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## PERSPECTIVE DIRECTIONS FOR THE ENERGY CROPS MARKET DEVELOPMENT TO PRODUCE BIOFUELS

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*Обґрунтовані основні фактори, що лежать в основі формування ринку рідкого біопалива та можливі перспективи його розвитку. Визначені перспективні напрямки розвитку ринку енергетичних культур для виробництва біопалива. Обґрунтовані інструменти стимулювання виробництва рідкого біопалива і запропоновані шляхи економічного впливу на взаємини між сільськогосподарським і енергетичним ринками.*

**Ключові слова:** біопаливо, розвиток, ринок, енергетичні культури, сировинна база, виробництво.

Recently, issues related to the prospects of alternative energy sources exploitation have attracted an increasing attention. This is due to a combination of factors, among of them are climate change, high oil prices, desire of some countries to ensure own energy security and independence, as well as the need to overcome the stagnation of the agricultural sector and other. In this regard, the task of satisfying the global population growing needs in fuel, electricity and heat, along with ensuring of environmental safety necessitates the biofuels market development.

It is necessary to create the conditions for an agricultural energy crops cultivation and sale as biological raw material to produce it for the biofuels market development. However, a common challenge when using agricultural raw materials to obtain fuel consists in the fact that it competes with food production. The goal is to determine a feasibility of the biofuel market development as well as make a power engineering direction environmentally sound, cost-effective and non-threatening for food security.

Economic issues over the biofuels production and exploitation in Ukraine are investigated by many Ukrainian researchers,

including: V.I. Boyko, V.O. Dubrovin, H.M. Kaletnik, Y.A. Kuzminskiy, B.V. Kolesnyk, V.Y. Mesel-Veseliak, V.M. Pasichnyi, S.P. Tzyhankov etc. Scientific papers of such scientists are devoted to the issues over the agricultural raw materials forming and effective utilization to produce biofuels: V.H. Andriychuk, Y.P. Voskobiynyk, V.I. Havrysh, L.V. Hoy-siuk, N.V. Zinovchuk, I.V. Kushnir, M.V. Royik, A.H. Samoilenko, M.M. Chornobay, O.H. Shayko, O.M. Shpychak etc.

Organizational and economic challenges of biofuel production, tools to stimulate energy crops cultivation to create biofuels resource base, determining the appropriateness of biofuel production by crops and other issues are addressed in the research. Considering an indisputable mentioned scientists' contribution to the theory and practice of bioenergy crops cultivation it should be noted that insufficient attention is paid to the investigation of ecological and economic aspects of energy crops market formation as the basis for the formation of raw material base for biofuel production.

The aim of the paper is to study perspective directions of the energy crops market development for biofuels production.

Application of biofuels into the transport sector is an important way to reduce a harmful emission into the atmosphere along with the improvement of its efficiency. An important role to ensure alternative fuels for aircraft, marine vessels and other heavy transport modes would play this type of fuel application progress.

The total production of liquid biofuels in the world has increased from 16 billion liters in 2000 up to 110 billion liters in 2011. Today, liquid biofuels account for about 3% of the total fuel for transportation, as well as achieves a substantial share in some countries most actively developing this sector [5]. Top locations over the ethanol production occupy the U.S., Brazil and the EU.

The United States have begun to mix ethanol with gasoline since the end of 1970s, yet ethanol has taken a significant share in gasoline consumption only in the last decade. The share of ethanol in gasoline has been about 1 percent of the volume of gasoline in 2001, but reached almost 10 percent of domestic gasoline consumption in 2011. Production of ethanol has reached historically high levels in 2011, but ceased to grow at rates that have been achieved in recent years due to the saturation of the gasoline market in the U.S. (Table 1) [4].

The second largest producer of ethanol after the United States in the world with an output of 24.9 billion liters is Brazil and the world's largest producer of sugar cane and sugar, 3.3 billion liters of which were exported. First generation Bioethanol (an ethyl spirit) is obtained by processing vegetable starch-containing raw materials (wheat, corn, sugar cane, sugar beet, crop waste, etc.), share in the prime cost of the final product amounts to 70–80% (Table 2) [6].

In the EU, about 80% of biodiesel is produced from rapeseed yield of which enables to produce approximately 1190 liters of oil per 1 hectare (for soybeans this indicator amounts to 446 liters, flax — 478 liters, peanurs — 1059 liters, palm — 5950 liters), at the same time 1 t of vegetable oil and 111 kg of alcohol (in the presence of 12 kg of catalyst) produces about 970 kg (1,100 liters) of biodiesel and 153 kg of initial glycerol. In the 2005–2009 world production of biodiesel increased by 4 times [1, p. 60].

The energy crops market development in Ukraine is caused not only by favorable climatic conditions, but also by the level of intensification of the oilseeds and grain production. In addition, European countries are primarily interested not in biofuels, but in raw materials for the production, ie energy crops. That is a

Table 1

The main characteristics of the liquid biofuels production and consumption in the United States, 2009-2011 (million gallons)

The indicator	2009	2010	2011
<i>Ethanol</i>			
Consumption	11.037	12.858	12.871
Consumption (% on the gasoline consumption volume)	8.0	9.3	9.6
Production	10.938	13.298	13.948
Gross Imports	198	16	172
Gross Exports	–	399	1.195
<i>Biodiesel</i>			
Consumption	326	263	878
Consumption (fuels% on the distillate consumption volume)	0.6	0.5	1.5
Production	516	343	967
Gross Imports	77	23	36
Gross Exports	266	105	73

Source: generated by the author according to the data [8].

Table 2

Bioethanol outturn with 1 ton raw materials

Name of raw materials	Ethanol, l	By-products, kg	Carbon dioxide, kg
Wheat	375	330	370
Rye	357	390	350
Barley	330	430	320
Corn	410	300	400

Source: generated by the author according to the data [3].

significant resource potential of biomass is the main advantage of Ukraine in comparison with other European countries. Prospects for energy crops market development for bioenergy are associated with recycled cultivated cereals and industrial crops surplus, as well as the introduction of existing large areas of unused land suitable for the cultivation of these crops.

Another direction of the biofuels market development could be called the intellectual resources, ie the totality of human, scientific, research resources through which measures to produce biofuels are to be implemented. It is also an important group of factors that affect the efficiency of the production process, because the result of the production process of creating the resource base will depend on the responsible persons qualification degree [3, p. 74].

Equally important area of biofuels market is the financial and economic tools that contain science-based financial allocations of raw materials for biofuels. Production of crops — canola, corn for grain or winter wheat as well as harvesting of straw and crop feeder should be based on developed financial plans with a budget of cash and financial resources in

general. This group of instruments includes the process of developing financial plans, ie, the process of a certain type production of agricultural production or harvesting of raw materials on which is to be held. Financial planning actually contains information about all the other factors, ie starting with the necessary logistics, capital and intellectual support, ending with the movement of funds and the results of production activities, ie income and the level of profitability [5; 7].

Measures to stimulate the development of biofuel production by encouraging primary producers and consumers of fuel are also very important (Fig. 1).

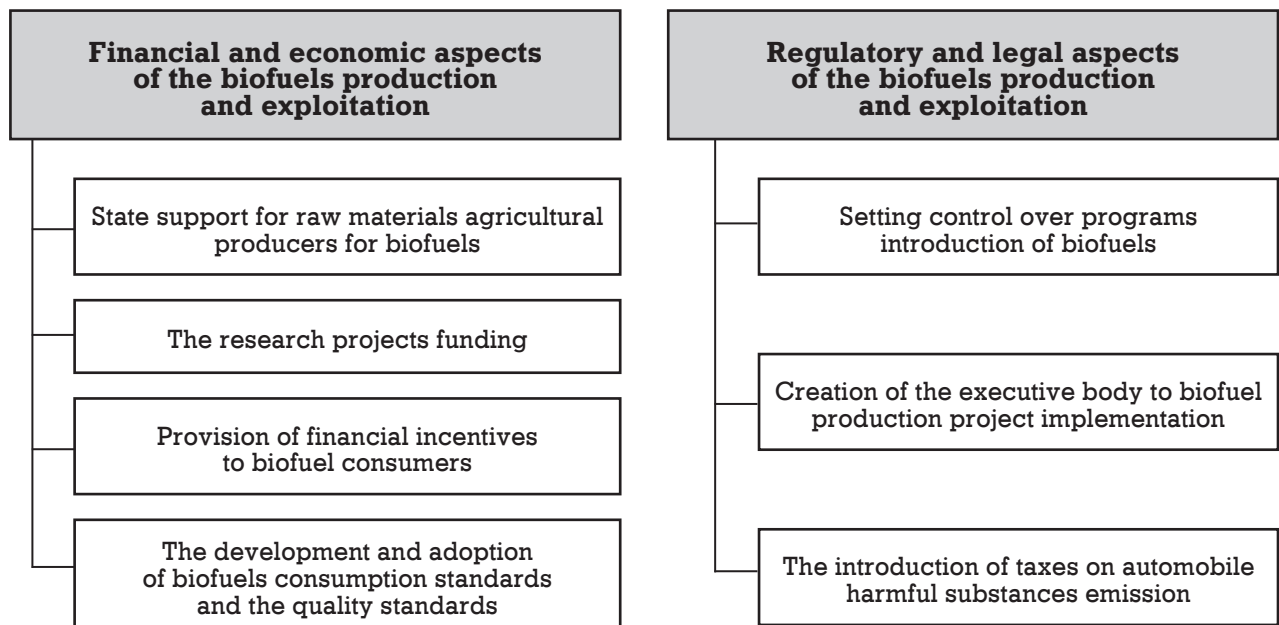


Fig. 1. Development trends of biofuels production with crop raw material

Source: constructed on the basis of [1; 2; 5]

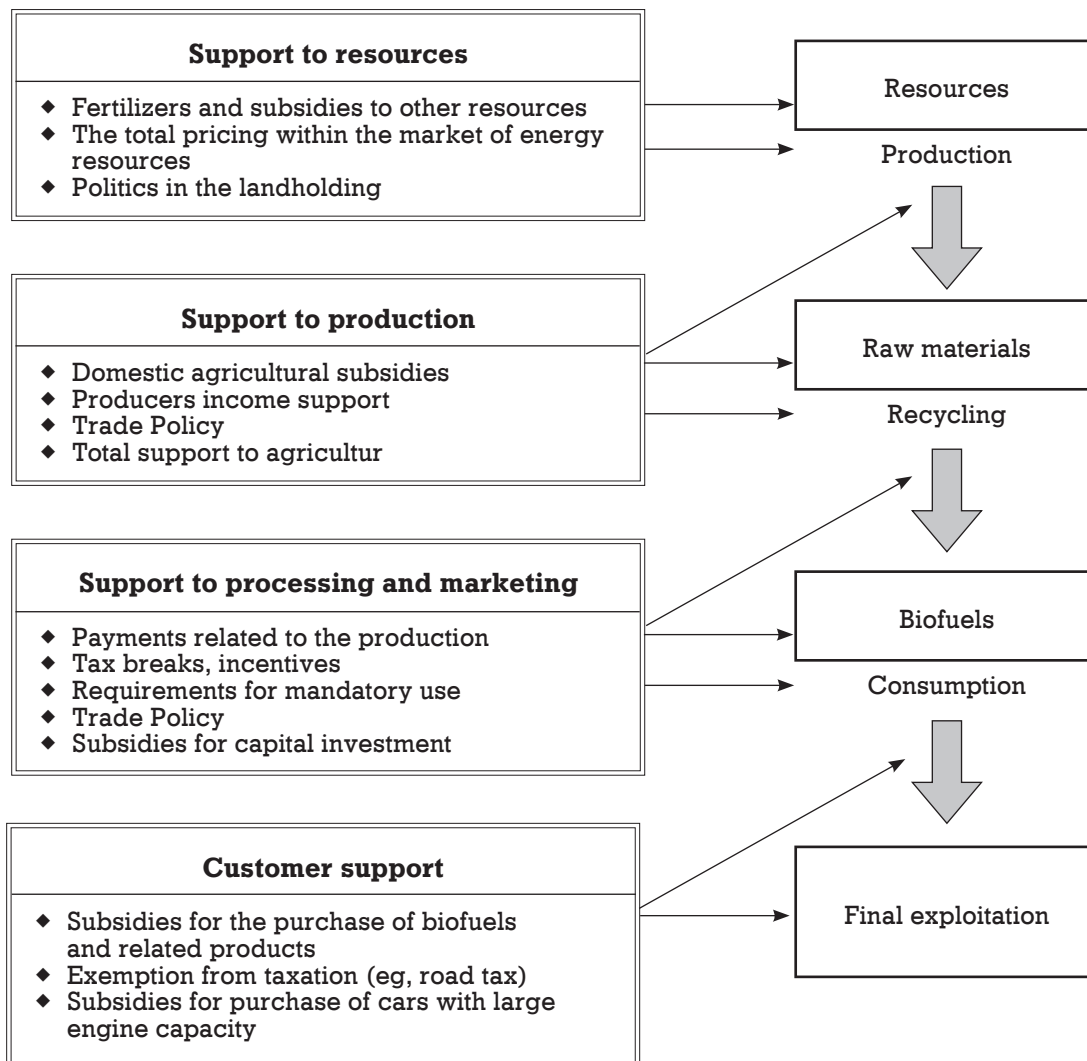


Fig. 2. Economic incentives at different stages of the value chain of liquid biofuels  
 Source: adapted by the author [9; 10].

Thus, the basis for the formation of both raw materials, as well as biofuel production is primarily a government support. The main determining factors of state sector support have been climate change and energy security, coupled with the desire to support the agricultural sector through the rising demand of agricultural products. Notwithstanding the impact of domestic farmers support, biofuel policy effectiveness in achieving objectives related to climate change and energy security, is subjected to increasingly rigorous analysis.

Establishing of appropriate policy and quantitative determination of its impact in specific cases is complicated due to diversity of policy tools and the application methods, however, It usually take the form of subsidies

(sometimes quite large) aimed at supporting of biofuels and affect the financial attractiveness of its production, trade and application.

Subsidies can affect the sector at different stages. Different stages of the value chain of biofuels, where the direct and indirect economic instruments can provide support to the sector, are shown in Fig. 2, prepared according to the Global Initiative for subsidies [9].

Quantitative target indicators are crucial catalysts for development and growth in most areas of modern bioenergy industry, particularly with respect to the liquid biofuels for transport, where the mixing rules are set more often. It is necessary to take immediate steps to prepare the domestic market for applying new types of fuel and mixtures with

mineral oil processing products. Undoubtedly, energy is used by different branches of industry unevenly and becomes as the most timely and faithful support for paramount use in the most important and vulnerable sectors of the economy on environmental point of view, namely, agriculture, utilities, parks and resort areas, metropolises, etc.

### CONCLUSIONS

Thus, the main challenge that arises when using biofuels is to develop a sustainable raw material infrastructure and selection of the best sources of bio-materials, enabling utilization of secondary co-products and provide the maximum efficiency of land planted area by wasteless processing technologies. Global growth in demand for energy crops promotes growth in the prices that generates supply growth. Therefore, agriculture of Ukraine has all the chances to become an industry able to provide not only food, but also, to some extent, energy security. In general, the problem of determining the prospects of development of the biofuels market lies in the fact that it is necessary to take into account a complex set of interrelated factors that have a direct impact on the bioenergy potential and the development of biofuel industry products trading.

Development of the biofuels market can be stimulated and supported by the state through a broad set of tools. Mandatory mixing of biofuels with petroleum-based fuel, subsidies on production and distribution, as

well as tax incentives are related to common tools of such economic policy. Moreover, tariff barriers on biofuels are widely used to protect domestic producers. This policy has a decisive impact on the profitability of biofuel production that, otherwise, in many cases would be commercially unviable.

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## НОВИНИ НОВИНИ

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#### ІГОР ШВАЙКА: ПЕРЕОРІЄНТАЦІЯ НА ВИРОБНИЦТВО БІОПАЛИВА ЗМЕНШИТЬ ЗАЛЕЖНІСТЬ ДЕРЖАВИ ВІД ІМПОРТУ ЕНЕРГОНОСІЇВ

В умовах зростання цін на пальне актуальним стає питання скорочення споживання нафтопродуктів за рахунок впровадження ресурсо та енергоощадних технологій. Зокрема, Україна має значний потенціал олійних культур як сировини для виробництва біодизелю. Розвиток виробництва біопалива у перспективі дозволить одночасно забезпечити сільгоспвиробників пальним за рахунок власних джерел, зменшити залежність держави від імпорту енергоносіїв, створити нові робочі місця та забезпечити розвиток інфраструктури у сільській місцевості та сформуванню гарантований ринок збуту сільськогосподарської сировини. Про це нещодавно повідомив міністр аграрної політики та продовольства України Ігор Швайка.