



Executive summary of the Report of the Committee of Biotechnology of the Polish Academy of Sciences *Bioeconomy, biotechnology and new genetic engineering techniques. Modern biotechnology-based bioeconomy in a circular economy*

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Abstract

Bioeconomy is an important element of every economy. The foundations of bioeconomy are constituted by innovative biotechnology as its development (especially in a closed circuit) requires modern “biotechnologies”. In economy the resignation of elements such as achievements of modern biotechnology – although possible – is associated with a significant increase in development costs and a loss of access to innovative technologies that are essential for the today’s and future economy of the country. Furthermore, it is necessary to gain public acceptance for the emerging market of bioproducts, bioservices and bioprocesses. Legislation amendments supporting innovation in general, and bio domains in particular, are also a necessity. The current state of Polish biotechnology is presented on the basis of detailed studies and published on the website of the Biotechnology Committee of the Polish Academy of Sciences (www.kbiotech.pan.pl): *Biotechnological centers in Poland – Map of Polish biotechnology*.

Key words: biotechnology, bioeconomy, circular bioeconomy

Introduction

The expertise *Bioeconomy, biotechnology and new genetic engineering techniques. Modern biotechnology-based bioeconomy in a circular economy* is a natural consequence of the previous activity of the Committee of Biotechnology of the Polish Academy of Sciences. In recent years, the Committee has presented to the members of the Polish Government and Parliament, as well

as to the President of the Republic of Poland, the views and positions on the development of biotechnology. As far as we, at the Committee, are concerned it is obligatory to present current views on broadly understood bioeconomy, especially modern, innovative biotechnology, due to its economic and social importance and dynamic development. The expertise contains substantive support for initiatives and legislative work related to the

development of Poland's position on new genetic engineering techniques. The document includes the latest data on genetics, medicine, industry, plant breeding, bio-control, molecular biology, risk assessment, intellectual property and a number of others, taking into account the needs of the Polish and European bioeconomies.

According to the expertise, based on the latest scientific data on genetics and plant breeding, molecular biology and risk assessment of modern technologies, Poland should develop a stance on new molecular engineering techniques. Also, the needs of Polish and European bio-based renewable raw materials should be taken into consideration.

General situation of Polish biotechnology

Advances in science, technology and biotechnology will be critically important for further development of bioeconomy. We, the scientists, have already collected tremendous volumes of data (the best known example is from genome sequencing). However, we are not able to extract all important messages from the data. The development of informatics [bioinformatics] and tools to find criticality important "universal" data will change our world. The organization of metadata gathered in order to, first, select the real most important information and, next, avoid duplication of research are the most important functions of informatics.

Another pressing issues the researchers need to address are the following basic questions: is there enough food, energy, materials, pharmaceuticals for a constantly growing world's population? and is there enough raw materials?

The correlation between basic research and application science is yet another important issue. In other words, it is the functioning of business and administration experts in the crossroads with natural sciences. How to convert basic science to commercial products and who should do it in a systematic, profitable way are the most important questions? As far as we, Polish biotechnologists are concerned, there is a growing gap between specialised research (basic study of fundamental processes) and exploitation of new discoveries for new commercial products.

In the case of basic developments in biotechnology (like molecular biology, in general), we would like to emphasize the significance of the following advances that

occurred in the past and are important in the ten years perspective:

- bioinformatics in application to the presented issues;
- utilization of human genome sequence data and collections of genomes of different organisms; application of genomic data to protect the environment;
- gene editing (including CRISPR/Cas technology with several modifications at the leading position); the ability to replace/activate/inhibit defective genes;
- precision and molecular (= personalised) medicine;
- replacement of fossil-fuel based chemical processes with environmentally friendly processes (first and most practical: biomass conversion to energy);
- holistic understanding of metabolism and metabolic pathways in order to guarantee food, biopharmaceuticals, new materials and energy.

To sum up, in the case of prospective development, we shall consider three issues fundamental for further development of bioeconomy in relation to biotechnology:

- holistic approaches to problem solving; it is essential to combine seemingly distant issues as sociology, social acceptance or religious views with innovative technologies of chemistry and biology in the functional body (gene expression, bioinformatics or molecular phenotyping, synthetic biology, etc.);
- mutual interactions: bioeconomy on biotechnology, as well as biotechnology on bioeconomy (this could be extended to interactions of several engineering disciplines and natural or molecular sciences with bioeconomy and back to or reversely – bioeconomy with scientific disciplines on bio-engineering);
- bioeconomy will not be homogeneous in its concepts; there will be no single, universal bioeconomy, thus there should be different views and trends: different bioeconomies in Mexico, Spain, and Poland – specific for each country; even more divergent will be the macroeconomics (e.g. in India, China, the European Union or in the United States); the presented issues are also essential for the analysis and understanding of the development of bioeconomics, as well as in the prediction of the development trends.

Conclusions and recommendations

In the light of such formulated conditions, it seems relatively simple to provide the conclusions and recom-

recommendations for future development of biotechnology within the framework of bioeconomy in our country:

- financing the development of basic and engineering research in closer correlations with the planning of possible applications of the results of molecular research;
- co-development of biotechnology-related disciplines such as legal science, especially intellectual property rights, management and organization, sociology and social acceptance;
- creating conditions stimulating the popularization of science and technology.

The development of our country must be directed towards building a sustainable economy that uses natural resources in a sustainable way. The aim is to achieve a more innovative and low-emission economy that guarantees food security and sustainable use of biological renewable resources for industrial purposes, while protecting biodiversity and the environment at the same time.

Addressing the current challenges of increasing global population, rapid depletion of resources, increasing human expansion and its pressures on the environment as well as climate change, require rational and comprehensive action. These factors threaten the stability of

the ecosystems that Europe depends on. The projections indicate that over the next 30 years the number of people in the world will increase by 20% – from 7.5 billion in 2017 to about 9 billion by 2050. Given the doubling of meat consumption, such an increase in global populations will lead to increased demand for food by about 70%. Ensuring food security and producing high quality food is a huge challenge today; as well as the production of biopharmaceuticals, biomaterials and bioenergy, which is also linked to population growth. At the same time, there is a dynamic development of new therapies, including diagnostics and innovative drugs such as stem cells and hormonal drugs, and also the production of completely new materials such as biopolymers. Europe must radically change its approach to production, consumption, processing, storage, recycling and disposal of biological resources. In the Europe 2020 strategy, bioeconomy is an important element of smart and green growth in Europe.

The current state of Polish biotechnology is presented on the basis of detailed studies and published on the website of the Committee of Biotechnology of the Polish Academy of Sciences *Biotechnological centers in Poland – Map of Polish biotechnology* and the full text of the report is available at www.kbiotech.pan.pl.