

**Yuriy SENIUK**  
**Kateryna DYACHENKO**

## **BIOECONOMIC PRIORITIES FOR INNOVATION TRANSFORMATION OF INDUSTRY AND EDUCATION**

### **National Public Health Network of Ukraine**

**Abstract.** The design, investment, organization and management of such GVCs requires both new knowledge and competencies and innovation, highly maneuverable biotechnological capacities and flexible Industrial technologies, with the involvement of a large number of micro, small and medium high-tech enterprises and innovative entrepreneurs. In this sense, BE and BEH really do indicate the top priority areas for post pandemic transformation of both industry and education.

**Key words:** bioeconomy, Knowledge-based economy, biologization+digitalization (Nano-Bio-Info-Cogno), bioeconomics of health

Bioeconomy (BE) as a new economic reality, the main means of production of which are living organisms, and not inanimate technical and technological systems, began to visibly form at the turn of the millennium, starting in the USA in the 90s due to the advances in the life sciences and medicine. The first mention of this term dates back to 1992 orally and 1994 writing by Dr. Bernadine Healy, Director of the U.S. National Institutes of Health, in her commencement address at Vassar College [1]:

“A revolution in the life sciences will also go away beyond medicine into agriculture, chemical production, environmental sciences and microelectronics. Biotechnology will be creating jobs, that we don't even have names for yet. And they will be high-paying, high-demand jobs - and intellectually satisfying ones. New industries will emerge that will be a growing source of national economic strength and world leadership. Some have gone so far as to suggest that the twenty-first century will be based on a BIOECONOMY”.

20 years later, the United States at the federal level is accepting in 2012 the National Bioeconomy Blueprint, and Engineering Biology and Development Act In 2019 and Bioeconomy Research and Development Act In 2020 [2]. The general structure of Bioeconomy defined by these documents is shown in Fig.1

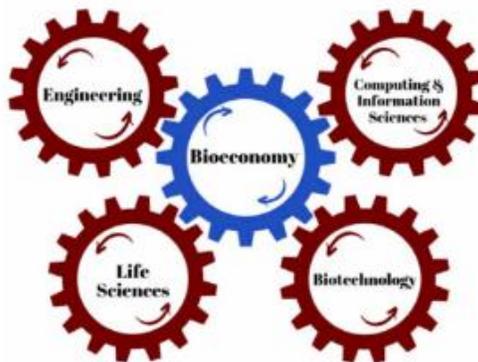


Figure 1. General sectoral structure of Bioeconomy in the American sense

In Europe, the formation of BE occurred somewhat later, growing out of the ambitious goal of leadership in the Knowledge-based economy (KBE), declared in Lisbon Agenda In 2000; in the early 2000s, there appeared the term of Bio-based economy (BBE), and by the middle of the first decade, the first mention of

BE [3]. At the official political level, EU began to talk about the prospects of the European Bioeconomy since 2007, under German presidency of the EC, and widespread in form of the Knowledge-based Bioeconomy (KBBE) after the First Global Bioeconomy Summit in Berlin In November 2015, where BE was defined as “knowledge-based production and utilization of biological resources, biological processes and principles to sustainably provide goods and services across all economic sectors” [3, p.2591]. In general, in contrast to the American approach, which started from the needs of human health, European vision on BE focused mainly on the agricultural sector and “green energy”, primary and bio pharmaceutical production as well as bioengineering and medical devices. In this sense, the European basis of BE is formed by three sectors: Renewable biomass; Biologization+Digitalization (Nano-Bio-Info-Cogno); and Integration across applications (primary production of all living natural resources; health bio pharmaceuticals and medical devices; and bio-based industry (i.e. chemicals, plastics, enzymes, pulp and paper, bio-energy, etc.) [4]. The current official interpretation of BE was given by EC in 2018 [5]:

“The Bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks: land and marine ecosystems and the service they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services”.

Now, there are 26 definitions of BE, however, the European one is considered dominant, focusing on the production and utilization of bio-based goods and services, but excluding functional foods (nutraceuticals), tailored food products to meet specialized dietary requirements and nutraceuticals [6, IEA-Bioenergy Task 42, 2014]. However, it must be assumed that the COVID19 pandemic and the processes of post-pandemic transformation of the world economy will lead to the formation of a qualitatively new, health-oriented stage in the global evolution of BE in the form of holistic innovative BIOECONOMICS OF HEALTH. Of course, such a complex economic organization required for this is practically impossible without the interdisciplinary integration of sciences and intersectoral cooperation of production on a global scale, which implies the creation of appropriate Global Value Chains (GVCs). A general idea of the level of complexity of such innovative-industrial cooperation based on GVCs can be obtained from Fig.2, which shows the full production cycle of biodegradable polymers (PHAs)

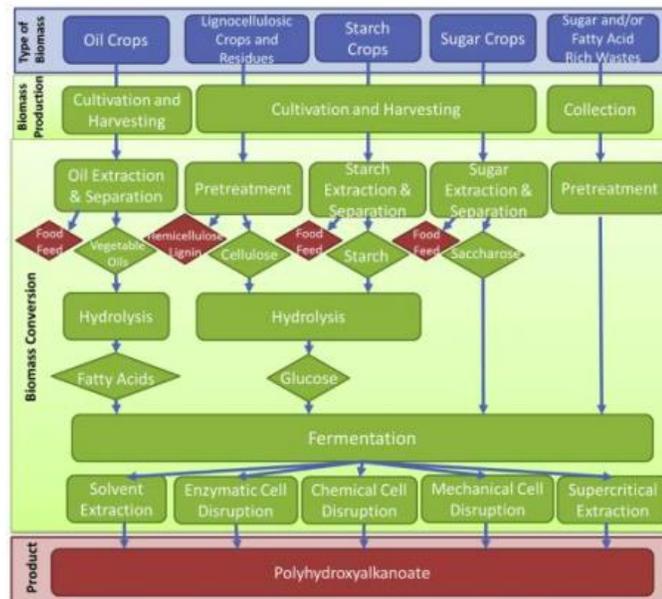


Figure 2. - Flowchart of the Polyhydroxyalkanoates production process

Biopolymers obtained as a result of this process substitute petrochemical polymers, which is of great environmental importance. At the same time, it underlines the main advantage of BE as a “Green economy”, in comparison with the Industrial one (“Brown economy”) which uses biomass as a feedstock instead of oil and other hydrocarbon raw materials. Another, the most promising from the point of view of the Bioeconomics of Health (BEH), is the sector of modeling value chains in healthcare, indicated by Michael Porter [7]. And of course, the design, investment, organization and management of such GVCs requires both new knowledge and competencies and innovation, highly maneuverable biotechnological capacities and flexible Industrial technologies, with the involvement of a large number of micro, small and medium high-tech enterprises and innovative entrepreneurs. In this sense, BE and BEH really do indicate the top priority areas for post pandemic transformation of both industry and education.

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#### Authors:

- Yuriy SENIUK**, National Coordinator, National Public Health Network of Ukraine, [iuriiseniuk@ukr.net](mailto:iuriiseniuk@ukr.net)
- Kateryna DYACHENKO**, Executive Secretary National Public, Health Network of Ukraine, [dyachenko.katya@gmail.com](mailto:dyachenko.katya@gmail.com)