

# Evolution of Bioeconomic Management in the context of Sustainable Development in the Age of Globalization

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**Abstract:** Currently, the States and regions around the world face with several economic, environmental, social challenges etc. The increase in the demand for power supply, for primary resources (agriculture, forestry and fishing), for industrial products and services, sets a significant pressure on the ecosystems sustainability. One of the solutions to support the sustainable development process may be the transition towards the bio-economy, innovative sector focused on the production of biotechnologies and biomass. The bio-economy is the field comprising all economic activities related to the use of biological renewable resources. Considering this, the goal of this paper is to draw the attention on the importance of bio-economy in the effectiveness of the use of natural resources and in the current context of obvious and irreversible climate changes. Moreover, lately, the concept of bio-economy gained the attention of the scientific and political environments, both in Europe and at worldwide level. We can already talk in Europe of a general transition towards the bio-economical field.

**Keywords:** Bio-economy, sustainable development, innovation, renewable resources management

**Jel Classification:** Q01, Q51, Q57

## Introduction

Currently, humankind faces the effects of overexploiting the natural resources and the consequences of a chaotic technological, industrial development, which is inefficient most of the time (the inefficiency of the natural resources use). These effects had a negative impact on biodiversity and on the quality of the eco-systemic services, adding to them the disappearance of some species and the loss of the water quality, all having negative impact on food security and, implicitly, on population welfare.

The worldwide economy functions within an unlimited ecosystem, and the increase in the materials flow and in the energy consume disagrees with the physical limits of the planet and with those of life-support delivered by the natural ecosystems<sup>1</sup>.

In an economic and ecological overview, the exhaust of the natural capital is viewed as a loss of the tangible material flows (natural resources) and a potentially irreversible loss of the elements generating intangible benefits flows (eco-system services). This statement is supported by the growth of the global water and power demand with about 40% during the next 20 years<sup>2</sup>, while the food demands will increase with about 60% until 2050, and the area for crop fields per habitant is going to reduce to 1.5% per year<sup>3</sup> (fields selling to foreign investors).

There are also other global pressures on the environment, which increased in

intensity, especially after 1990, namely:

1. A small number of countries dominating the worldwide production and consume;
2. Worldwide population growth and the increase in its mobility leading to the increase of the exposure risk for new pandemics, usually associated with the precarious distribution of the food;
3. The increase of the environmental pollution correlates directly to the climate changes, with the exposure of the eco-systems to high levels of pollution, which leads to the loss of the food security and the occurrence of extreme weather phenomena.

These global pressures determine economic growth based on consume, on changes of the technological patterns and demographic growth. According to some UN reports, 60% of the ecosystem services altered during the last 50 years, about 54% of the world population lives in urban centers.

The current economic patterns do not guarantee further the maintaining the environmental quality and the terms for healthy lifestyle support. Usually, the cost of environmental deterioration (air and water pollution, food etc.) is not comprised in NGP.

In this regard, the deep paradigm change, the institutional, technological transformations, the modification of the lifestyle etc. are required for the decoupling the economic growth by the environment degradation and for reaching a stable and lasting eco-system.

## 1.The Concept of Bio-economy

Generally, the bio-economy is regarded as an extremely dynamic, active, process of society transformation and adjustment to the

<sup>1</sup> Herman E. Daly, (2007), *Ecological Economics and Sustainable Development*, Selected Essays of Herman Daly, Edward Elgar Publishing, Inc., ISBN 978 1 84720 101 0

<sup>2</sup> <https://www.eia.gov/>

<sup>3</sup> <http://www.fao.org/home/en/>

new climate and resources challenges, process which cannot be achieved without total involvement, both long-term political, societal, financial, and spatial, territorial (as it is not enough to be applied only by one region or country).

Having a programmatic character, adjusted to the specificity and nature of the consume resources and patterns, the countries on the globe have full freedom in defining their vision and concept on the bio-economy, including the strategies, the actions and measures meant to render it applicable.

The theories and concepts setting the grounds for the definition of the bio-economy field targeted elements coming from two fields so different considering the aimed goals but mutually influencing each other more and more visibly: the economics, and the environmental protection. The analyses in the field of environmental protection interfering with those from the field of economic and social sciences succeeded to create a model of societal evolution which to take under consideration the constraints resulting from the intensive use of the natural resources. Nevertheless, in a first stage, the classical theory claimed that economics and environment had diametrically opposed objectives. The wish to obtain profit –the declared purpose of all theories of classical economics – is obvious, regardless if we talk about the capitalist economics or the socialist one. As the profit or the added value are growing, more and more resources are consumed in the technological process, resources of any kind, natural, human or technological, ideas or knowledge, constantly exerting a negative effect on the environment and biodiversity. At a certain point, the environment surrenders, entering a negative slope of supporting the manufacture and reproduction process,

affecting the profit beneficiary itself. From this point of view, we identify several theoretical approaches on the relation between economics and environmental resources:

1. the first approach is that of eco-centric type, the natural resources being assigned an intrinsic value, regardless on their usefulness (H. D. Thoreau and J. Muir etc.);

2. the second direction is oriented towards the preservation of the natural resources, being the result of some pragmatic concerns; the nature has value as far as it supports human life and activity and is predominant even nowadays (for instance, how can certain natural resources be managed so that the future generations could also benefit) (G. Marsh is one of the representatives, 1864).

3. the third approach represents a mix of elements from the above, and relies on the concept of ethics of the land, developed by Aldo Leopold by the middle of the 20th century. He considers that people is morally liable for the protection of the natural resources and that these have intrinsic value, beyond their use in the human beings interest. This approach triggered the movement known as deep ecology (in the 70s and 80s). The approach led to some more radical movements which considered that the eco-system general welfare had to be a first priority, and the human aspirations and needs had to be re-considered through the fact that they are not priority but only a small element among many others. With the development of the petrochemical industry, of the town and sub-town planning, of the automotive large expansion, after the Second World War, the environmental issues have become public, global, national and regional priorities.

As for the definition of the concept of “bio-economy”, it has several meanings:

- sustainable and eco-efficient transformation of the waste into renewable biological resources, in the food products, energy and products for other industries (DG Research, 2006).

- the production and sustainable conversion of the biomass, of the organic waste including, into a range of food, fibers, industrial products etc.<sup>4</sup> (EPSO, 2011).

- the production of renewable energy, of biological resources and their and waste flows transformation into products with added value (for instance, food, feed, bio products, bio-energy) (EC, 2012). Thus, the concept of bio-economy covers the following fields: agriculture, forestry, fishery, food industry, biotechnology and chemical industry.

- the bio-economy is a world where the bio-technology corresponds significantly to the economic production (IECD). The emergent bio-economy implies: (I) use of advanced knowledge, of the complex genes and processes in order to develop new processes and products, (II) use of renewable energy and biomass in order to support the sustainable production; (III) integrating the biotechnological knowledge and applications in the industries.

- an economy of the future put in service of life, people, by rational use of the environmental resources (Acad. A. Bogdan).

- bio-economy is precisely the human species way of survival under the terms of some unpredictable climate changes, an inter-disciplinary science becoming by every passing day the center of the debates on the current (economic, political, military, industrial, etc.) crisis of the modern civilization (G. Roegen)<sup>5</sup>.

<sup>4</sup> <http://www.epsoweb.org/file/560>

<sup>5</sup>Georgescu-Roegen, *The Entropy Law and the Economic Process*, Harvard University Press, 1971.

The bio-economy is regarded as a new paradigm operating and managing the values hidden in bio-resources and bioprocesses, in a sustainable way. The biomass may be of forestry, agricultural, aquatic origin, a material of biological origin (CEN, 2011).

OECD estimates that, by 2030, the use of bio-technology is to be of 35% of the industrial production of chemical products and of other products which could be manufactured with the help of bio-technologies (for instance, bio-plastic materials), of 80% of the pharmaceutical products and of about 50% of the agricultural production (OECD, 2009).

Consequently, the bio-economy aims to differentiate itself from the nature and to have more control with regard to the technology and innovation.

There are certain differences between bio-economy and bio-based economics but, generally, the distinction is made in relation with the production and use of biomass, often with the exclusion of the production of food and feed.

The bio-economy comprises the production of biomass, either primary (from agriculture, forestry, fishing, aquaculture and industry) or by collecting the waste flows and using the biomass in consume, power and materials.

Bio-based economics is part of the global bio-economy and approaches only the use of the biomass for materials, power, chemical substances and other biological products, though excluding the food.

The European Union identified the economics based on biology as one fully integrating the range of natural and renewable biological resources, terrestrial and maritime resources, bio-diversity and biological materials (plants, animals and microbial), their

processing and consuming included (EC, 2012). This definition of the concept focuses mostly on raw materials than on conversion processes, being applied in Germany, Finland and Sweden. Due to its innovative character, the definition of the concept of bio-economy knows constant changes.

## **2. Fields of Application of the Bio-economy**

The bio-economy is an inter-disciplinary field reuniting the economical innovation and activity, involving more fields, as follows:

- the industry, including the chemical products, the bio-plastic materials, enzymes, bio-synthesis, bio-fuels, bio-remedy, bio-sensors, and other methods of reduction of the pollution impact on the environment;
- the agriculture (primary production, plants, respectively animals cross-breeding and improvement; veterinary applications etc.);
- medical industry and human health (pharmaceutical genetics, bio-pharmaceuticals, dietetics etc.).

### **a. Bio-refinery**

In the bio-economy, the sustainable production and biomass capitalization represents the framework for its functioning. Sustainable biomass production (cultures, algae, residues) is used to complete the demand for human food, for animals feed, for bio-energy (power, heating and bio-fuels for transport) and that for biological products (chemical products, materials). The relatively low availability of the raw materials requires the development and the implementation of the technologies for biomass conversion into various bio-products.

The bio-refinery transforms the biomass into various products and refers to the equipment using a range of technologies for bio-conversion of various raw materials (trees, energy, crops, wastes, ...) into a wide range of products, including food, ingredients for animals feeding, chemical substances, biomaterials (fibers including) and bioenergy, targeting to maximize the added value along the three pillars of sustainability (environment, economics, and society). The bio-refinery exploits various elements of the biomass and produces more valuable refined products. For instance, the forestry bio-refinery uses the whole potential of the raw materials and of the secondary flows of the forestry field, and turns them into a wide range of products, efficiently.

Currently, the biomass is mainly used for human feeding, for animal feed and for fuels production.

### **b. Forestry Industry**

As effect of the traditional markets reduction, the forestry field knows important changes leading to excessive losses of workplaces with effect on rural communities. The governments try to stimulate the new industries focused on the use of sustainable forestry bio-fibers and the production of biofuel for the production of energy, chemical substances, and polymers.

The forestry industry comprises the industry of cellulose, paper, hard paper and wooden products. The latest comprise timber, pressed wood and the industry of construction products.

### **c. Food Industry**

The agricultural crops are not used in the bio-economy only for the production of food and feed, but they are used also to

produce chemical products, materials and biofuels. The agriculture produces significant volumes of residues. The wastes have been investigated and the findings were that some antioxidants, vitamin E and vegetal sterols could be extracted from this resource.

#### Microalgae

Algae represent a group of relatively simple organisms, likely to the plants, living in the oceans, seas, and rivers waters and being able to perform photosynthesis. There are thousands of various species of algae of various sizes. The algae contain lipids (oil), proteins and carbohydrates (sugars).

The use of the microalgae on the food products and for feed is increasingly often met, as some of their components have the potential of being competitive. The micro-elements of the algae have specific advantages with regard to the traditional advantages, making them market viable even if the production costs are higher.

Recently, algae are used in the production of ethanol or bio-diesel. They play an important part also in aquaculture, being incorporated in cosmetic products; they are cultivated as sources of poly-unsaturated fatty acids etc.

In the current global context, the extension of the research in bioscience is strictly dependent on the sophisticated infrastructure and modern equipment. Therefore, it is necessary also to support and fund the research and to promote cooperation projects. Thus, a coherent alignment of the priorities is required: investments in research and development, innovation and competencies, support policies in the bio-economy field, encouragement of the entrepreneurial spirits and dissemination of the culture of innovation.

### 3. The Bio-economy Field in Europe

At the level of the European Union, there is in progress the implementation of several inclusive and smart policies and strategies of sustainable development which support unequivocally the economy based on bio-products and biotechnologies, on a community of recycling, preservation and equitable share of the ecosystems. Among these, the 2020 Europe Strategy distinguishes itself by far, proposing five goals and, in the same time, establishing concrete targets to be reached: the labor force occupancy (75% of the population to be employed), reduction of poverty (20 million persons less exposed to risk of poverty), climate changes and energy sustainability (20% reduction of the greenhouse gas, 20% energy from energy renewable sources, an increase with 20% of the energy efficiency), research and development (3% of the EU GDP), education (reduction of early school dropout rates below 10%). Other sector objectives are also added to these (for instance, stopping the illegal forestry exploitations by 2030, reaching cohesion by 2050 etc.).

In the 2020 Europe Strategy, the bio-economy is more than a goal, it is a reality built on the recognition, capitalization and uses of the entire research and innovation potential, of the implementation of the biotechnologies and of putting into practice the principles of sustainable development. From the performed analyses, it was found out that some member states have been applying for long strategies to support the bio-economy field, parallel with funding, promoting and developing a stronger research-innovation field (for instance, Netherlands, Germany, Finland, Sweden etc.).

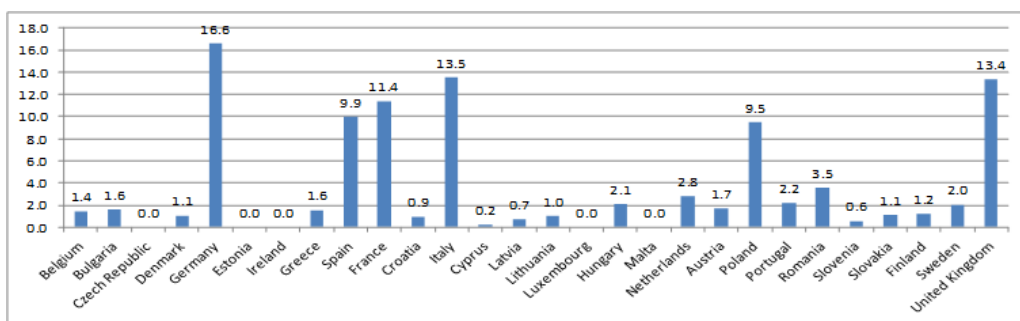
As recognition of the importance of this field, the European Union promoted



the Strategy on Bio-economy in 2012, which aimed to develop a society of knowledge and innovation, the increase in the productivity simultaneously with the sustainable use of the resources, and the reduction of the pollution impact on the environment. The Strategy also supports the implementation of an adequate management of the ecosystems and to insure of the bio-diversity. It is predicted in the Strategy that about 130,000 workplaces are going to be created and an added value of 45 billion Euros is going to be reached (by 2025). Currently, the situation

of the occupancy in bio-economy is presented in figure 1. The bio-economy represents a field playing an important part considering the occupancy in the EU Member States. For instance, Pilvere et al (2015) show the possibility to increase the occupancy in forestry, this aspect being regarded as an advantage for the society . 3,874,966 persons were employed in the field of bio-economy in the European Union, most employees being in the agriculture area (56%), followed by the employment in food (25%) and wood industries (7%).

Figure 1: Occupancy rates in the field of bio-economy, in EU-28, in 2015 (% of the total)



Sources: Processing of Eurostat data

The European Strategy on bio-economy is structured on three pillars: investments in research, innovation and specialization (skills), development of specific markets and increase of their competitiveness, strengthening the policies, and stakeholders' involvement.

This EU involvement in the field of bio-economy relied on the high quantity of generated waste, namely 16 tons of waste per person per year. Moreover, in 2010, only 36% of the total of waste production in the EU was recycled, the rest being stored or burnt. It is predicted that about 600 million of tons (37.5%) could be recycled or re-used.

For instance, the Framework Directive on European Waste (Directive 2008/98/EC) defines the waste as being those substances or object thrown away by their holder, or which he/ she intends to get rid of. The directive comprises two recycling and recovery goals which are to be achieved by 2020: (a) 50% for the reuse or recycling of certain waste from the households, and (b) 70% for reuse, recycling and other retrievals from constructions and demolitions.

In 2012, the European Commission passed the strategy called "Innovating for Sustainable Growth: Bio-economy for Europe", which proposes a comprehensive

approach of some ecological, environmental, energetic aspects, food supply and the challenges related to natural resources. In the same time, the strategy is to contribute in achieving the growth of economics sustainable development. As worldwide leader in research and innovation in the field of bio-economy, EU is trying to manage sustainably its resources, contributing to the opening of new markets of food bio-products, of animal feed, of power etc.

Under the auspices of the EU Strategy on Bio-economy, support tools for various fields, sectors and stakeholders were established. In addition, many of the member states in the EU designed their own national strategies on the bio-economy.

#### **4. New Perspectives of the Bio-economy Progress after 2020**

In EU, promoting the use of biomass is regulated by the Medium and Long Term Strategic Framework on Sustainable Energy (timeframe 2020-2030-2050), but also with the help of some documents of programming. One of these documents is called the Green Paper - A European Strategy for Sustainable Competitive and Secure Energy [COM(2006)]. Achieving the economic, social and environmental goals, but also solving some major issues on energy, the increasingly higher dependence on energy imports, the volatile prices for oil and gas, the climate changes, and so on represent strategic desiderata considered by the prior mentioned Green Paper. In the field of joint energetic European policy, six priority fields have been set as follows:

1. Increasing the competitiveness and the development of the energy internal market;

2. Diversifying the energetic mix by promoting ecological diversification of the power supply;

3. Solidarity – measures to be taken at community level in order to prevent the crisis of the power supply and their management in case of occurrence;

4. Sustainable development – better energetic strategy to balance the objectives of environment protection with the competitiveness and security of the supply;

5. Innovation and technology – measures that should be taken at community and national levels in order to make sure that Europe remains a worldwide leader in the field of energetic technologies.

6. The need for joint European policy in the field of energy .

By far, the most important is the Action Plan for Biomass [COM (2005) 628 final], which is the component of the EU new energetic policy established in the Green Paper on energy. The definition given to biomass is the following: the totality of animal and vegetal products used to produce energy; the biomass represents currently about half (44-65%) of the total of renewable sources of energy used in the EU. Currently, the biomass supplies 4 % of the EU energy needs (69 million tons equivalent oil - tep). An increase in the weight of the biomass in the energetic mix up to 150 million tep may cause the following benefits: diversification of the European energy supply, significant reduction of the greenhouse gas emissions (209 million tons), 250,000-300,000 direct workplaces, and possible decrease of the oil price due to lower demand.

Biomass for heating

Heating is the process/ sector using mostly the biomass due to simple and less



costly technologies. However, the use of biomass is not appropriate, the intent being of appealing to various measures to improve this situation, such as: the passing of a new specific legislation on energy from renewable sources for heating, developing a survey on the ways to improve the boilers performance on biomass for household use and for reducing the pollution, too.

The use of the biomass for heating is more appropriately to be performed in centralized heating systems than in individual ones. It is highlighted that there are many ways of producing power supply from renewable sources of energy. The use of biofuels in transports is regulated by the Directive on biofuels for transport, which stipulates among others:

- ⊙ the establishment of national objectives for the biofuels market share;
- ⊙ the obligation to use biofuels;
- ⊙ the implementation of a system for compliance certification with the biofuels standards.

#### Stimulating the offer of biomass

As for the agriculture, the reform of the Common Agriculture Policy (CAP) introduced an „aid for energetic cultures“ in particular. Moreover, the Commission is to fund an information campaign on the priorities for energetic cultures and the perspectives for exploiting them.

The statistics for forestry show that about 35 % of the annual growth of the EU forests remains unused. An action plan is to be drafted in order to stimulate the electricity produced from wooden biomass.

Wastes are also an insufficiently exploited energy resource. From this reason, the Commission drafts in currently a theme strategy on wastes prevention and recycling,

and a draft for the revision of the framework legislation on waste is under preparation.

Sub-products of animal origin, which are not meant for human consume, are used more and more for generating energy.

In addition, a particular attention is paid to the adoption of European standards for solid biomass fuels in order to facilitate the trade, the markets development and for increasing consumers' trust.

The European Commission encourages the drafting of national and regional action plans for biomass evaluation at various levels (physical and economic availability, priorities for use, measures to be taken etc.).

#### Funding in the field of biomass

Supporting the development of renewable and alternative energy sources is a key object for the Structural and Cohesion Funds. Consequently, the European Union and the Member States have to promote the development of the renewable sources of energy through the regional policy.

In addition, the Commission emphasizes that the support for the production and use of biomass have to be consistent with community policy on state aids.

#### Biomass and research

The proposition of the Commission for the seventh framework program assigns high priority for the research in the field of biomass. It is intended to promote the best methods to stimulate the research in the optimization of the use of the agriculture crops and the wood residues for energetic purposes, as well as in the conversion processes.

As for the evolution of the bio-economical field at the European Union level, four scenarios have been submitted for the period after 2020, which are to unblock the innovation potential and the creation of workplaces for research-development-innovation.

The analysis of the social, economic and environmental impact of the four scenarios is to allow for the identification of the most efficient way to achieve the set objective, while being consistent with the principles of subsidiarity and proportionality.

These scenarios are presented below:

Scenario 1: bio-economy considered from the perspective of “normal or regular businesses”.

Scenario 2: research and innovation coordinated outside EU: in this option, the EU research efforts in the field of bio-economics are no longer coordinated at community level, but each Member State is performing them apart. The coordination of the research and innovation efforts between the member states is relatively limited. Despite all, the policies on bio-economy continue within the national agreements on sectorial approach and with minimal coordination.

Scenario 3: the bio-economy is supported by increased efforts in the field of research and innovation. In this scenario, the bio-economic research benefits of a new approach supporting the Union of innovation via the Horizon 2020 program. The research is carried out specifically in an integrated approach of research and innovation in order to address the society challenges and to support innovation, in order to allow for better development of the products and processes on the market and to increase the social innovation. Moreover, it is supported by tools promoting the excellence on scientific basis and creates competitive industrial management and staff. Various policies related to bio-economy continue to function at sectorial approach both at EU and Member States levels. As specified in the draft for the Multiannual Financial Framework (CFM), the research

and innovation in bio-economy benefit of more funding compared to FP 7 (4.5 billion EUR for 2014-2020).

Scenario 4: bio-economy supported by the strengthened political interaction and increased efforts in the field of research and innovation: in this option, the bio-economy has a coherent interaction framework of sustained public policies targeting the conciliation of the competing activities and the overlapped initiatives. Research and innovation are so structured that they correspond to the political challenges and goals of the society. This scenario is related to CAP and PCP, and to policies related to industry, environment, and energy due to innovation potential in these fields. The future European Innovation Partnership (EIP) on “Agriculture Productivity and Sustainability”, proposed in the reforms package for CAP after 2013 and the Communication named “A Union of Innovation” is to become, for instance, a key-instrument for inducing the innovation in agriculture.

The regional policy contributes in the development of innovative new enterprises and infrastructures in Europe. Ensuring proper human capital supposes the coordination with the training and educational policies. The research in the field of bio-economy benefits of a new approach while supporting the Innovation Union implementation via Horizon 2020 Program: research is carried out in a new inter-disciplinary approach, targeting namely how to address the bio-economic society challenges, and making efforts to support innovation in order to allow for a better development of the products and processes on the market. Research and innovation in bio-economy benefit of increased funding compared to the current level, as specified in the Multiannual Financial Framework (MFF).

## 7. Conclusions

Innovation and knowledge are regarded as symbols of human beings' emancipation, as they bring about competitive advantage and economic growth. Recently, they are the central elements of the strategies for sustainable development and for transition to bio-economy. The new attitude towards the nature causes a wiser management of the natural resources, and production patterns environment friendly as well.

A biomass-based economy instead of fossil fuels represents a significant change in the socioeconomic, agriculture, energetic and technical systems. This type of economy may achieve the sustainability requirements ecologically, socially and economically.

In this context, it can be supposed that bio-economy is to represent an opportunity for decoupling the industrial development

from environmental deterioration by using production methods based on biotechnology at industrial level. A balance has to be ensured between the existing natural resources and the economic aspirations, and it could be easily comprised in bio-economy. In addition, the establishment of new non-food markets in synergy with the existing food ones and in combination with alternative sources of income may provide for the rural region with a major impetus.

This paper tried to prove that bio-economy is much more than a simple evolution of the knowledge based economy, though it is part of it, towards a smarter sustainable economy, favorable to inclusion. The challenge human kind is currently facing is precisely to reach this balance between the current technical means and technology and the wish to maintain a clean environment and biodiversity for future generations.

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