

## THE WAYS OF ENHANCING THE COMPETITIVENESS OF ENERGY BIOMASS

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**The statement of the problem.** The scenarios developed by the International Energy Agency and other organizations have shown that a wide range of environmentally friendly energy technologies is necessary to address the challenges of the transition to clean, reliable, safe and competitive energy resources. Renewable energy can play an important role in achieving this goal. Many countries promote the use of alternative energy sources in the energy supply successfully, but obstacles still remain on the way, and more actions must be done to overcome them.

Ukraine has a great potential for biomass which is available for energy use. Attracting this potential for energy production in the short term, 13-15% of the state's primary energy needs can be met. The development of the bioenergy sector in Ukraine should be conducted consistently and reasonably, taking into account the possible impact on the national economy and the environment.

**The analysis of recent researches and publications.** A significant number of scientific works of domestic and foreign scholars is devoted to the issue of competitiveness, among them: O.A. Gavrish, V.V. Dergacheva, T.I. Lepeiko, M. Porter, D.M. Stechenko, R.A. Fatkhutdinov and many others. Research works of R.D. Vasilishin, P.F. Vasko G.G. Geletuki, M.Ya. Humennik, G.M. Zabarny, V.L. Kurilo, S.O. Kudri, P.I. Lakida, V.F. Reztsova, M.V. Royk, A.R. Shchokin and others are devoted to the problems and perspectives of development of alternative energy. At the same time, the analysis of scientific papers shows that a number of problematic issues need further study, there is a need to explore ways to increase the competitiveness of energy biomass.

**The formulation of the articles purposes.** The purpose of the article is to study the features of energy biomass as a kind of alternative energy raw materials and to develop proposals for increasing its competitiveness.

**The presentation of the basic material of the research.** Currently, as the population of the planet and the rates of economic growth

increase, especially in developing countries, demand and energy consumption in various sectors of the economy and in the quality of life continue to grow, meanwhile, in forecasts for the near future it is not expected to slow down. In this regard, meeting the global demand for energy simultaneously reducing greenhouse gas emissions into the atmosphere has become one of the main world problems.

It is known that Ukraine belongs to energy-dependent countries: energy resources are imported more than exported, which is reflected in the unceasing rise in prices of non-renewable energy sources, lowering economic indicators of almost all industries. Implementation of alternative energy sources, expansion of the use of renewable resources, including energy crops used for the production of various types of biofuels, are topical issues for Ukraine. This opinion is supported by a number of authors [11, 19], arguing that it is urgent for our country to search for alternative energy sources with a constant decrease in the share of fossil fuels. Therefore, the main principles of state policy in the field of alternative fuels should be comprehensive assistance to the development and rational use of non-traditional sources and types of energy raw materials for fuel production in order to save fuel and energy resources and reduce Ukraine's dependence on their imports. To do this, there are all the necessary preconditions in our country, especially the soil-climatic, which enable to grow crops with a high yield of vegetative biomass in large volumes. Therefore, taking into account the actuality of the problem, it is necessary to use the results of domestic science, introducing them into production, which will significantly increase the efficiency of bio-fuel use from plant raw materials and reduce the energy dependence of Ukraine.

The country's energy security is heavily dependent on the degree of diversification of energy used to meet its energy needs. Among all renewable energy sources, biomass is the most promising substitute for natural gas and other fossil fuels in Ukraine.

According to the research results of the scientists of the Institute of Bioenergetics Cultures and Sugar Beet of the National Academy of Sciences of Ukraine, a compendium of the bioenergy potential of different types of plants has been made (Table 1).

Biomass is a carbon-rich organic substance of plant and animal origin. The bulk of biomass is phyto-biomass (97-99 %), and a part of zoo biomass is 1-3%. The following groups of renewable energy carriers derived from biomass and products of its life are distinguished:

– wood, its waste, products of sanitary felling of forests, peat, leaves, sawdust, etc.;

- plants specially cultivated for energy purposes (aspen, rape, seaweed, etc.);
- agricultural waste (manure, poultry dung, stems, husk, etc.);
- waste of human life, including industrial activity (solid and liquid household waste, food industry waste, garbage, lignin, etc.).

Table 1

**Comparative energy characteristic of crops used as energy plants [19]**

<i>Culture</i>	<i>Output of biomass, t / ha</i>	<i>Type of bio-fuel</i>	<i>Heat output of biofuels, MJ / kg</i>	<i>Fuel equivalent</i>	<i>Output of biofuel with 1 ton of biomass, kg</i>	<i>Output of biofuel from 1 hectare, t / ha</i>	<i>Output of conditional fuel, kg UМ / ha</i>	<i>Output of energy, GJ / ha</i>	<i>Output of energy, GWh / ha</i>
Potato	25	bioethanol	21,1	0,65	120	3000	1950	65,1	18,08
Wheat Cereal	4	bioethanol	21,1	0,65	260	1040	676	21,9	15,25
Wheat straw	4	granules	15	0,55	1000	4000	2200	33	
Rape seeds	3	biodiesel	33,1	0,91	401,5	1204,4	1096,1	39,9	19,08
Straw of rape	3	granules	16	0,60	1000	3000	1800	28,8	
Roots of sugar beets	45	bioethanol	21,1	0,65	100	4500	2925	95	7,11
Sugar beet tops	35	biogas	21,8	0,60	200	7000	4200	161	
Grain corn	6	bioethanol	21,1	0,65	240,4	1442,4	937,6	30,4	72,33
Green mass of corn	50	biogas	21,8	0,60	200	10000	6000	230	
Sugar Sorghum	50	bioethanol	21,1	0,65	100	5000	3250	105,5	93,19
Green mass of sugar sorghum	50	biogas	21,8	0,60	200	10000	6000	230	
Dry mass of sugar sorghum	25	granules	17,0	0,60	1000	25000	15000	425	118,06
Silver grass(dry mass)	20	granules	17,0	0,60	1000	20000	12000	320	88,89
Sweet grass (dry weight)	15	granules	17,0	0,60	1000	15000	9000	255	70,83

Predominantly solid biomass is used for energy production as well as liquid and gaseous fuels derived from it - biogas, biodiesel, bioethanol. In addition to energy problems, the use of biomass and biofuels can also help in addressing a number of important environmental issues. First, it is the

state of the air contaminated by harmful substances of exhaust and flue gases. Second, it is a large amount of greenhouse gas emissions - carbon dioxide, methane and others. Biomass is a renewable, environmentally friendly fuel provided environmentally sound production and use. Since biomass is a CO<sub>2</sub>-neutral fuel, its use does not lead to an increase in the global greenhouse effect. Implementation of bioenergy projects under the Kyoto Protocol mechanisms is an effective way to reduce greenhouse gas emissions. In terms of the existing energy and environmental situation, Ukraine should immediately begin to apply bioenergy technologies and the use of all types of biofuels widely - solid, liquid and gas. But this should be done taking into account the issue of sustainable development and the need to preserve the biodiversity of the country. Today biomass occupies the fourth place among fuels and provides about 2 billion tons per year, or 14 % of the total primary energy consumption in the world (in developing countries - more than 30 %, sometimes up to 50-80 %).

Renewable energy production, including biomass, is developing dynamically in most European countries. Today, renewable energy sources cover 7 % of energy consumption in the European Union, including biomass – 4 %, which is more than a half. In some countries, the share of biomass in the total consumption of primary energy significantly exceeds the average European number and is 23 % in Finland (the world leader in developed countries), in Sweden – 19 %, in Denmark – 12 %, in Austria – 12 % [14, 16]. According to the EU's New Energy Plan approved by the European Parliament, the contribution of alternative energy sources to total energy consumption should be 20 % by 2020. At the same time, their share in thermal energy production should increase to 20 % (contribution of biomass – 76 % of all alternative sources of energy), in electricity production - up to 34 % (contribution of biomass – 24 % of all alternative sources of energy). Not any developed country or developing country has published plans to reduce biomass energy production. On the contrary, the national energy programs of the countries of the European Union, the USA, Canada, Brazil, China, India, Malaysia and other countries provide for further substantial expansion of this sector. Among all types of biomass, solid biomass has a leading position in energy production in the EU.

A wide range of different types of biomass results in a large number of technologies for its processing and, accordingly, getting various energy products (Table 2), but biomass burning is about 80% of its worldwide use volume [10, p. 300-301].

Table 2

### Bioenergy technologies and types of energy products

<i>Biomass type</i>	<i>Technological process</i>	<i>Energy products</i>
Dry biomass	Burning	Thermal and electric energy
	Gasification	Combustible gases, methanol
	Pyrolysis	Combustible gases, resins, charcoal
	Hydrolysis and distillation	Ethanol
	Briquetting by pressing	Fuel pellets, fuel briquettes
Wet biomass	Anaerobic digestion	Biogas
	Fermentation, fermentation and distillation	Fuel alcohol
	Etherification	Biodiesel

Biomass processing is one of the most promising directions for the use of renewable energy sources. By the amount of fuel consumed in the world, biomass is 4th in yielding only oil, coal and gas. Biomass accounts for up to 15 % of the total amount of primary energy resources, and in developing countries up to 40 %. A wide range of technologies is used for the processing biomass, among which the most common are: direct combustion, pyrolysis, gasification, anaerobic fermentation with the formation of methane, production of alcohols and oils for motor fuel production. Within each of these technologies there is a large number of different technological processes and equipment. They differ considerably both in terms of investment costs and the cost of energy received (Table 3).

Table 3

### Investment costs and electricity costs for different biomass processing technologies [7]

<i>Biomass processing technologies</i>	<i>Investment costs, USD / kW</i>	<i>Cost of electricity, USD / kW • h</i>
1. Burning of biomass	1880 – 4260	0,06 – 0,21
2. Burning biomass in boilers with a circulating boiling layer	2170 – 4500	0,07 – 0,21
3. Anaerobic digestion and gasification	2140 – 5700	0,07 – 0,24
4. CHP with combustion	3550 – 6820	0,07 – 0,29
5. Gas-generating CHP	5570 – 6545	0,011 – 0,28
6. Use of landfill gas	1917 – 2436	0,09 – 0,12
7. Biomass Pyrolysis	2574 – 6104	0,06 – 0,15
8. Combined biomass burning	140 – 850	0,04 – 0,13

In the case of the use of technologies that allow to receive not only electricity but also thermal energy, the cost of investment costs is significantly increasing, while the small costs of joint biomass combustion include the retrofitting of a traditional thermal power plant for the possibility of combustion of biomass with coal or other traditional fuels [7, p. 6-7].

At present, the global power of power plants using plant biomass is, according to various estimates, from 54 GW to 62 GW. The share of biomass in world-wide electricity production is around 1.2 %, and in Europe, North and South America, which account for 85 % of the total installed capacity of such power plants, it is within the range of 1.4-1.5 %. European biomass burning capacity is 45 GW, and in North America it is about 10 GW [3, 7]. In Europe, 61 % of the total power of power plants operating on solid biomass falls on England, Scotland and Sweden. European capacities in forestry waste are 67.5 % concentrated in Finland, Sweden, England and Germany, and the capacity utilizing gas from landfill waste of 45 % is concentrated in England. The share of biomass used for co-firing in European countries ranges from 5 % to 35 %. In North America, 65 % of biomass energy comes from wood waste and 16% from landfill gas. Brazil is the largest producer of electricity from waste from sugar production. Developing countries, despite the significant reserves of different types of biomass, use them much less, mainly in the form of firewood for heating or cooking [7, p. 33-34].

Ukraine has a great potential for biomass available for energy use. The economically feasible potential of biomass is estimated at 27 million tons of fuel equivalent per year. The main components of the potential are agricultural waste and energy crops. By attracting this potential for energy production, about 15 % of Ukraine's primary energy needs can be met. The development of the bioenergy sector in Ukraine should be conducted consistently and reasonably, taking into account the possible impact on the national economy and the environment.

**The conclusions.** Further development of biomass use should take place with necessary considering its impact on the environment and the observance of criteria for sustainable development. At the same time such the ways to increase the competitiveness of energy biomass should be highlighted:

– the study of the features of energy biomass as a kind of raw material for harvesting and industrial use as an alternative energy raw material;

- state stimulation of industrial use of energy biomass;
- analysis and formation of the market of suppliers and consumers of energy biomass;
- creation of efficient machines and equipment for harvesting, transportation and use of energy biomass;
- the formation of the market for machinery manufacturers and equipment for harvesting, transportation and use of energy biomass;
- justification of the parameters and modes of operation of such machines and equipment;
- increase in the operational characteristics of energy biomass, among which a special place is occupied by the production of fuel wood, fuel briquettes, pellets and wood pellets.

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## **Анотація.**

**Заїка С.О. ШЛЯХИ ПІДВИЩЕННЯ КОНКУРЕНТОСПРОМОЖНОСТІ ЕНЕРГЕТИЧНОЇ БІОМАСИ.**

Нині в більшості країн світу спостерігається підвищена зацікавленість до використання альтернативних джерел енергії, яка пов'язана з постійним зменшенням

запасів викопних енергоносіїв, погіршенням екології, викликаним газовими викидами, що спричиняє парниковий ефект, а також бажанням значної кількості країн звільнити енергетичні джерела від політичної ситуації в світі.

Дослідження демонструють, що для України рослинна біомаса є найкращим джерелом одержання твердого біопалива. Адже держава має значний потенціал біомаси, придатної для енергетичного використання, залучення якої для виробництва енергії в близькій перспективі може задовольнити до 15 % потреби країни в первинній енергії.

**Ключові слова:** енергії, енергетична біомаса, відновлювальні джерела енергії, паливо, конкурентоспроможність, потенціал.

#### **Аннотация.**

#### **Заика С.А. Пути повышения конкурентоспособности энергетической биомассы.**

Сейчас в большинстве стран мира наблюдается повышенная заинтересованность к использованию альтернативных источников энергии, которая связана с постоянным уменьшением запасов ископаемых энергоносителей, ухудшением экологии, вызванным газовыми выбросами, которые создают парниковый эффект, а также желанием значительного количества стран освободить энергетические источники от политической ситуации в мире.

Исследования показывают, что для Украины растительная биомасса является лучшим источником получения твердого биотоплива. Ведь государство имеет значительный потенциал биомассы, подходящей для энергетического использования, применение которой для производства энергии в ближайшей перспективе может удовлетворить до 15 % потребности страны в первичной энергии.

**Ключевые слова:** энергия, энергетическая биомасса, возобновляемые источники энергии, топливо, конкурентоспособность, потенциал.

#### **Abstract.**

#### **Zaika S.O. Ways of enhancing the competitiveness of energy biomass.**

Currently, in most countries of the world, there is a high interest in the use of alternative energy sources, which is associated with a permanent decrease in fossil fuel reserves, environmental degradation, gas emissions caused by the greenhouse effect, and the desire of a significant number of countries to release energy sources from the political situation in the world.

Studies show that plant biomass is the best source of solid biofuels for Ukraine. After all, the state has a significant potential of biomass, suitable for energy use, the attraction of which for energy production in the near future can meet up to 15 % of the country's needs in primary energy.

**Key words:** Energy, Energy Biomass, Renewable Energy, Fuel, Competitiveness, Potential.