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THE USE OF BIOENERGY RESOURCES IN THE PRODUCTION OF ELECTRICITY

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Abstract

The use of bioenergy resources in electricity production is a relevant and effective direction in the field of renewable energy sources. Bioenergy is based on the utilization of organic material, such as plant residues, animal manure, biomass, for the production of electricity. This process reduces dependence on fossil fuels and mitigates harmful impacts on the environment. The article discusses various methods of bioenergy production, such as biogas, bioethanol, biodiesel, and their advantages and limitations. Global experiences and examples of successful utilization of bioenergy resources are analyzed, highlighting the economic and environmental feasibility of bioenergy utilization in electricity production. Research findings confirm that the use of bioenergy resources represents a promising solution for diversifying and enhancing the resilience of the energy sector and contributes to the achievement of sustainable development goals.

Bioenergy resources, the most common of which are biomass and its derivative biogas, are one of the current alternative ways to obtain energy, including electricity. However, their use, particularly biomass utilization, until recently involved burning fuel either in open fires or in furnaces, resulting in relatively low energy efficiency.

It should be noted that this method is extremely environmentally friendly, which is crucial in today's world with its focus on environmental conservation. The use of biomass for energy production through modern technologies is environmentally safer compared to traditional organic resources such as coal and oil. Biomass-based electricity production is considered to be the most environmentally reliable sector of the energy industry, as it contributes to reducing environmental pollution [1].

Let us consider bioenergy resources. Biomass in bioenergy refers to organic matter formed in plants through photosynthesis that can be used to generate energy, including all types of vegetation, agricultural and forestry waste, and other types of industrial waste. Moreover, with a broad approach to the issue, biomass can also include non-vegetable household and industrial waste that can be utilized using the same principles [2].

Biomass can be classified into primary biomass and secondary biomass depending on its use and sources of renewal. Ground and aquatic plant worlds are the sources of primary biomass, while secondary biomass includes waste biomass generated after the collection and processing of primary biomass into finished products, as well as waste generated during human and animal activities [3, 4].

Therefore, modern bioenergy allows for energy production using various types of biomass, such as:

1. Logging and wood processing residues
2. Agricultural residues - plant and animal
3. Aquatic plant biomass.

Biomass, primarily in the form of wood fuel, is a fundamental source of energy for nearly a quarter of the world's population. It is often the only available energy source for rural areas. Additionally, biomass as an energy source plays a significant role in developed countries, accounting for about one-seventh

of the world's fuel volume and ranking third in terms of energy production, along with natural gas. Notably, biomass generates four times more energy than nuclear power [5]. In addition to direct use in energy production, biomass is used in the production of biogas from agricultural and household waste. Thus, the processing of biomass through anaerobic fermentation to produce biogas, which contains about three-quarters methane, and organic fertilizers, holds a significant place in unconventional energy production. The biogas produced is a mixture of methane and carbon dioxide formed during the anaerobic digestion in so-called methane tanks, designed and operated to maximize the extraction of methane. The energy obtained from burning biogas can be comparable to the energy from fossil fuels. Another important note is that the process of converting biomass into biogas results in much lower levels of harmful microorganisms in the waste compared to the original material.

It is also noted that the production of biogas is economically justified and preferable for processing a continuous stream of waste, such as livestock manure, slaughterhouse waste, plant residues, etc. The economic benefits include the elimination of the need for pre-collection of waste and the organization and management of waste delivery; it is known how much and when waste will be received. Biogas production, possible in installations of various scales, is particularly effective in agro-industrial complexes, where there is the possibility of a complete ecological cycle [5]. Biogas can be used in household applications such as cooking, heating buildings, lighting, as well as for operating various machinery, transportation, and power generators.

The relevance and effectiveness of biogas utilization in the modern world are demonstrated by the experience of countries lacking natural gas, such as the People's Republic of China. For example, China's experience indicates that remote rural areas can be reasonably gasified using small bio-installations that operate on organic waste from private households and agro-industrial enterprises [6].

In addition, bioenergy can also include the use of other technologies such as thermal processing of biomass (pyrolysis, gasification), or the use of agricultural crop residues, forestry residues, and food industry waste as fuel for electricity production.

One of the main advantages of using bioenergy resources for electricity production is their renewability. Bioenergy is based on the use of organic materials that can be replenished in natural cycles, making this form of energy sustainable and environmentally friendly.

Furthermore, the use of bioenergy resources also contributes to reducing greenhouse gas emissions, as bioenergy is based on the use of organic material that, when burned, releases an amount of carbon dioxide that can be absorbed by plants during photosynthesis, creating a carbon-neutral cycle of greenhouse gas emissions.

Bioenergy also helps reduce dependence on oil and other fossil fuels, as biomass can be produced locally and used on-site for electricity production, which can reduce the reliance on fuel imports and improve regional energy security.

However, like other energy sources, bioenergy also has its drawbacks. Bioenergy production from biomass can compete with food production, as it uses agricultural crops and land resources. Therefore, it is important to maintain a balance between bioenergy production and food security.

It is also important to consider the environmental aspects of bioenergy production, as uncontrolled use of biomass can have negative consequences, such as soil degradation, loss of biodiversity, and emissions of harmful substances into the atmosphere.

Thus, the use of bioenergy resources for biogas production and the production of high-quality fertilizers associated with it is currently relevant and highly effective.

Keywords: *Energy, Biomass, Biogas, Bioenergy*

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