development—and for this, it must accurately and scrupulously calculate all the remaining energy resources at its disposal, first of all, and not make a mistake in choosing its technological drivers: after all, the industrial revolution from its very beginning was associated with an increase in the shortage of energy resources, inevitably leading to economic and social crises. At the same time, however, one cannot agree with the generally very thorough researcher V. Milovidov, who categorically asserts that the concept of sustainable development, which involves the rejection of traditional resources, will lead to the triumph of an "ecological utopia": the transition to more expensive and less effective alternatives: so, in his opinion, the efficiency of biomass processing is only slightly more than 35% [3]. The proposed research methodology shows the high economic efficiency of alternative energy production technologies.

2. Results and discussion

The development of the livestock industry is a fundamental factor for the effective development of the entire agro-industrial complex, since the share of livestock products is about 35% in the structure of all agricultural products produced [2]. In particular, the increase in milk production should be considered as a problem of national importance, the solution of which will allow in the future, scientifically justified and in the interests of the entire population, to meet the demand for milk and dairy products at the expense of domestic production.

The adopted Food Security Doctrine of the Russian Federation provides for bringing the share of domestic milk and dairy products to 90% in the total volume of sales on the market. According to the Government of the Russian Federation for March 2020, the provision of the population with dairy products is 50%. There is a shortage of milk production, so the country is forced to import dairy products from abroad. This led to a significant reduction in the number of cows and reduced productivity. The problem is compounded by the fact that the remaining dairy farms use old equipment, as well as the technologies of keeping cows themselves lead to a complication of the environmental situation in the regions (a large accumulation of manure) [6].

The slowdown in rural development is also due to the lack of electricity supply to some localities. According to statistics, 54% of rural settlements in the Russian Federation are provided with electricity. In addition, the increase in electricity tariffs has a noticeable impact on the increase in the cost of production. The environmental situation also leaves much to be desired. Many agricultural enterprises, in order to save money, throw waste into the fields or store it in unsuitable places for storage [4].

The accelerated development of renewable energy sources (RES) in Russia should be considered as an important factor in the modernization of the economy, including those related to the development of innovative industries, the development of new innovative technologies, the development of small and medium-sized businesses, the creation of new jobs, the improvement of social conditions, the environment, etc.
With the use of renewable energy in Russia, about 8930 million kWh (0.9% of total electricity production) is generated per year. In the total capacity of renewable energy installations, small HPPs account for 37%, geothermal-5%, bio-power plants based on woodworking waste and pulp and paper mill – 57% [7].

At a meeting in the Ministry of Agriculture of the Russian Federation, a decision was made to promote the development of bioenergy in the agro-industrial complex. The state program for the period 2013-2020 provided for subsidizing part of the costs of loans received for the purchase of biogas plants [5].

Currently, pilot projects are being implemented in a number of Russian regions to create biogas plants for processing agricultural waste, and bioenergy development programs are being adopted. The implementation of these projects contributes to the solution of a number of important economic, social and environmental problems.

Following the meeting, in particular, it was decided to establish an Interdepartmental working group to coordinate the development of bioenergy in agricultural production, which will include representatives of the Ministry of agriculture, Ministry of energy, Ministry of economic development, industry and trade, as well as agricultural scientists. Regional agribusiness management bodies are recommended to include bioenergy facilities for processing agricultural waste in the implementation of economically significant programs in the field of crop production and animal husbandry.

The interest of the Russian Federation in biogas plants causes the following reasons:

- the problem of low coverage density of gas and electric distribution networks. According to the agricultural census, today only 37% of large and medium-sized agricultural producers have access to gas distribution networks and 20% to heat supply networks [4]. Limited access to the electric grid not only hinders the development of existing agricultural enterprises, but also restricts the development of new agricultural industries. The introduction of biogas plants can solve these problems both in regions with energy shortages and in regions with weak network infrastructure development;
- the problem of waste disposal in the agro-industrial complex of Russia, since most of this waste is not disposed of. This leads to problems of soil oxidation, alienation of agricultural land during the storage of manure, contamination of groundwater and emissions of methane—a greenhouse gas into the atmosphere. Recycling agricultural waste into biogas and fertilizers solves this problem;
- low intensity of domestic agriculture. The Russian agro-industrial complex uses very little mineral and organic fertilizers of high quality. This is one of the factors that determine the low competitiveness of Russian agricultural products.

Agricultural waste in the Russian agro-industrial complex annually amounts to more than 770 million tons and is a significant energy resource, the processing of which is possible to obtain biogas, electricity and heat, high-protein feed for livestock and poultry. For example, as a result of their processing, you can get 66 billion cubic meters of gas, which is equivalent to 33 billion liters of gasoline and about 120 million tons of high-quality granular fertilizer.

In the Belgorod region, the situation with renewable energy sources is much better than in other regions. Yevgeny Savchenko, who led the Belgorod region for 27 years, supported the construction of biogas plants on pig farms of local agricultural holdings operating on livestock runoff.

The first pilot project was a biogas plant put into operation in 2012 by JSC "Regional Center of Biotechnologies" in the Borisovsky district of the Belgorod region at the Strigunovsky pig complex, which belongs to the Agro-Belogorye group of companies. The design capacity of the Baitury biogas plant is 7.4 million kilowatt hours and 3,200 gigacalories of heat per year. The station was built next to the existing pig farm for 16 thousand heads. In addition to energy products, the plant also plans to produce more than 19 thousand cubic meters of organic fertilizers per year [3].
The second pilot project was a biogas plant created by the Agro-Belogorye group of companies and the Alt Energo company in the village of Luchki in the Prokhorovsky district. The plant processes 73.5 thousand tons of raw materials per year. This is the waste of the meat processing plant and the hybrid breeding center of the Agro-Belogorye Group of Companies. The volume of electricity production is 19.6 million kilowatt-hours per year, heat energy-18.2 thousand gigacalories per year and 66.8 thousand tons of organic fertilizers. At the same time, the biogas plant serves two enterprises of Agro-Belogorya. Meanwhile, only this agricultural holding has 52 agricultural enterprises in the region, and in the whole region there are about three hundred [1].

With state support, similar projects are planned on the basis of "Belgorod bacon", "Miratorg" and other companies. In relation to the needs of consumers, the following areas of use of biogas plants with different productivity can be distinguished: for small farms, eco-farms and villagers who have a personal subsidiary farm, including 2-3 cows, several pigs and several dozen chickens, for medium-sized farms, eco-farms with 50 or more heads of cattle, or from 500 head of pigs, or from 5000 head of poultry; for large agricultural enterprises: cattle farms, eco-cooperatives, eco-clusters, pig breeding complexes, poultry farms. The estimated cost of the installation depends on the performance and degree of automation and is on average from 100 to 1500 thousand rubles, technical documentation - from 60 to 500 thousand rubles. If the customers of the plant are small and medium-sized farms of the livestock industry, then the cost of the entire project falls on the cost of a liter of milk. But it is wrong to load the cost of a liter of milk with extra expenses. Livestock farms, as customers and investors of the construction of biogas plants, will be able to get an increase in the environmental friendliness of existing production facilities and the production of organic fertilizers for related agricultural industries, as well as providing production with their own electric and thermal energy. This is quite burdensome in terms of the additional investment burden that affects competitiveness. Therefore, livestock farms are not ready to fully act as customers for such projects without significant state support.

In Germany, the situation is exactly the opposite compared to Russia: there is an overproduction of milk, the country is provided with 100% dairy products, and most farms are equipped with the latest technology. Despite the overproduction, state support for dairy farming in Germany is 4 times higher than in Russia. A special place in Germany is given to the so-called associations of family farms, where the number of cattle does not exceed 40 heads, associations are provided with subsidies for the purchase of equipment for processing, cooling, sorting and pre-sale preparation of products. The largest subsidies are allocated to support waste-free production. The maximum amount of subsidies for these purposes is 200 thousand euros for a 3-year period, and state guarantees are also provided for a loan in the amount of 80% of its value. Thanks to the biogas plants on the farms, waste-free milk production technology is used, and the electricity generated on them is supplied to the nearest settlements. In Germany, too, there are problems of their own, they are associated with a high cull of the herd and with a low price for the sale of milk, which makes it unprofitable to produce milk and threatens the disappearance of entire dairy industries in a number of regions of the country. These problems arose, first of all, because of the "pursuit of increasing the productivity of cows" and the reduction of markets for dairy products. For example, the peak of the decline in prices occurred when Russia imposed a ban on the supply of dairy products on August 7, 2014. To address these problems, Germany has developed the programs "Support for innovations in the field of agriculture" and "Anti-crisis program of the German government on agriculture".

In order for the Belgorod region to take a leading position in bioenergy, it is necessary to improve the legislative framework through the introduction of preferential tariffs and special benefits, and it is also necessary to work out in detail the federal law "On Production and Consumption Waste". As an example of the introduction of biogas plants in production, both Western and eastern countries can serve-Germany, Japan, China, Israel, where the legislative framework in this matter is strictly regulated [7].

For example, in Germany and Japan, there are green tariffs for electricity producers based on biogas plants. In these countries, the legal framework stipulates that all enterprises are required to buy surplus electricity produced using renewable energy sources at a reduced rate, and the cost of electricity sold is 10-15% higher than when using traditional fuels. In China, special subsidies are allocated for the
purchase of biogas equipment in the amount of $200 million annually to support the construction of biogas technologies. The subsidy for each installation is equal to 50% of the average cost. There is also a policy of grants for the development of its own production of biogas equipment.

In the Belgorod region, the problem of ecology occupies a special place, as the region is one of the leaders of the Russian agro-industrial complex. It produces 1679.8 thousand tons of meat and 442.5 thousand tons of milk, which is a tenth of the profit in the Russian agriculture. The concentration of a large number of farms leads to a large accumulation of manure, which has a detrimental effect on the environment. For example, on an agricultural land plot adjacent to a dairy complex in the village of Erik, Belgorod district, on an area of 4.6 hectares, an inspector of the Rosselkhoznadzor administration during the inspection found piles of cattle manure. Studies of soil samples showed contamination of this part of the land plot with bacteria of the Escherichia coli group and enterococci. Such cases are not isolated, similar situations can be traced in Gubkinsky, Chernyansky districts, where the heads of agricultural enterprises often neglect the environment for their own profit.

In order to study the practical application of biogas equipment, the calculation of the "Lily of the Valley" farm was carried out in the JSC Green Valley of the Belgorod region. The calculated data are listed in table 1.

### Table 1. Economic efficiency of a biogas plant for the year.

| Indicator Name                                      | Value                |
|----------------------------------------------------|----------------------|
| The amount of biogas consumed by the biogas plant  | 200101.76 m³        |
| Commercial quantity of biogas                      | 4303304.74 m³       |
| Total amount of biogas produced                    | 4503406.5 m³        |
| The cost of corn and grass silage is               | 158884800 rubles.   |
| Income from the sale of electricity                | 23237846 rubles.    |
| Income from the sale of fertilizers                | 7533600 rubles.     |
| Total income                                       | 30771446 rubles.    |
| Profit                                             | 1488646 rubles.     |
| The installation cost is                          | 112095000 rubles.   |
| Payback period                                     | 7.5 years           |

3. Conclusion

Based on the calculation of the economic efficiency of our project, we can conclude that the amount of biogas consumed for our own needs is insignificant, most of the revenue comes from the sale of electricity, the main and only costs go to corn and grass silage, the payback of the installation is medium-term. Taking into account the fact that the annual profit of the entire Green Valley company is 65 million rubles, the company will pay for the installation in installments, and in Germany this is quite often practiced.

For faster implementation of biogas plants, it is necessary to use an administrative resource:
• oblige neighboring enterprises to buy surplus electricity produced with the help of renewable energy sources at a reduced rate;
• provide a grant for each installation in the amount of 50% of the average cost, implement a grant policy for the development of its own production of biogas equipment;
• significantly increase fines for violations of environmental legislation;
• develop tax incentives for those organizations that will comply with the technology of waste-free production, and take responsibility for the disposal of waste from nearby enterprises. For example, the introduction of a non-taxable minimum for profit for the first 10 years.

Studies have shown that in the Russian Federation, it is advisable and vital to use alternative energy sources of non-waste technological production. Thanks to them, you can not only receive a permanent income from the sale of electricity to the nearest settlements and the sale of fertilizer-effluent, which remains after methane fermentation, but also contribute to the development of the technological process of waste-free production, which will allow you to achieve independence from external suppliers of energy and fertilizers.

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