

УДК 338.43:57:339.923:061.1ЄС

## THE STATE OF DEVELOPMENT OF BIOECONOMY IN THE AGRICULTURE INDUSTRY IN THE EU

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The European Commission has embarked on the development of a competitive, resource efficient and low carbon economy. In the article defined the term «bioeconomy» in the European Commission's. Also investigated the contribution of the bio-based economy in the EU in 2012. Presents the turnover of the bioeconomy in the EU in 2013. Shows the distribution of total employment in the EU in the bioeconomy. Prospects for future research is to identify ways to address the key issues for the development of the bioeconomy in the EU.

**Keywords:** bioeconomy, agriculture, bioenergy, biomass, the European Union.

**Problem formulation.** Since the industrial revolution, economic growth has been synonymous with increasing energy use, ever-greater reliance on fossil fuels and accelerating damage to the environment. The more we have produced, the more we have exploited our planet and depleted its resources. We may not yet have broken this cycle, but we are rapidly becoming aware that oil is a resource which is finite and that price will rise over time owing to supply and demand dynamics, especially from developing countries. The need to cut CO<sub>2</sub> emissions to fight climate change has made the transition from fossil fuels a priority for everyone, industry, decision-makers and consumers alike. Together with renewable power generation techniques like wind and solar, rapidly developing industrial biotechnology has the potential to be a key tool for the low-carbon emission economy. Because biotechnology is based on renewable resources and bioprocesses are often more efficient, it can lead to significantly reduced carbon emissions. In addition, more efficient agricultural practices have led to increased crop yields, stimulating rural development and creating opportunities to develop alternative economies such as the bio-based economy [1].

**Analysis of the researches and publications.** Among the research and publications in the field of bioeconomy development I have to provide works of Nicholas Georgescu-Roegen, Maire Geoghegan-Quinn, Juan Enriquez, Rodrigo Martinez, Christian Patermann.

**Unresolved parts of the general problem.** Unprecedented and unsustainable exploitation of natural resources, potentially irreversible changes in the global climate and the lack of ability to stop the loss of biodiversity form a serious threat to the biological basis of the European society. Over the next decades, the global population is expected to increase to exceed 9 billion in 2050. These complex and inter-connected challenges will need to be addressed by an integrated and effective policy combined by an extended programme for scientific research and innovation in order to facilitate sustained changes in lifestyle and resource use across all levels of the economy.

In order to be able to cope with increasing global population, (over)exploitation of natural resources, increasing environmental pressure and climate change, Europe has to change the way it is organising the production, consumption, processing and recovering of its biological feedstocks. The bio-

economy has been proposed as a key element of a smart and green development path. Advancements in bioeconomy research and innovation uptake will facilitate the improved management of biological resources and the opening and development of diverse food and biobased markets [6].

The vision of a society that is far less dependent on fossil fuels for energy and industrial raw materials is closer than ever to becoming a reality in Europe. The application of biotechnology for the sustainable processing and production of chemicals, materials and fuels from biomass creates an opportunity to reduce significantly our dependence on coal, oil and gas. That vision and that opportunity have a name: the bio-based economy.

With its new Europe 2020 strategy, the EU has created a framework through which to achieve an ambitious series of goals – economic, social and environmental – by the end of this decade. The growth of bio-based products opens up diverse pathways towards the achievement of these goals.

Greater use of renewable and expandable resources offers increased potential for cutting greenhouse gas emissions. Production processes that use less water and energy and generate less waste can make industry both more sustainable and more competitive. And the creation of new non-food markets for crops, together with the emergence of alternative income sources for farmers, can give depressed rural areas a new lease of life [1].

**Setting tasks.** The aim of the study if to analyze the state of development of bioeconomy in the agriculture industry in the EU.

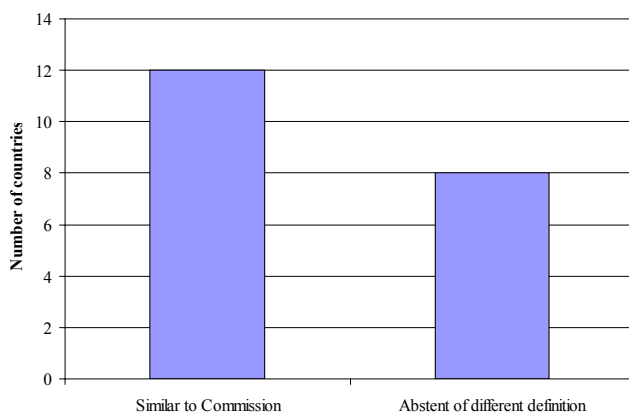
**Statement of the main material of the study.** Europe, in common with the rest of the world, faces a number of major environmental, economic and social challenges which have to be properly addressed if future generations are to enjoy a safe, healthy and prosperous future. The solutions we arrive at will change the way we live and work and – if we make the right choices – these changes will generally be for the better. The transition from a dependence on fossil fuels to a situation where agriculture not only will continue to provide food security but also biomass as a renewable raw material for industry will be the basis of the coming integrated bioeconomy [7].

Bioeconomy is Europe's response to key environmental challenges the world is facing already today. It is meant to reduce the dependence on natural resources, transform manufacturing, promote sustainable production of renewable resource-

es from land, fisheries and aquaculture and their conversion into food, feed, fibre, bio-based products and bio-energy, while growing new jobs and industries [8].

Bioeconomy has been defined in the European Commission's as: «The bioeconomy encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. It includes agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries. 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].

Twelve countries (60%) use a definition for the Bioeconomy that is more or less similar to the definition used by the European Commission (Figure 1). Among the ten Member States (63%) have a similar definition to the one used by the Commission. Most of the other countries do not use a definition [6].



**Figure 1. Bioeconomy definition resemblance with the Commission's definition**

Source: [6]

Europe has a number of well-established traditional bio-based industries, ranging from agriculture, food, feed, fibre, forest-based industries, including pulp and paper and wood products, to the biotechnology, chemical, biofuels and bioenergy industries [2]. Based on 2012 data, the bio-based economy turn over at about EUR 2.4 billion, including agriculture, food and beverage, agroindustrial products, fisheries and aquaculture, forestry, wood-based industry, biochemical, enzymes, biopharmaceutical, biofuels and bioenergy, with almost 22 million persons employed (Table 1).

Agriculture covered 174.1 million hectares of land or 40% of the total land area of the EU in 2012. Of this, about 103.9 million ha are arable land, 59.1 million ha are permanent grassland and meadow and 10.7 million ha permanent crops. The output value of the EU's agricultural industry at producer prices, comprising the output values of crops and animals, agricultural services and the goods and services produced from non-agricultural secondary activities was estimated to EUR 404 billion in 2012 (Table 2) [3].

Table 1

**The contribution of the bio-based economy in the European Union in 2012**

Sector	Annual turnover (EUR billion)	Value added (EUR billion)	Employment (1000 s)
Agriculture	404	157	10200
Food and beverage	1040	207	468
Agro-industrial products	231	62	2092
Fisheries and aquaculture	36,6	9,7	199
Forestry logging	42	22	636
Wood-based industry	473	136	3452
Bio-chemicals	50		120
Bioplastics	0,4	1,4	
Biolubricants	0,4	0,6	
Biosolvents	0,4	0,4	
Biosurfactants	0,7	0,9	
Enzymes	1,2		
Biopharmaceuticals	30	50	142
Biofuels	16		132
Bioenergy	34		350
<b>Total</b>	<b>2357</b>		<b>21790</b>

Source: [3]

Table 2

**Main indicators for agricultural industries in the European Union in 2012**

	Turnover (EUR billion)	Value added at factor cost (EUR billion)	Number of enterprises (1000 s)	Number of persons employed (1000 s)
<b>Agriculture</b>	<b>404</b>	<b>157</b>	<b>12200</b>	<b>10200</b>
Food products	890	169	262	4,091
Vegetable and animal oils and fats	51	4	8	59
Starch and starch products	10	2	0	16
Sugar	13	4	0	21
Beverages	150	38	24	377
<b>Food and beverage</b>	<b>1040</b>	<b>207</b>	<b>286</b>	<b>4468</b>
Tobacco products	30	7	0	33
Textiles	80	22	60	621
Wearing apparel	73	21	126	1015
Leather and related products	47	12	36	422
<b>Industrial products</b>	<b>231</b>	<b>62</b>	<b>223</b>	<b>2092</b>
<b>Agricultural industry</b>	<b>1675</b>	<b>426</b>	<b>12709</b>	<b>16759</b>

Source: [3]

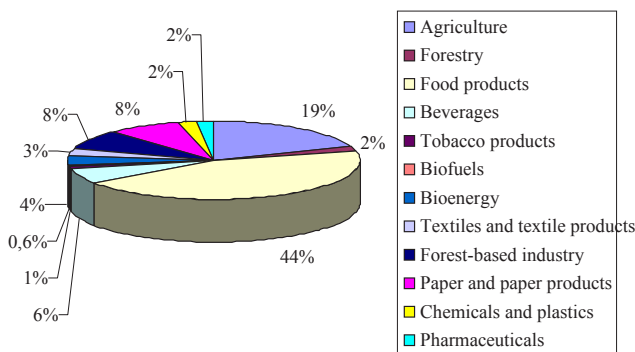
Gross value added at producer prices of the EU-28's agricultural industry in 2012 was an estimated EUR 156.5 billion. There were 12.2 million farms across the EU in 2010. The agricultural labour input in the EU-27 in 2012 was estimated at 10.2 million annual working units (equivalent to one person working full time for a whole year) [4].

With a turnover of EUR 1040 billion, a value added of EUR 207 billion and 4.5 million people employed in almost 286000 companies, the food and

beverage industry is one of the largest and the most important manufacturing sectors in the EU [3].

There is a wide range of food and beverage products that are made available for human consumption and animal feed, as well as a range of inputs for non-food processes. The industrial products derived from agriculture worth additional EUR 231 billion and a number of 2.1 million persons employed in the EU in 2012 [5].

The analysis of the Eurostat data of 2013 shows (Figure 2) that the turnover of the total bioeconomy (including food and beverages and the primary sectors agriculture and forestry) in the EU-28 results in 2.1 trillion EUR. Roughly half of this is accounted for by the food and beverages sector, almost a quarter of the turnover is created by the primary sectors (agriculture and forestry), while the other quarter is created by the so-called bio-based industries (such as chemicals and plastics, pharmaceuticals, paper and paper products, forest-based industries, textile sector, biofuels and bioenergy) [9].



**Figure 2. Turnover in the EU bioeconomy (EU-28, 2013)**

Source: [9]

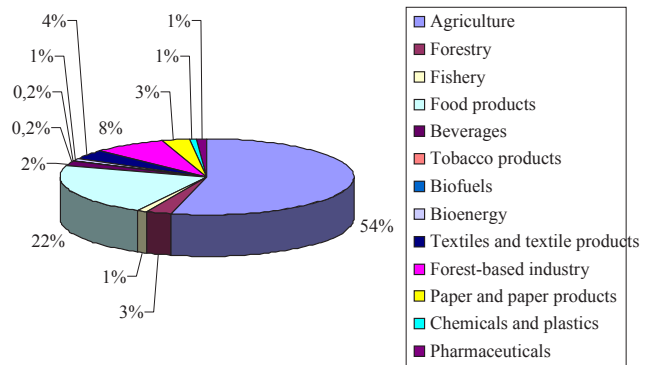
The agricultural and the «food, beverage and tobacco» sectors are leading the European bioeconomy in terms of turnover and employment, followed by the wood and paper industry. Slightly more than a half of the European bioeconomy turnover comes from the «food, beverage and tobacco» sector, 19% comes from agriculture, followed by the «manufacturing of wood and wood furniture» and the «manufacturing of paper» with 9% and 8% respectively [10].

The figure 3 shows the distribution of total employment in the EU bioeconomy for the same sectors as depicted in the figure 2 for total turnover. The comparison of both charts shows clearly that the primary biomass production, mainly agriculture, generates a lot of employment but low turnover.

A bioeconomy dominated by agricultural employment in Romania, Greece, Poland, Slovenia, Ireland, Portugal and Croatia, agriculture employs more than 60% of the total people employed in the bioeconomy [10].

Europe is confronted with an unprecedented and unsustainable exploitation of its natural resources, significant and potentially irreversible

changes to its climate and a continued loss in biodiversity that threaten the stability of the living systems on which it depends. Overcoming these complex and inter-connected challenges requires research and innovation in order to achieve rapid, concerted and sustained changes in lifestyle and resource use that cut across all levels of society and the economy. The welfare and well-being of Europe's citizens and that of future generations will depend on how the required transformations will be made.



**Figure 3. Employment in the EU bioeconomy (EU-28, 2013)**

Source: [9]

The bioeconomy provides a useful basis for such an approach, as it 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. Its sectors and industries have strong innovation potential due to their use of a wide range of sciences, enabling and industrial technologies, along with local and tacit knowledge [2].

**Conclusions and proposals.** The analysis of 2013 shows that the turnover of the total bioeconomy, including food and beverages and the primary sectors agriculture and forestry, results in 2.1 trillion EUR in the EU-28. Roughly half of the turnover is accounted for by the food and beverages sector, almost a quarter is created by the primary sectors, agriculture and forestry. The other quarter is created by the so-called bio-based industries, such as chemicals and plastics, pharmaceuticals, paper and paper products, forest-based industries, textile sector, biofuels and bioenergy.

The bioeconomy employs 18.3 million people in total. The primary biomass production, mainly agriculture plus forestry and fishery, generates a lot of employment (58%) but low turnover (21%).

In order to cope with an increasing global population, rapid depletion of many resources, increasing environmental pressures and climate change, Europe needs to radically change its approach to production, consumption, processing, storage, recycling and disposal of biological resources.

Bioeconomy serves as a tool for agriculture development, rural development, energy independence, climate mitigation, regional specialisation, knowledge transfer from science to practice, innovation progress.

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**СТАН РОЗВИТКУ БІОЕКОНОМІКИ  
У ГАЛУЗІ СІЛЬСЬКОГО ГОСПОДАРСТВА В ЄС****Анотація**

Європейська комісія стала на шлях розвитку конкурентоспроможної, ресурсозберігаючої та низьковуглецевої економіки. У статті визначено термін «біоекономіка» в Європейській Комісії. Також досліджений внесок біозаснованої економіки в ЄС в 2012 році. Представлений оборот біоекономіки в ЄС у 2013 році. Перспективами подальших досліджень є визначення шляхів вирішення ключових проблем для забезпечення розвитку біоекономіки в ЄС.

**Ключові слова:** біоекономіка, сільське господарство, біоенергетика, біомаса, Європейський Союз.

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**СОСТОЯНИЕ РАЗВИТИЯ БИОЭКОНОМИКИ  
В ОТРАСЛИ СЕЛЬСЬКОГО ХОЗЯЙСТВА В ЕС****Аннотация**

Европейская комиссия стала на путь развития конкурентоспособной, ресурсосберегающей и низкоуглеродной экономики. В статье определен термин «биоэкономика» в Европейской Комиссии. Также исследованный вклад биосозданной экономики в ЕС в 2012 году. Представлен оборот биоэкономики в ЕС в 2013 году. Показано распределение общей численности занятых в ЕС в биоэкономике. Перспективами дальнейших исследований является определение путей решения ключевых проблем для обеспечения развития биоэкономики в ЕС.

**Ключевые слова:** биоэкономика, сельское хозяйство, биоэнергетика, биомасса, Европейский Союз.