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## **CONDITION AND MAIN FACTORS OF DEVELOPMENT PRODUCTION OF BIOFUELS IN UKRAINE AND THE WORLD**

*Basic aspects of development, international experience and status of biofuels in the world are considered. Researched the possibilities of raw materials in Ukraine and Vinnytsia region for biofuel production and identified the main factors that influence the development of bioenergy in our country.*

**Keywords:** *biofuels, biodiesel, bioethanol, biofuel market, power plant, ecological factor, the price factor.*

**Introduction.** Every year in Ukraine consumes about 200 million tons of fuel, and the mining of natural sources of the country is only 80 million tons. An important potential resource for such a balance of own and imported energy resources can be a biofuel.

The share of renewable energy sources (RES) in the primary energy consumption in the countries of EU - 27 reached 12.5% in 2010 and continues tendency of increase. According to EU Directive 2009/28/EC the share of renewables in 2020 should reach 20%. Despite the financial and economic crisis, the growth of renewables continues from year to year. However, 49% RES is produced of wood and secondary wood resources. If the amount of biomass increases, the relative proportion of RES biomass decreases annually, due to the rapidly increasing production of wind energy, biogas and solar energy (such as biofuels and wind energy has doubled in the last 5 years) [14].

EU set ambitious goals - to reduce greenhouse gas emissions to 20% by 2020, increase the proportion of renewable energy to 20% and increase energy efficiency to 20%. For this purpose all 27 EU countries are developed action plans for renewable energy. For example, Sweden in 2020 should increase the share of renewable energy to 49%, Latvia - 40%, and Finland - 38%. To date majority of EU countries has achieved significant growth in renewable energy. For example, Sweden has "exceeded" the plan and crossed scheduled level to 2020. The latest report about implementation plans for renewable energy shows that 13 countries are ahead of schedule and only two - with some lag from the intended goals. In general, the EU passed the bar at 13% with 2% excess of the planned level. It is assumed that 20% of the EU crossed a line until 2020 [13].

**Analysis of recent publications.** A significant contribution to development of theoretical and methodological aspects of the production and consumption of biofuels made such scientists as: Gavrish V. Gukov Ya., Davie V, Dubrovin V., Kaletnik G., Kudrytska N., Magomedov A., Melnychuk M., Myronenko V. and others.

However, despite the considerable amount of publications on this subject, the numbers of contentious issues not decrease, especially in the search for raw materials for the production of biofuels and establish of mass production and consumption in Ukraine.

**The aim of the article** is research of basic aspects of biofuels, condition of its production in the leading countries and in Ukraine in terms of the most common types: solid and liquid biofuels, which will allow to identify the main factors that can influence the development of biotechnology in the country.

Research results. The word "energy" is composed of two parts, "bio" and "fuel". "Bio" the first part of compound words, which indicates their relationship with life and life processes, such as biology, biography, biosphere [11, p. 156]. "Fuel" - combustible substances which allocated by burning a significant amount of heat. It is used in industrial processes or converted into other forms of energy [1, p. 81].

Other words biofuel - this is fuel that has the biological origin.

Biofuels are produced by thermal treatment of organic compounds (biomass) without air, so-called pyrolysis. The biomass have taken to determine all organic substances as vegetable and animal origin. The source of which is now existing biosphere of our planet [8, p. 37].

The term "biofuel" includes all types of transport and liquid fuels produced from biomass. Forms of biomass for use as biofuels are quite varied.

Biomass as an energy resource can have multiple areas of use: it can burn (in the form of sawdust, wood briquettes, pellets), recycled into liquid biofuels (bioethanol, biodiesel), and produce biogas.

V.I. Gavrish, examining the problems of development production and consumption of biofuels in Ukraine, made a classification of alternative fuels, including: gaseous (natural and artificial) and liquid (for diesel motors and for petrol motors) [2, p. 57].

Scientists of the National University Biotechnology and Environmental Sciences of Ukraine V.O. Dubrovin, M. D. Melnychuk, V.G. Myronenko showed a block diagram the differentiation of agricultural products for non-food use of one of the areas which is making biofuels. Regard to the diagram of work, the researchers divided of biofuels into the following types: solid (powdered, extruded, nature), liquid (methyl esters, industrial alcohol, oil) and gaseous (biogas) [5, p. 79].

We propose to classify the following types of energy (Fig. 1).

Bioenergy potential of Ukrainian areas is different, because it depends on a favorable combination of natural and anthropogenic factors. Vinnytsia region is a region with relatively high bioenergy potential (Table 1).

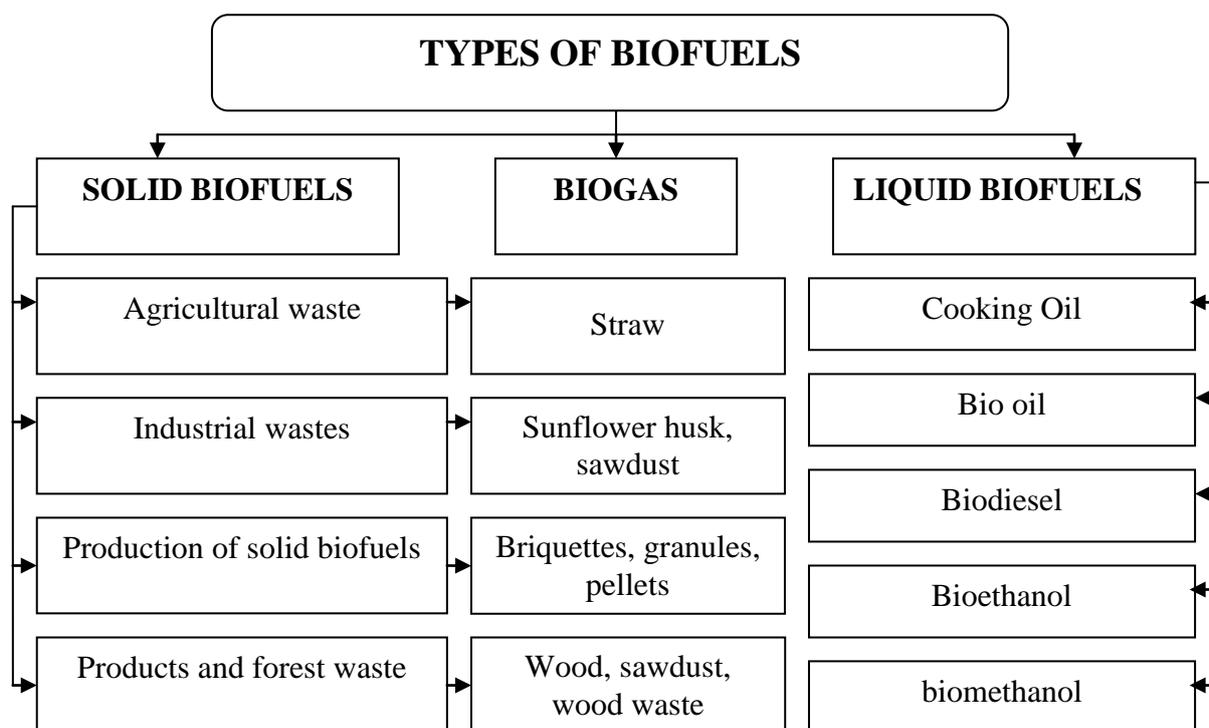


Figure. 1. Classification of biofuels

Energy potential of Vinnytsia oblast technically feasible for the by-products of agriculture, according to the Ministry of Agriculture, is 0.67 million tons of fuel. According to this index area is 6th place among the other regions of Ukraine.

Table 1

**Technically feasible energy potential of Vinnytsia region, thousands tons of fuel**

№	The energy potential	Ukraine as a whole, million tons	Vinnitsa region, million tonnes	Rating among the regions of Ukraine
1	Over Adverse agricultural products	12,81	0,67	6
2	Woody biomass	1,66	0,06	10
3	Energy crops	12,39	0,55	9
4	Animal waste	2,46	0,16	1
5	Biodiesel from rapeseed	0,51	0,045	2
6	Bioethanol	2,33	0,15	5

Source: [12, p. 144].

Vinnychna by the energy potential of wood biomass (60 thousand tons of standard fuel) - on the 10th, the potential energy crops (550 tons of fuel) - on the 9th place, the energy potential of animal waste (161.4 thousand tons of standard fuel) - 1 place, for energy potential of biodiesel from rapeseed (44.7 thousand tce) - 2 place, the energy potential of ethanol (146.7 thousand tons of standard fuel) - on 5th place .

With perspective indicators of regional bioenergy development Vinnytsia region is among the five regions of Ukraine [12, p. 142,144].

Let us briefly consider the features and trends of technology production and use of each type of biofuel globally and in Ukraine.

**Solid biofuel.** The basic technology of thermal processing of wood and biomass is direct burning (the most studied and commercially developed), gasification (on demonstrational level of development) and pyrolysis (located at the experimental level of development).

The quality of solid biofuel is formed at the stages of growing, storing and processing of biomass, and efficiency of its use also depends on the technical excellence of thermal generators.

The greatest efficiency can be obtained in the case of solid biofuels in the form of granules (pellets) or briquettes, large bales of herbaceous or woody biomass.

Comparative evaluation of different types of solid fuel will carry out in the table. 2.

*Table 2*

**Comparative evaluation of heat burning of different solid fuels**

Kind of fuel	Heat of burning	Sulphur,%	Ash,%	Carbon
Natural gas	35-38 MJ/m <sup>3</sup>	0	0	57 kg / GJ
Pellets of wood	17.5 MJ / kg	0,1	0,5-0,3	0
Pellets of straw	14,5 MJ / kg	0,2	4,0	0
Wood pellets of Husk	15,5 MJ / kg	0,1	1,0-2,0	0

Source: [4, p. 27].

The last scientific developments of the National University Biotechnology and Environmental Sciences of Ukraine, performed together with Czech colleagues, allowed to master the production of modern boiler-machines that work like on the traditional coal and on the solid forms of biofuels.

For the drying grains in particular rape, for energy purposes is advisable to use heat generators that work on rolls of straw, including rape. This equipment has produced in Ukraine, it helps agricultural enterprises to cover their own domestic and industrial energy needs through biomass from their fields [10, p.13].

Production of granules (briquettes) with husk seeds, stalks or straw to cover the cost of planting, cultivation and gathering of crops. These calculations are made by farmer Zhovkivskyi district in Lviv region. Fuel pellets are a high-calorie fuel and in high demand in the EU.

The industry in Ukraine of solid biofuel is fully export-oriented, as more than 90% of the fuel pellets and briquettes export from the country. The main importers solid biofuel are Poland, Germany, Italy. An area of solid biofuels in Ukraine continues to evolve rapidly, as evidenced by the following data: in 2008 Ukraine was produced together pellets and briquettes 77 tons, in 2009 - 350 thousand tons (pellets - 260 thousand tons, briquettes - 90 tons) [9, p.23].

At the beginning of 2010 in Ukraine there were 155 enterprises producing wood and straw briquettes, 73 plants producing pellets made of sunflower husks. However, most of the production goes for export.

According to the energy balance in Vinnitsa region the types of solid biofuels are agricultural residues (straw, sunflower husk, waste crops), wood mass (lump wood waste, sawdust, firewood, firewood) (Table 3).

The decision of the 25th session of the Vinnitsa Regional Council of the fifth convocation in 29.07.2009 № 828 approved the Energy Saving Program in the Vinnitsa region 2009 - 2013, which provides for measures to transfer heating systems of social institutions to work using local kinds biofuels and electricity. According to this program Vinnytsia National Agrarian University has to perform a leading role in

the development and implementation of biotechnology in the agricultural sector in Vinnitsa region.

*Table 3*

**Provision of Vinnitsa region solid biofuel species  
(according to the energy balance)**

№	Solid biofuels	Quantity
1	Straw crops	951.5 thousand tons
2	Husk sunflower	82,0 thousand tons
3	Waste crops	61,1 thousand tons
4	Wood mass (lump wood waste, sawdust, brushwood, firewood)	331,3 thousand m <sup>3</sup>

*Source: [6, p. 44].*

**Liquid biofuels.** According to the forecasts of experts the nearest future provide coverage up to 10% the world demand for diesel by vegetable liquid fuels. Methyl esters are used as a clean fuel in Germany, Austria, and as 30, 20 and 5% - not mixed with diesel fuel in France, Sweden, USA, Czech Republic and other countries. Thus, for example, in the U.S. by 2012 planned to produce annually about 20 million tons of liquid biofuels.

Researches have shown that liquid biofuels are becoming perspective kind of energy resources which for its significance in the global energy sector occupies second place after solid biofuels (Table 4).

Liquid biofuels are produced in unified technological process from the seeds of energy-intensive crops or processed in two stages: seed - in oil, and oil - in biofuels. Technology of production of diesel fuel from rapeseed oil is based on the physical and chemical processing of filtered oil to form methyl ester. Under the influence of the catalyst is re-oil by methanol to methyl ester of glycerol exemption. Output components almost do not mix, so after the end of the reaction mixture happens gravity distribution into two layers.

The most common and used on a global scale are bioethanol and biodiesel.

1. Biodiesel (RME - rape-methyl ester) - a type of biofuel which is produced from fats of vegetable and animal origin and which replaces petroleum diesel.

**Types of liquid biofuels and their use**

№	The component of fuel	Energy crops, agricultural and forestry	The process of conversion raw material	Directions for use
1	Vegetable oil	Rape, sunflower, soybean, other oilseeds		The component of heating fuel
2	Bio oil	Poplar, willow, miscanthus	Pyrolysis	Additive for of motor oil and gasoline
3	Biodiesel	Rape, sunflower, soybean, other oilseeds	Esterification	Replacement or part of diesel fuel
4	Bioethanol	Crops, potatoes, Jerusalem artichoke	Hydrolysis and fermentation	The component of gasoline
		Sugar beet, cane, sorghum	Fermentation	
		Poplar, willow, straw, grass	Pretreatment, hydrolysis and fermentation	
5	Biomethanol	Poplar, willow, miscanthus, rumeks	Gasification and methanol synthesis	The component of gasoline

Source: [3, p. 8, 9].

2. Bioethanol (ethyl alcohol for gasoline engines, which is produced by fermentation of sugar (sugar beets, sugar cane) or starch (wheat, corn).

Researches allow asserting that the main factors increasing the production of liquid biofuels are:

1. The price in the last decade, there was a significant increase in world prices for oil and oil products.

2. Ecological liquid biofuels, even when you use it as a supplement to conventional gasoline and diesel fuel has obvious environmental benefits compared to traditional fuels. When burning of fuel mixtures instead of conventional oil significantly reduced emissions of oxides of hydrogen aerosol particles, volatile carbohydrates, sulfur oxides. Adding ethanol to gasoline provides the necessary

octane fuel mix and makes it possible to abandon toxic additives such as lead, aromatic hydrocarbons, methanol.

So, the potential of Ukraine in terms of bio-energy resources is extensive. First, taking into account rising prices of oil and other energy resources, and low standard of living in the country, the demand for alternative and cheaper fuel in the population is quite high. Second, taking into account large number of "empty" of arable land, which is quite be approached for growing energy crops, Ukraine owns such deficient in the rest of the world's resources - land. So there are all prerequisites for the establishment of a national bioenergy sector.

Attractive environmental performance of liquid biofuels is the basis for state support for its production and use, even in conditions of low oil prices and biological materials. Such support is needed until the optimal ratio between the cost of growing and processing of initial biomass and energy composition of the target product are achieved. Equally important is the fact that in many cases not resolved the issue of commercial realization of by-products of agricultural raw materials (bards, meal, glycerin, etc.), which could significantly increase the efficiency of biofuel production.

**Conclusions.** The question of importance of production and consumption of biofuels associated with the limited world reserves of fossil energy resources and environmental pollution as a result their use. Research showed that the main factors that encourage the world community to the production of biofuels is the price and ecological. The most important and most valuable feature of biofuels is it renewable nature that creates opportunities for the agricultural sector serves their producer and consumer.

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#### ***Анотація***

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***Стан та основні чинники розвитку виробництва біологічного палива в Україні та світі***

*Розглянуті основні аспекти розвитку, світовий досвід та стан виробництва біологічних видів палива в світі. Досліджено можливості сировинної бази України та Вінницької області для виробництва біопалива та виділені основні чинники, які впливають на розвиток біоенергетики в нашій країні.*

***Ключові слова:*** біопаливо, біодизель, біоетанол, ринок біопалива, енергетичні рослини, екологічний фактор, ціновий фактор

#### ***Аннотация***

***Гуцаленко Л.В., Фабиянская В.Ю.***

***Состояние и основные факторы развития производства биологического топлива в Украине и мире***

*Рассмотрены основные аспекты развития, мировой опыт и состояние производства биологических видов топлива в мире. Исследованы возможности сырьевой базы Украины и Винницкой области для производства биотоплива и выделены основные факторы, которые влияют на развитие биоэнергетики в нашей стране.*

***Ключевые слова:*** биотопливо, биодизель, биоэтанол, рынок биотоплива, энергетические растения, экологический фактор, ценовой фактор.