
**ANALYSIS OF THE CONDITION OF BULGARIAN BIOECONOMY AND
POTENTIAL DIRECTIONS OF ITS DEVELOPMENT**

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Abstract: The population of Europe and the world is constantly growing, and so does its need for food, more and more natural resources are exhausted, the environmental impact and the related climate change challenges are increasing. It is therefore essential to move to a new way of economic growth that is compatible with environmental protection and sustainable use of limited natural resources, while ensuring a much higher standard of living reducing poverty. The development and application of innovative biotechnology methods and processes in the agriculture, health, chemistry and energy sectors has recently been seen as one of the solutions to accelerate sustainable growth and development. By focusing more on scientific research and innovation, new products from biomass and new services needed for the development of the bioeconomy would be created, helping to reduce climate change, waste and create new jobs. According to the OECD, by 2055 the bioeconomy will be the key principle of development of the European economy. This means that the focus will be on production of renewable bio-resources in agriculture, forestry and aquaculture, and biomass will become the main source of industrial raw materials.

The purpose of this Study is to evaluate the state and the potential of bioeconomy in Bulgaria, to take into account the best practices of the EU Member States and to present the conclusions and recommendations for the development of bioeconomy in Bulgaria and the innovation encouraging measures in this sector, to identify the areas of bioeconomy where the business cooperation between Bulgaria and other EU Member States has the greatest potential and to establish the measures for promotion of cooperation.

Various research methods were used for the Study: general scientific abstraction, induction and deduction, analysis and synthesis, content analysis, statistical data analysis, econometric time series analysis, general equilibrium modelling, questionnaires, interviews, case studies and others.

As the results the analysis of Bulgarian bioeconomy statistical indicators (gross value added, employment, labour productivity, turnover, exports, earnings and the number of economic entities in operation, including farms) was conducted according to the three first groups of activities attributable to bioeconomy - biomass production, fully bio-based manufacturing sectors and partly bio-based manufacturing sectors, and types of economic activities attributable thereto, which have also been referred to as subsectors in the Study.

Keywords: bioeconomic enterprises, bioresources, innovative biotechnology methods, bio-based sectors

1. INTRODUCTION

Long-term forecasts show that, without radical political changes, the current trends in world economic growth and development will have a major impact on the natural resources and the ecosystem³. The population of Europe and the world is constantly growing, and so does its need for food, more and more natural resources are exhausted, the environmental impact and the related climate change challenges are increasing⁴. It is therefore essential to move to a new way of economic growth that is compatible with environmental protection and sustainable use of limited natural resources, while ensuring a much higher standard of living reducing poverty. The development and application of innovative biotechnology methods and processes in the agriculture, health, chemistry and energy sectors has recently been seen as one of the solutions to accelerate sustainable growth and development⁵. By focusing more on scientific research and innovation, new products from biomass and new services needed for the development of the bioeconomy would be created, helping to reduce climate change, waste and create new jobs⁶.

The first steps towards bioeconomy in the European Union (EU) were made in 2002, when the Life Science and Biotechnology Strategy was adopted, devoted to the development and application of life sciences and biotechnology

³ OECD (2016) *The Bioeconomy to 2030: Designing a Policy Agenda*. OECD Publishing. Paris.

⁴ Rönnlund, I., Pursula, T., at al (2014). *Creating value from bioresources: Innovation in Nordic Bioeconomy*. Nordic Innovation. Oslo.

⁵ Piotrowski, S., Carus, M. und Carrez, D. (2016). *European Bioeconomy in Figures*

⁶ Ronzon, T., Lusser, M., Klinkenberg, M. (ed.) at al (2017): *Bioeconomy Report 2016*. JRC Scientific and Policy Report.

. In 2009, the Renewable Energy Directive of the EU set the renewable energy targets to be met by 2020. One of them was that 20 percent of the EU's final energy consumption should be generated from renewable energy resources, in order to reduce the carbon dioxide emissions⁷. The bioeconomy strategy *Innovating for Sustainable Growth: A Bioeconomy for Europe* was adopted in 2012⁸. The Bioeconomy Strategy and its Action Plan have become the foundation for a more innovative, more resource-efficient and more competitive society that combines food security, sustainable use of renewable resources for industrial purposes and environmental protection. The European Commission has set a long-term target for creating a competitive, resource-efficient and low-carbon economy by 2050. It is expected that bioeconomy will be an important element of the low-carbon economy⁹. Under the Paris Agreement (2016), the EU has committed itself that by 2030, its GHG emissions would be reduced by at least 40 percent, compared to the level of the 1990.

According to the OECD, by 2055 the bioeconomy will be the key principle of development of the European economy. This means that the focus will be on production of renewable bioresources in agriculture, forestry and aquaculture, and biomass will become the main source of industrial raw materials. The purpose of this Study is to evaluate the state and the potential of bioeconomy in Bulgaria, to take into account the best practices of the EU Member States and to present the conclusions and recommendations for the development of bioeconomy in Bulgaria and the innovation encouraging measures in this sector, to identify the areas of bioeconomy where the business cooperation between Bulgaria and EU Member States has the greatest potential and to establish the measures for promotion of cooperation.

To achieve this, the following tasks have been fulfilled:

1. To analyse the use of the definition of "bioeconomy" in the legislation and guidance documents of the EU institutions, the Organisation for Economic Cooperation and Development (OECD), the EU Member States and to assess whether the description of the bioeconomy sector provided in Section 1.6 of the Technical Specification used in the European Commission communication "Innovating for Sustainable Growth: A Bioeconomy for Europe" is suitable for defining the bioeconomy sector in the Bulgarian legislation;

2. To analyse the state of bioeconomy in Bulgaria and the possible directions of its development;

3. To analyse the possibilities of Bulgarian and EU Member States business cooperation in the field of bioeconomy and to propose measures for promotion of cooperation;

4. To provide recommendations on the development of bioeconomy in Bulgaria and innovation encouraging measures in this sector by forming a plan of the proposed measures.

Data limitations: the statistics on national accounts, employment, business, science and technology according to the NACE 2 economic activities is not suitable for the macroeconomic indicator analysis of development, R&D and innovation of partially bio-based manufacturing (textile, clothing, leather, chemical products, pharmaceuticals, rubber and plastic products, furniture), bioenergy and biowaste processing sectors. The production of bioenergy resources is integrated into several economic activities: solid biofuels (firewood, chips and pellets) – in forestry and logging as well as the production of wood and its products; bioethanol and biodiesel – in manufacturing of chemical products; biogas production – in gas production and waste management.

Another limitation is the difference in the time series of cumulative statistics according to the indicators in question. As a result, the beginning and the end of the empirical research period are not strictly defined due to the high diversity of the indicators in question. The Study used the latest statistical data from the above-mentioned statistical databases extracted in April – August 2019.

2. ANALYSIS OF THE CONDITION OF BULGARIAN BIOECONOMY AND POTENTIAL DIRECTIONS OF ITS DEVELOPMENT

2.1. The essence of bioeconomy

The bioeconomy encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy¹⁰. The

⁷ Scarlat, N., Dallemand, J.F. et al. (2015). *The role of biomass and bioenergy in a future bioeconomy: Policies and facts* // Environmental Development Volume 15.

⁸ Council of the European Union, (2016). *Council Decision* (EU) 2016/1841 of 5 October 2016 on the conclusion, on behalf of the European

Union, of the Paris Agreement adopted under the United Nations Framework Convention on Climate Change.

⁹ SINTEF. (2015). *Towards a bioeconomic future*.

¹⁰ European Commission, (2017), *The Bioeconomy Strategy. Research & Innovation: Bioeconomy*.

bioeconomy includes the sectors of agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries¹¹. Bio-based products are products that are wholly or partly derived from materials of biological origin, excluding materials embedded in geological formations and/or fossilized¹². The bioeconomy relies on life sciences, agronomy, ecology, food science and social sciences, biotechnology, nanotechnology, information and communication technologies (ICT), and engineering¹³.

Comparative analysis of the definition of bioeconomy in the EU, OECD and the EU member state documents allowed determining that bioeconomy is a part of economics associated with the following: *sustainable production of bio-resources and their processing into value added products; land and water* (plants, animals and micro-organisms) and bio-based products; *types of economic activities* (in other words – economic sectors) *related to the manufacture, processing or recycling and use of such as plants, animals, micro-organisms and their products; the use of advanced technologies, such as biotechnology, nanotechnology, information and communication technologies, in addition to traditional technologies.*

Thus the definition of bioeconomy according to the Communication from the European Commission “Innovation for Sustainable Growth: A Bioeconomy for Europe” reflects the essence and the content of bioeconomy, covering all the specified material elements of bioeconomy. According to this Communication, “.....*the bioeconomy encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy*”. This description of bioeconomy is clear, easily understandable and suitable for defining the bioeconomy in Bulgarian legislation. It should be added that this definition of bioeconomy has recently been often quoted in various EU bioeconomy studies.

2.2. Economic activities attributable to bioeconomy

Various political documents, researches and statistical reviews analyse different composition of bioeconomy by economic activities and sectors. For example, the Strategy for Sustainable Bioeconomy approved by the European Commission attributes agriculture, forestry, fisheries, manufacture of food, wood and paper, as well as the industries of chemicals, energy and technology to the bioeconomy sector. The National Bioeconomy Profiles published by the European Commission (by the EU states) provide the classification of bioeconomy sectors by a threefold composition of types of economic activities:

- *biomass production sectors* – agriculture, forestry and fisheries;
- *fully* (100 percent) *bio-based manufacturing sectors*, processing biomass to higher added value products, which include manufacture of food, beverages and tobacco; manufacture of wood, cork and their products, except for furniture; manufacture of paper and its products and manufacture of leather and related products;
- *partly* (less than 100 percent) *bio-based manufacturing sectors*, where biomass is used as a part of materials. This includes manufacture of textile and apparel, chemicals, pharmaceuticals, rubber and plastics, furniture and other bio-based manufacturing.

Manufacture of biogas, biotechnology-based sewerage and biowaste management are also characterised as partly bio-based economic activities. In turn, NACE REV. 2 categorises the production of biofuels as manufacture of chemicals (NACE REV. 2 codes C2014 and C2059), the production of solid biofuels – as logging (NACE REV. 2 code A0220) and manufacture of wood products (NACE REV. 2 codes C1610 and C1629). Construction using wood and its products as construction materials can also be attributed to the partly bio-based sector of economy.

The OECD Bioeconomy Strategy 2030 defines three main sectors according to the criterion of the used biotechnology: agricultural, health and industrial sectors. The Innovation in Nordic Bioeconomy Study refers to a number of national economy areas comprising bioeconomy. Agriculture, fisheries, aquaculture and forestry are attributed to the core bioeconomy area generating feedstock. Only six sectors, which completely fall under the bioeconomy area on the basis of feedstock production and processing, were included in the assessment of the EU Member States bioeconomy development: agriculture, fisheries and aquaculture, logging, food industry, forestry and bioenergy. The significance of bioeconomy sectors has been determined to be very different among the Nordic

¹¹ Chambers, G., Dreisin, A. and Pragnell, M.(2015). *The British bioeconomy: An assessment of the impact of the bioeconomy on the United Kingdom economy*. Capital Economics. 11 June

¹² Bio-based Industries Consortium (BIC). (2017). *Annual Report 2016*, January

¹³ European Commission. (2017). *The role of waste-to-energy in the circular economy*. Communication from The Commission to the European

Parliament, The Council, The European Economic And Social Committee And The Committee of The Regions Brussels

countries. For example, in Finland and Sweden, forestry-based industries are highly developed, Denmark can be characterised by the importance of its agricultural sector and food processing, while Iceland and Norway are known for fisheries. Different areas of manufacture of renewable energy sources have been developed in Norway and Sweden. In addition to wind energy, manufacture of agro-biomass is well developed in Denmark, and manufacture of forest biomass – in Finland and Sweden.

The examined material revealed that the attribution of certain economic activities or economic sectors to bioeconomy may be based on different concepts. Their practical application may depend on different goals, factors or criteria. The scope of bioeconomy composition is not finite – it changes with time, because bioeconomic activities are developing. It has been emphasised that new technologies creates possibilities to replace products made of fossil resources with fully or partly bio-based products¹⁶, or to use biomass as “the energy carrier” in new sectors of economy in the future. The summary of analysis of the concept and composition of bioeconomy allows stating that different scope of bioeconomy may be applied in Lithuania, depending on the examined context and goals. The recommended base list of areas of economic activities attributable to bioeconomy is presented in Table 1.

Table 1. The scope of economic activities in the bioeconomy

NACE Rev. 2 codes	Corresponding NACE Rev. 2 labels	Abbreviated NACE Rev. 2 labels used in this Study
<i>Biomass production</i>		
A01	Crop and animal production, hunting and related service activities	Agriculture
A02	Forestry and logging	Forestry and logging
A03	Fishing and aquaculture	Fishing and aquaculture
<i>Fully (100%) bio-based manufacturing</i>		
C10	Manufacture of food products	Manufacture of food
C11	Manufacture of beverages	Manufacture of beverages
C12	Manufacture of tobacco products	Manufacture of tobacco
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	Manufacture of wood products
C17	Manufacture of paper and paper products	Manufacture of paper
<i>Partly (< 100%) bio-based manufacturing</i>		
C13	Manufacture of textiles	Manufacture of bio-based textiles
C14	Manufacture of wearing apparel	Manufacture of bio-based wearing apparel
C15	Manufacture of leather and related products	Manufacture of leather products
C20	Manufacture of chemicals and chemical products	Manufacture of bio-based chemicals
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	Manufacture of bio-based pharmaceuticals
C22	Manufacture of rubber and plastic products	Manufacture of bio-based plastics
C2365	Manufacture of fibre cement	Manufacture of fibre cement
C31	Manufacture of furniture	Manufacture of bio-based furniture
C32	Other manufacturing	Other bio-based manufacturing
<i>Partly (< 100%) bio-based others activities</i>		
D3521	Manufacture of gas	Manufacture of biogas
E38	Waste collection, treatment and disposal activities; materials recovery	Biowaste treatment

Bioenergy is not distinguished into a separate type of economic activities in NACE REV. 2. manufacture of bioenergy products falls within certain areas of logging, wood products and chemicals, gas production and waste management, as per Table 2. the Bio-Based Industries Consortium (BIC) annual report distinguishes two areas of bioenergy, namely, biofuels (bioethanol and biodiesel) and bioenergy (biogas and solid biomass) for the production of heat and electricity .

Table 2. Scope of economic activities in the bioenergy

NACE Rev. 2 codes	Corresponding NACE Rev. 2 labels	Product descriptions in PGPK or PRODCOM
A0220	Logging	Firewood and charcoal produced in the forest
C1610	Sawmilling and planing of wood	Wood in chips or particle
C1629	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	Briquettes, pellets and other biofuels from wood, logging waste and straw
C2014	Manufacture of other organic basic chemicals	Undenatured and denatured ethyl alcohol, wood charcoal whether or not agglomerated
C2059	Manufacture of other chemical products	Biofuel
D3521	Manufacture of gas	Production of gas from by-products of agriculture or from waste
E3821	Treatment and disposal of non-hazardous waste (in order to obtain biogas)	Treatment and disposal services of non-hazardous waste in order to obtain biogas

Biotechnology sector According to the latest OECD definition, biotechnology is defined as “the application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services”.

Main biotechnology activities include :

- *research and experimental development on biotechnology* (R&D), which covers 1) the development of biotechnology techniques and processes or the creation of products and 2) knowledge received in the performance of R&D. The Frascati Manual²² distinguishes four biotechnology R&D fields, i.e. environmental biotechnology, industrial biotechnology, medical biotechnology and agricultural biotechnology;
- *manufacture, such as* 1) the use of biotechnology techniques to manufacture bioproducts and 2) the use of biotechnology processes in manufacture, including environmental protection goals.

The main areas of application of biotechnology in the EU economy can be classified into three large groups : in healthcare and pharmaceutical applications, biotechnology has led to the discovery and development of advanced medicines, therapies, diagnostics and vaccines; in agriculture, aquaculture and veterinary, biotechnology has improved animal feed, produced vaccines for livestock, improved diagnostics of diseases and plant selection, created genetically modified organisms; and in industrial processes and manufacturing, biotechnology has promoted the use of enzymes in the production of detergents, pulp and paper, textiles, biomass, biofuels and other bio-materials, and instead of traditional chemical synthesis, it has led to higher efficiency of industrial processes and decreased energy and water consumption, which in turn led to the reduction of toxic waste.

2.3. Analysis of key statistical indicators of Bulgarian bioeconomy

According to absolute and relative units of Gross Value Added - GVA presented in Figures 1, it was determined that the majority of the EU countries are engaged in concentrated biomass and/or fully bio-based manufacturing. In 2017, the share of both sectors in GDP was greater (ranging from 4 to 10.1 percent) than the EU average (3.9 percent) in nineteen countries (out of the 26 analysed countries, Malta and Luxembourg were not included in the analysis due to the lack of data). Meanwhile, the contribution of both sectors to GDP of the United Kingdom, Germany, Denmark, Belgium, Cyprus and Sweden (from 2.4 to 3.6 percent) was lower than the EU average, while in France it corresponded to the EU average, despite the fact that France and Germany are the largest manufacturers of agricultural and food products in the EU, while the United Kingdom ranks fifth.

Biomass production sector - Romania and Bulgaria are the EU countries specialised in biomass production the most. The share of GVA in GDP created in this sector in both countries (4.7 and 4.6 percent, respectively) is more than three times greater than the EU-28 average (1.4 percent). Hungary and Slovakia are two other countries highly specialised in biomass production, where the contribution of this sector to GDP (having reached 4 percent) was by almost 2.8 times greater than the EU-28 average.

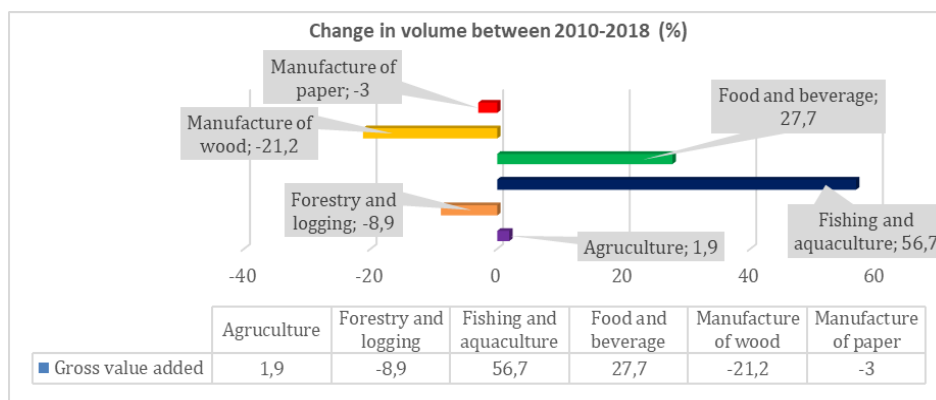


Figure 1. Change in the gross value added in Bulgarian bioeconomy sectors
 Data source: author's calculations (Production account and income generation, by industry)

Growth in bioeconomy sectors Figure 1 presents data on the change in GVA in 2010-2018 calculated according to the chained volume index (in 2010 = 100) illustrating which EU countries and which bioeconomy subsectors increased or decreased in the last period of average duration. Forestry and logging grew the fastest throughout the EU (by an average of 3.1 percent per year); paper industry and fishing increased slowly (by 1 percent per year) with agriculture and food, beverages and tobacco sectors (0.4 percent and 0.3 percent per year, respectively) experiencing a very slow growth. Meanwhile, wood industry (excluding furniture production) decreased by 8.3 percent, however, these bioeconomy subsectors experienced a very rapid or rapid growth in certain EU countries:

- Fishing grew very rapidly in Slovakia, Romania and Cyprus – by 25 percent in the first two countries, and 14 percent – in Bulgaria per year. The fishing sector also grew rapidly in Lithuania (by an average of 8.5 percent per year), Hungary, Austria, Spain and Greece (more than 5 percent per year);
- Slovakia can also be distinguished for a very rapid growth of the agricultural sector (by an average of 20 percent per year). A rapid growth in agriculture was also observed in Estonia, Latvia and Hungary (by 9.2, 8 and 6 percent per year, respectively), while agriculture in Lithuania and the United Kingdom increased by more than 4 percent per year;

4. CONCLUSION

In summary, the development of bioeconomy in Bulgaria can be stated to be mainly regulated and promoted via certain sectoral policies to this day, including policies of agriculture, forestry, fisheries, energy, environment (including waste management), development of research, innovation and biotechnology, etc. The content analysis of strategic documents of the EU, OECD and of good practice of EU countries allowed determining that bioeconomy or related strategies and action plans are based on the following 4 principles: 1) to give the priority to food security; 2) to combine food security with sustainable use of renewable resources for industrial purposes and assurance of environmental protection; 3) to apply the cascading principle in the biomass value chain, first of all using biomass in the production of the highest value added products. The Bulgarian bioeconomy strategy and the action plan should be based on the said principles, integrating the sectors of bioeconomy and including all stakeholders in order to ensure sustainable growth of bioeconomy via the biomass value chain.

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