

CREATING CONDITIONS FOR THE SUSTAINABLE DEVELOPMENT OF THE LIQUID BIOFUEL MARKET IN UKRAINE



I.V. CHEBAN, PhD Student of the global economy department
National University of Life and Environmental Sciences
of Ukraine
ORCID ID 0000-0001-5265-0193
E-mail: irynacheban@ukr.net



A.D. DIBROVA, Doctor of Economics of the global economy
department
National University of Life and Environmental Sciences
of Ukraine
ORCID ID 0000-0003-2503-2431
E-mail: dibrova@nubip.edu.ua

Abstract. *In light of the growing importance of biofuels in the world and Ukraine's potential of its production, the current research focuses on analyzing the future development of liquid biofuel market and production possibilities in Ukraine. This research aims at analyzing the current status and future projections of the liquid biofuel market in Ukraine until 2030 using the AGMEMOD model - an econometric, dynamic, partial equilibrium, the multi-commodity model. This is a new market for the Ukrainian AGMEMOD model, and it was implemented in the model for the first time. The current paper offers the introduction of state aid in form of direct support and tax preferences for liquid biofuels producers to meet the needs of the domestic market in biofuels and to achieve the indicative target of 10% consumption biofuels in the total consumption of motor fuel by transport sector till 2020. The research suggested conditions for the creation of sustainable development of the liquid biofuel market in Ukraine for a long-term period. All proposed measures, such as direct support for liquid biofuels producers, tax incentives for producers and the introduction of a mandatory mixing rate, will contribute to achieving the indicative target of 10 % consumption biofuels by the transport sector.*

Keywords: *biofuel market, AGMEMOD, partial equilibrium, econometric model.*

The topicality of the research.

Depletion of traditional types of energy resources, aggravation of a negative environmental impact of energy sector and, consequently, strengthening

of environmental standards, significant fluctuations in energy prices, objective to strengthen energy and economic security, the politicization of energy supplies and other factors have led to the urgent need to revise current state in the

energy sector and look for opportunities for its modernization and policy review.

Ukraine is one of many countries that are suffering from all these problems. Its dependence on the import of expensive energy resources leads to considerable socio-economic problems. An extremely high degree of the infrastructure depreciation (the energy sector) and consequently a very low efficiency of energy resources use are the factors explaining the position of Ukraine among the countries with high indexes of energy intensity of the economy. Thus, the energy intensity of Ukraine's GDP was 2.8 times higher than the corresponding indexes of OECD and Visegrad countries in 2014. A similar situation is observed with the GDP carbon intensity [1].

Ukraine is among the largest grain and oilseed producers in the world and has abundant natural resources for further increase of its crop production. According to the State Service for Food Safety and Consumer Protection, in the 2017/2018 marketing year, Ukraine exported more than 4,8 million tons of oilseeds, including rapeseed - 2.1 million tons, soybeans - 2.7 million tons. At the same time, rapeseed production in 2017 amounted to 2.2 million tons and soybeans - 3.9 million tons. 2.5-3 kg of oilseeds is required to produce 1 kg of biodiesel. Thus, 1.6-1.9 million tons of biodiesel could be obtained from exported seeds in the marketing year 2017/2018. Consequently, if the already existing annual production volumes of industrial oilseeds are processed, more than 30% of imported diesel fuel can be replaced. Therefore, Ukraine has considerable potential for biomass production, including liquid biofuels. Today they are the only direct substitute for oil in transport and are available on a significant scale.

Ukraine has one of Europe's highest biomass potentials for several basic segments of liquid biofuels products: biodiesel - 2 million tons; bioethanol - from 2 million tons to 5 million tons; biogas \approx 35 billion m³; solid biofuels - 40 million toe [2].

As a member of the Energy Community, Ukraine has implemented the EU Directive 2009/28/EC on the promotion of renewable energy (hereinafter - RE) and committed to the share of green energy in 2020 in the overall consumption structure would be 11% [3]. Taking into account the commitments undertaken by Ukraine with the accession to the Energy Community, the Resolution of the Cabinet of Ministers of Ukraine dated October 01, 2014 No. 902 approved the "National Renewable Energy Action Plan for the period up to 2020" (hereinafter - NREAP), which established mandatory national indicative targets for the use of renewable energy sources with final energy consumption in the transport sector in 2020 - 10% [4].

According to many experts, the slow pace of growth of "green" energy in the country is conditioned by the imperfection of existing economic mechanisms managing and supporting the development of this sector. The ineffective interaction between stakeholders of various sectors of the economy: public, financial has a significant negative impact on the development of the private sector of RE [5].

As the use of biofuels is driven by mandates - which in most countries are introduced in terms of percentage of the total fuel use - this means changes in fossil fuel use could change how biofuels are used. In general, mandates on the domestic use of bioethanol or biodiesel play an important role in modeling the demand for biofuels. Domestic

mandates for biofuels can be either binding or non-binding depending on country-specific use. The mandate is non-binding if the mandated level of biofuels use is below the market equilibrium and binding when the domestic mandate pushes biofuels use and production beyond the conventional market equilibrium. In the case of a binding mandate, the biofuels price is above the equilibrium price, while the non-binding mandate has no effect on the market equilibrium. Where the mandate is binding, this is considered policy support to biofuels producers.

For the quantitative assessment of the above objectives, the model AGMEMOD - an econometric, dynamic model of partial equilibrium modeling the effects of changes in agrarian policy on production, consumption, imports, exports, and prices of agricultural products - was used [6].

Analysis of recent research and publications.

Significant contribution to the development of theoretical and methodological aspects of the production and consumption of biological fuels, the development of the bioenergy market, the study of the possibility of solving the problem of realization of different directions of bioenergy through its increasing relevance, highlighted in the works of a number of domestic and foreign scientists, among them G. Geletukh T. Zhelezna, O. Markarchuk, V. Savchuk, V. Mesel-Veselyak, S. Kudrya, N. Mkhitarian, V. Reztsov, T. Johanson, A. Konechenkov, V. Gavrish, M. Nilson, G. Kaletnik, V. Potapenko, A. Prokip, T. Reichenbach, V. Dubrovin, M.P. Talavirya, O. Baranovskaya, M. Dobrovskaya,

I. Cheban, A. Dibrova, O. Shpychak and other well-known domestic and foreign scientists and practitioners.

The aim of the study. Due to the importance of biofuels in the world and Ukraine's potential of its production, the current research focuses on analyzing the future development of liquid biofuel market and production possibilities in Ukraine. Provided the appropriate framework conditions it is worth to consider Ukraine's ability to achieve the above objectives for the consumption of liquid biofuels by the transport sector, analyze the state of the biofuel production in Ukraine, identify the obstacles that exist in achieving the mandatory national indicative targets, assess the feasibility of implementation taken on Ukraine's international obligations regarding motor biofuels, and propose measures to enable the obligations. This study focuses on assessing the possible implications of the introduction of such a state support system starting from 2018 for motor biofuel producers to achieve the indicative target of 10% by 2020 and the realism of Ukraine's commitments. On top of that, this research demonstrates how the development of liquid biofuel market will be.

Materials and methods of research.

The article has been used such general scientific methods: dialectical for analysis of scientific works; abstract and logical approach for summarizing of the research results and formulating conclusions; empirical for evaluating current state and development of the research object; method of factor analysis. In the current research, the AGMEMOD model is used because the

model has advantages in comparison to the models and approaches used for the modeling of the bioenergy market. The main of them are: the model simulates a wide range of agricultural product markets and related parameters such as market prices, production, consumption, import, export, yield, and land use; the model can simulate the effects of the policy reforms that are of key interest for the current project and considers changes in the general economic environment; most of the core functions of the model are estimated econometrically. The results of such an estimation provide a more realistic outcome in terms of parameter estimation and choice of the functional form in comparison to the results of the calibration.

Results of the study and their discussion.

Before we move on to the data and modeling scenarios, we should consider the current state of the liquid biofuel market in Ukraine and the main problems of its further development. The main producers of bioethanol in Ukraine are enterprises based on the State Enterprise “Ukrspirt”, the priority of which is the introduction of energy-saving technologies, the use of alternative fuels, renewable energy sources and raw materials in all technological processes. In 2017,

Ukraine produced around 21 thousand tons of bioethanol and consumed 71 thousand tons [7;8]. (see Table 1).

According to the State Statistics of Ukraine for the period 2011-2017, there is a sharp fluctuation in the production of liquid biofuels: from 9.73 thousand tons in 2011 to 66 thousand tons in 2013, biofuel production has increased almost by 7 times, but in 2016 production biofuels decreased by 11 times compared to 2013. In 2017, the volume of production reached the level of 2014. As we can see, the largest volume of production and consumption was observed in 2013 before the introduction of excise on alternative motor fuel and biodiesel. Therefore, it should be noted that the main support instrument for the development of bioethanol and biodiesel sector is a tax exemption as an excisable product.

To create projections of liquid biofuels development, AGMEMOD uses a combination of exogenous and endogenous data (parameters). A change in exogenous variables may determine the assumptions of scenarios simulated by the model. Future values of variables (by 2030) that are exogenous to the model (that is not estimated by the model), such as GDP, GDP deflator, exchange rate of the national currency, the population of Ukraine and world prices for diesel, gasoline, gasoline and diesel consumption in Ukraine, as well as

1. Energy balance of liquid biofuels in Ukraine for the period from 2011 to 2017

	2011	2012	2013	2014	2015	2016	2017
Production liquid biofuels, kt	9.73	60	66	26	16	6	21
Import				38	46	58	54
Export					-9	-6	-4
Domestic supply			66	64	53	58	71
Final consumption	9.73	60	66	64	53	58	71

excise duty on alternative motor fuel, on gasoline and biodiesel, are forecast estimates of various institutions (United States Department of Agriculture (USDA), Food and Agriculture Organization of the United Nations (FAO) and EU Agricultural Outlook).

The data for our research was collected from publications of State Statistics Service of Ukraine (SSSU), personal communication with the largest biofuel producer in Ukraine “Ukrspyr” and with the Ukrainian association of alternative fuels producers “Ukrbiopaliwo”. Using data collected, equations representing the indicators of the biofuel market in Ukraine are estimated as time-series regressions. They are then introduced into the AGMEMOD Ukraine country model.

Modeling scenarios.

To assess the development of the motor biofuel market (bioethanol, alternative motor fuel, biodiesel), the following scenarios were developed for the achievement of the above-mentioned goals: “Policy_10%”, “Direct support_10%”, “Direct support”, “Returning excise duty”, “Cancelling excise duty” and “Baseline Scenario”.

The “Policy_10%” scenario is designed to assess the required level of bioethanol consumption from different

crops (wheat, corn, rye, sugar beet) and biodiesel (rapeseed and sunflower oil) based on the performance of the - NREAP to determine the amount of bioethanol, AMF and biodiesel consumption to achieve 10% of biofuels in the total consumption of motor fuels by 2030. Due to NREAP, Ukraine must achieve the following mandatory indicative targets for 2020 in the transport sector: 503 thousand tons of bioethanol and AMF consumption and 79 thousand tons of biodiesel by 2030. Therefore, the values of bioethanol and biodiesel consumption were calculated from 2018 to 2030 (see Table 2).

Today in Ukraine there is no direct support and incentives for the production of liquid biofuels and development of the appropriate market. However, provided the situation on the liquid biofuel market the achievement of 10% of RES in the transport sector by 2020 it is impossible without government support. That why we should assess the effect, implementing direct support and tax preferences for bioethanol and biodiesel producers on further biofuel development.

The “Direct Support_10%” scenario was designed to assess the implications of introducing a new producer support system in the form of direct subsidies to stimulate and expand biofuel production and achieve 10% biofuel consumption

2. Volume of consumption of liquid biofuels to achieve 10% biofuel use in the overall structure of motor fuels by 2030

Year	Indicative target 10% according to NREAP, kt, Breakdown by 2030		Bioethanol and products based on it				Biodiesel and products based on it	
	bioethanol	biodiesel	Sugar beet	wheat	maize	rye	Rapeseed oil	Sunflower oil
2018	49,67	6,08	45,25	1,33	2,65	0,44	3,65	2,43
2020	90,48	18,23	78,41	3,62	7,24	1,21	10,94	7,29
2030	503	79	452,7	15,09	30,18	5,03	47,4	31,6

tion (bioethanol, alternative motor fuel, biodiesel) in total consumption of motor fuels. Support is provided for producers who process the above products into bioethanol, alternative motor fuel, and biodiesel and depending on the volume of these produced biofuels. The size of direct support in the AGMEMOD model implemented in the form of price additions in the calculation of UAH per 100 kg of preferential products. Pricing additions are included in scenario equations, which results in calculating the impact on biofuel production.

To model the *“Direct Support_10%”* scenario, it was necessary to determine the total amount that would be allocated from the budget to the support program in the form of direct budget subsidies to bioethanol producers, components based on it and biodiesel. This was done by expert estimation and using the AGMEMOD model.

To achieve 10% biofuel consumption by the transport sector in the total consumption of motor fuel, the support for bioethanol producers, alternative motor fuel, biodiesel and mixtures based on it was 5 500 UAH / 100 kg of the finished product. To simulate the state support scenario, this amount of subsidies was calculated as per UAH / 100 kg, which is then added to the producer price of the product that is being subsidized, and is applied in the equations of the processing model and affects the production and consumption of the product concerned.

The *“Direct Support”* scenario is designed to assess the implications of introducing a new system of direct support for producers, calculated and estimated depending on the expected level of gasoline and diesel consumption by 2030 to meet the needs of consumers in bioethanol, alternative motor fuel

and biodiesel in the domestic motor fuel market. Demand for bioethanol, alternative motor fuel, and biodiesel is closely related to the consumption of gasoline and diesel, respectively, since bioethanol is used as an octane-enhancing additive for the production of traditional gasoline and alternative motor fuels, and biodiesel as an octane-enhancing additive for the production of conventional diesel and products based on them. Based on the data of gasoline consumption in Ukraine for the period from 2012 to 2017, the calculation of the demand for bioethanol for Ukraine was made, depending on the consumption of gasoline and the percentage of bioethanol in it, respectively, 5%, 7%, 10% during the period from 2012-2017.

In 2017, the transport sector consumed 1 986 thousand tons of gasoline and 5 149 thousand tons of diesel fuel. Let's assume that the same approximately proportions of fuel consumption for energy content (30% of gasoline, 70% of diesel) will be saved until 2020, and it will be necessary to ensure the replacement of approximately 30% of gasoline, 70% diesel. Therefore, to maintain the current structure of fuel consumption by the transport sector (in particular, for preserving the approximate share of vehicles on gasoline and diesel) at 2017 levels, to provide 10% energy consumption from RES by the transport sector, there will be need 109 323 thousand tons of fuel equivalent bioethanol and 325 thousand tons of fuel equivalent biodiesel.

The *“Returning excise duty”* scenario is designed to assess the implications of introducing a new support system for alternative motor fuels producers and biodiesel producers in the form of returning excise duty to producers from the sales of alternative motor fuels and

biodiesel for a year. The scenario “Returning excise duty” was implemented in the form of price additions - the excise duty on alternative motor fuel and biodiesel in the calculation of UAH per 100 kg of preferential products, which is then added to the price of the producer of the product and is applied in the equations of the model of processing and affects the production and consumption of the products concerned.

The “Cancelling excise duty” scenario is designed to assess the consequences of the abolition of the excise duty on the sale of alternative motor fuels and biodiesel produced by these biofuels’ producers. The tool for supporting the development of this sector is the tax exemption for bioethanol and biodiesel as an excisable product. According to the Tax Code of Ukraine, as of 01.11.2018, excise duty on the alternative motor fuel was 130 EUR /1000 kg, biodiesel - 91.2 EUR / 1000 kg [9].

In 2030, the amount of excise duty per 100 kg of alternative motor fuel production will amount to 353.63 UAH / 100 kg, and biodiesel - 248.08 UAH / 100 kg. If we cancel the above types of excise, then the producers price of alternative fuel motor will increase by 5% in 2030 (from 2338.8 UAH / 100 kg to 2 456.1 UAH / 100 kg), the producers price of biodiesel and products based on it will increase by 13.27% (from 2 637.3 UAH / 100 kg to 2 987.2 UAH / 100 kg).

It follows that producing bioethanol for the producer will be more profitable than producing alternative motor fuel since bioethanol is not an excisable product, but alternative motor fuel is excisable goods and the price of alternative motor fuel includes the corresponding excise duty. As for the biodiesel production, as expected, the abolition of excise duty for the producer will in-

crease its production and will increase profitability.

The “Baseline scenario” - based on the assumption that during the projected period 2018-2030, the policy framework conditions in general in Ukraine remain at the 2017 level and the biofuel sector does not receive any state support from 2018 on. This also means that the model considers such factors as conditions of Deep and comprehensive free trade area agreement (DCFTA) as well as other trade regulations, military conflicts in the Donbas region and annexed Crimea, which is excluded from modeling as they were in 2017. Due to modeling results, it is expected that in the Baseline scenario biofuel production will not face major changes, because the use of raw materials for food and feed consumption, as well as their export, shall remain a more profitable option for Ukrainian producers. However, it is expected to motivate biofuel production by the introduction of a minimum of 10 % biofuel use for the transport sector. In particular, the increase of demand for biofuel by at least 10% shall positively affect the respective domestic market price and, consequently, positively influence on the use of commodities for biofuel production. Therefore, it might be the case that correctly specified domestic policy will trigger the development of biofuel production in Ukraine.

Conclusions and Prospects.

Ukraine has a great competitive advantage in the production of biofuels as availability of the feedstock, fertile soils and supports through investments and know-how from abroad. Whereas the country disadvantageously exports feedstock to Europe for cheaper price and purchase expensive gas and oil instead.

Thus, national interest should be shifted from the export of raw material to processing them into final biofuel products.

In recent years, Ukraine has worked on the fulfillment of European standards in the sector of biofuels. Ukraine has built a legislative base, which aims to support industry development and offer a large scale of benefits. However, due to high excise duty, low oil prices and no penalties for not achieving established indicators, the biofuel industry currently remains non-operating.

According to Ukrainian Association of alternative fuels producers, main barriers that hinder Ukrainian biofuel industry from rising are as follows: high rate of excise duty that made the production of biofuel non-competitive to traditional motor fuels and highly corrupted process of regulation of bioethanol production and fulfillment of standard technical requirements [10].

This research proposes to introduce the obligatory admixture with traditional gasoline and diesel and return non-excite production of alternative fuel and biodiesel fuel for a certain period (up to 10 years) to achieve the indicative target of 10% biofuels consumption by the transport sector and then promote the excise duty at an economically justified level of 10-20% of the excise tax rate on traditional gasoline and diesel. All the above measures, such as direct support for liquid biofuels producers, tax incentives for producers and the introduction of a mandatory mixing rate, will contribute to achieving the indicative target of 10 % consumption biofuels by the transport sector.

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Анотація. Зважаючи на зростаюче значення біопалива у світі та потенціал його виробництва в Україні, поточне дослідження зосереджено на аналізі майбутнього розвитку ринку рідкого біопалива та можливостей його виробництва в Україні. Це дослідження спрямоване на аналізі поточного стану та майбутніх проєкцій розвитку ринку рідкого біопалива в Україні до 2030 року за допомогою моделі AGMEMOD - економетричної, динамічної, моделі часткової рівноваги, багато товарної моделі. Це новий ринок моделі AGMEMOD Україна, і він був втілений у моделі вперше. У даному дослідженні пропонується запровадити державну допомогу у вигляді прямої підтримки та податкових преференцій для виробників рідкого біопалива для задоволення потреб внутрішнього ринку біопалива та досягнення індикативної мети 10% споживання біопалива в загальному споживанні моторного палива транспортним сектором до 2020 року. У дослідженні запропоновано умови для створення сталого розвитку ринку рідкого біопалива в Україні на довгостроковий період.

Ключові слова: ринок біопалива, AGMEMOD, часткової рівноваги, економетрична модель.

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Аннотация. В свете растущего значения биотоплива в мире и потенциала его производства в Украине, настоящее исследование направлено на анализ будущего развития рынка жидкого биотоплива и возможностей его производства в Украине. Цель этого исследования - проанализировать текущее состояние и будущие прогнозы рынка жидкого биотоплива в Украине до 2030 года с использованием модели AGMEMOD - эконометрической, динамической, с частичным равновесием, мульти-товарной модели. Это новый рынок для модели AGMEMOD Украина, и он был внедрен в модель впервые. В настоящем исследовании предлагается ввести государственную помощь в форме прямой поддержки и налоговых преференций для производителей жидкого биотоплива для удовлетворения потребностей внутреннего рынка в биотопливе и для достижения индикативного целевого показателя 10% потребления биотоплива в общем потреблении моторного топлива транспортным сектором к 2020 году. В исследовании предложены условия для создания устойчивого развития рынка жидкого биотоплива в Украине на долгосрочный период.

Ключевые слова: рынок биотоплива, AGMEMOD, частичного равновесия, эконометрическая модель.
