

USE OF BIOGAS IN THE ENERGY SECTOR OF UKRAINE

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Abstract

Sustainable development of bioenergy makes it possible to reduce Ukraine's dependence on expensive imported energy sources and ensure the effective use of local resource potential. The transition to the use of biomass for energy needs will contribute to the development of the local economy due to the receipt of taxes and fees, and at the state level will lead to an improvement in the country's trade and payment balance due to a decrease in energy imports. A positive social impact is also expected, associated with the creation of new jobs, a decrease in thermal energy tariffs and an increase in the reliability of heat supply. Bioenergy plays an important role in reducing greenhouse gas emissions, which is especially relevant in connection with the problem of global warming and climate change.

Keywords: biomass, biogas, fuel, gas turbine, steam turbine, cogeneration plant.

Introduction

According to a study by the Bioenergy Association of Ukraine, about two-thirds of biogas produced worldwide was used for electricity and heat generation, and one-third was used in the residential sector. A small percentage of biogas was purified to biomethane, injected into the gas network, or used as fuel. Biogas can be used to replace fossil fuels in the energy, transport, and residential sectors. Biogas and biomethane have numerous advantages, including reducing Europe's energy dependence. These gases make an important contribution to baseload electricity generation [1-2].

The aim of the work is to analyze the prospects for the production and use of biogas as a component of renewable energy and to identify promising ways to apply biomethane in the energy sector in Ukraine.

Research results

Biogas is a gas obtained from biomass, which is used as fuel. The production of energy from biogas is not harmful to the environment, as it does not cause additional emissions of the greenhouse gas CO₂ and reduces the amount of organic waste. Unlike wind energy and solar radiation, biogas can be obtained regardless of climatic and weather conditions, and unlike fossil energy sources, biogas in Ukraine has a very large renewable potential. The annual theoretical potential of biogas in Ukraine is 3.2 billion m³ [3].

The basis of biomass is organic carbon compounds, which, when burned, release heat when combined with oxygen. The initial energy of the "biomass-oxygen" system occurs under the influence of solar radiation in the process of photosynthesis, which is a natural way to convert solar energy. Using chemical or biochemical processes, biomass can be transformed into other types of fuel or into final energy. When biomass or its derivatives are burned, the organic carbon contained in it and oxygen from the atmosphere react to form carbon dioxide and water. The process is cyclical, since the carbon dioxide released during combustion can participate in the production of new biomass [1].

So, biological fuels (biofuels) are solid, liquid and gaseous fuels made from biologically renewable raw materials (biomass) that can be used as a fuel or a component of other fuels [1].

In turn, biomethane is a gaseous fuel obtained from biogas, the methane concentration of which is 95-98%. Enriched biomethane is no different from natural gas, so it can be transported and used with minimal infrastructure modernization. Biomethane has the advantages of natural gas, while remaining carbon neutral [4].

An effective way to supplement and replace traditional fuel and energy resources is the production and use of biogas, which is formed as a result of the use of methane fermentation technologies of livestock

biomass and consists of 60-70% methane. Another source of biogas is garbage dumps at solid waste landfills. In addition, wastewater is a source of biogas. The utilization of municipal and industrial wastewater sludge provides a solution to important environmental, energy and social problems of cities, especially megacities. Municipal and industrial wastewater sludge contains a large amount of organic matter [3]. The total potential for biogas production from agricultural waste, food industry, MSW, municipal wastewater and industrial enterprises in Ukraine at the current level of production and consumption is estimated at 3.2 billion m³ of CH₄ per year. Another 3.3 billion m³ of CH₄ can be obtained by growing energy corn (or other energy crops) on an area of 1 million hectares (3% of the total arable land area of Ukraine)[5]. Also, experts of the Bioenergy Association of Ukraine estimate the biogas potential from grain straw at 3.8 billion m³, from corn silage - 2.7 billion m³, from other livestock and processing industry waste - 1.3 billion m³. Most biogas plants in Ukraine currently use livestock waste or sugar beet pulp as raw materials. The potential of crop residues and corn silage currently remains unused [4].

Biogas is identical in composition to natural gas, but it can be inferior or superior in calorific value, depending on the method of production and subsequent purification. The fundamental difference is in the method of production, because natural gas is extracted from the subsoil, and biogas is from biological waste or specially grown raw materials. Thus, biogas is a renewable energy source. According to experts, world reserves of natural gas at the current rate of consumption will last for another 50 years. Therefore, biogas can be an equivalent alternative. Especially if it is purified to the state of biomethane, with a methane concentration of 95-98% [6]. According to the State Agency for Energy Efficiency, today there are 49 plants in Ukraine that produce energy from biogas and operate at a "green" tariff. The total installed capacity of such plants is 86 MW, which is almost 5 times more than at the end of 2015 (18 MW). Of these, 59 MW (21 plants) operate on agricultural waste, 27 MW (28 plants) on solid household waste [4].

During 2020, 12 MW of biogas capacity (12 plants) was commissioned, during 2021 – 40 MW (16 plants). At the same time, according to the National Commission for the Regulation of Energy and Power Generation of Ukraine, during 2021 biogas plants produced 247 million kWh of electricity. Thus, the growth rate of biogas capacity in Ukraine in 2022 exceeded the indicators of 2020 by almost 3.5 times. The total amount of investment in this sector during 2012-2019 was 140 million euros [7].

The main goal of the biogas industry is to reduce fossil fuel consumption with the ultimate goal of mitigating global warming. Biogas production increases the country's energy security by solving three tasks. Firstly, reducing the specific fuel consumption per unit of energy received. Secondly, ensuring electricity backup and increasing the reliability of energy supply. Thirdly, reducing greenhouse gas emissions into the atmosphere (methane, carbon dioxide), which prevents global warming, reduces wastewater pollution and reduces the epidemiological risk from waste storage [8].

Biogas and biomethane production contributes to solving two global problems of modern life: the growth of organic waste produced by modern societies and economies, and the negative impact of greenhouse gas emissions on the climate. The largest biogas projects being built in Ukraine, with a capacity of 10-20 MW, cost 2-2.5 thousand euros/kW. The main components of investment in biogas projects focused on combined heat and power generation are the costs of the power generation unit (30-40%), the construction of reactors and other technological facilities (35-45%), as well as technological equipment (15-25%). The payback period of biogas projects in Ukraine can be up to 4 years, even if only electricity is sold at a "green" tariff. However, the potential for building such large-scale projects is limited, and the efficiency of biogas projects operating in Ukraine often does not exceed 50-60% (according to the KVVP). The payback period of most biogas projects in Ukraine is estimated at 5-6 years at best, and taking into account the level of efficiency - at least 7-8 years.

Biomethane production from biogas is associated with additional costs for the separation of methane and carbon dioxide. Therefore, a unit of energy in biomethane costs more than in biogas. Biogas is usually used only for electricity generation, and in some cases partly for heat generation. At the same time, new opportunities are opening up for biomethane, which include:

1. Electricity and heat generation from biomethane using the gas transmission network.
2. Storage of biomethane in the natural gas network for electricity generation on the balancing market.
3. Use of biomethane as a motor fuel for municipal transport and in agriculture.
4. Replacement of natural gas with biomethane.
5. Export of biomethane to the EU using the National Register of Biomethane Production and Consumption.

Currently, biomethane production in Ukraine is not competitive with the market price for natural gas and requires support [8].

Conclusions

Assessing the current state, Ukraine can compete with any country in the production of biogas and biomethane, can offer the cheapest raw materials, as it has the largest area of agricultural land in Europe and, accordingly, one of the best raw material potentials in the world for their production. Investments in biogas and biomethane installations with electricity generation are almost identical. As the State Agency for Energy Efficiency notes, the adopted draft law will also allow reducing natural gas imports and promoting the development of the domestic energy market.

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