

Green, Blue & Digital Economy Journal

Vol. 3 No. 1 (2022)

Riga 2022

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Green, Blue & Digital Economy Journal, Volume 3 Number 1. Riga, Latvia : “Baltija Publishing”, 2022, 64 pages.

The journal "**Green, Blue & Digital Economy Journal**" publishes scientific researches on economic analysis related to the use of natural resources, the solution of environmental and economic problems. The last decade has been characterized by numerous economic crises and the development of global environmental problems. In response to the negative effects of economic development on the environment, as well as the financial crisis, the international community is looking for solutions to develop a sustainable economy and society. In this context, concepts such as "green economy", "blue economy" and "digital economy" have emerged and become more widespread at the international level. Integration between them leads to new paradigms and creates opportunities for recovery of the economic processes. The "green economy" is based on practical and theoretical knowledge related to climate change and environmental policy development. In turn, the "blue economy" becomes an alternative development paradigm, which combines the economic use of the oceans with environmental sustainability.

Green, Blue & Digital Economy Journal, a Scientific Journal of the Publishing House “Baltija Publishing”, is published four times per year.

Latvia registered mass information mediums (MIM). Registration No. 000740447.

Indexed in the following international databases:

Index Copernicus; Research Papers in Economics (RePEc); Google Scholar.

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Printed and bound in Riga by LLC Publishing House “Baltija Publishing”.

Journal is available: www.baltijapublishing.lv/index.php/gbdej

DOI: <https://doi.org/10.30525/2661-5169>

ISSN 2661-5169 (PRINT)
ISSN 2661-5282 (ONLINE)

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CONTENTS

Mariia Bahorka, Larysa Kurbatska, Liudmila Kvasova Marketing reserves to increase the competitiveness of the enterprise in modern conditions	1
Nataliia Holovchenko, Oleksand Holovchenko Development and strengthening the institute of tax consultants in the tax system of Ukraine	8
Nadiia Hryshchuk Development of the modern market of bioenergy – the driver in increased competitiveness of the Ukrainian economy	15
Hanna Kalashnykova Main ways to increase investment efficiency of agricultural sector development	23
Olena Makarova Criminal liability for smuggling of goods: Ukrainian prospects and foreign experience	28
Ludmila Markevich Specificity of organic production in Ukraine and its influence on the formation of related costs	34
Mykhailo Rushkovskiy, Dmytro Rasshyvalov European REMIT regulation as the latest determinant of corporate risk management strategies in energy sector	40
Anatoliy Sydoruk The practice of household expenditure in Ukraine: factor analysis and estimate	47
Tetiana Yavorska, Olha Sobolevska Ecological and economic aspects of expenditure of hunting farms in Zaporizhzhia region	54

DEVELOPMENT OF THE MODERN MARKET OF BIOENERGY – THE DRIVER IN INCREASED COMPETITIVENESS OF THE UKRAINIAN ECONOMY

Nadiia Hryshchuk¹

Abstract. *The purpose* of the work is to study the development of the bioenergy market to determine its role and place in increasing the competitiveness of the Ukrainian economy, to determine the priority financial programs for financing alternative energy. *Methodology.* Theoretical and methodological basis of the study are general and special methods of scientific knowledge: generalization, analogy, analysis and synthesis, induction and deduction (to clarify the conceptual apparatus, theoretical generalizations of research results, conclusions and proposals); economic-statistical, tabular research method is used. *Results.* Theoretical, methodological approaches to the development of bioenergy are substantiated. The understanding of the essence of the concept of "bioenergy" is revealed and the ecological-economic and legal aspects of development of the agricultural sector of the economy on the basis of combination of economic and ecological interests are analyzed. Analytical assessment of the types of financial security showed that attracting different types of financial resources will improve the ability to gain a competitive position in the bioenergy market. *Practical consequences.* According to the results of the research, priority areas for improvement have been identified. Bioenergy crops are an important component of Ukraine's bioenergy potential. Their cultivation will have a number of positive effects, including: replacement of natural gas, which will improve the balance of payments of our state; the possibility of reducing the heat tariff, which will contribute to economic security, through a balanced and sound public policy to support economic activity and implement the proposed recommendations for businesses and authorities.

Key words: bioenergy potential, agricultural sector, natural resources, alternative sources, environment, financial provision, financial resources.

JEL Classification: P34, G32, Q14

1. Introduction

Natural resources are an important component of full-fledged human activity, but among them are those without which the existence of society is impossible. The basis for its life are biological resources that form the biological cycle of matter and energy in nature. Natural resource potential includes renewable and partially renewable resources. The world's energy problem every year exacerbated by the constant depletion of traditional energy sources. Among renewables, energy sources of biological origin (biodiesel, biotalon, biogas) are becoming more and more developed as energy sources, the main raw material for the production of which is agricultural products. Mankind is increasingly interested in the main source of energy – wildlife. It will further

provide a person with energy both for life through food consumption and for the use of renewable energy sources of biological origin. At the present stage of state development, alternative fuels are the main catalyst for new global trends in the agricultural market, which is objectively due to the reduction of mineral reserves, high dependence of the country on oil imports, changing the structure of agro-industrial constant growth of price disparities in energy, industrial and agricultural products. The need for production and consumption of biofuels in the world associated with limited world reserves of fossil energy resources, as well as environmental pollution due to their use. Ukraine is particularly in need of biofuel market development, as our country faces the issue of energy security and inability to

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provide itself with its own energy resources, such as coal, oil, natural gas, which serves the development of this topic and requires further study of possibilities and practical use of energy crops.

2. Literature review

The study of theoretical and methodological and practical issues of biofuel production in Ukraine are engaged in a number of scientists, among which: G. Geletukha (2015), M. Gumentyk (2007), G. Kaletnik (2008), O. Makarchuk (2011), V. Savchuk (2011), V. Baidala (2014), O. Shpychak (2015), M. Talavyria (2012), and others. Special scientific and of practical interest are scientific works on the reform of the agricultural sector of Ukraine through the prism of biofuel production of outstanding scientists-economists G. Kaletnik (2008). Their fundamental ideas, concepts, approaches and proposals are significant enriched economic thought. However, further research is needed and systematization of the bioenergy market, which can be considered from the proposal of global human resources for energy as a strategic priority in the system sustainable development of Ukraine's economy in the current dynamic environment. An important component in strengthening Ukraine's energy independence is the development of bioenergy, which will contribute to the effective use of the country's potential to achieve economic, social and environmental effects.

Given the importance of the development of bioenergy as an important component of energy security in Ukraine, the prospects for the development of this area of energy is devoted to the work of prominent scientists. In particular, G. Kaletnik (2008) studies the impact of biofuel production from biomass on energy, environment and food security of the state. G. Geletukha (2015) notes that Ukraine has significant potential for bioenergy development.

Studying the issues of bioenergy as the need to ensure food security of the country, the formation of a state strategy to support development. M. Talavyria (2012) defines the concept of "bioenergy" as an interdisciplinary ecologically oriented branch of science and agro-industrial complex, which includes subjects of science and management, whose activities are related to the cultivation of bioenergy crops, processing of biomaterials (biomass of plant and animal origin

and other biologically active external sources of alternative energy, including (coal, peat, oil, gas, etc.), owned by or on other grounds provided by law to bioenergy entities or others.

Given the urgency of the issue of energy security of the state and individual sectors of the economy, the issue needs to be detailed in order to identify potential capacities to increase bioenergy potential, especially in the context of conservation of natural resource potential.

3. Current state and significance bioenergy resources market

Current state and significance bioenergy resources market. The beginning of the XXI century was a period of active formation and development of the bioenergy market, in the process of which the future model of the world's energy system is laid. The formation and rapid development of the bioenergy market in Ukraine is a requirement of today. As stated in the Unified Comprehensive Strategy and Action Plan for the Development of Agriculture and Rural Areas in Ukraine until 2030, Ukraine has significant potential for energy production from biomass, which includes waste from agriculture, utilities and food industry, wood waste, energy crops and energy plantations of willow and poplar. Biomass is a cheap and affordable local fuel. Its use is important from a strategic point of view, as it increases the country's energy security, reduces energy costs and increases agricultural efficiency, improves the country's balance of payments.

According to the scientist O. Shpychak (2015) in the scientific work of the same name, the economically justified energy potential of existing biomass waste in Ukraine is 24.5 million tons of conventional fuel (ppm), and the energy potential of energy crops and plantations that can to grow on agricultural lands (approximately 4 million hectares) that are not used – about 13.7 million tons. The total potential is 38.2 million tonnes, which is up to 18 percent of total primary energy consumption in Ukraine.

The volume of biomass consumption as a biofuel since 2012 amounted to 2.3 million tons p.p. (1.2 percent of total energy consumption). The annual level of use of biomass potential does not exceed 6 percent. The potential for biogas production is 2.9 billion m³ / year from livestock waste and 31.7 billion m³ / year from crop waste. In addition, the production of biofuels provides an opportunity to reduce the energy dependence

of our country. Due to the establishment of production and use of biofuels in agriculture of Ukraine, it is possible to create additional jobs, and thus increase employment of the rural population

If we monitor the potential of renewable energy sources in Ukraine, we find that under current conditions, alternative energy meets from 1.0 to 2.0% of energy needs, which is a small share. Priority in development is the improvement of approaches to increasing the capacity of bioenergy, solar, wind, geothermal energy. The energy potential of renewable sources is shown by us in table 1.

At the present stage of bioenergy development in Ukraine, special attention is paid to greening and conservation of resources. Bioenergy, like the economy of sustainable development, needs not only investments or new technologies, but also environmentally oriented innovations.

In Ukraine, the main strategic goals for the state environmental policy are prescribed in the Law of Ukraine "On the basic principles (strategy) of the state environmental policy of Ukraine for the period up to 2030".

This greening strategy provides for:

- development and application of environmental technologies;
- achieving Ukraine's sustainable development goals;
- wider use of waste disposal technologies;
- development of information technologies and production of new types of products;
- formation of requirements for environmental control of existing technologies.

Research has shown that the current conduct of economic activity is accompanied by exacerbation of environmental problems in the world in general and in Ukraine in particular. The need to solve environmental problems is confirmed by the fact that Ukraine has shown worse results

in international environmental rankings. This ranking is compiled by the Universities of Yelsin and Colombia in conjunction with the World Economic Forum. The places in the ranking are determined according to the environmental efficiency index, which shows the achievements of countries in the rational use and management of natural resources .

It is recognized and proven that the key to increasing the competitiveness of the economy and reducing consumer spending on energy is the cultivation of certain types of energy crops and their processing into solid biofuels as an important component of energy autonomy of agricultural enterprises.

Bioenergy plays a leading role, bioenergy consumption has reached 119,301 kilotons, it is a unique role in the energy sector, there are significant advantages and priorities in terms of energy security, affordability, sustainability and competitiveness.

Researching the issue, we know about 20 species of fast-growing plants that can be grown for the development of bioenergy in Ukraine. The table presents the main and indicators of energy crops that are suitable for many regions of Ukraine.

The main technical and economic indicators of promising energy crops for Ukraine using data from Ecolog-ua.com

Among the positive consequences for the environment are the reduction of greenhouse gas emissions through the use of carbon-neutral fuels and the replacement of fossil fuels with biomass, as well as the cleaning of contaminated lands. the potential of energy crops for 4 million hectares is equivalent to replacing almost 20 billion cubic meters of natural gas per year. At the same time, Ukrainian energy plantations, which are able to improve soil quality, occupy only 0.5% of the total number of unproductive and degraded lands.

Table 1

Potential of renewable energy sources in Ukraine

Direction of development of energy recovery	Annually technically achievable energy potential		Annual volumes of natural substitution gas billion m ³
	billion kW year million	tons of p.p.	
Wind energy	41,7	21,0	18,3
Solar energy	28,8	6,0	5,2
Geothermal energy	105,1	12,0	10,4
Small hydropower	8,3	3,0	2,6
Bioenergy	162,8	20,0	17,4
Environmental energy	154,7	18,0	15,7
Total	501,4	80,0	69,6

Source: presented by the author using information from the Institute of Renewable Energy

Table 2

The main promising energy crops for Ukraine*

Culture	Life cycle, years	Yield That year	Dry mass yield, (t/ha) / year	Energy production, GJ/ha	Water content at the time of harvest, %
Miscanthus is a giant	Until 20	15-20	8,0-32,0	311,9-419,0	15,0
Switchgrass (millet rod)	8-10	10-17	9,0-18,0	266,8-312,2	15,0
Willow	20-25	12,4-22,7	8,0-20,0	280,0-315,0	53,0
Poplar	20-25	10-20	9,0-16,0	170,0-300,0	49,0

*These tables show that the cultivation of energy crops has economic and environmental effects

Currently, development is hampered by the lack of the term "energy plants" in Ukrainian legislation, complicated state and municipal land lease procedures, short terms of land lease agreements, long payback periods and the lack of a civilized biomass market.

To accelerate the development of the sector, the State Agency for Energy Efficiency and the Ministry of Energy have developed relevant bills, which were registered in March 2021 to remove barriers to energy crops, strengthen the conditions necessary to attract investment and long-term energy crops, including simplify administrative burdens.

In the context of Ukraine's Energy Strategy until 2035, it is envisaged and approved that the consumption of energy and bioenergy based on bioenergy crops should increase to 11 million tons, which is 4 times more than in the previous 2019 economic recovery. To achieve the desired positive result, you should rely only on an integrated approach. Success depends on many factors, one of the main ones being the alternative energy financing program.

4. Problems of attracting and using bioenergy financing

We can confidently say that the Alternative Energy Financing Program in Ukraine (USELF) is a credit line of up to EUR 50 million, opened by the European Bank for Reconstruction and Development (EBRD) to facilitate the implementation of renewable energy projects in Ukraine. loans and assistance in the development of projects that meet the financial, technical and environmental criteria of the Program. In addition, the Clean Technology Fund, part of the Climate Investment Funds, provides additional funding of 20 million euros. USELF provides financing for small and medium-sized projects directly from the EBRD under a simplified and accelerated lending scheme that reduces operating costs. The program provides funding for all forms of electricity

production from renewable sources, such as water, wind, biomass, solar energy.

Conformity criteria, requirements for companies:

- privately owned companies registered and operating in Ukraine;
- companies operate in accordance with national legislation on environmental protection, health and safety;
- companies not involved in activities prohibited from financing with EBRD loans;
- Project requirements:
 - replacement of electricity from traditional sources and significant reduction of greenhouse gas emissions;
 - application of proven technology and financial viability of the project.

Investment projects are evaluated by the EBRD on the basis of information provided by companies (feasibility study, business plan). Technical consultants prepare a project analysis and provide the EBRD with technical, environmental and financial assessments of promising projects, as well as provide legal support to companies.

Free technical support, funded by a grant from the Global Environment Facility, is provided to companies interested in obtaining a loan under the Program.

Support for borrowing companies includes: obtaining a permit and project licensing, feasibility study, commercial negotiations, recommendations for project management. We will also pay attention to innovation vouchers as a financial instrument that allows Ukrainian companies to finance the implementation of climate innovation. Innovative vouchers can be used by a variety of companies, from climate technology developers to those who want to use them to reduce environmental impact or reduce energy consumption. These funds are not a loan or credit. In 2017–2018, 1,000,000 euros will be used under the Innovation Voucher program. In total, the program is planned to support 50 Ukrainian companies.

The program is implemented in Ukraine by the European Bank for Reconstruction and Development under the FINTEC program and funded by the EU Neighborhood Facility. The Ukrainian Energy Innovation Network Greencubator is implementing and administering Innovation Vouchers.

Vouchers of two categories are offered:

- vouchers up to € 20,000 (most of the companies that win the competition will receive Innovation Vouchers with an average amount of EBRD financial support of up to € 20,000);
- mega-voucher up to 50,000 euros (for companies with projects that have the potential to breakthrough, 5 mega-vouchers up to 50,000 euros are offered).

USAID Municipal Energy Reform in Ukraine Project – funded by the United States Agency for International Development (hereinafter referred to as the USAID MED Project)

Activities under the USAID MED project are aimed at improving energy policy, developing energy efficiency, reducing traditional energy consumption, increasing investment in the energy sector, reducing energy costs and energy imports, and reducing greenhouse gas emissions. The project budget is \$ 16.5 million.

The program of lending to SMEs of Ukraine in priority areas from the German-Ukrainian Fund. Priority areas for investment loans under the program are agriculture, processing industry, energy efficiency and renewable energy projects, etc. Individual entrepreneurs or enterprises with no more than 250 people and an annual income of no more than 10 million euros in equivalent, operating for at least 3 years, have income for the last 4 consecutive quarters and a positive credit history of the bank for at least 12 months, and do not belong to large companies. The maximum term of an investment loan is 6 years, and a loan to replenish working capital is 2 years. Under the program, financial support to enterprises will be provided through partner banks in the national currency at an interest rate below the market average. The maximum loan amount is 100,000 euros.

Financial support of the State Innovative Financial and Credit Institution. This institution was established in accordance with the resolution of the Cabinet of Ministers of Ukraine dated 13.04.2000 № 654 and is the legal successor of property rights and obligations. The institution belongs to the sphere of management of the

Ministry of Economic Development and Trade of Ukraine and has several regional offices. The purpose is to provide financial support to businesses of various forms of ownership in the framework of state innovation policy. In their activities SIFCU are guided by the current legislation of Ukraine, including the Law of Ukraine "On Innovation".

According to Bioenergy Europe, bioenergy accounts for about 60% of renewable energy consumed in EU countries and heats 66 million European households.

Implementation of the state energy program will ensure the development of energy-saving technologies and reduce energy dependence. At the same time, it will help increase the greening of production and development of bioenergy. This is explained by the fact that in the agricultural sector the production process is closely related to living organisms: plants and animals, biological processes that occur according to certain laws of nature and objectively require adaptation of certain technological processes to the rhythm of nature, types of natural resources, including bioenergy.

Thus, the development of bioenergy is an important direction on the way to increasing the competitive advantages of the domestic economy and preserving the environment, which creates opportunities to ensure a balanced development of the industry.

The leaders among the EU countries in terms of total areas under energy crops are Poland, Germany, Sweden and Greece, according to the European Bioenergy Association. In all these countries, measures of state support for the cultivation of energy crops were applied at different times.

Almost all EU member states consider energy crops as a promising area of bioenergy and already have a total of about 118 thousand hectares of plantations in their territories. In Ukraine, 6.4 thousand hectares are still reported.

Given the cultivation of energy crops on 2 million hectares of unused agricultural land, it is possible to potentially replace 8.9 billion cubic meters of natural gas annually, which is 35% of its consumption.

The development of the bioenergy market can be considered from the proposal of global provision of mankind with energy resources. In the twenty-first century, humanity has almost the only problem – the energy security of their

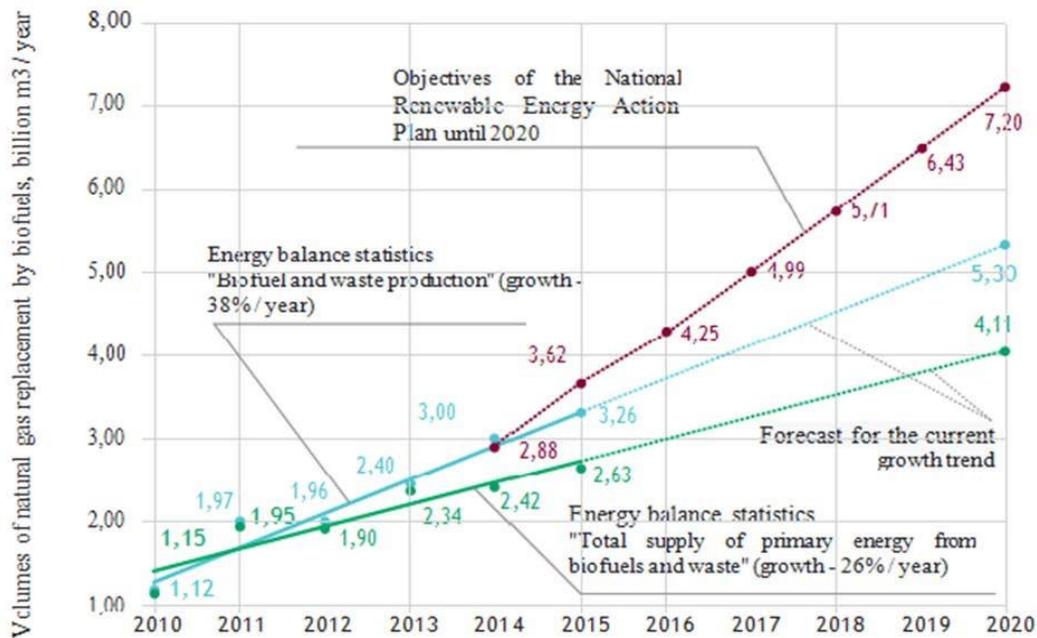


Figure 1. Dynamics of renewable energy sources in Ukraine

own existence, which exists constantly regardless of the stage of evolution.

Energy efficiency and "green" energy are the areas that need to be developed even in difficult times. After all, this is the key to increasing the competitiveness of the economy and reducing consumer spending on energy.

In 2020, about € 2 billion was invested in bioenergy projects in Ukraine. Ukraine's bioenergy replaces 5.2 billion m³ of natural gas per year, and investments in this area bring Ukraine closer to energy independence and a stable energy system based on renewable energy sources.

In Ukraine, the share of bioenergy has grown by 26% in 2020 and replaces 5.2 billion m³ of natural gas per year. The total supply of primary energy from biofuels and waste increased by 26% and amounted to 4.2 million tons. in 2020 (against 3.3 million tons in 2019). Thus, in the structure of electricity production from RES in 2020 the share of biofuels was 4.3%, while in 2019 it was 3.1%.

At the same time, Ukraine follows global trends, has chosen a course for sustainable development and supports the ambitious program of the European Green Course.

Given the high energy intensity of the domestic economy and international obligations, the State Agency for Energy Efficiency, together with the Ministry of Energy and partners, has introduced

a cross-sectoral approach to energy efficiency, intensified work on legislation and financial support instruments.

Together with the Ministry of Regional Development, the development of requirements for buildings with close to zero energy consumption was initiated and a law was adopted to introduce the green bond market.

A whole package of bills has been developed to intensify the development of bioenergy, namely:

- on the development of a transparent and competitive market for solid biofuels through the introduction of an e-commerce system for such biofuels;
- on the mandatory use of liquid biofuels in the field of transport;
- to stimulate the cultivation of energy crops;
- on the exemption of biofuels from the tax on CO₂ emissions;
- on the introduction of a mechanism for trade in biomethane and the introduction of guarantees of origin of biomethane.

There is reason to believe that the adoption of legislative initiatives will further replace expensive gas with its own biofuels, whose imports in 2019-2020 amounted to 14 billion m³. Given the maximum potential for the use of biofuels in Ukraine (agricultural waste, energy crops, biogas, biomethane), the potential for substitution of imported gas is more than 35 billion m³ of gas per

year. So, concluding, we conclude that renewable energy sources can serve as a cost-effective replacement for old coal-fired power plants. The desire to integrate into the European ENTSO-E system will change the economic and technological requirements for the electricity system, which will be better met by the new capacity. For Ukraine, this will serve as an impetus for structural changes in the entire energy system. After all, proposals have been developed to stimulate the production of energy from renewable sources for own needs, work has begun on creating a system of guaranteeing the origin of energy from renewable sources and the National Energy Efficiency Action Plan until 2030 to ensure secure, economical and low-carbon electricity supply, increasing the competitiveness of the economy.

5. Ways and vectors of further development

Entities that finance the activities and development of bioenergy should be primarily interested in the current diagnosis of the financial condition of the entity. Their interest is to guarantee the ability of quality and energy-saving products and fulfill their obligations. If the company has exhausted reserves to further increase additional borrowing and increase the share of borrowed capital in the financing structure, the best way to further financial security is to reform financial policy and focus on another vector of development.

It should be noted that in total, the alternative energy sector of Ukraine has 881 business entities for which "green" for electricity generated at electricity facilities.

Starting from April 1, 2020 "Green" tariffs for electricity produced by economic entities at power facilities using alternative energy sources, and allowances to "green" tariffs for compliance with the level of use of Ukrainian equipment, set by the NCREC at level 2, 1954 UAH/kWh (including VAT) to 15.807 UAH/kWh (including VAT), i.e. the average "green" tariff is 9.0012 UAH/kWh (including VAT)(Strategy for the development of the agricultural sector of the economy until 2020). We can state that the issue of bioenergy development at the present stage of economic development is an extremely relevant, innovative and strategic guideline for achieving energy, food and environmental security of Ukraine. An important task today is to take into account the significant threats to the development of energy security in Ukraine, namely: the lack of effective structural reforms in the energy sector, quality

and efficient energy management system; lack of effective control over the activities of natural monopolies. Given the high level of Ukraine's energy dependence on imports of fuel and energy resources, it is the development of energy-saving technologies and renewable fuels that will have a positive effect, which will be reflected in the improvement of environmental performance. During the period of Ukraine's independence, examples of successful attraction of foreign investments into the national economy. At the same time, for three quarters of 2020. \$ 1.2 billion worth of investments in the alternative energy sector. According to the results of 2019, participants in the alternative energy market paid UAH 19.8 billion to the budgets of all levels, which is three times more than paying taxes to the coal sector. Analytical assessment of the types of financial security showed that attracting different types of financial resources will improve the ability to gain a competitive position in the bioenergy market.

During the economic recovery, UAH 93.6 billion was paid to the state budget, which is UAH 45.4 billion more than the level of tax payments by coal mining and heat generating enterprises. The largest share of taxes fell on VAT and personal income tax. A significant difference between the tax burden on the coal industry and alternative energy is the payment of the latter at the same time land tax and environmental tax. It should be noted that will grow (Strategy for the development of the agricultural sector of the economy until 2020).

A study of the situation in the alternative energy sector indicates that in 2020. the attention of market participants is evenly focused and is exclusively in the range of medium-high level of business activity. This fact indicates the aggravation of the situation, the emergence of new challenges, increasing the importance of information and political factors.

6. Conclusions and prospects for further research

Bioenergy crops are an important component of Ukraine's bioenergy potential. Their cultivation will have a number of positive effects, including: replacement of natural gas, which will improve the balance of payments of our state; the possibility of reducing the heat tariff for the population by 10%; land reclamation and restoration; decarbonisation of the economy and the beginning of the transition to a bioeconomy based on the use of biological resources as energy sources; economic growth in rural areas through job creation,

increased revenues to local budgets in the form of taxes of enterprises engaged in growing energy crops and processing them into biofuels, etc. Thus, the implementation of the state energy program will ensure energy saving technologies and reduce energy dependence.

Thus, the reproduction of natural resource potential is influenced by the possibility of greening production and development of bioenergy. This is explained by the fact that in the agricultural sector the production process is closely related to living organisms: plants and animals, biological processes that occur according to certain laws of nature and objectively require adaptation of certain technological processes to the rhythm of nature, types of natural resources, including bioenergy.

Given the above, the development of bioenergy is an important area for increasing the competitive advantages of the domestic economy and preserving the environment, which creates opportunities to balance the development of the industry. Summing up the researched problems we state that the implementation of measures for the efficient (optimal) use of renewable energy sources remains a strategic issue for the development of the agricultural sector. This is due to a number of objective factors: ensuring energy security and reducing dependence on energy imports; development and efficiency of enterprises; creating new jobs and increasing budget revenues at all levels; improving the environmental situation. This is a basis for further scientific discussions and achievements in the field of research.

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Green, Blue & Digital Economy Journal. Volume 3 Number 1 (2022).
Publicētie materiāli ne vienmēr atbilst redakcijas viedoklim.
Par skaitļu, faktu pareizību un sludinājumiem atbild autori.

Izdevniecība "Baltija Publishing"
Valdeku iela 62-156, Rīga, LV-1058
Iespests tipogrāfijā SIA "Izdevniecība "Baltija Publishing"
Parakstīts iespiešanai: 2022. gada 31. maijā
Tirāža 100 eks.