

█ ЕКОНОМІКА ТА ЕФЕКТИВНІСТЬ ВИРОБНИЧО-ГОСПОДАРСЬКОЇ ДІЯЛЬНОСТІ

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BIOFUELS PRODUCTION: WORLD EXPERIENCE AND POSSIBILITY FOR DEVELOPING IN UKRAINE ©

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The modern problems of the energy dependence of Ukraine have been investigated in the article. The modern situation on world biofuels market has been analyzed and the countries – leaders of biofuels production have been determined. The experience of the USA, Brazil and the EU in the development of the biofuels market has been presented in the scientific research. Both bioethanol production and consumption in the USA have been investigated. The methods of stimulation and support of biofuels production in the EU have been presented as well. The current status of the biofuels industry in Ukraine and the possible ways of implementation of the world experience for the development of Ukraine biofuels market have been explored in this article.

Key words: renewable energy, biomass, biofuels, the USA biofuels production, world experience, energy security, energy independence.

Figure 2. Lit. 10

Problem Statement. Utilization of the renewable energy is one of the main tendencies of the world development. This tendency substantiated by the reasonable causes, such as: the energy consumption in the world is growing; the volume of recourses for the traditional fuels is becoming less and less every year; greenhouse effect is a global problem over the world. As Mr. Reddy sad: "World energy crisis and global warming are the two major problems human kind faces today, which are mainly due to the more population growth, fast industrialization, and increased use of fossil fuels. The importance for identification of potential renewable source for sustainable energy production has gained momentum recently. Currently many countries are using biomass, waste, solar, wind, hydro and geothermal energy sources as alternative to fossil based fuels"[1].

Overall, development of the biofuels production is actual problem for Ukraine. Implementation of the world experience in the biofuels production area is one of the ways of development the biofuels market in Ukraine.

Previous Researches and Publications. Scientific researches in the biofuels production sphere were done by national and overseas scientists. The most famous of them are: O. Adamenko, V. Beregovii, I. Goncharyk, G. Kaletnik, I. Kurulenko, O. Klimchuk, S. Medipally, P. Sabluk, O. Skoruk, O. Prutska and others.

The Aim of the Article is to analyze the current situation on the biofuels market in the world; to investigate the countries – leaders of biofuels production and explore their experience to implement it in Ukraine.

The Essence of the Article. The role of the global energy system in the economic development of the countries in the last years is growing as fast as it could solve more and more technological, environmental and social problems of the society. The twenty-first century in the first place put forward the problem of optimal functioning of the global energy system to ensure energy security and stability in the world while preserving the environment, ensuring sustainable development and improving living standards. To achieve these goals in a strategic perspective, we need to transition from industrial to post-industrial energy system that should be independent of traditional fossil resources, and, simultaneously, more eco-friendly [2].

To solve the strategic problems of energy consumption and production of the energy resources in the countries of the world are using alternative energy resources. One of the most efficient and popular of them today is biomass production. The production of the biogas, biodiesel and bioethanol is growing all over the world [3].

Bioenergy uses renewable biomass feedstocks from many sources. Renewable biomass feedstocks use the process of photosynthesis in plants to capture the sun's energy by converting carbon dioxide (CO₂) from the air and water (H₂O) into carbohydrates and complex oil and fiber compounds made up of carbon, hydrogen and oxygen. These energy-rich carbohydrates, oils and fibers can be harvested and used for many types of bioenergy. There are hundreds of ways to turn biological materials into energy, although currently only a few of them represent legitimate short-term opportunities for the average farm or rural landowner.

Bioenergy can be produced from feedstocks such as trees, agricultural crops, plant residues, animal parts and many other biological materials. The benefits of one feedstock versus another are regionally specific. This makes feedstock selection a key consideration in bioenergy production. Feedstocks may be dedicated to energy production or non-dedicated. Feedstocks that are dedicated are often called energy crops. Each feedstock has advantages and disadvantages that may include how much usable biomass they produce, soil types required, water and energy inputs, energy density, air quality benefits, production cost and other considerations [4].

Biofuels are lumped into first, second and even third generation categories. First-generation biofuels, created from crops traditionally used as food, are used in our fuel tanks today and have been blamed for increasing world hunger by taking away land from food production as well as contributing to rising food prices.

Meanwhile, second-generation biofuels are created largely from non-food feedstocks using advanced technical processes including enzyme-based and thermochemical processes. Here pyrolysis and gasification technologies produce a synthesis gas, from which a wide range of biofuels can be reformed. Cellulosic ethanol is the most developed second-generation biofuel.

Then there are third-generation biofuels, derived mainly from algae. Here, light, carbon dioxide and nutrients are used to produce the feedstock "extending" the carbon resource available for biofuel production. ExxonMobil and Synthetic Genomics, US, for example, are developing new, more productive strains of algae [3].

A lot of attention to the development of biofuels production is paid in the USA. The country is one of the world leaders of biofuels production.

Production of biodiesel in the USA was 105 million gallons in January 2016. Production came from 96 biodiesel plants with capacity of 2.1 billion gallons per year. Producer sales of biodiesel during January 2016 included 46 million gallons sold as B100 (100% biodiesel) and an additional 45 million gallons of B100 sold in biodiesel blends with diesel fuel derived from petroleum. There were a total of 753 million pounds of feedstocks used to produce biodiesel in January 2016. Soybean oil remained the largest biodiesel feedstock during January 2016 with 392 million pounds consumed [5].

The USA is the largest producer of bioethanol in the world also (Figure 1). U.S. exports of fuel ethanol exceeded 800 million gallons for the second time in four years in 2015, totaling 844 million gallons, nearly equal to the 846 million gallons exported in 2014. The United States remained a net exporter of fuel ethanol for the sixth consecutive year and exported the fuel to 35 different countries in 2015.

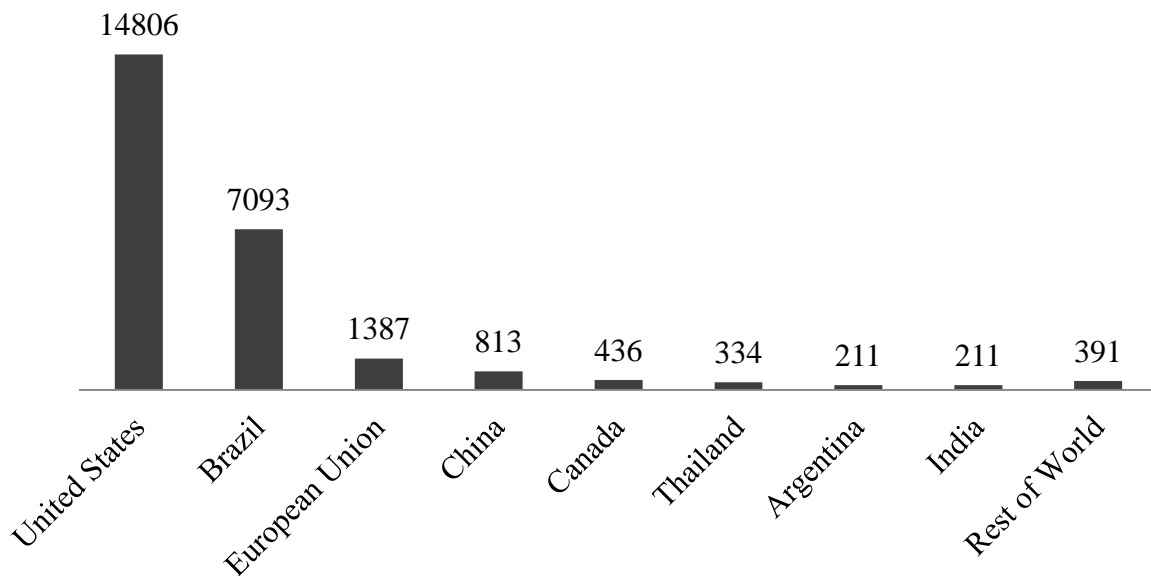


Figure 1. Bioethanol Production in the Countries of the World, Millions of Gallons
[designed by author from the 5]

In the United States, ethanol is primarily used as a blending component in the production of motor gasoline (mainly blended in volumes up to 10% ethanol, also known as E10). Corn is the primary feedstock of ethanol in the United States, and large corn harvests have contributed to increased ethanol production in recent years.

In 2015 in the USA fuel ethanol production reached 14,8 billion gallons of ethanol fuel, the highest level ever. The growth in U.S. fuel ethanol production has outpaced growth in corn consumed as feedstock — as the industry has grown, it has become more efficient, using fewer bushels of corn to produce a gallon of ethanol. Most of the fuel ethanol used in the United States is distilled from corn. Scientists are working on ways to make ethanol using all parts of plants and trees rather than just grain. Farmers are experimenting with fast-growing woody crops like small poplar and willow trees and switchgrass, to see if they can be used to produce ethanol.

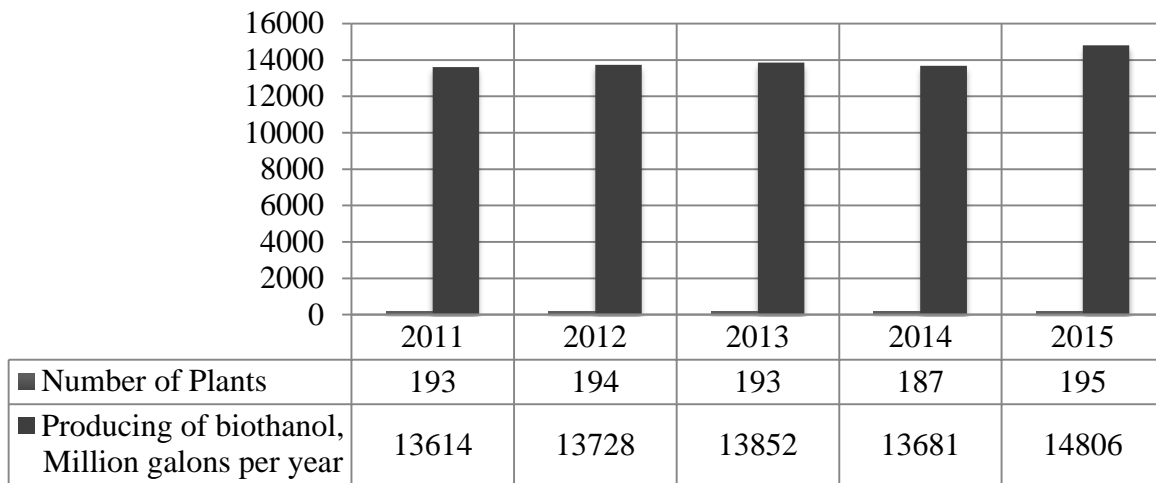


Figure 2. Bioethanol Production and Number of the Plants in the USA

[designed by author from the 5]

Ranking second in biofuels production and consumption is Brazil, whose sector is dominated by sugarcane-ethanol and soybean-biodiesel. Brazilian sugarcane production has been increasingly orientated towards biofuels – or, more broadly, bioenergy.

Currently, 50%–60% of Brazil's sugarcane output is used for ethanol rather than for producing sugar. The exact rate fluctuates because producers can shift between one or the other depending on ethanol and international sugar prices, but on average the percentage destined for biofuels has grown significantly over the past decade.

In addition, electricity generation from sugarcane biomass has become increasingly relevant and already meets 11% of Brazil's demand for electricity. As for biodiesel production, it grew from virtually nothing before 2008 to about 2.7 bl in 2011, replacing 5% of Brazil's total diesel consumption – as defined by a government mandate.

This has been beneficial to soybean growers, who can now count on one more downstream market, greater demand and, therefore, higher prices. In 2012 about 30% of Brazil's vegetable oil (mostly soybean) was diverted to biodiesel.

Overall liquid biofuels amount to 15% of Brazil's fuel consumption in the transport sector.

The EU has the world's third largest biofuels output, coming mostly from Germany, France and Spain [6].

Development of sustainable advanced biofuels is part of the Strategy for a Sustainable European Bioeconomy proposed by the European Commission in February 2012 to shift the European economy towards greater and more sustainable use of renewable resources and processes (for food, feed, energy and industry).

The plan focuses on three key aspects:

- developing new technologies and processes for the bioeconomy;
- developing markets and competitiveness in bioeconomy sectors;
- pushing policymakers and stakeholders to work more closely together.

In 2009 the EU bioeconomy had a turnover of nearly €2 trillion (2012) and employed more than 22 million people, 9 % of total employment in the EU. Each euro invested in EU-funded bioeconomy research and innovation was estimated to trigger €10 of value added in bioeconomy sectors by 2025.

According to the estimate there are approximately 5.5 million hectares of agricultural land on which bioenergy cropping takes place. This amounts to 3.2 % of the total cropping area (and around 1 % of the utilised agricultural area) in the EU-27. Practically all of this land is used for biofuel cropping, mostly oil crops (82 % of the land used for biomass production), which are processed into biodiesel. The rest is used for the production of ethanol crops (11 %), biogas (7 %), and perennials which go mostly into electricity and heat generation (1 %). The table below shows the cultivated area of the most important energy crops in Europe [7].

Governing the European transition toward a lowcarbon economy by 2050 has urged policy makers to develop new regulatory approaches for integrating actions to mitigate climate change and to produce secure but sustainable energy. The European Union (EU) sustainability scheme for biofuels, established by the Renewable Energy Directive (RED), is a practical example of such an alternative regulatory approach.

The primary objective of the RED is to increase the overall share of renewable energy to 20% of the EU's gross final consumption of energy by 2020. In addition, the RED sets a fixed objective to increase the use of renewable energy in transport to 10% for the same target year. The strategic targets for 2050 are more ambitious, ranging from 55–100 %.

Although these targets may sound unfeasible, striving for ambitious policy goals is a prerequisite for achieving the ultimate objective of drastically reducing the EU's greenhouse gas emissions. Transport biofuels play a central role in the attainment of the objectives, and for establishing a stable renewable energy policy sector in the EU.

Biofuels have been a touchy topic both for the EU's climate, energy and environmental policies and for the European biofuel industry. Although it has been proclaimed the 'most comprehensive and advanced binding sustainability scheme of its kind anywhere in the world', the current regulatory framework for biofuels is failing to facilitate the attainment of the objective of reducing greenhouse gas emissions, and the scheme is to be revised.

Finally, we could see that biofuels production is the main tendency and one of the main energy sources in the economy of the developed countries, such as the USA, Brazil and countries of the Europe Union. According to the forecasts the sector of the renewable energy and Bioenergy production will be grown fast in the nearest few years. The competitive strategy for Ukraine should include the providing conditions for the alternative energy and biofuels production development. It could help Ukraine to solve a lot of problems, including energy dependence.

Ukraine is among the countries that are energy-dependent and it could cover it needs of the energy consumption only about 53% and imports 85% of the 144 required volume of crude oil and petroleum products. This creates a dependency of the economy on oil-exporting countries and poses a threat to the energy and national security [8].

The solution of this problem is Bioenergy production. Ukraine has rich soils and good climate condition for the growing of the energy crops. Moreover, producing of the biofuels will help to create new work places and make agricultural companies more profitable.

Currently, the main constraints that oppose the deployment of the biofuels industry in our country can be combined into three groups:

1) the investment attractiveness of bioenergy cultivation of raw materials for export purposes;

- 2) the incomplete and the unregulated in practice the law frameworks;
- 3) the lack of the established infrastructure of the biofuels market and the lack of preparedness of the consumers to use the product [9].

Despite of the problems, biofuels production in Ukraine has a lot of perspectives. At all, it is necessary to have the balanced government policy and support of the bioenergy that will include different tools and methods such as: economic methods (subsidies, lower taxes), administrative methods (rules and standards) and coordination of the laws in biofuels production sphere.

The research done by Pyvovar showed that the key promising ways of further development of the biofuels market are:

- 1) to stimulate biofuels producers due to lower tax rate;
- 2) providing the financial support for biofuels producers and manufacturers of equipment for the production of biofuels through government grants and subsidies;
- 3) to stimulate scientific and technological development through the development of public research programs for researchers;
- 4) to oblige to sale the fuel composition that include at least 15% biofuel;
- 5) to develop of regulations that can to stimulate creation of agricultural service cooperatives for the production of biofuels [10].

Conclusion. The renewable energy production and consumption is growing in the world and according to the forecasts this tendency will be continued in the nearest years. The developed countries of the world try to find alternative resources of the energy and one of the most common and useful of them is biofuels. The USA, Brazil and the EU are the largest producers of biofuels in the world. To provide the sustainable growth and development of biofuels production the Government of these countries is implementing the system of support of the bioenergy that includes different tools. A lot of attention is being paid on the scientific research of the second and the third generation of biofuels.

Ukraine could become one of the world leaders of biofuels production as well. Our country has all necessary resources such as rich soils, good climate conditions and powerful agriculture sector that could provide energy crops for the biofuels production. Unfortunately the growth of biofuels production is restraining by the objective causes. To solve the problems, firstly Ukraine needs to create up to date both legal regulation and the comprehensive stimulation systems.

Secondly, our country needs to stimulate the scientific research through the special grants. And the last but not the least, create the conditions to the processing of the energy crops in Ukraine.

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АНОТАЦІЯ
ВИРОБНИЦТВО БІОПАЛИВА:
СВІТОВИЙ ДОСВІД ТА МОЖЛИВОСТІ РОЗВИТКУ В УКРАЇНІ

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В статті були досліджені сучасні проблеми розвитку енергетичної галузі економіки та проблеми енергетичної залежності України. Визначено нагальну необхідність розвитку виробництва біопалива як основи забезпечення енергетичної сталості та незалежності держави. Здійснено аналіз сучасної ситуації на світовому ринку біопалива, а також вивчено досвід країн – лідерів у виробництві біопалива. В наукових дослідженнях опрацьовано досвід США, Бразилії та ЄС щодо стимулювання розвитку ринку біопалива. Досліджено обсяги виробництва і споживання біоетанолу в США. В статті вивчені методи стимулювання і підтримки виробництва біопалива в ЄС. Було вивчено сучасний стан біопаливної галузі в Україні та можливі шляхи імплементації світового досвіду для розвитку ринку біопалива України.

Ключові слова: відновлювальна енергетика, біомаса, біопаливо, виробництво біопалива в США, світовий досвід, енергетична безпека, енергетична незалежність.

Рис. 2. Літ. 10.

**АННОТАЦИЯ
ПРОИЗВОДСТВО БИОТОПЛИВА:
МЕЖДУНАРОДНЫЙ ОПЫТ И ВОЗМОЖНОСТИ ДЛЯ РАЗВИТИЯ В
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В статье были исследованы современные проблемы развития энергетической отрасли и проблемы энергетической зависимости Украины. Определена необходимость развития производства биотоплива как основы обеспечения энергетической устойчивости и независимости государства. Осуществлен анализ современной ситуации на мировом рынке биотоплива, а также изучен опыт стран - лидеров по производству биотоплива. В научных исследованиях отображен опыт США, Бразилии и ЕС по стимулированию развития рынка биотоплива. Проведено исследование объемов производства и потребления биоэтанола в США. В статье изучены методы стимулирования и поддержки производства биотоплива в ЕС. Было изучено современное состояние биотопливной отрасли в Украине и возможные пути имплементации мирового опыта для развития рынка биотоплива Украины.

Ключевые слова: возобновляемая энергетика, биомасса, биотопливо, производство биотоплива в США, мировой опыт, энергетическая безопасность, энергетическая независимость.

Рис. 2. Лит. 10.

Інформація про автора

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