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BIOECONOMY: INNOVATIVE AND TECHNOLOGICAL SOLUTIONS FOR MODERNIZING THE ECONOMY OF UKRAINE

Modernization of the economy of Ukraine requires a transition from a linear economy to a circular economy (closed-loop economy) and the introduction of a bioeconomy based on the use of biotechnology.

The bioeconomy is the part of the economy based on products, services and processes that are derived from biological resources (such as plants and microorganisms). The key element of the bioeconomy today is the use of biotechnology. The bioeconomy thrives on expertise and collaboration across multiple industries. The bioeconomy covers several sectors, in whole or in part (for example, agriculture, energy, food industry, biopharmaceuticals, etc.).

It is predicted that the bioeconomy will become a key component of the future technological policy of the economy. In particular, many see the development and transition to a bioeconomy as a means of solving global problems such as climate change, food security, energy independence and environmental sustainability. The development of the bioeconomy is also seen as an opportunity to create new jobs and industries, improve people's health through the development of new pharmaceutical products, and also contribute to the social development of the countryside. In the conditions of the latest global challenges, the following future is predicted: the economy will be primarily a bio-economy.

Experts estimate the direct economic impact of bioproducts, services and processes to be up to \$4 trillion annually worldwide over the next 10 years. According to the McKinsey Global Institute (MGI), "almost 60 percent of the physical resources for the global economy can, in principle, be produced biologically" [1].

Such predictions are based in part on advances in bioeconomic knowledge and understanding of the biological sciences. For example, people have long been breeding plants and animals for desirable properties (for example, with higher yields, resistance to pests); however, we now understand the genetic basis of some of these traits and how information can be transmitted within cells between generations. Researchers can not only read an organism's genetic code, but also edit it with high precision and create organisms with synthetic genomes.

Potential benefits of the transition to the bioeconomy:

- replacement of fossil fuels with renewable biomass or bio-raw materials in the production of energy, chemicals and materials;
- increase in crop production and livestock production;
- increasing the efficiency of biomass use and reducing waste;
- new pharmaceutical products to improve human health;
- creation of new jobs and industries;
- acceleration of village development.

According to the Organization for Economic Co-operation and Development (OECD), the potential benefits "will not become a reality without careful and active support from governments and the public at large [2]. Potential challenges associated with the transition to the bioeconomy and the successful development and commercialization of bioeconomy-related products and services include:

- ensuring policy coherence and coherence between the various sectors involved;
- overcoming the "closedness" or rigidity of existing production systems;
- ensuring equal access to products and services related to the bioeconomy;
- promotion of consumer acceptance and demand.

There is no standard definition of the bioeconomy. The scope, strategies, definition of the country's bioeconomy depend on the country's technological potential, natural resource base, economic and trade policy. However, all countries that have a definition of the bioeconomy see it as a cross-cutting program of action covering several sectors, in whole or in part.

Countries divide the bioeconomy into three categories or visions:

1. Vision of biotechnology.
2. Vision of bioresources.
3. Bioecological vision.

According to the vision of biotechnology, activities in the bioeconomy are centered around the generation of scientific knowledge through work with DNA and processes operating at the molecular level, the commercialization of such processes, and the development of new commercial products through bioproduction.

The bioresources vision involves converting biomass and biological materials (e.g. crops, trees, etc.) into energy sources and/or new products such as bioplastics or biofuels.

The bioecological vision emphasizes the importance of ecological processes that optimize the use of energy and nutrients, promote biodiversity, and avoid monocultures and soil degradation.

However, these categories or visions are not mutually exclusive.

In a broad sense, the bioeconomy can be considered a megatrend. This understanding involves not only the production of goods or the provision of services based on biotechnology and the use of renewable biological raw materials. In this sense, bioeconomy can act as a tool for achieving the goals of sustainable development, and as a state-political concept that contributes to solving the problems of interstate integration. This is also a new principled vision of the economy, which is based on biotechnologies of the future, such as biorefining, biofabrication, and bioprinting.

Over the past 20 years, interest in the concept of bioeconomy as a science and a sector of the smart economy – a research topic and focus of economic, technological and security policy – has been growing at a rapid pace. There is currently no consensus on the definition of the bioeconomy, but many definitions share key elements (such as the replacement of fossil fuels with biological resources for the production of electricity, fuel and industrial goods). Definitions of the bioeconomy are evolving and will continue to change over time.

In recent years, the term "bioeconomy" (bioeconomy and bio-based economy) has become increasingly used in the scientific environment, in the field of public administration and business activity, especially in the countries of the European Union. At the same time, the topic of bioeconomy is heard in different contexts – in connection with sustainable development, reduction of anthropogenic load on the environment and the transition from the old (traditional, high-carbon, "brown") model of the economy to a "green", low-carbon one.

The key element of the bioeconomy today is the use of biotechnology – "biological systems, living organisms or their derivatives, which are used for the purpose of manufacturing or changing products and processes for practical use". Biotechnologies have a wide range of applications: for example, with their help, energy is obtained from organic waste, new materials are produced from plant raw materials – for the light (textile), food, medical industry and other industries. Biotechnologies are used for the production of medicines, for the purification of natural systems from pollution, as well as for increasing oil yield when extracting oil from wells.

By the beginning of 2018, more than 50 countries already had state concepts related to the formation of the bioeconomy – regarding the development of biotechnology and the use of biomass; it is the bioeconomic strategies (with the appropriate name and goals) adopted, for example, by the OECD and the EU, the USA, Germany, Finland and other countries. This upward trend has been going on for the past few years.

It should be noted that back in 2010 there was no specific bioeconomy strategy in the world, and today more and more countries are striving to adopt comprehensive bioeconomy strategies.

The economic performance of the bioeconomy in the world is highly dependent on the measurement methodology, but in general also looks impressive.

Around the world, government agencies, academics, and private business organizations continue to develop new definitions of the term "bioeconomy" to communicate what economic activity related to the life sciences they mean.

Currently, there is no generally accepted consensus definition of this term. Some actors use vague formulations: the bioeconomy is called a "concept", a "new concept", a "policy concept", while the definitions have shown an evolution over a relatively short period of time, with different definitions classified according to different "visions". However, it remains unclear what the bioeconomy is, and there is currently no consensus on what the bioeconomy actually means.

In a broad sense, the bioeconomy can be considered a megatrend. This understanding involves not only the production of goods or the provision of services based on biotechnology and the use of renewable biological raw materials. In this sense, bioeconomy can act as a tool for achieving the goals of sustainable development, and as a state-political concept that contributes to solving the problems of interstate integration. This is also a new fundamental vision of the economy, which is based on the biotechnologies of the future, for example, such as: biorefining, biofabrication and bioprinting.

Biorefining is the production of knowledge-intensive products with high added value based on deep complex mechanical and chemical processing of forest resources directly in the growth region.

Biofabrication and bioprinting are, in fact, "printing" based on cellular technologies of various products: organs and tissues for transplantation, or meat for food use, or, for example, natural skin for the production of goods. It is assumed that such technologies can revolutionize health care, the food industry and other industries. In a broad sense, the bioeconomy also needs new value orientations related to the understanding of the importance of natural resources and the importance of the use of biotechnology in the population and decision-makers.

Also, bioeconomy can be considered through the prism of science, for example, as a certain interdisciplinary field of research at the junction of humanitarian and natural science disciplines.

With a broad understanding of the bioeconomy, it is important that it is not just a concept of replacing petrochemicals with renewable biological resources and not just a post-oil, post-carbon or "post-carbon" economy. Within this view of the bioeconomy, it is important to use the potential of biological resources, rather than seeing them as a substitute for fossils. For example, to evaluate the forest not only as forest biomass, but also as a source of ecosystem services that make a significant contribution to the maintenance of natural balance, biodiversity, and the climate system.

Examining the economy through the prism of bioeconomics opens up wide opportunities for the use of biological knowledge, knowledge of life sciences and the environment, and not only in a technological utilitarian sense. With this approach, it is important to take into account biological risks, which can cause significant damage to the economy and society. A well-known example is the problem of "food vs. fuel" is related to the production of first-generation biofuels, when valuable arable land is used to grow plants as energy raw materials, instead of growing food raw materials. Another issue that is now widely discussed is the production of genetically modified products [3].

In the conditions of the latest global challenges, the consideration of the economy through the prism of bioeconomy opens wide opportunities for the use of biological knowledge, knowledge of life sciences and the environment, and not only in a technological utilitarian plan. With this approach, it is important to take into account biological risks, which can cause significant damage to the economy and society.

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