

DEVELOPMENT OF BIOENERGY AS AN INNOVATIVE ASPECT IN THE CONTEXT OF ENERGY SECURITY OF UKRAINE

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Abstract. *In article opportunities and prospects for the development of bioenergy in Ukraine as an alternative source of energy are highlighted; it has been proven that bioenergy has a rather important role in the socio-economic development of the country - it contributes to the improvement of the ecological state, increasing the competitiveness of production and reducing the country's energy dependence.*

Keywords: bioenergy; agribiomass; energy security; renewable energy sources.

Climate change, which occurs on a global scale, has devastating consequences for society due to the increase in the number of adverse natural phenomena and leads to the deterioration of the living conditions of a large part of the planet's population and the environment. Climate change is a problem that no conscious individual in society can ignore.

The development of bioenergy is one of the ways that will contribute to increasing environmental safety and reducing the negative impact on the natural environment. 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. Bioenergy is important from several aspects: its powerful potential can and should act as a driver of the development of the national economy; the development of bioenergy is one of the directions of decarbonization of the economy in accordance with global trends and the obligations that Ukraine has in the process of European integration. Solving the socio-economic problem of energy security is possible only through the rational use of all existing sources of fuel and energy on Earth and in the surrounding space or the search for alternative energy sources.

Bioenergy makes up about 60% of all renewable energy sources in the world and about 70% in Ukraine, therefore, it is an integral component of the "green" energy transition of all countries. For Ukraine, bioenergy is one of the strategic directions for the development of the renewable energy sector, taking into account the country's high dependence on imported energy sources and the great potential of biomass available for energy production. Currently, the development of renewable energy is one of the main ways to solve problems related to the instability of supply and replacement of fossil energy resources. The field of bioenergy in Ukraine has great potential for development, this is due to the peculiarities of the climate, the potential of the agricultural sector and the availability of the necessary workforce.

The use of traditional energy sources leads to an increase in the number of emissions of greenhouse gases into the atmosphere, deterioration of ecology, as a result of which society faces the problems of global warming, pollution of air, water and land resources.

Biomass is a by-product of crop production and waste of biological origin in animal husbandry, which can be used as raw materials for energy production, which can be either directly burned for heat or converted into solid, liquid, or gaseous biofuel. Biomass in developing countries is actively used as fuel for heating or cooking. In developed countries, it is already used as a means of producing heat and electricity or as a raw material for the production of liquid biofuel. Today, bioenergy accounts for about a tenth of the total volume of primary energy in the world.

The share of energy production from biomass in the total production of "green" energy in EU countries varies from 15% (Malta) to about 90% (Czech Republic, Hungary, Latvia) and even 100% (Estonia). On average, this figure for the EU is 64%. It should also be noted that about 75% of energy produced from biomass is consumed as thermal energy, 13% as electrical energy, and 12% as fuel for transport. Liquid biofuels, for example, ethanol, biodiesel, biogasoline, are produced from wood materials (sawdust, charcoal, pellets, logging waste), sugar cane, corn, rapeseed, agricultural waste, industry and household waste. The most powerful producers are the USA and Brazil, which together produce up to 90% of liquid biofuel in the world, the amount of which is steadily growing [1]. The interest of the world community in various types of biofuels produced from biomass will increase.

Over the past 20 years, the world has seen an exponential increase in biomass electricity generation capacity: from 28,120 MW in 2000 to 148,912 MW in 2022. At the continental level in 2022, Asia represented 43% of total biomass electricity capacity, Europe 28% and America 26%. In 2020, the world produced 38.1 billion m³ of biogas with an equivalent energy content of 1.46 EJ. Europe is the world leader in biogas production, with 20 billion m³ of biogas produced in 2020 with an energy equivalent of 0.71 EJ, which is more than half of global biogas production. Asia took second place with a share of 32% [2].

Agriculture of Ukraine is a source of biofuel raw materials. Raw materials are grown on agricultural fields, obtained in the form of agricultural waste from both the crop and livestock industries.

According to the estimates of the Bioenergy Association of Ukraine, in 2021 the potential of biomass available for energy production amounted to more than 26 million tons of oil equivalent, which is 30% of the total supply of primary energy to Ukraine in 2020. A significant share of the energy potential is agricultural residues - 42 % of the total volume, the contribution of biogas obtained from various types of raw materials (waste and by-products of agricultural activity, industrial and communal wastewater, solid household waste) - 31%, wood biomass and energy plants (for solid fuel) is relatively small - 10 each %, liquid biofuel – 7% [3]. Biomass is considered one of the main renewable energy sources, replacing fossil fuels and reducing greenhouse gas emissions in the context of the goals of the Paris Agreement.

In Ukraine, the development of renewable energy is one of the five priorities of the country's recovery. Ukraine's recovery plan should take place through the prism of decarbonization and the "green" transition policy, and bioenergy is an important component that can systematically affect the improvement of heat supply in the territory of Ukraine and reduce the impact of war losses to restore infrastructure.

According to UN experts, during the full-scale war, the Russians destroyed up to 90% of Ukraine's wind power and 30% of solar power. A third of Ukrainian power plants have been under temporary occupation since February 24, 2022 [4]. An extensive system of combined heat and power plants could replace those destroyed and lost during the war.

For the production of biofuel in Ukraine, there are the following opportunities: increasing the area for growing energy crops (fast-growing trees - willow, poplar, paulownia or certain types of plants - sorghum, miscanthus) by at least 2 times. The economic efficiency of growing energy plants depends on their productivity and costs for harvesting and processing into biofuel. Since most energy plants provide a harvest for more than one year, the initial investment and production costs will approximately pay off within 2-3 years. Energy crops are grown on land that is not suitable for agricultural production, which allows to preserve the soil from erosion, increase the content of the humus layer, and improve the state of the environment; the use of crop production waste for the production of bioenergy - grain straw and residues from the processing of sunflower and corn [5]; the use of sugar beet for the production of various types of biofuel, because sugar beet is a universal bioenergy crop. Both bioethanol and biogas can be obtained from sugar beet raw materials, as well as used in combination with animal manure [6]; increase of biogas plants for processing livestock waste into biogas The list of raw materials used in Ukraine for biogas production is limited to 5 main types: pig manure, cattle manure, chicken manure, sugar beet pulp and corn silage. At the same time, according to the assessment of the Bioenergy Association of Ukraine, the total potential of pulp is used approximately 20%, pig manure - 6%, cattle manure - 4%, chicken droppings - 1%. The use of the potential of other types of raw materials for biogas production does not exceed 1 -2% [7].

Therefore, the development of bioenergy in Ukraine, along with solving the issues of economic security and economic independence, will contribute to increasing environmental security and reducing the negative impact on the natural environment. 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. Biomass is considered one of the main renewable energy sources, replacing fossil fuels and reducing greenhouse gas emissions in the context of the goals of the Paris Agreement.

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