

## The Current State of Bioeconomy in Romania

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### Abstract

*This paper presents the development potential of bioeconomy in Romania, in the context of European Union membership. The paper presents the concept of bioeconomy and an overview of the documents referring to the bioeconomy sector in the European Union and in Romania. Many European Union countries, including Romania, emphasize the importance of bioeconomy in many official documents, but they have not developed a complex strategy for this sector. Romania has one of the largest agricultural sectors in Europe and a strong chemical industry. These sectors, together with the food industry, wood processing, pulp and paper industry can contribute to the development of bioeconomy in Romania, creating high value-added and environmentally friendly products.*

**Key words:** bioeconomy, sustainable development, renewable resources, smart specialization

**J.E.L. classification:** O44, Q01, Q20

### 1. Introduction

Given the context of current climate change, there is a growing pressure on non-renewable resources and the need to develop more sustainable production and consumption patterns. Moving to a more efficient use of biological resources can help reduce waste, pollution, fossil resources and climate change. This change involves a whole set of changes in the primary production as well as in the industrial and economic processes.

It is clear that, without radical changes, the current model of global economic growth and development will have a major impact on the natural resources and the ecosystem. The world's population is constantly growing, more and more natural resources are almost depleted, food needs are growing, and the impact of economic activities on the environment and climate change could be devastating in time. It is therefore essential for us to move to a new way of economic growth compatible with the environmental protection and the sustainable use of the limited natural resources, while guaranteeing a much higher standard of living. Developing and applying innovative methods and processes of biotechnology in the sectors of agriculture, health, chemistry and energy is one of the solutions for sustainable growth and development. The scientific research and the innovation could create new biological resources and new services needed to develop the bioeconomy, helping to reduce climate change, waste and create new jobs.

Bioeconomy means to develop knowledge-based products and to use biological resources to provide goods and services in all economic sectors. Bioeconomy exists in every country in the world, even if the characteristics of this sector vary significantly worldwide. The bioeconomy includes all economic sectors and their associated commercial services involved in the production, processing, use or marketing renewable resources - such as plants, animals and micro-organisms - and products derived therefrom. The purpose of the bioeconomy is to make possible the transition to a different economic functioning, other than the current one based on fossil resources (especially on oil and natural gas). Therefore, the bioeconomy is essential in building a viable and sustainable economic system.

The concept of bioeconomy aims at "biologizing" the economy with the aim of sustainable development. In this respect, there are many overlaps with the scientific and sustainability strategies of many countries, as well as with the concept of "ecological economy".

The bioeconomy describes a concept that recognizes the full potential of biotechnological research and innovation for the economy and society as a whole. It has been promoted during the last decade, especially by countries that have made progress in the field of biotechnology, such as the Netherlands, Germany and Finland. In 2012, the European Commission presented the first European strategy on bioeconomy (European Commission, 2012). According to it, "the bioeconomy encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. [...] Its sectors have a strong innovation potential due to their use of a wide range of sciences (life sciences, agronomy, ecology, food science and social sciences), enabling and industrial technologies (biotechnology, nanotechnology, information and communication technologies (ICT), and engineering), and local and tacit knowledge".

## 2. Literature review

The concept of the bioeconomy emerged in the 1990s, but has become extremely popular on the agenda of global politics and research. The importance of the concept is demonstrated by the its bold objectives and the resources allocated for its implementation at international, national, regional and local levels.

Today, bioeconomy is already a system that integrates natural resources, technologies, markets, people and policies, actively establishing links between industries that previously had no direct connections, in a new symbiotic relationship, in which an industry uses the by-products of another.

Today, the biological resources play an indispensable role in meeting the global challenges of humanity: a rapidly growing population, depletion of fossil resources, environmental protection and climate change. In this sense, it is not surprising that biological resources are increasingly used in many sectors of the economy. The sum of all these ramifications forms the so-called bioeconomy, defined as "all industrial and economic sectors and their associated services which produce process or in anyway use biological resources (plants, animals, micro-organisms)" (Efken et al., 2016).

Bioeconomy is a multidimensional concept, therefore difficult to define. Globally, there is a very broad terminology and multiple definitions given to the same concept by different actors, depending on the area of interest. The definition of bioeconomy depends on the point of view the concept is approached: international organizations, public authorities, companies, economists, engineers, ecologists. The table below presents the most relevant definitions of the term bioeconomy.

In 2018, the European Commission updated its 2012 strategy in the field of bioeconomy, in order to maximize the contribution of this sector to the major priorities of European policies. The five objectives of the 2012 Bioeconomy Strategy (ensuring food and nutrition security, sustainable management of natural resources, reducing dependence on non-renewable and unsustainable resources, mitigating and adapting to climate change, strengthening the European competitiveness and creating jobs) remain valid, but in order to support them given some evolving policy priorities, this updated strategy proposes three main areas for action:

- strengthening and expanding the bioeconomic sectors, unlocking investments and markets;
- rapid implementation of local bioeconomies throughout Europe;
- understanding the ecological limits of the bioeconomy.

Table no. 1. Bioeconomy definitions

Bioeconomy definition	Year	Document
The bio-based economy uses renewable (agricultural, forestry and marine) and eco-efficient processes (including bioprocesses) to produce sustainable bioproducts, jobs and income.	2001	The Application of Biotechnology to Industrial Sustainability – A Primer. OECD, 2001
A sustainable, eco-efficient transformation of the waste of renewable bio-resources in food, energy and products for other industries	2006	DG Research (2006) FP7 Theme 2: Food, Agriculture, Fisheries and Biotechnology. 2007 Work Programme.
The application of biotechnology to primary production, health and industry could result in an emerging bioeconomy. Bioeconomy is transforming life science knowledge into new, sustainable, eco-efficient and competitive products.	2009	International Futures Project The Bioeconomy to 2030: Designing a Policy Agenda, Maine Findings and Policy Conclusions. OECD, 2009
The production and conversion of sustainable biomass, including organic waste, in the broad sense, into a variety of food, health, fibres and industrial products and energy	2011	EPSO (2011) The European Bioeconomy in 2030: Delivering Sustainable Growth by Addressing the Grand Societal Challenges. European Plant Science Organisation.
The concept of bioeconomy covers the agricultural industry and all manufacturing sectors and their respective service areas, which develop, produce, process, reprocess or use them in any form biological resources such as plants, animals and microorganisms.	2011	Federal Ministry of Education and Research (BMBF). National Research Strategy BioEconomy 2030 – Our Route towards a biobased economy.
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.	2012	Innovating for Sustainable Growth: A Bioeconomy for Europe. European Commission, 2012
The bioeconomy refers to an economy that relies on renewable natural resources to produce food, energy, products and services.	2014	The Finnish bioeconomy strategy.

Source: Author's contribution

Many countries have developed strategies and policies in the field of biotechnology or other bio-based products, but more and more countries are integrating all these sectors of the economy into a single strategy, an integrated strategy for bioeconomy development (Staffas, Gustavsson and McCormick, 2013). Such an approach may have important effects on the economy, society and the environment. A strategy in the field of bioeconomy shows a country's intentions to protect biodiversity, reduce climate change and increase the quality and quantity of agro-food products.

### 3. Research methodology

In drafting this paper, we consulted a rich literature, from which we selected the most interesting ideas and practices. We consulted some official documents published by the public authorities of Romania, other European countries or international organizations with concerns in the field. We conducted a systematic research to identify the most relevant information for Romania, an analysis based on comparative assessments, in order to identify the current state of bioeconomy in Romania and the possibilities to develop it.

### 4. Bioeconomy sector in Romania

Bioeconomy represents an important issue of this strategy that must enable the European Union to achieve growth: smart, through the development of knowledge and innovation; sustainable, based on a greener economy, more efficient in resource management and more competitive; favorable to inclusion, aiming at strengthening employment, social and territorial cohesion.

In Romania, the importance of bioeconomy is recognized in various structural strategies implemented so far at national level. The National Strategy for Research, Development and Innovation 2014–2020 establishes the bioeconomy as a national field of smart specialization. Bioeconomy is considered one of the "smart" areas of specialization for Romania. This field benefits from the huge potential of the Romanian agriculture, given the increasingly active local food industry with growing standards, successful applied research in this field and in the pharmaceutical industry, as well as the global trends such as the high food demand. Food safety and optimization, the development of horticulture, forestry, livestock breeding and fisheries or the capitalization of biomass and biofuels are subdomains with obvious potential.

Bioeconomy is one of the strategic priorities of the Strategy for Research, Development and Innovation in the agro-food field on medium and long term (2014 - 2020; 2020 - 2030). According to this document, the strategic objectives of bioeconomy aim at assessing the national bioeconomic potential to produce and capitalize non-food bio-resources, converting agricultural residues into biofuels, developing the knowledge base and introducing technical progress specific to the field, scientific support for policy decisions and implementing a strategy in the field of bioeconomy and long-term reduction of greenhouse gas emissions.

The National Strategy for Competitiveness 2015-2020 identifies 10 economic sectors with competitive potential that correlate with the areas of smart specialization stated by the National Strategy for Research, Development and Innovation 2014-2020. The document specifies the importance to converge the public and private policies and initiatives towards the development of these areas, because they may provide the best results. 5 of these 10 sectors identified as having competitive potential are part of the bioeconomy (agriculture, forestry, fisheries and aquaculture, biopharmaceuticals and biotechnologies) or are related to this sector (tourism and ecotourism, food and beverage processing, health and pharmaceuticals, energy and environmental management).

The Competitiveness Operational Program (COP) 2014-2020 includes bioeconomy among the supported areas of smart specialization. The subdomains to be supported are: the sustainable development of the agro-food sector, increasing its competitiveness and the quality of life; obtaining high-purity and low-cost medicinal substances to increase the accessibility of the population to medicines (innovative and generic); developing new methods, means and effective biotechnological products for diagnosis and therapy for human and veterinary medicine.

In Romania, the main sectors of the bioeconomy are represented by agriculture, food industry, beverages and tobacco products (especially food), textile industry (bio-textiles), wood industry, followed by other industries included in the bioeconomy. It is a situation similar to that recorded in Europe.

Structuring the bioeconomy by sectors and activities is a challenge for science and research, since the official statistics report only the traditional sectors, without distinguishing between the synthetic and the biological production. Therefore, the indicators of bioeconomy are estimated by combining multiple sources.

The latest statistics on bioeconomy were published by the European Commission in 2016. These were the result of an extensive study, in which the share of bio production was estimated by the specialists of Nova Institute of Technology by interviewing 15 experts from different European countries. Although at the time of the study, the specialists promised a periodicity in the appearance of statistical data on bioeconomy, it has not been achieved (Ronzon et al, 2017).

The number of employees in the bioeconomy sector decreased significantly between 2008 and 2015, mainly due to the significant decrease of the population employed in agriculture. The low incomes from agriculture have reduced the number of people employed in this sector, as part of the workforce migrated to other sectors in the country or to other countries in the European Union. The phenomenon of population aging also contributed to this phenomenon, as well as the tendency to concentrate the agricultural lands. In fact, this reduction of the population employed in agriculture is a normal phenomenon and it is expected to continue in the next period.

Reductions were also registered in other sectors of bioeconomy (food industry, textile industry). Only the pioneering sectors of bioeconomy recorded (insignificant) increases: biofuels and bioelectricity.

Table no. 2. The evolution of the number of employees in the bioeconomy sector, for the period 2008 - 2015

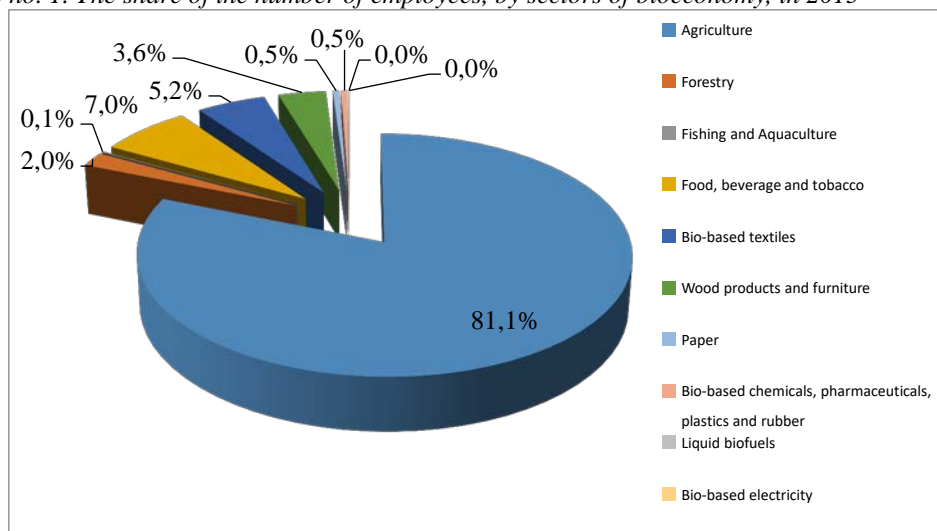
	2008	2009	2010	2011	2012	2013	2014	2015
TOTAL	3229433	3152176	3143144	2950960	3009571	2950486	2888087	2625538
Agriculture	2635700	2633300	2650700	2446800	2498100	2445100	2391600	2129600
Forestry	49100	53300	47900	46100	56600	53900	47300	51600
Fishing and Aquaculture	3544	2958	4377	3123	3439	2655	2872	2894
Food, beverage and tobacco	208537	194755	187837	189400	187037	186059	183099	182514
Bio-based textiles	182378	145151	136046	144024	141512	139748	142353	136888
Wood products and furniture	124102	97496	91292	95059	95602	95782	93405	94071
Paper	12954	12954	12123	11826	12455	12489	12738	13126
Bio-based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels)	12188	11003	11411	12921	13436	13375	13055	13255
Liquid biofuels	920	1254	1402	1611	1268	1215	1370	1309
Bio-based electricity	10	6	56	96	122	162	294	280

Source: <https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html>

According to the European Commission, in 2015, the last year with available data by activity sectors, 81.1% of the labor force employed in the bioeconomy worked in agriculture, this percentage corresponding to a number of 2,129,600 employees. The remaining almost 19% of employees worked in the food, beverage and tobacco industry (182,514 people, respectively 7.0%), textiles (136,888 people, respectively 5.2%), etc. The last two positions were occupied by two of the sectors considered a priority at the European level, namely biofuels and bioelectricity, with 1,309 and respectively 280 employees.

Between 2008 and 2015, there were no significant increases in employment in any of the sectors of the bioeconomy, only in the forestry, paper and biochemical, biopharmaceutical and bioplastics sectors, employment remained relatively constant. Instead, there were significant reductions in the following sectors: agriculture (506,100 people, respectively 19.2%), wood and furniture products (30,031 people, 24.19%) and food, beverages and tobacco (26,023 people, 12.5%).

Figure no. 1. The share of the number of employees, by sectors of bioeconomy, in 2015



Source: <https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html>

The turnover of the Romanian bioeconomy remained relatively constant in the period 2008-2015, though registering slight fluctuations. The economic crisis of 2009 also had a negative impact on the bioeconomy, the sector recording its lowest value (29,211 million Euros, compared to 37,197 million Euros in the previous year, the decrease being about 21%). There have been declines in other years as well, but those could not be attributed to an economic crisis, but to some conjectural factors, such as the falling prices of some products on the world market (agricultural products, for example).

Table no. 3. The evolution of turnover in the bioeconomy sector, for the period 2008 - 2015

	2008	2009	2010	2011	2012	2013	2014	2015
TOTAL	37197	29211	31787	36625	33329	37303	36832	36972
Agriculture	16683	12658	13960	16670	13001	16092	15007	13822
Forestry	760	656	898	1294	1355	1523	1753	1930
Fishing and Aquaculture	15	14	32	18	19	22	22	23
Food, beverage and tobacco	12382	10088	10246	11022	11203	11415	11345	12257
Bio-based textiles	2416	1822	1981	2274	2175	2245	2500	2447
Wood products and furniture	3449	2667	3052	3455	3656	3974	4071	4213
Paper	708	579	671	754	762	822	879	967
Bio-based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels)	722	635	823	982	1028	1086	1079	1147
Liquid biofuels	62	91	119	147	119	111	154	141
Bio-based electricity	1	0	5	10	11	13	23	25

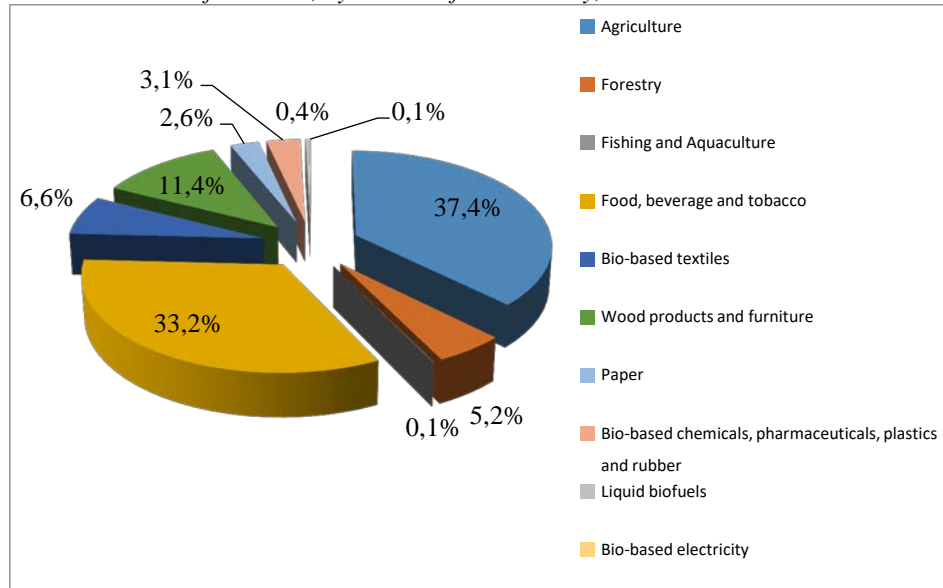
Source: <https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html>

Even if the sector recovered since 2011, the annual growth rate of turnover was low. Romania's contribution to the total turnover of the EU bioeconomy was low due to the high share of agriculture in the total bioeconomy sector (low value-added activity).

The analysis of the turnover of the Romanian bioeconomy by activity sectors indicates a much lower contribution of agriculture (37.4%), compared to the contribution of this sector to the employment in the bioeconomy sector (81%). Important contributions also had food, beverages and tobacco (33.2%) and wood and furniture products (11.4%). The situation in Romania, where agriculture has the largest share, is different from that existing in the European Union, where, in terms of turnover, agriculture (17%) is ahead of food, beverages and tobacco (50%) (Ronzon et al., 2017).

Obviously, the new sectors had the lowest contributions to the turnover of the bioeconomy sector: biofuels and bioelectricity (less than 0.1% each).

Figure no. 2. The share of turnover, by sectors of bioeconomy, in 2015



Source: <https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html>

Agriculture is the main employer of the labor force, Romania being the European state with the largest number of people employed in this field, but with a much lower added value than other European countries having much smaller agricultural areas. Due to the high share of agriculture in GDP, Romania's economic growth depends on the performance of this sector. That is why rapid action is needed to make the agricultural producers, the agricultural sector as a whole, more competitive on the European and global markets.

## 5. Conclusions

Bioeconomic concerns in the European Union date back decades. Starting from the strategies, projects and programs developed by the European institutions, several initiatives have emerged to support the bioeconomy. We can mention the proposals to adopt regional strategies or ways to combine the various existing funding programs, in order to support the bioeconomy sector. However, in order to implement a coherent policy in the field of bioeconomy at European level, it is necessary to make compatible the different policies that directly or indirectly target sectors of the bioeconomy.

Romania has a high potential to develop an economy based on bio-products, because it is a country endowed with various natural resources. Unlike the developed countries in Western Europe, in Romania, the bioeconomy is used mainly in primary sectors, such as agriculture, forestry and fishing. Even these sectors have significant potential to promote a sustainable growth through the transfer of knowledge and technology. Bioeconomy may increase employment and develop the private sector, especially the small and medium-sized enterprises. Bioeconomy may also contribute to the development of the less developed regions, especially the rural areas, reducing the economic gaps between different areas and regions of Romania.

To develop bioeconomy, Romania must maximize its potential by creating an appropriate strategy and action plan to ensure increased investment in research and development of organic production.

There are Member States of the European Union that have developed national strategies; the same should be done in Romania, in order to achieve a coherent vision, appropriate policies and appropriate financial instruments. The European Union is already funding research, demonstration and implementation of some sustainable solutions in the field of bioeconomy, including a funding of 3.85 billion Euros allocated for the current European program Horizon 2020, and 10 billion Euros for the program Horizon Europe 2021-2027.

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