

BIOECONOMY: INNOVATIVE DIRECTION IN THE DEVELOPMENT OF MODERN

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Abstract: *the issues of the economics of biotechnological development, referred to for brevity as bioeconomic issues, have become significantly updated in recent years. There is not only a quantitative, but also a qualitative growth of scientific works on this issue. Of particular interest are the works in this area in the framework of relationships with the section of scientific knowledge - the economics of environmental management. The issues under consideration are interesting as part of the analysis of implementations in the educational sphere of higher education, the real sector of the economy (industry), as well as in the financial sector.*

Keywords: economics; bioeconomy; biotechnology; development steel; ecology; society.

Today, biotechnology is one of the most dynamically developing and investment-attractive sectors of the world economy. According to leading industry experts, by 2030 biotechnology will provide 2.7% of GDP in developed countries. For developing countries, the contribution of biotechnology will be even greater. By 2030, biotechnology will provide 80% of medicines, 35% of the chemical industry and 50% of agricultural production. By 2050, the global bioenergy market will amount to \$150 billion. 30% of the total world energy demand will come from renewable sources. The biomass market to meet the demand will amount to \$150 billion by 2050. According to experts, the global biotechnology market in 2025 will reach \$2 trillion. The size of the European bioeconomy is currently around 2.200 billion euros, which corresponds to 17% of EU GDP. The bioeconomy in Europe employs 21.5 million people.

Man is dependent on nature, since he can live only by using its riches. However, the understanding that they must be used sparingly came only when people felt the negative consequences of an irresponsible attitude towards nature. Today, natural and environmental problems are extremely dangerous and global in scope. Without a doubt, they have a direct and strong impact on the economy, which is directly based on the use of natural resources. But natural resources (together with labor) form the basis of the country's national wealth. These problems, together with population growth, as well as a number of other factors, have created the need to find new ways to save resources and develop the economy. One of them is bioeconomics.

It would not be a mistake to say that the predatory, wasteful nature of man's relationship to nature is immanent in the traditional principle of using its resources. Bioeconomics, on the other hand, takes a completely different approach. This concept is relatively new, but at the same time very relevant. It combines three such sciences as economics, biotechnology and ecology. Simply put, the bioeconomy is an economy based on the use of biotechnologies in order to increase the efficiency of the use of natural resources and reduce the harmful effects on the environment. Today it is the most high-tech part of the economy. In many countries, it has become widespread and developed, however, in Ukraine it is only in its infancy, although Ukraine has great opportunities to succeed in this.

Finland is leading the industry in both research and application. Advanced biotechnologies can play a significant role in improving the quality of life and human health, ensuring the economic and social growth of states (especially in developing countries).

By the beginning of 2018, more than 50 countries already had state concepts related to the formation of the bioeconomy – on the development of biotechnologies and the use of biomass; specifically, bioeconomic strategies (with an appropriate name and goals) have been adopted, for example, by the OECD and the EU, as well as by the USA, Germany, Finland and a number of other countries. This upward trend has continued in the last few years [1; 2]. It should be noted that back in 2010 there was no specific bioeconomic strategy in the world [3], and today more and more countries are striving to adopt comprehensive strategies in the field of bioeconomy [1]. The economic indicators of the bioeconomy in the world are highly dependent on the measurement methodology, but in general they also look impressive. Thus, about 300,000 people work in the field of bioeconomy in the United States, and its volume is more than \$48 billion per year [4]. In China, the bioindustry market was expected to reach \$1.2–1.5 trillion by 2020 [5]. According to officially approved

data, the share of the bioeconomy in the EU countries in 2015 already accounted for 4.2% of annual GDP, more than 18 million jobs (8.2% of the total) and 2 trillion euros of turnover per year [6].

The EU is a leader in the development of the bioeconomy in the world. The very implementation of this concept was largely due to the countries of the European Union, when they in the mid-2000s, both at the pan-European and at the national level, they began to prepare appropriate programs.

The first pan-European strategy, *Innovating for Sustainable Growth: A Bioeconomy for Europe*, was adopted in 2012 and updated in 2018.

Considering the bioeconomy in the European Union, the following key characteristics can be identified.

First, the bioeconomy is an important part of the image of the economy of the future EU. One of the priorities of the current European strategy is to strengthen the sectors of the bioeconomy, including attracting additional investment and creating markets. Also, this strategy involves the deployment of technological and economic solutions based on biotechnologies and nature-like technologies. To create a new type of economy, the European Union provides significant financial support to projects in this area. For example, the Horizon 2020 (2014-2020) and Horizon Europe (2021-2027) programs provide €3.85 billion and €10 billion respectively for projects related to the bioeconomy. It is also planned to create an investment platform of 100 million euros to support biorefining, making such projects more financially sustainable.

The investment platform should play an important role in the early stages of production or in situations where market mechanisms do not provide sufficient incentives for the transition to biotechnology. It is expected that up to a million new jobs will be created in the European Union thanks to the bioeconomy by 2020 [7].

Secondly, the bioeconomy is considered in the EU as an effective tool for solving environmental problems, as it makes it possible to reduce the negative impact on the environment and make more efficient use of available resources. It is important that the implementation of the bioeconomy policy leads to significant synergies with other environmental policies. For example, the bioeconomy is in line with the low-carbon development paradigm of minimizing climate impact in line with the goals of the Paris Climate Agreement.

Also, the development of the bioeconomy has a synergistic effect with efforts to achieve the UN Sustainable Development Goals. For example, bioeconomy offers a solution to the problem of water pollution, the development of responsible consumption, and the sustainability of cities. Examples of bioeconomy technologies include the use of bio-substitutes for plastics or the recycling of food waste to produce biogas. The latter measure should reduce food waste in European landfills by 50% by 2030 compared to 2018, as well as create 75 billion euros a year of added value annually in the 50 largest cities in Europe, while reducing greenhouse gas emissions by 30 million tons CO₂-eq [8].

Considering the environmental aspects of the bioeconomy, it should also be noted that the EU strategy in this area updated in 2018 is called "A sustainable bioeconomy for Europe: Strengthening the connection between economy, society and the environment). At the same time, the strategy closely integrates the objectives of the circular economy, and the official slogan of bioeconomy in Europe is "Bioeconomy: the European way to use our natural resources" (Bioeconomy: the European way to use our natural resources) [8].

Thirdly, the bioeconomy for the EU is an important element of the contribution to ensuring energy security and self-sufficiency in resources, including agricultural ones. For example, an article by Kalt et al. [9] shows that Austria can fully provide its own economy with clean energy by increasing the collection of biomass and its utilization, as well as reducing energy consumption by 40%. The use of biotechnology is also estimated to be a key component of the renewable energy system. At the same time, according to the plan, it should account for 20% of the generation of all European energy in 2020, and 32% in 2030 [7].

Fourthly, the bioeconomy in the EU is a tool for European integration and the fulfillment of common European tasks by each member country. One of the main mechanisms for the development of bioeconomy is rule-making at the pan-European level. The bodies of the European Union are actively working on the formation of legislation and the development of recommendations in the field of bioeconomy. These recommendations are further implemented at the national level. In turn, many EU countries form their own concepts and approaches related to bioeconomics and biologization of the economy. Examples are Finland, where a forest-based bioeconomy is implemented, or Germany, where official documents use the terms "biologization of the economy" and "biological transformation of industry". Also at the level of regional

strategies, the concept of “bioregion” (Lodz Decalation of Bioregions) appeared. Finally, the EU adopted a strategy aimed at the development of biocommunities, including biovillages, biocities, and bioregions [1].

It should be noted that the process of developing the bioeconomy in the EU faces its own difficulties. First of all, the very process of its formation did not take place immediately – it took 10 years to start implementing the first programs aimed at implementing the European biotechnology strategy. Moreover, 30 years elapsed between the launch of the first biotechnology programs and the adaptation of the bioeconomy strategy. Such long lags were associated with the inertia of management practices and the imperfection of the sectoral policies involved in the development of policy documents [10]. In addition, the success of the implementation of European legislation by individual countries is uneven. It depends, in particular, on the quality of public administration and the readiness of governments to introduce elements of the bioeconomy. Countries such as Finland and Germany are better at adapting bioeconomy principles than, for example, Hungary or Lithuania. It can be assumed that it is the institutional efficiency of the state that determines the success of the development of the bioeconomy.

In general, the role of the bioeconomy in the EU is expected to increase. It will contribute to the achievement of social, environmental and economic goals through the creation of new products and technologies with high added value. It should also help increase competition in the energy generation and raw materials extraction market (due to the emergence of medium and small enterprises processing biomass), as well as increase the diversity of economic activities. The development of the bioeconomy is inextricably linked with the use of new technologies and advanced management practices, which should lead to an increase in the competitiveness of both individual companies and entire sectors of the European economy [2].

Thus, this century will be the century of the development of a new innovative direction - bioeconomy based on biotechnologies and their wide application in the economy, which will help in solving the problems of limited resources. However, in order to eliminate existing problems, the main thing is not to create new ones. And this is where state control and regulation play a key role.

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