BIOECONOMY AND WHITE BIOTECHNOLOGY AS A BASIC PILLAR OF THE LISBON STRATEGY

ĽUDOVÍT POLÍVKA, EVA ÜRGEOVÁ

Department of Biotechnology, University of SS. Cyril and Methodius, J. Herdu 2, Trnava, SK-917 01, Slovak Republic (ludovit.polivka@ucm.sk)

Abstract: The entrance into the new millennium is branded by intensive development of science and new technologies. Life science and biotechnologies are widely recognize to be, after ICT, the parallel wave of knowledge – based economy, creating new opportunities for our society and economies. This application is the basic object of Lisbon strategy in Europe.
This new trends, to make full use of biotechnology for sustainable economy, is official titled as bioeconomy around the world.
The characteristics of bioeconomy and utilization of industrial biotechnology are presented in this article.

Key words: bioeconomy, Lisbon strategy, biotechnologies

1. Introduction

The development of the world society since the last decades of the past century and the beginning of a new millennium has been characterised by several specific factors (SAFRANSKI, 2006):

- The process of globalisation has come into the next phase, defined as a stage of fast economic growth, yet accompanied by the world global problems. Many of them cannot be resolved by individual nation-states acting alone: deterioration of soil, air and water pollutions, global warming, exploitation of natural resources, problems connected with the world population growth - to name the most essential ones.
- Contemporary and future economic and social growth is conditioned by the building of a knowledge-based economy. The Lisbon Strategy is a paradigm for Europe. The knowledge and operative introduction of new scientific results into practice have become the basic pillars for further development.
- In connection with the environmental pollution, depletion of natural resources, accumulation of wastes and other negative anthropogenic activities, exigency of sustainability and sustainable development have come to the forefront of progress. Sustainable development aims to reduce the environmental pollution and decrease energy and resources consumption. In order to be sustainable, new technologies must be economically feasible and socially responsible in addition to being environmental friendly – they must present a cost advantage, monetary or other, before they can be accepted by the industry.
- A new phase of scientific and technical revolution came after automatisation, regulation and robotisation started three decades ago. It is a stage of biological revolution, nanotechnology and ICT (Information and Communication Technologies).

From this short characteristics of the contemporary and future development follows that the knowledge and new scientific results applicable in practice are motive forces for further growth of economy, decrease of environmental pollution and sustainment of natural resouces.

2. The Lisbon strategy and European technology platforms

The Lisbon Strategy, also known as the Lisbon Process, is an action and development plan for the European Union. The main goal of this strategy is clear – to make the EU "the most competitive and dynamic knowledge–based economy capable of sustainable economic growth with more and better jobs and greater social cohesion" (http://www.svez.gov.si/en/higlights/ Lisabon_strategy; 2000, http://www.europsky parlament.sk, 2004).

In a knowledge-based society, the knowledge is understood as "the knowledge triangle which refers to the interaction between research, education and innovation".
The main priority areas are:

- Investment in the network of knowledge (3 % of GDP)
- Strengthening competitiveness in industry and entrepreneurial environment
- Informative society
- Increasing the labour market

The EU Commission is active in a number of initiatives which will give a boost to the bio-based economy. Some of the most recent initiatives include the new Seventh Framework Research Programme; Environmental Technology Action Plan (ETAP); and European Technology Platforms.

2.1 European Technology Platforms

a) The European Commission has established a helpful new mechanism for fostering important areas where research, technology and development are key to addressing major economic, technological or societal challenges, the Technology Platforms (TP). These can enable the formation of strategic alliances to foster public-private partnerships between the research community, industry and policy makers. The intention is to stimulate effective investment in R&D, accelerate innovation and remove barriers to growth. At the same time, they provide an important output to national and EU policy makers. Participation in the Technology Platform should include the research community, industry (including small and medium-sized enterprises – SME's, and private research and technology transfer firms), public authorities (e.g., policy makers, regulators, and purchasers), the financial community, consumers, civil society groups, and other relevant stakeholders (http://www.bio-economy.net/centre3europ.html, 2006).

b) The expectation is that each Technology Platform should:

- provide a common vision that contributes to coherent policy making,
- overcome obstacles at all levels to accelerate market penetration of new technologies,

- stimulate knowledge and innovation, thereby increasing productivity and competitiveness and making the investment climate more attractive,
- encourage public debate on risks and benefits to facilitate technology acceptance.

To accent the importance of knowledge and continual application of the newest results of biotech research in the practice of economy, the conception of Knowledge-Based Bioeconomy (KBBE) has been used since 2005. The content and meaning of KBBE are known as the "Cologne Papers". The most important technological platforms are:

EuMat – Engineering Materials and Technologies
ARTEMIS – Embedded Computing Systems
Plants – Plants for the Future
SusChem – Sustainable Chemistry
FOOD – Food for Life
NanoMedicine - Nanotechnology in Medical Applications
ECTP – European Construction Technology Platform
Foresty – Forest-Based Sector Technology Platform
INDUSTRIAL SAFETY – Industrial Safety ETP
EUROP – Robotica
BF TP – Biofuel TP
HFP – Hydrogen and Fuel Cell Technology Platform
WSS TP – Water Supply and Sanitation Technology Platform
FTC – Future Textiles and Clothing
eMobility – Mobile and Wireless Communications

c) The development of each Technology Platform consists of three phases (MEADOWEROLT *et al*., 2005):

1. Characterisation of the current situation and the vision for future determination of the participants of a platform – alliance of academic research, production, stakeholders, government, consumers.
2. Strategic research agenda – research and development priorities from the medium to long-term, measures for the networking of research capacity and resources.
3. Develop an Action Plan, encourage implementation - time relations, barriers, public awareness, public acceptance.

3. Biotechnology and bioeconomy

The term "biotechnology" was first used by Karoly Ereky in 1919, to mean "all lines of work by which products are produced from raw materials with the aid of living organisms".

The definition has been broadened slightly to include producing things with the aid of substances from living organisms and some raw materials that are produced by living organisms themselves, and narrowed to focus on new technologies, rather than traditional production.

There have been proposed several definitions of biotechnology up to the present time. Their content has reflected the new achievements and knowledge of life sciences in a concrete period of time, at a particular stage of development. It is possible to find the basic philosophy of the word "biotechnology" – pragmatic aspects of science and technology, making use of our knowledge about living systems in practical applications.

We have witnessed extraordinary advances in natural sciences in general, and life sciences in particular, especially since the middle of the last century. The most important achievements have affected the fields of genetics, molecular biology and biochemistry (elucidation of a chemical structure of genetic materials, understanding of chemical principles of heredity, solving of principal arrangement of genetic codes, mechanisms of synthesis and degradation of DNA, and proteosynthesis).

The growth of such knowledge has engendered the development of several sophisticated biochemical and genetic methods which enabled a new insight into the mystery of living cells (BARNETT, 2005).

These methods have become the basic tools for genetic and biochemical modification of cells, or biological living systems. The most revolutionary of these methods became the recombinant DNA technology, genetic engineering r-DNA technology. It was firstly implemented by S. COHEN and H. BOYER in 1975.

The new biosystems or their metabolites can be created by this method, incorporating segments of DNA from one organism into the cells of another organism. The first biotech company was established in 1976 – Genetech (GEN–etic ENgineering TEChnology). The first biotechnological products – human growth hormone and insulin, were produced between 1979 and 1980.

The first genetic engineering of plants and mammalia was carried out in the eighth and ninth decades of the last century. The Human Genome Project was launched in 1990. In connection with these discoveries and their real utilisation in practice, the character of definition of biotechnology was accepted. For the purpose of this article, the definition according to the Agenda 21 is introduced. "Biotechnology engineering, a knowledge–intensive field, is a set of enabling techniques for bringing about specific man–made changes in deoxyribonucleic acid - or genetic material - in plants, animals and microbial systems, leading to useful products and technologies."

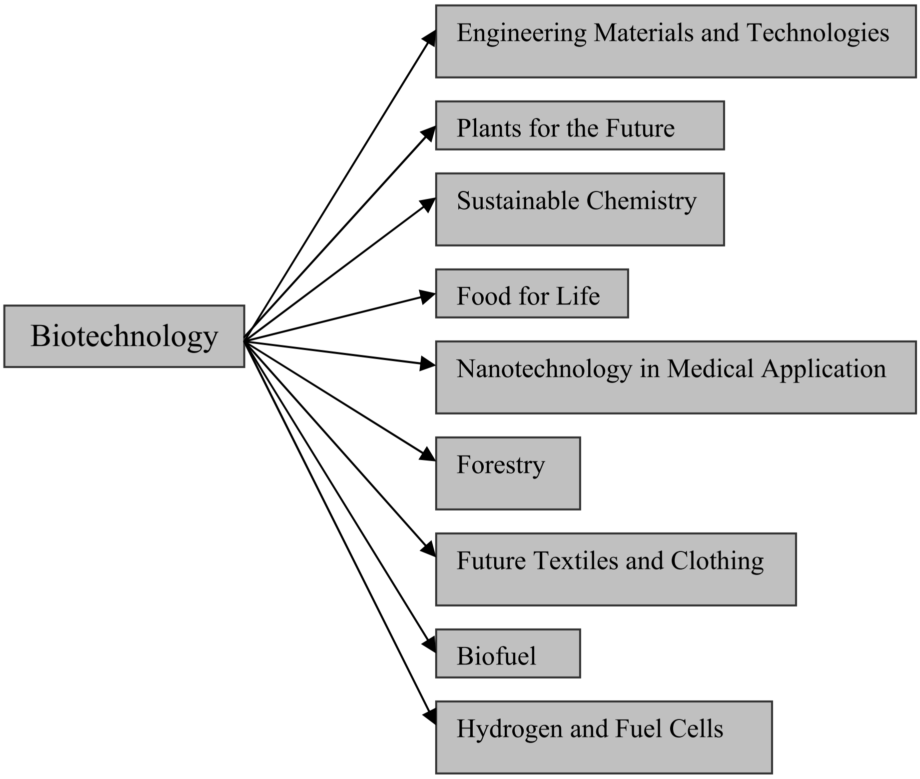
From this point of view, Biotechnology possesses a big potential for not only fermentation industries but for the whole economic sector.

Since the beginning of 1975, the development of biotechnology has been very rapid. The following table (Tab. 1) shows a survey of the European biotechnology situation in the year 2004 compared to 2003 (RATZINGER, 2005).

Tab 1. Survey of the European biotechnology situation in the year 2004 compared to 2003

Measure	2004	2003
Companies	2163	2200
Employed	96500	96000
In R&D	42500	41000
R&D Spend	€7.6 bn	€7.6 bn
Revenue	€21.5 bn	€20.5 bn
New firms	119	132

Biotechnologies are the basic pillar of several important European Technological Platforms, for example:



It clearly follows from this scheme that:
- Biotechnology has been applied in several sectors of economy
- Biotechnology has become a driving force of sustainable economic growth
- Meeting the goals of ETP, in which biotechnologies are included, is determined by the new results of integrated scientific disciplines and bioscience.

The new expression for infiltration of biotechnology into economic sectors – bioeconomy – has been used since 2003 (http://www.oecd.org, 2005).

Bioeconomy – bio-based economy is a term which (GAVRILESCU and CHISTI, 2005):

1. Encapsulates our vision of the future society that is no longer wholly dependent on fossil fuel energy and non-renewable raw materials.
2. Involves all industries, agricultural and economic sectors that produce, manage or otherwise exploit biological resources (including GMO's) using environmentally acceptable technologies.

Very often the 4 "R's" of sustainable bioeconomy are published:

1. REPLACE fossil-based energy, chemicals and materials with renewable biomass through the new innovative technologies and appropriate policies.

2. REDUCE greenhouse gases and other emissions associated with biosystems by improved management strategies, technologies, and policies.
3. REMOVE atmospheric CO_2 by developing new plant genotypes and improved management practices for building healthy, energy-rich ecosystems.
4. RESPOND to global atmosphere and climate changes by implementing technologies and management strategies which are environmentally acceptable.

Looking to the future, new techniques in biotechnology (analytical method and the relating equipment, achievements of new scientific disciplines) will continue to converge with other technologies resulting in potentially large-scale changes in global economies in the next thirty years. From this point of view, bioeconomy is part of strategic development on the base of sustainability.

4. Colours of biotechnology and white biotechnology

The new system for designation of biotechnology activities – according to the colour type – was accepted at the beginning of a new millennium. According to the authors, the colour index may be a useful guide with further additions, as biotechnology and colours intertwine over time in promoting public perception and understanding of biotechnology applications for the cause of science, development, and the current and post-human future of humankind (DASILVA, 2004).

Tab. 2 Colour type of biotechnology and area of activities

Colour Type	Area of Biotech Activities
Red	Health, Medical Diagnostics
Yellow	Food Biotechnology, Nutrition Science
Blue	Aquaculture, Coastal and Marine Biotech
Green	Agricultural, Environmental Biotechnology – Biofuels, Biofertilisers, Bioremediation, Geomicrobiology
Brown	Arid Zone and Desert Biotechnology
Dark	Bioterrorism, Biowarfare, Biocrimes, Anticrop Warfare
Purple	Patents, Publications, Inventions, IPRs
White	Gene-based Bioindustries
Gold	Bioinformatics, Nanobiotechnology
Grey	Classical Fermentation and Bioprocess Technology

These colours designations are widely used at the present time.

White biotechnology

White or Industrial Biotechnology is the application of biotechnology in processing and production of chemicals, materials, and energy. The whole cell system, GMO's, enzymes, tailorised enzymes, and synthetic cells – the products of synthetic and systems biology - are used or will be used.

White Biotechnology is by nature a multidisciplinary area, combining the knowledge of different scientific disciplines. Industrial Biotechnology is the basic pillar of the European Technological Platform – Sustainable Chemistry. Together with materials technology and reaction, the process design forms a complete technological platform. It is estimated that biological processes will account for 10 – 20 % of production across the whole chemical industry by the end of 2010.

The strategic research agenda includes the following main research areas:

Novel enzymes and microorganisms
Microbial genomics and bioinformatics
Metabolic engineering and modelling
Biocatalyst function and optimisation
Biocatalytic process design
Innovative fermentation science and engineering
Innovative down–stream processing

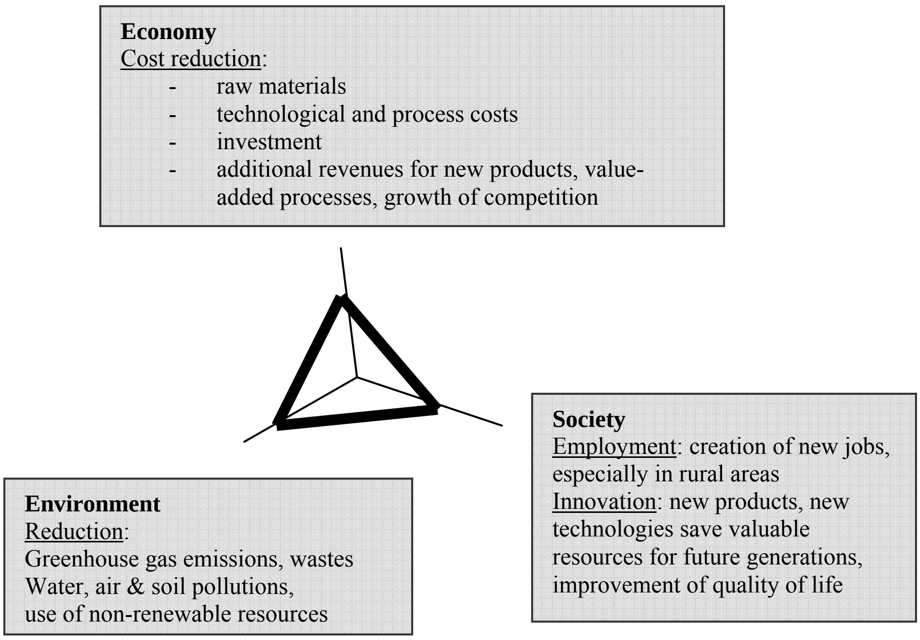


Fig. 1. Three dimensions of sustainable development

The action plan – policy measures to provide incentives to reduce barriers and to raise public awareness and encourage public acceptance of industrial biotechnology were published in August 2006.

A vision for Industrial Biotechnology in Europe – the year 2025

1. Industrial biotechnology will enable a range of industries to manufacture products in an economically and environmentally sustainable way.
2. Increasing numbers of chemicals and materials will be produced using biotechnology in one of its processing steps. Biotechnological processes

are used for producing chemicals and materials otherwise not accessible by conventional means or in a more efficient way.

3. Biotechnology will allow an increasingly eco-efficient use of renewable resources as raw materials for industry.
4. Biomass-derived energy based on biotechnology will be expected to cover an increasing amount of our energy needs.
5. Rural bio-refineries could be a source of important chemical products as a raw material for chemicals.
6. Green Biotechnology will make a substantial contribution to the efficient production of raw materials.
7. European Industry will be innovative and competitive, it will sustain cooperation and support between the academic community, industry, agriculture, and society.

White Biotechnology has the potential to improve industrial production along all three dimensions of sustainable development (Fig. 1) (http://www.suschem.org , 2005).

5. Conclusions

The potential of White Biotechnology is very promising and it is expected that industrial application of biotechnology will be a key technology contributing to the achievements of the Lisbon Strategy to make Europe the most competitive and dynamic knowledge-based economy in the world on the principles of sustainability.
The contemporary "bio-economisation" is a specific symptom characterising the processes of the globalisation of the world economy.

References

BARNETT, T. P. M.: A. Bluepnint for Action – a Future Worth Creating. Ed. G. P. Putman s Son, N.Y. 2005 ISBN 019 – 852 – 498 – 6

DASILVA, E.: The colours of Biotechnology: Science, Developnet and flumankind Elektron. J. Biotechnol 7, 3, 2004, 1-2

EUROPEAN TECHNOLOGY PLATFORM, 2006, http://www.bio-economy.net/centre3europ.html

GAVRILESCU, M., CHISTI, Y.: Biotechnology – a sustainable alternative for chemical Industry, Biotechnol. Adv., 23, 2005, 471-499

LISABON STRATEGY, 2000, http://www.svez.gov.si/en/higlights/ Lisabon_strategy, LISABONSKÁ STRATEGIA, 2004, http://www.europskyparlament.sk

MEADOWEROLT, J., FARREL, K., SPANGERBERY, J.: Developing framework for sustainability in the EU. Int. J. Sustain. Dev., 8, 2005, 3-9

RATZINGER, J.: Európa. SSV Trnava, 2005, ISBN 80 – 7162 – 570 – 1

SAFRANSKI, R.: Koľko globalizácie znesie človek Ed. Kaligram Bratislava 2006; ISBN 80 – 7149 – 858 – 8

THE BIOECONOMY IN 2030, APOLICY AGENDA.OECD 2005, http://www.oecd.org

THE VISION FOR 2025 AND BEYOND, Suschem, 2005, http://www.suschem.org