

Prospects for Green Gas Production in the Russian Federation and its Potential Export to the European Union

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Keywords: renewables, green gas, biogas, export, EU

Abstract

The paper discusses prospects of green gas production in Russia and its export into the European Union as a separate product alongside with natural gas.

Background

Recently the price growth for the energy sources and restrictions on emissions have become the main reasons for dynamic growth of the renewable energy market. Solving the energy and environmental issues is impossible without using renewables, among which one of the most perspective is biogas, which is often considered as a fuel that can partly substitute fossil fuels in mid-term.

Nevertheless, waste processing is a very important factor when producing biogas since highly toxicity of the some feedstock, such as swine manure.

State of affairs

The EU Directive 20/20/20 gave the renewables a chance to start fast development. According to the Directive, the share of renewables in total consumed energy has to be 20%, which means that the potential green gas market in the EU is around 30-35 bln cm in 2020.

Presently Europe has around 9 000 biogas stations with a total produce of 8 bln cm p.a. The biggest biogas producer is Germany, where ca. 8 000 biogas plants are located with a total capacity of ca 3.4 GW in 2013¹.

Germany is also the biggest consumer of green gas in Europe. The local government has pointed out the target to reach the biomethane share in the gas networks not less than 10% until 2030. To reach this target, a number of incentives were enacted:

- Fixed (for 20 years) feed-in-tariffs for electricity and biomethane.
- Streamlined proceedings for network connection (gas and electric).

It should be noted that such measures have drawbacks. Foremost they affect construction costs of the plant. According to the DZ Bank, the specific capital expenditures for 1 kW of installed capacity of biogas plant has been rapidly growing. The largest growth was in the period 2003 – 2006, when the specific cost increased twice and continued to grow further.

¹ Biogas: the Energy Revolution's All-Rounder

Other noticeable green gas markets in the EU – Netherlands, France and UK.

The typical biogas producers in Europe are large-scale agricultural works, waste management facilities (including wastewater treatment), for whom biogas production is often a good option to reduce environmental hazard.

In most cases, biogas projects in EU are aimed at local consumption as an alternative to other fuels. Since 2008, the number of biomethane projects in EU and its supply to third party consumers through existing gas networks is constantly growing.

In spite of huge legislative, technological and industrial success of biogas production in EU, the leader by the number of plants is China. By different estimations, China has up to 10 million biogas plants. Most of them are small-scale, help manage the organic waste of households or small farms, and are very simple to construct and operate. Huge demand on biogas plants has brought to vast technological progress and origination of numerous biogas enterprises. The other large market players (India and Pakistan) mostly use cheap construction materials or even material at hand to produce biogas plants, which means that they cannot be considered significant firmware producers.

Biogas production in Japan is not of mass character, but many companies, including the ones from the natural gas sector, are working on developing this market. Osaka Gas participated in biomethane production project on wastewater treatment plants with further processing and using as fuel for vehicles. The peculiarity of this project is that it has a nearby waste incineration plant, which provides free heat. This was the main driver for the project, since additional heat was no longer required.

The Kikkoman company project, aimed only at waste utilization is also noticeable. The soybean cake produced insufficient amounts of biogas to provide the process with the necessary heat, but the amount of processed waste was very significant, which allowed receiving of additional bonuses with waste burial.

According to the National Biogas Association of the United States, there are ca 1700 projects (mostly on water treatments plants) in the US, 200 projects are implemented on landfill gas. Not less than 500 of them use biogas as fuel, the others burn it (it is considered unfeasible for waste treatment plants to use the gas other than burning it if less than 4000 cm per day is produced). The US experience for Russia is interesting in the part that there is no feed-in-tariffs and the support of the projects is made only by the ecological part – subsidized loans, grants etc. The US is also the world leader for biogas plants on wastewater treatment facilities (ca. 250 projects).

Biogas production potential in Russia

The Energy Strategy of Russia (until 2030) targets the renewable energy produce of 80-100 bln kWh p.a.

According to the Russian Academy of Sciences, there are 3 bln tons of renewable non-food biomass in Russia. This includes wood production, agriculture, peatery and cellulose waste. It is reasonable to expect that in the near future bioenergy will develop, what the Complex Biotechnology Development Program of Russia (until 2020) confirms.

It is also adjacent with the fact the large-scale pig-breeding complexes are put in commission as well as poultry. The agro industrial complex of Russia now faces the waste management issues of huge waste amounts – presently most of them are just in land storage. The amount of this waste in Russia currently reaches 600 mln tons p.a., most of which is not utilized correctly. The alienation of land is thus a huge problem (more than 2 mln hectares of agricultural land is used to store manure)². Only 37% of large- and medium-scale agricultural farms have access to gas distribution networks and only 20% have access to heat supply systems.

According to the Russian Energy Agency, the current waste potential is enough to produce 60-70 bln cm of biogas p.a. This is enough to satisfy the needs of the internal market as well as the EU.

Table 1 demonstrates the biogas production potential, based on the data of the Institute of Energy Strategy of The Ministry of Energy

Table 1 – Biogas production potential in Russia

	Organics mln tons*	Biogas bln cm	Total GW
Crop production	147	94,8	84,4
Agro industrial complex (processing)	14	12,8	11,4
Wastewater	4,9	2,6	2,3
Household waste	16	20,8	18,5
Total		131,0	117,7

Among the regions, the biggest resource base is located in three Federal Districts: South, Volga and Central. Fig. 1 demonstrates the biogas potential breakdown.



Fig. 1. Biogas potential breakdown (other than wood processing and peat)

There is a number of reasons, why biogas production and utilization are poorly developed:

² Karasevich V., Albul A., Akopova G. Biogas as a complex solution of economic and ecological tasks. // Scientific review of Russian Gas Society. - № 2. – 2014 – p. 147-152.

- Highly competitive fossil fuels.
- Imperfection and poor control of environmental legislation.
- Lack of regulation for biogas production and energy service contracts implementation.
- Lack of financing schemes for biogas projects.
- Lack of reasonably priced equipment for biogas plants on the market.
- Ossification of owners of works, where biogas production is possible.
- Low level of government support of renewables in total and biogas in particular.

Nevertheless, the situation is getting better for biogas plants due to the following factors:

- Stable cost rise for natural gas, heat and electricity.
- Remote territories.
- High connection costs to existing natural gas and electric grids.
- Unstable and unreliable energy supply from energy retailers.
- Government promotion of biogas.
- Growth of fines for environmental impact.
- Demand for biogas from EU and Asia-Pacific Region.

The analysis of the situation with biogas production demonstrates positive trend. A number of farms are starting to use the alternative fuels for their needs. The regions of Vladimir, Kaluga, St. Petersburg, Nizhniy Novgorod, Lipetsk, Vologda, Murmansk, Dagestan, Tatarstan, Mariy-El, Udmurty, Krasnodar have examples of biogas plants implementation. Most of them produce biogas from farming waste. The situation with wastewater processing is less well. The most problematic are landfills. Their owners are very conservative and less inclined to innovations. Furthermore, landfill gas production is considered currently as mineral production and requires corresponding licensing.

The most known example of biogas production on wastewater treatment plants (WWTP) in Russia is the aeration plants of JSC Mosvodokanal (Moscow). In the 1980s the plants used the anaerobic digestion to process the wastewater. In 2009, Mosvodokanal launched a mini-CHP plant made by "EVN" on Kuryanovo WWTP. In 2012 a similar plant started operation on the Lyubertsy plant. The contracted biogas price for the CHP is significantly lower than the natural gas price. The reason for this is that there were no investments in the digestion facilities, which already existed.

The authors themselves carried out the feasibility study for biogas production on WWTP of St. Petersburg. The preliminary calculations showed significant cut of processing costs by increasing the processing speed and cost cuts on aeration fields. This allowed to achieve an acceptable payback period (ca. 10 years) on some of project variants – biomethane production, bio-LNG with further export and other).

The Belgorod region is the pioneer in building the biogas plant with manure feedstock in Russia. The region in 2009 – 2012 had a government Strategy on biogas development, which included the following:

- Environmental safety for the territories of the region.
- Innovative biomass processing technologies implementation.
- Creation of a local market of organic fertilizers.

The Strategy resulted in construction of two biogas plants with a total capacity of 500 kW and 2,5 MW. The latter was qualified as an electricity producer by analogy with the EU procedures; it has a feed-in-tariff on electricity and sells it to local grids for electricity losses compensation. In spite of huge administrative support, this procedure took more than two years and the total tariffs is significantly higher than the average in the region.

An important event in biogas development in Russia was the signing of a memorandum on green gas production between JSC Gazprom, Gasunie, JSC Evrotechnika and JSC BioGasEnergostroy. According to it, the companies are looking forward to creating a joint venture in Russia. Biogas is planned to be upgraded and transported to Netherlands. A scientific cooperation between JSC Gazprom and Gasunie preceded this memorandum, in which the authors of this article took active participation.

Biogas usage

Alongside with the traditional biogas use to generate electricity and selling it to the grid by feed-in-tariffs, it is possible to use it alternatively. In most cases, biogas can be used for technological and heating needs. In this case, there is no need to invest in cost-intensive cogeneration units, which allows sufficient improvement of economic performance.

One of the most perspective ways to use biomethane is to use it as vehicle fuel. This market is currently rapidly developing in EU and other regions. Given that fact and an EU directive on a renewable share in total energy supply of 10%, biomethane and bio-LNG production is a very perspective area of activity.

Conclusions

Bioenergy development is a timely concern for the Russian Government: agricultural complex has to be more independent from energy supplying companies; the amounts of waste have to be reduced as well as greenhouse gas emissions, eventually resulting in a more environmentally friendly economy.

The biogas market in Russia has great growth potential: there is significant feedstock available and enough consumers. The production of biogas should be united with agricultural waste processing to be more feasible. The large potential in biogas production shows interest in creating a network of biogas plants, oriented at the local consumer as well as green gas export to the EU.

The biogas production in Russia is held back by the imperfection of the environmental legislation and lack of control over its execution. Furthermore, in order to develop this market, inexpensive equipment has to be available, as well as additional finance mechanisms have to be at hand.