Bio-based Industries Consortium

Mapping Romania's bio-based potential

Country Report

CONTENTS

EXECUTIVE SUMMARY

Romania has the industrial actors, the academic support, and the feedstock available to expand its bio-based industrial activities on a regional and national basis. Encompassing diverse landscapes including the forested Carpathian Mountains, gentle hills and lowlands, Romania offers a wealth of biodiversity. Romania has one of the largest agricultural sectors in Europe. It also has significant industrial activities for food and beverages, food processing and wood processing.

The presence and activities of these sectors, a strong chemical industry, broad and expanding academic and research support in bioeconomy fields put Romania in an excellent position to rapidly increase bio-based industrial operations.

The primary sectors and downstream processing sectors have substantial side streams, residual streams and waste that could serve as feedstock for local bio-based operations. Since precise and up-to-date information on these streams is not available across all sectors, neither so on the organic fraction of municipal solid waste, this report contains some initial estimates thereof to show the potential for bio-based industrial activities in the country.

The bioeconomy sector in Romania has been increasing during the last few years, from a turnover of €36.6 billion in 2017 to €43.7 billion in 2019, but stagnated in 2020 at €41.2 billion mainly because of drought. In terms of turnover per employment in the bio-based economy (excluding agriculture, forestry, fisheries, food, beverages, and tobacco), Romania performs with about 35 thousand € per FTE, implying a large share of production of primary biomass.

Romania is an emerging innovator on the European innovation scoreboard 2023, with a performance of 33,1% of the EU average. This performance is below the average of the emerging innovators (54%) and has been growing at a rate lower than that of the EU. However, with its relative strengths among others in broadband penetration, medium- and high-tech goods exports, knowledge-intensive services exports, and most cited publications, it has shown strong increases in these sectors and in innovation expenditures per employee. In its new *National Strategy for Research, Innovation and Smart Specialisation*, Romania details steps to advance the country from emerging innovator to moderate innovator by 2030.

Romania's Smart Specialisation Strategy includes priorities that are highly relevant for the bioeconomy, such as safe, accessible, nutritionally optimised food; sustainable development in forestry, fishing and aquaculture; new products, practices, processes and technologies in horticulture; sustainable development of fields crops; and relevant key enabling technologies.

The country's Rural Development Programme supports investments in modernisation of farms and cooperatives, and in expanding the infrastructure for forestry.

This document is part of the 'strategic outreach programme' of the Bio-based Industries Consortium (BIC). The objective of the programme is to identify opportunities for bio-based industrial activities in European countries where these activities are relatively low. Bio-based activities heavily depend on innovation, and hence are relatively low in 'moderate/emerging innovators' countries.

This may be the result of insufficient knowledge of the potential for the bio-based industry in these countries, by actors in bio-based activities in these countries as well as by BIC. Additionally, actors in these countries may not be fully aware of the opportunities offered by BIC and the Joint Undertaking it has with the European Union.

This report does not pretend to be complete. Nor may it be based on the most recent statistical data. The report is an update of a first draft published in 2018 that has been prepared by collecting and analysing available data by BIC.

The report is mainly feedstock-driven, to use relevant available feedstock for higher values than currently is the case. We've had significant assistance from contacts in industry, academia and government in collecting and reviewing data used in this report.

1. CURRENT BASIS OF ECONOMIC ACTIVITIES

To establish or expand industrial bio-based activities in any country, its economic strength is of crucial importance. From a bio-based perspective, the presence and strength of the primary sectors, the conversion industries, the market demand of sustainable products and services, combined with the academic and innovation power and supportive legislation, are key elements to accelerate developments towards a full-fledged bioeconomy.

Bio-based activities in Romania have been relatively low compared with other EU members in Northwest Europe. Also, the number of industrial and academic actors from Romania in projects on a European level has been relatively low. The national bio-based activity level corresponds with the innovation performance as defined and monitored by the European Commission.

Romania is a modest innovator with a performance that, since 2016 had an initial increase, dropped in 2019, and then increased strongly between 2020 and 2022, after which performance declined.

Figure 1. Gross Value Added of bio-based primary sector (current prices, M€, Eurostat, National accounts aggregates by industry, 2022 provisional)

Crop and animal production, hunting and related service activities

11.383,8

Forestry and logging

1.043,2

Fishing and aquaculture

356,3

The innovation dimensions that have shown the largest performance increase since the base year 2016 are 'broadband penetration' in the section *Digitalisation*, 'most cited publications' in the section *Attractive research systems*, and 'public-private co-publications' in the section *Linkages*. Romania's broadband penetration is the only dimension with a performance above 125% of the performance of the EU in 2023.

The relative weaknesses in innovation performance are 'population with tertiary education', 'business process innovators', 'innovative SMEs collaborating with others', 'job-to-job mobility of HRST', and 'employment in innovative enterprises'. However, Romania has published a new national strategy for research, innovation and smart specialisation to improve scores in all these dimensions and advance the country from emerging to moderate innovators group.

Romania has one of the largest agricultural sectors in Europe and a strong chemical industry. These two factors, combined, put the country in an excellent position to expand its bio-based industrial activities.

The notion of bioeconomy as a multi-sectoral discipline is just surfacing in Romania and the massive amount of biomass available that could be used for industrial bio-based activities is un- or under-exploited. However, relevant bioeconomy themes are included in the in the country's Smart Specialisation Strategy.

The agricultural landscape is in rapid evolution after the government enforced liberalisation of land purchase by foreign entities in 2014. This opened the market to a massive influx of foreign capital, but also caused social concerns in rural areas because of the predominantly export-oriented production set up by some of the new actors.

The forest sector, on the other hand, is still largely controlled by the state. The sector suffers from a low productivity level, because of insufficient infrastructure and difficulty in accessing remote forest areas.

The figures below show the relative importance of bio-based sectors in terms of Gross Value Added (GVA).

For sectors such as textiles and leather, chemicals, pharmaceutical and furniture it is not possible to distinguish between the bio-based and non-bio-based contributions. They are therefore shown in Figure 3. as 'partially bio-based'.

Figure 2. Gross Value Added of bio-based manufacturing sector (current prices, M€, Eurostat, National accounts aggregates by industry, 2022 provisional)

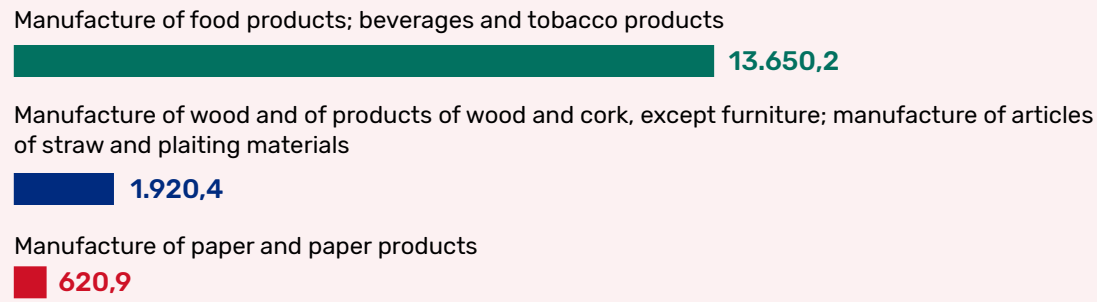


Figure 3. Gross Value Added of partially bio-based manufacturing sector (current prices, M€), (Source: Eurostat, National accounts aggregates by industry, 2022 provisional)

1.1. Agriculture

Of Romania's total area of 238,000 km2, 87% is rural, broken down to 57% agricultural land and 30% forestland. The share of agriculture in the Romanian economy of 6.6% of GVA is one of the highest in the EU (EU average is 1.7%).

87%

of Romania's total area is rural

6.6%

Share of agriculture in the Romanian economy of GVA - one of the highest in the EU.

Approximately one-third of all farms in the EU are found in Romania, with some 3.9 million farm holdings. Increasing competitiveness of the sector and accompanying the restructuring process are key challenges.

Farming structures are highly polarised. Large and medium-sized farms, account for around 7% of holdings, but manage some 70% of agricultural area, and have a clear competitive potential. On the other hand, 93% of the holdings are less than 5 ha - these are typically subsistence and semi-subsistence holdings, which manage the other 30% of the agricultural area.

The average farm size is considerably smaller than the EU average (3.4 ha in RO compared to an EU average of 14.4 ha). Average productivity is low, currently 30% of EU average levels, despite Romania's potential in the sector. The subsistence and semi-subsistence farms are poorly technically equipped and lack market orientation or involvement in cooperative activities, which could assist them to better integrate in markets. Access to credit and farm insurance is difficult for the sector overall, particularly for small farmers.

Agriculture provides about 30% of total employment in Romania, compared to the EU Member States' average of 4%. A further 2% are employed in the food industry. Only 7% of farmers are young farmers.

There is a strong need for upgrading professional skills in agriculture, while at the same time promoting economic diversification in rural areas (only 18% of the non-agricultural SMEs in Romania are in rural areas) to provide new jobs, reduce over-dependence on agriculture, and to increase rural incomes. Basic infrastructure and access to services in the rural areas are of poor quality and insufficiently developed. 40% of the rural population is at risk of poverty and social exclusion.

However, among the opportunities and potential of the Romanian rural areas are the recent trend in agricultural export growth; high quality of agricultural land conducive to increasing agricultural production; rich cultural herit-age; and biodiversity, closely associated with the use of traditional extensive land management practices.

In recent years, Romanian farmers have consistently sought to maximise production efficiencies and, therefore, have become increasingly open to smart agriculture. Land conservation practices, chemical mapping, and

variable densities based on soil structure and nutrient levels are being increasingly adopted by Romanian farmers.

The severe drought in 2020 highlighted the need to improve the irrigation infrastructure. Some of the old and non-functioning pumping stations have been refurbished. Farmers close enough to water supplies accessed EU financing to set up irrigation systems. However, for many farmers, access to irrigation can only come from large-scale irrigation infrastructure, including large canals and pumping stations. This level of large-scale irrigation is still not available widely.

Romania accounts for 10% of EU grain and oilseed production. Corn remains Romania's top grain crop in terms of both area and production, followed by wheat and barley. Romania is Europe's largest sunflower producer, as well as a top three producer of corn, wheat and soybeans. In 2022, grain and oilseed production is forecast to return to normal levels after a historically high level of production in the previous year. The reduced grain production is expected to result in a 22% reduction in exports. On average, about half of the harvest is exported.

Figure 5 shows the trend of the two major components of the agricultural output in 2018-2022. It shows the impact of the severe drought in 2020 (also the first year of the COVID-19 pandemic) on the crop output. See also Table 1.

Figure 4. The Romanian agriculture output in 2022 ranks the country in seventh position in EU27: (Production value at basic price; € million)

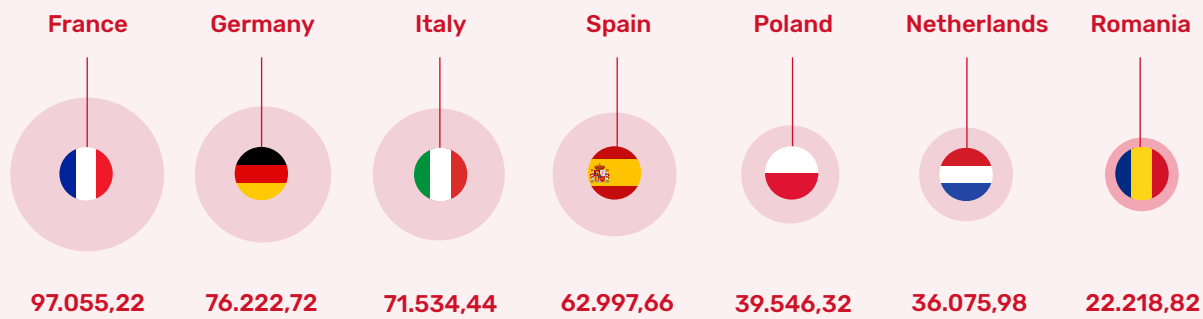


Figure 5. Agricultural Production trend (Production value at basic price, M€) (Eurostat, Economic accounts for agriculture)

Impacts of war in Ukraine

Farmers in countries neighbouring Ukraine, including grain-producing Romania, need help to compete with the proliferation of cheap grain from the war-torn state.

Ukraine, a major global grain producer and exporter, received EU aid after the outbreak of Russia's war and created solidarity corridors so the country could continue its grain exports.

Besides the solidarity corridors, the suspension of customs duties and dropping the requirement of sanitary and veterinary certificates have made it easier for the product to penetrate the markets of its neighbouring countries at low prices.

As a result, Romania imported an unprecedented 13.9% of $1.24 billion worth of Ukrainian grain, way ahead of any other country globally. But for the country's grain farmers, this creates a troubling situation.

Many Romanian farmers have seen their products languishing in warehouses for over a year as they cannot compete with the low prices of Ukrainian grain. In addition, transporting grain for the external market is also almost impossible because all the logistical capacity is concentrated on Ukrainian cargo, including at the Port of Constanţa, which is blocked by Ukrainian ships.

1.1.1. Crop production

The impacts of the drought and the war in Ukraine on the crop production are visible in Table 1, especially in the harvested production of cereals. While the cultivated/harvested/production area has remained practically constant throughout the period (around 5,300 thousand ha), the cereals production dropped significantly in 2020, and again in 2022.

Table 1. Harvested production in EU standard humidity (2017-2022, Eurostat)

	Thousand tonnes per year					
	2017	2018	2019	2020	2021	2022
Cereals for the production of grain (including seed)	27.138,88	31.553,28	30.412,43	18.153,71	27.791,26	19.183,59
Dry pulses and protein crops for the production of grain (including seed and mixtures of cereals and pulses)	301,68	191,48	236,42	121,98	173,95	122,30
Fresh vegetables (including melons)	2.471,26	2.614,96	2.383,53	2.303,25	2.323,37	1.340,49
Permanent crops for human consumption	2.064,79	2.894,92	2.406,31	2.468,64	2.658,66	2.169,10

1.1.1.1 Cereals

Romania is Europe's largest sunflower producer as well as a top three producer of corn, wheat, and soybeans. Romania accounts for 10% of EU grain and oilseed production. Corn remains Romania's top grain crop in terms of both area and production, followed by wheat and barley.

For the first time since 2007, 2022 saw corn production fall behind wheat production.This was a result of the drought that reduced the harvest by 40-50% compared to previous years.

Table 2. Production of cereals by area and tonnage (2022, Eurostat)

Crops	Area (cultivation/harvested/ production) (thousand ha)	Harvested production in EU standard humidity (thousand tonnes)
Common winter wheat and spelt	**2.172,10**	**9.096,57**
Common spring wheat and spelt	15,98	52,11
Durum wheat	10,30	30,11
Rye and winter cereal mixtures (maslin)	11,17	28,77
Winter barley	**418,94**	**1.854,56**
Spring barley	53,74	152,10
Oats	79,88	180,61
Grain maize and corn-cob-mix	**2.483,65**	**7.486,38**
Triticale	65,51	264,08
Sorghum	8,19	13,12
Other cereals n.e.c.* (buckwheat, millet, canary seed, etc.)	4,76	8,47
Rice	3,68	16,52

* n.e.c.: not elsewhere classified

1.1.1.2 Oilseeds

Oilseeds account for over 42% of the overall industrial crops production. Oilseeds production is followed by sunflower, rape and turnip.

Table 3. Production of oilseeds by area and tonnage (2022, Eurostat)

Crops	Area (cultivation/harvested/ production) (thousand ha)	Harvested production in EU standard humidity (thousand tonnes)
Oilseeds	1.686,51	9.096,57
Rape and turnip rape seeds	460,80	1.222,64
Winter rape and turnip rape seeds	451,72	1.192,19
Spring rape and turnip rape seeds	15,08	30,45
Sunflower seed	1.081,79	2.079,01
Soya	134,40	255,75
Linseed (oilflax)	2,01	2,90
Other oilseed crops (n.e.c.)*	1,50	1,56

* n.e.c.: not elsewhere classified

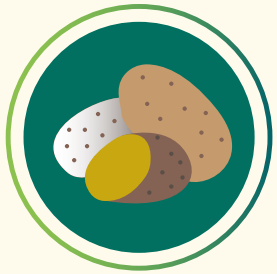
1.1.1.3 Fodder crops

Green maize and leguminous plants harvested green are the most relevant green crops harvested.

Table 4. Production of fodder crops by area and tonnage (2022, Eurostat)

Crops	Area (cultivation/harvested/ production) (thousand ha)	Harvested production in EU standard humidity (thousand tonnes)
Temporary grasses and grazings	30,51	48,74
Leguminous plants harvested green	640,17	1.992,97
Green maize	44,53	899,91

1.1.1.4 Potatoes



While the production of potatoes reached 3.1 million tonnes in 2017, it has been dropping since, falling to 1.2 million tonnes in 2022.

The yield had been fluctuating over the past years and failed to regain momentum. Despite the increased use of modern agricultural techniques and methods, the yield figures continued to be impacted by adverse weather conditions.

1.1.1.5 Permanent crops

Regarding the area to produce permanent crops, Romania ranks fourth in the EU after Italy, Greece and France. However, the area is relatively small compared with the leaders (approx. 2.5 million ha, 1.2 million ha and 0.9 million ha respectively), but significantly larger than in other EU countries. Fruits and grapes are the most produced permanent crops in Romania.

Table 5. Production from permanent crops by area and tonnage (2022, Eurostat)

Crops	Area (cultivation/harvested/ production) (thousand ha)	Harvested production in EU standard humidity (thousand tonnes)
Fruits, berries and nuts (excluding citrus fruits, grapes and strawberries)	137,72	1.360,34
Grapes	161,58	808,76
Cultivated mushrooms	0,01	14,73
Strawberries	2,59	17,18

1.1.1.6 Fresh vegetables

The Romanian diet is mainly based on meat: a Eurostat survey found that 65% of Romanians do not consume any fruit or vegetables daily. Romanians who do consume fruit daily, prefer apples, melons and exotic fruit. And for vegetables they eat potatoes, cabbage and tomatoes most.

Romania is the European country with the highest number of vegetables holdings (22% of the total), but more than 80% of fruit and vegetables producers are located in holdings sized less than 5 ha.

Only around 40% of acreage is exploited in farms bigger than 5 ha for fruit production, while the percentage is 50% for vegetables. The total area devoted to vegetables growing represents 7.1% of the European total and to fruit 4.5%.

In addition to the small size and fragmentation of estates, low productivity represents a problem of the Romanian fruit and vegetables segment. Examples are productivity rates for apples and tomatoes: while Romania hosts 9.5% of the area dedicated to tomatoes in Europe, it produces just 2.6% of the total tomatoes; while it hosts 10.2% of the area dedicated to apples, production is just 3.6% of the total.

Table 6. Production of fresh vegetables (including melons) by area and tonnage (2022, Eurostat)

Crops	Area (cultivation/harvested/ production) (thousand ha)	Harvested production in EU standard humidity (thousand tonnes)
Brassicas	17,93	343,33
Leafy and stalked vegetables (excluding brassicas)	0,19	2,75
Vegetables cultivated for fruit (including melons)	44,05	726,43
Root, tuber and bulb vegetables	27,43	255,01
Fresh pulses	3,51	12,97

Table 7. Production of major fruits by area and tonnage (2022, Eurostat)

Crops	Area (cultivation/ harvested/production) (thousand ha)	Harvested production in EU standard humidity (thousand tonnes)
Apples	53,42	9.096,57
Pears	3,21	1.222,64
Other pom fruits n.e.c*	1,26	1.192,19
Peaches and nectarines	1,28	30,45
Apricots	1,96	2.079,01
Cherries	5,88	255,75
Plums	65,97	2,90
Berries (excluding strawberries)	1,63	1,56
Nuts	3,11	2,90
Grapes	1,50	1,56
Stawberries	1,50	1,56

* n.e.c.: not elsewhere classified

Main players

- Romania is one of the top producers of oil crops in Europe. The sector is dominated by foreign players **Bunge** and **Cargill**.
- **InterAgro**, once the largest agricultural group in the country, declared insolvency in 2016 after legal issues. The agricultural branch of the group continues its activities but at a much lower scale.
- Agro-Chirnogi, belonging to the Lebanese holding Maria Group (which also owns a large livestock business in the country), is the main player on the grain producers' market. The company has more than 600 employees, registering a turnover of €210 million in 2016.
- Nationally owned Agricost ranked second in 2016 with more than 900 employees and a turnover of €85 million.
- **Racova Group** is a large holding, grouping agriculture, livestock, food, services and biodiesel businesses. It has a turnover of €140 million and 2,100 employees. It owns 54,000 ha of land.
- Cerealcom is also one of the largest nationally-owned agribusinesses, owning 25,000 ha of land.
- **Zoo Sintex** is active in the cereals sector.
- The Al Dahra group, from UAE, has announced its intention to expand its Romanian operations with a massive acquisition of 30,000 ha.

About 20% of fruits and vegetables are produced in large farms while the remaining 80% in holdings. Hence, fluctuation in quantities and quality of the produce, as well as the high production costs (or low productivity), result in higher prices for the local products. About 65% of the national consumption comes from imports.

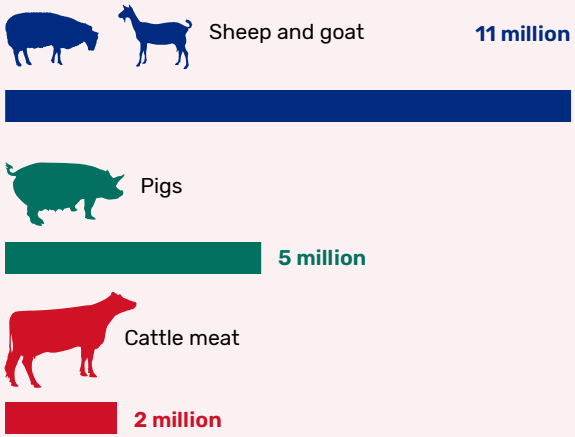
The significant fruit and vegetables growers are mainly gathered in associations or producers' groups such as:

- Matca - vegetables, mainly tomatoes
- Frutis Voinești - fruits, mainly apples
- Cartof de Făgăraș – potatoes

1.1.2. Livestock

Around two million cattle heads are present in Romania, of which approximately 1.2 million are milk cows, 700,000 are beef cows and 100,000 are heifers for breeding. Sheep and goat heads total 11 million, while pigs total five million.

Figure 6. Livestock by type (animal headcount)



1.2. Forest

Romania's forests covered 30.1% of the country's land surface in 2020. Despite having the largest remaining intact tract of contiguous natural and naturally regenerated forests in Europe, the overall area occupied by forests is well below the European average of 42%, and well below the national target of 40% set by the government. Just over 30% of the forest area is owned by private entities. Most holdings are small and often fragmented.

30.1%

of Romania's territory is covered by forest

6.51

Forest ownership area in Romania (million ha, 2014)

Figure 7. Forest ownership in Romania (2014)

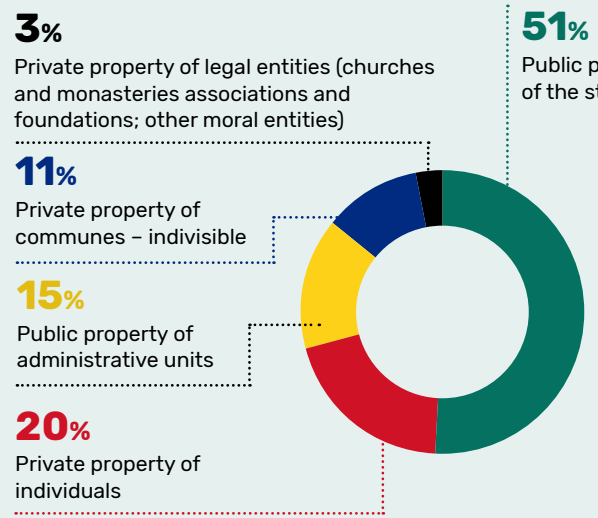


Figure 8. The Gross Value Added from the forestry industry has been increasing over the past few years (current prices, M€)

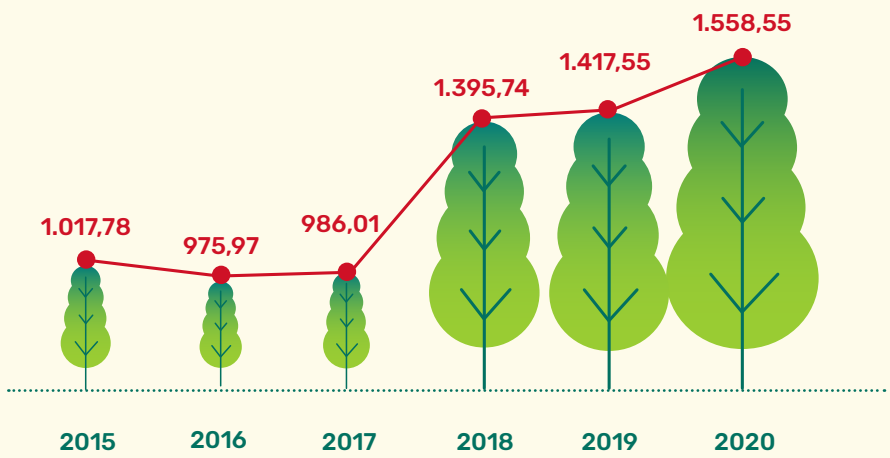
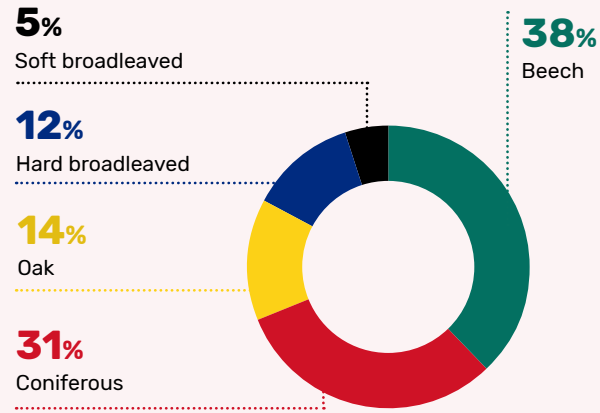
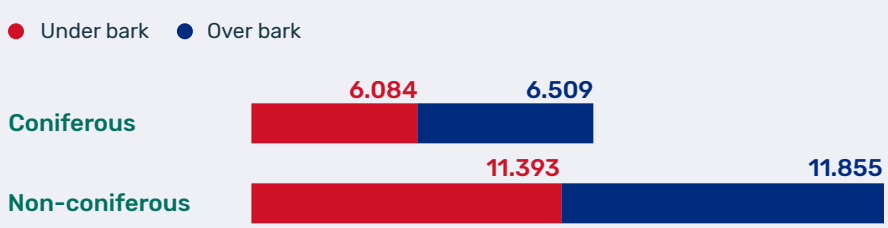


Figure 10. Trend of the Gross Value Added of forestry industry at basic prices (M€, Eurostat)



The volume of wood harvested in 2016 was around 18 million m³, see Figure 9. below.

Figure 9. Roundwood removals by type of wood and assortment (2022 provisional, thousand m³, Eurostat)



Main players

- Romsilva is the state-owned authority that manages all the state-owned forests plus 1.2 million ha of privately-owned forest. It is the main timber and wood biomass producer in Romania.
- Privately owned forests not administered by Romsilva are grouped in **Private Forest Districts (PFD)**. About 140 PFDs are currently registered in Romania. The umbrella association of PFDs is the **Association of Forest Administrators –** Asociația Administratorilor de Păduri.
- **Proforest** is the trade association of private forest landowners.

1.3. Fisheries, aquaculture and the blue economy

Situated in south-east Europe, Romania has a coastline 256 km long, representing 5.3% of the total Black Sea coastline and 0.5% of the total coastline of the 22 EU coastal Member States. Around 900,000 people, or 4.5% of Romania's total population, live in coastal areas.

Romania produces less than

20%

of its fish consumption, meaning that over 80% is imported.

Aquaculture is by far the largest contributor, accounting for roughly 70% of the volume, followed by inland fishing (around 20%) and sea fishing (around 10%)[1].

1.3.1 Fisheries

Marine fishing is exclusively in Romanian territorial waters in the Black Sea. The national fishing fleet is mostly small-scale, i.e. vessels less than 12 metres in length. In 2012, the number of fishing enterprises in the Romanian fleet totalled 91, with the vast majority (79%) owning a single vessel.

In 2020, marine catches and landings totalled 4.465 tonnes, which is almost 40% less than in the previous year due to the decreased catches of the main commercial species, rapa whelk (Rapana venosa), whose annual share in the total marine catches fluctuates around 95%. The fleet also targets Mediterranean mussel (Mytilus galloprovincialis), turbot (Psetta maxima), European anchovy (Engraulis encrasicolus), and red mullet (Mullus barbatus), though the annual share of the species other than rapa whelk is less than 10% altogether.

The fishing activity is seasonal and depends on the weather conditions in the Black Sea, where there are large differences of temperature between winter and summer, as well as strong winds.

All fish landed is used for human consumption.The main ports used by fishers for landing catches include Constanţa, Mangalia, Olimp, Costineşti, Mamaia, and Cape Midia. Fisheries and aquaculture are of particular importance in remote areas, where they represent the primary source of income for local populations.

The total area of inland waters exceeds 7,000 km², about 3% of the total area of the country. The Danube, home of Romania's most important inlands fisheries, has a total length of 1,074 km in Romania, corresponding to about 3,430 km² and holding an average of about 2.2 million m³ of water. Other waters which are of interest for inland fisheries activities include 500,000 ha of stagnating waters and 66,000 km of running waters in the mountain, hill, and plain areas.

Inland fishing is a full-time occupation practiced mainly by traditional fishers. In most cases it is a subsistence activity. In 2020 the catches from inland waters amounted to 2.864 tonnes.

[1] Neculita et al., 2015, Analysis of Romanian Fisheries and Aquaculture in Regional Context.

1.3.2 Aquaculture

Aquaculture is the largest contributor to fish and seafood production, accounting for roughly 70% of the total catches. It is mostly performed in inner waters.

Main players

Doripesco SA, **Pirania SRL**, **Euro Fish SRL**, **Baltic Marine Grup SRL**, **Rompescaris SRL** are the main aquaculture companies. They operate in inland freshwater.

Table 8. Aquaculture by Region (2013)[2]

Region	Units	Facilities	Total area	Nurseries area	Farms area	%
North-East	58	72	9412	942	8470	9.2
South-East	**93**	**99**	**66726**	**3385**	**63341**	**65**
South	**143**	**160**	**14123**	**1473**	**12650**	**14**
South-West	38	39	2544	129	2415	2.5
West	39	37	1709	280	1430	1.7
North-West	66	75	3129	381	2748	3
Centre	53	57	2726	83	2643	2.7
Bucharest Region	28	5	1986	0	1986	1.9

1.3.3 Algae

The only company identified in this field is Algaefit, a small producer of microalgae, mainly Spirulina, for food purposes.

[2] Neculita et al., 2015, Analysis of Romanian Fisheries and Aquaculture in Regional Context.

1.4. Food and beverages

The food industry is a considerable contributor to the national economy. Meat, beverages, and bakery products are the three main sectors by production value, turnover and number of enterprises (set aside the 'other food products' category).

The top three sectors by turnover and production value are dairy, meat and beverages. Figure 11. shows the generated value evolution of all food sectors (dairy, meat, fish, plant-based food, etc.) and the beverages sector.

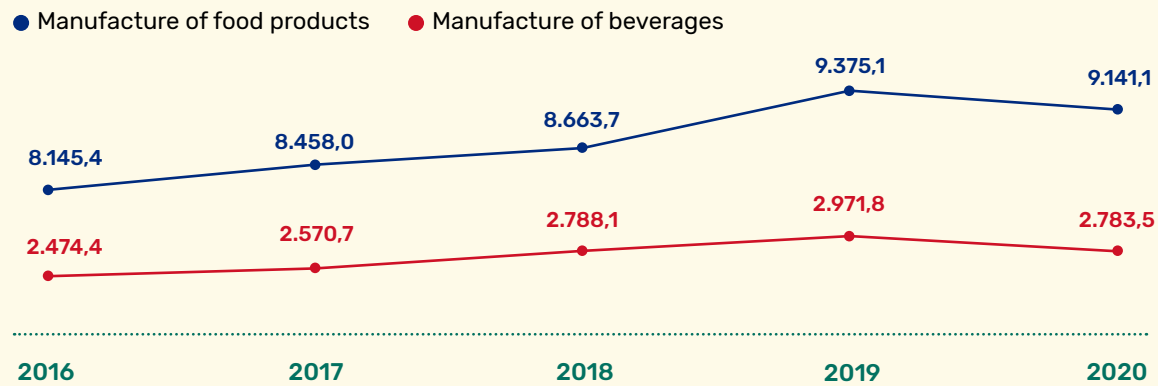
1.4.1 Meat

Meat processing is the highest by turnover among food and beverage subsectors.

€3.1B
Turnover

+800
Companies

Figure 11. Trend of production value of food and beverages production (Production value, M€) (Eurostat, Annual enterprise statistics for special aggregates of activities)



Main players

Several national and international players are present, either with their own brand or with a local brand. The following list shows the main dairy players in the market with locally manufactured products.

- **Aldis**, **Angst**, **Smithfield**, **Cris-Tim**, **Unicarm**, **Sigma Alimentos**, **Meda Prod** and **H&E Reinert** are active in pork and sausages.
- **Diana** produces both pork and beef.
- **Transavia**, **Aaylex**, **Agricola** are producers of poultry meat.

1.4.2 Fish and aquaculture products

Due to the low fishery and aquaculture output, fish processing is quite small in the country. 31 companies are involved in this activity.

€100M

Turnover

Most of the finfish and seafood raw material is imported. According to the Romanian Fish Processors, Importers, Distributors and Merchants Association RO-FISH, the needs of fish in Romania are met mainly by imports (87%) while domestic production represents only 13%.

Main players

- **Ocean Fish**, **Negro 2000**, **Pescado Grup**, **Sabiko Impex**, **Peștișorul de Aur**, **Costiana** and **Doripesco** are the main fish and seafood players.

1.4.3 Beverages

The beverage subsector is second to meat processing in terms of turnover. Production of soft drinks leads, with around half of the total (€1.3 billion); beer is second with €870 million; wine and spirits follow with €230 and €110 million respectively.

Main players

- Romania hosts local branches of several international large players, among whom are **Coca-Cola**, **PepsiCo**, **Heineken** and **Maspex**.
- The three leading beer producers, **Ursus Breweries**, **Bergenbier** and **United Romanian Breweries Bereprod**, are owned by Asahi Breweries, the Molson Coors Group and Carlsberg respectively.
- Locally owned companies Romaqua and European Drinks are active in soft drinks.
- Liquors are a traditional product from Romania. Some of the most representative distilleries are **Scandic Distilleries**, **Alexandrion Group**, **Szicsek**, **Distileriile Bran** and **Prodal**.

1.4.4 Dairy products

€1B
Turnover

500
Companies

Table 9. Dairy production (tonnes, 2015)

Product class	Production
Milk	259.508
Acidified milk, yogurt	190.519
Cheese	81.650
Cream	67.385
Butter	11.196

Main players

- International players such as **Danone**, **Lactalis**, **FrieslandCampina**, **Bongrain** and **Hochland** are active in the country.
- Among national players, the main dairy producers are **Fabrica de Lapte Brașov**, **Covalact**, **Simultan**, **Lacto Food**, **Carmo-Lact Prod**, **Gordon Prod**, **Five Continents**, **Lacto Solomonescu** and **Therezia Prodcom**.

1.4.5 Cereal-based foods, bakery, sweets

Bakery products account for the highest number of enterprises in the food and beverage sector (around 4,700), with a turnover of €1.7 billion. Romania is among the top three countries in Europe for consumption of bread per capita. It is home to several national and international producers of biscuits, snacks and cakes. Several national and international producers of pasta, made from both corn and wheat, are present.

Main players

- The main international players present in the country are **Dr. Oetker**, **Ferrero**, **MARS foods**, **Mondelez**, **Nestlé**, **PepsiCo Star Foods** and **Maspex**.
- Kandia is a producer of chocolate and snacks.
- Vel Pitar produces bread and sweets.
- Boromir, Pambac and Dobrogea produce bread, pasta and biscuits.
- SAM Mills and Băneasa Pasta produce pasta.

1.4.6 Other food products

- There are four producers of sugar in Romania: **Agrana**, **Fabrica de Zahăr Bod**, **Tereos** and **Zahărul Oradea**.
- Some of the producers of acetic acid: **Chemical Company**, **Silal Trading**, **Chimopar Trading**.
- Producers of salicylic acid: **Chemical Company**, **Sinteza**.
- Vinegar and seasoning producers include **Alexandros Impex**, **Romvintec**, **Sitemani**.
- One main producer of raw materials used for the processed fruit and vegetable industry in Romania is **Supremia Grup**.

1.5. Wood products

Romania has a trade surplus in wood and articles of wood with the world in both value and volume terms. Wood fibreboard accounts for the highest percentage among wood products (21% in 2016). Wood in the rough ranked second (17%), builders' joinery followed at 14%, wood sawn or chipped accounted for 12%. Other elements such as particle board, plywood, veneered panels and veneer sheets have smaller shares[3].

Furniture is a major use of wood, with a total value of

€2.5B

3000

Companies

Exports of wood products surpassed €1.6 billion in 2018, representing around 2.4% of the country's total exports. EU and non-EU destinations split export volume almost equally, with 49% and 51% respectively. Italy, Germany and Hungary are the main EU destinations for logs and timber, while China, Japan and the USA are the main non-EU destinations[4].

Furniture is a major use of wood, with a total value of €2.5 billion. Imports covered more than half of the domestic consumption, while local production is predominantly export-oriented (85% of furniture production goes to foreign markets).

The sector employs around 61,500 employees in 3,000 companies. High-value furniture items are exported, with EU being the destination for a large part of this segment of furniture. Two fifths of Romanian furniture exports reach Germany and France. Other major markets are Italy, United Kingdom, Czech Republic and the Netherlands.

A relevant share (28%) of the wood production is consumed for heating[5].

Main players

- International players active in the country include **IKEA**, **Holzindustrie Schweighofer**, **Egger**, **Kronospan**, **Kastamonu**, **JAF**, **Yıldız** and **Losan**.
- **Lafor** is one of largest saw-milling and wood processing companies in the country.
- **Massiv** is a large producer of hardwood and plywood.
- **Romanel** is a large producer of whitewood and hardwood.
- Pulp and paper companies active in the country include **Vrancart**, **Petrocart**, **Ambro**, **Comceh (Sofidel group)**, **Dunapack Rambox**, **Monte Bianco**, **Rondocarton**, **Pehart Tec**, **Ceprohart**, **Someș**, **Sistelse**, **Ecopack**, **Letea**, **Elfi** and **Rompaper**.
- **ROMPAP** is the national association of pulp and paper industry.

[3] USDA, 2017, GAIN report RO1707 'Romania – forestry and wood products'.

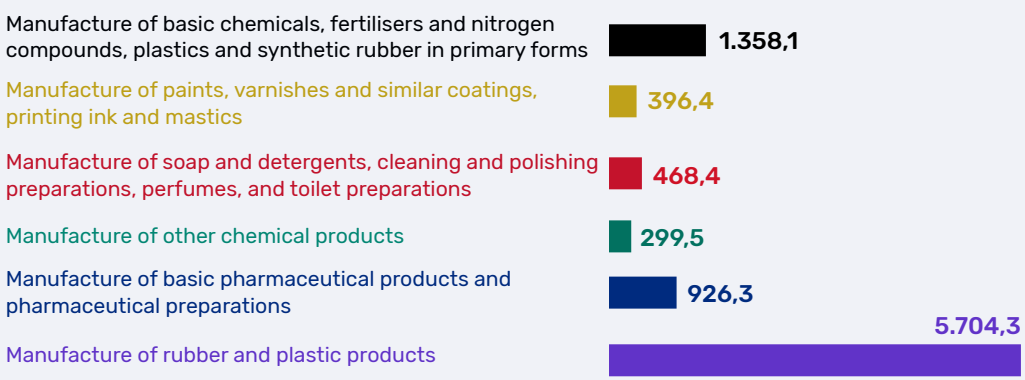
[4] Source: the National Statistics Institute.

[5] Combined from USDA, 2017, GAIN report RO1707 'Romania – forestry and wood products' and https://www.pwc.ro/en/press_room/assets/2016/wood-industry.pdf

1.6. Chemical and pharmaceutical industry

Romania has a traditionally strong chemical industry. Production of rubber and plastic products is high.

Figure 12. Production value of the chemical and pharmaceutical sector, 2020 (Production value, M€) (Eurostat, Annual detailed enterprise statistics for industry)



Main players

- **BASF** has two plants in the country, producing products for the construction industry, and paints and additives.
- **Chimcomplex Borzești** is a large producer of polymers, polyols and other chemical products.
- **Oltchim**, the largest chemical company in the country, is currently under insolvency procedure but is still operating normally.
- **Chemical Company** is a producer of high purity organic and inorganic chemicals.
- The country hosts five main petrochemical complexes: **Arpechim**, **Petrobrazi**, **Petromidia**, **Petrotel Lukoil** and **RAFO**.
- **APDCR** is the Romanian association of chemical producers and distributors.
- **Antibiotice** is the largest Romanian-owned pharmaceutical company.

1.7. Biotech industry

Agricultural biotechnology was the first biotechnology branch to find extensive application in the country, since Romania is the only European state that allows large scale cultivation of genetically modified (GM) crops.

Agricultural biotech continues to be relevant but is now flanked by biotech applications in the pharmaceutical and chemical industry.

- **AgroBiotechRom** is the national association grouping R&D and industrial stakeholders related to agricultural biotechnology.
- **BioROne** is a cluster dedicated to biotechnologies (mainly in the pharmaceutical area) active in the north-eastern region of the country.

1.8. Clusters and organisations

Romania has an extensive network of clusters and organisations that support bioeconomy and bio-based research, innovation and industrial activities. The following is a non-exhaustive list of major actors.

The **Romanian Clusters Association 'ClusteRo'** acts as an umbrella organisation for local industrial clusters. The organisation groups 21 clusters across the country, including Agro-Food (Bucharest), Agro-Food (Covasna), Pro-wood and Green Energy.

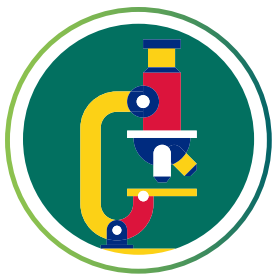
ClusteRo has several initiatives which may be related to bioeconomy in place, in particular a Swiss-Romanian bilateral cooperation on eco-innovation, a national network for eco-innovation and a 'Green entrepreneurs club'.

Table 10. Clusters and organisations in the bioeconomy

NAME	REGION	MAIN ACTIVITY
AGROFOOD - The Regional Cluster of Food Industry and Products	Center	The cluster groups 27 companies, 16 banks and foundations, 5 universities and research centres and 6 public institutions from the Centre region.
AGROPRO Oltenia	South-west	The cluster groups 11 industries, 4 universities and research centres, 11 associations and public institutions. It is incorporated in the Regional Development Agency of Oltenia.
AgroTransilvania	North-west	The cluster groups 29 companies, 2 universities and 3 public administrations from the region of Cluj-Napoca.
IND-AGRO-POL	Bucharest region	The cluster has 95 members, including 50 SMEs.

NAME	REGION	MAIN ACTIVITY
PRO WOOD Regional Wood Cluster	Center	The cluster has 32 industrial members and its main objective is to foster the competitiveness of the local forest-based value chains. The cluster is a participant in the Interreg project FORESDA - Forest based cross-sectoral value chains fostering innovation and competitiveness in the Danube Region.
BioROne	Noth-east	The cluster is dedicated to biotechnology, with 20 members: 12 universities or research centres, 1 large enterprise and 7 SMEs.
Green Energy	Center	The cluster's aim is to link biomass producers and users along multiple value chains, focusing on energy use of agricultural and forest residues. It groups 25 companies and 45 other entities active in the sector of biomass and bioenergy.
BIODANUBIUS	South-east	This is a small cluster with 7 members located in Danube delta region. Its focus is on promoting sustainable industrial activities in such a biodiversity-rich region.
ROMALIMENTA - Romanian Employer Federation from Food Industry	Nation-wide	The cluster is a reference in the food and drinks industry. It groups 18 large companies and 8 sector associations.
PRO AGRO - National Federation of the Producers in Agriculture, Food Industry and Related Services	Nation-wide	This is an umbrella organisation grouping sectoral associations in the agri-food industry.
APDCR - Romanian Chemical Producers and Distributors Association	Nation-wide	An association of producers and distributors in the petrochemical sector. Its members are BASF, Brenntag, Chimcomplex Borzești, Donau Chem, Dow, Elton, Interallis Chemicals, Oltchim, Nordmann Rassmann and Ravago Chemicals.

1.9. Academia and research centres



In addition to the industrial clusters and organisations, Romania also has many academic and research centres that support bioeconomy and bio-based R&D and industrial activities.

The major actors include:

The **National Institute of Research and Development for Biological Sciences** is the reference for biotech R&D in the country.

The main universities in the country have laboratories or research centres dedicated to bioeconomy-related topics; some of them also host incubators and/or cooperate with local technology parks:

- The **University of Bucharest**, faculty of biology hosts biotech laboratories specifically focused on the food industry, pharmaceutical and cosmetics industries. It also incorporates MICROGEN, a research and consultancy centre on microbiology and genomics.
- The **University of Agronomic Science and Veterinary Medicine**, also in Bucharest, hosts a research and consultancy centre on microbial biotechnology, named BIOTEHGEN.
- The **Polytechnic University of Bucharest** has an embedded **business incubator** to help students develop their business ideas.
- The **Babes Bolyai University** in Cluj-Napoca hosts a renowned biology faculty and cooperates with local **business incubator Risky Business** to help former students launch their own start-ups.
- Cluj-Napoca also hosts the **University of Agriculture and Veterinary Sciences**, a public university active in agriculture, horticulture, zootechnics, biotech and molecular engineering, as well as food production engineering.
- The **Alexandru Ioan Cuza University of Iasi**, faculty of biology, features facilities for field studies in marine biology on the Black Sea coast and freshwater biodiversity in the Danube delta.
- The **Gheorghe Asachi Technical University of Iasi**, the faculty of chemical engineering and environmental protection features facilities for field studies in biochemical engineering, polymeric biomaterials and bio-resources and waste management, treatment and recovery.

Cluj-Napoca hosts **Liberty Technology Park**, the largest technology park in Romania. It hosts several large hi-tech companies as Siemens and Altran, but also start-ups.

Vox Technology Park is in Timisoara.

Bucharest hosts **ICPE**, a research hub on technologies for sustainable energy production and energy efficiency.

In Bucharest is also **ICECHIM – Institutul Naţional de Cercetare – Dezvoltare Pentru Chimie şi Petrochimie**, the national institute for research and development in chemistry and petrochemistry.

The country hosts several incubators, some of whom have a track record in bio-based projects (see Table 11).

Table 11. Incubators (some active in the bioeconomy)

INCUBATOR	LOCATION	REGION	ACTIVE IN BIOECONOMY
Risky Business	Cluj-Napoca	North-west	✓
Innovations by Crossrider	Bucharest	Bucharest region	✗
SprintPoint	Cluj-Napoca	North-west	✓
Privacy Accelerator Program	Bucharest	Bucharest region	✗
Seed for Tech	Cluj-Napoca	North-west	✓
StepUP	Cluj-Napoca	North-west	✓
Simplon	Cluj-Napoca	North-west	✓
Gemini Solutions Foundry	Bucharest	Bucharest region	✗
Innovation Labs	Bucharest	Bucharest region	✗
Spherik Accelerator	Cluj-Napoca	North-west	✗
AICAR	Alba Iulia, Braşov, Mangalia, Sfântu Gheroghe, Târgu Mureş, Cluj-Napoca, Bacău, Satu Mare, Dorohoi, Câmpia Turzii, Timişoara	Government supported nationwide network	

1.10. Research projects

Many of the abovementioned industrial and academic actors have been participating in significant national and international projects at all technology readiness levels (TRLs) enabling and establishing bio-based industrial activities.

Research work in applying innovative technologies to mobilise, pre-treat and convert various biomass feedstock into valuable products and services is essential for designing and upscaling sustainable and circular value chains.

Academic and industrial partners from Romania have been contributing to these objectives of the BBI JU and other programmes in European consortia for research and innovation actions (RIA). RIA projects need to deliver solutions at TRL levels 4–5 and enable value chains to further upscale towards commercial levels (via demonstration at TRL 6–7; and flagship project at TRL 8).

The following list shows just some examples of BBI JU RIA projects in which partners from Romania have been delivering significant contributions to further bio-based activities across Europe.

The list organises the projects along three of the four strategic orientations of the bio-based industry in Europe:

1. Foster supply of sustainable biomass feedstock to feed existing and new value chains.
2. Optimise efficient processing for integrated biorefineries through research, development and innovation.
3. Develop innovative bio-based products for identified market applications.

The fourth strategic orientation, 'create and accelerate the market uptake of bio-based products and applications' regards studies to facilitate a dynamic bioeconomy. Partners from Romania have also been participating in these studies, but these are not covered in this report.

A. For example, in the field of expanding biomass feedstock base for bio-based operations:

Libbio *- Lupinus mutabilis for Increased Biomass from marginal lands and value for BIOrefineries*

Project duration 2016 - 2021

- A BBI JU RIA. The project will adapt the Andean Lupin, grown in Ecuador, Peru and Bolivia, for cultivation under European conditions on marginal lands, to produce food, feed and bioenergy.
- **Universitatea de Științe Agricole și Medicină Veterinară "Ion Ionescu de la Brad" din Iași**, is a partner in the project.

BeonNAT *- Innovative value chains from tree & shrub species grown in marginal lands as a source of biomass for bio-based industries*

Project duration 2020 - 2025

- A BBI JU RIA that will explore the use of tree and shrub species cultivated on marginal lands.
- **Universitatea "Ștefan cel Mare" din Suceava** is a partner of the project.

B. In the field of developing and applying innovative technologies for preparing and converting (new) biomass feedstock some examples are:

NeoCel *- Novel processes for sustainable cellulose-based materials*

Project duration 2016 - 2019

- A BBI JU RIA that set out to develop innovative and techno-economically feasible alkaline processes enabling the sustainable production of higher quality eco-innovative textile fibres from reactive high-cellulose pulps and integrating these processes in pulp mills.
- **Katty Fashion SRL** was a partner of the project.

C. In the field of developing innovative and sustainable Products for market applications, some examples are:

BIOMOTIVE *- Advanced BIObased polyurethanes and fibres for the autoMOTIVE industry with increased environmental sustainability*

Project duration 2017 - 2021

- A BBI JU Demonstration project. The project aims at developing, manufacturing at semi-industrial scale and testing in representative environment bio-based polyurethane foams and fibres for the automotive sector.
- **I.S.C. RO Technology SRL** is a partner of the project.

EXCORNSEED *- Separation, fractionation and isolation of biologically active natural substances from corn oil and other side streams*

Project duration 2018 - 2023

- A BBI JU RIA. The EXCornsEED project combines chemistry, biology, engineering and biotechnology tools and expertise to develop and validate processes for recovering a range of bioactive compounds from bioethanol and biodiesel refinery side streams. In particular, the project focuses on corn oil/thin stillage from bioethanol and rapeseed meal. It will valorise the side streams of these two growing sectors at a time when changes in legislation on liquid biofuels are likely to strongly increase demand for biofuels. By extracting proteins and bio-active compounds from these side streams for application in food, specialty chemicals and cosmetics, the project will maximise the value of biofuels production and make them more competitive.
- **Institutul Național de Cercetare – Dezvoltare pentru Chimie și Petrochimie – ICECHIM** is a partner of the project.

NEWPACK *- Development of new Competitive and Sustainable Bio-Based Plastics*

Project duration 2018 - 2021

- A BBI JU RIA. The objective of NEWPACK is to validate in an industrial setting the production of at least two new bio-based plastics based on PHB-PLA blends with improved sustainability performance, obtained by the addition of natural extracts with antioxidant/ antibacterial properties and nano-additives from cellulose and chitin.
- **TRITECC SRL** is a partner of the project.

The appendix includes some other relevant projects. The above and the appendix are by **no means an exhaustive list** of research and innovation work by actors from Romania.

2. CURRENT OPPORTUNITIES FOR BIO-BASED ACTIVITIES

The bio-based industry requires sustainably produced and supplied biomass feedstock for conversion into value-added products and services. The bio-based industry works intimately together with the primary sectors to jointly add value to available and unused biomass, side streams, by-products, and residual streams (waste) from these sectors.

This interaction includes returning nutrients to the soil and lowering or eliminating pollution of soil, water, and air. It will thus help to increase food and feed production, support sustainable forestry, and make their value chains more efficient and competitive by adding higher economic value to biomass streams that today find no or low value only.

For the bio-based industry it is therefore of interest to explore availabilities of unused and residual streams from the agricultural, forestry and marine/aquatic sectors in Romania, given their size and strengths (see chapter 1). In addition, relevant and attractive feedstock for the bio-based industry can come from the food and feed processing industries, wood-based industries, other bio-based industries (such as breweries) municipalities and relevant gaseous sources.

For a sustainable bio-based industry it is essential to create new value systems that cross the boundaries of the various and distinctive industrial and academic sectors for synergies in areas of feedstock, technology and market.

Supportive legislation and governmental programmes on regional and national levels can significantly add to the success of new bio-based activities in Romania, benefitting all.

2.1. Bio-based residues: availability and use

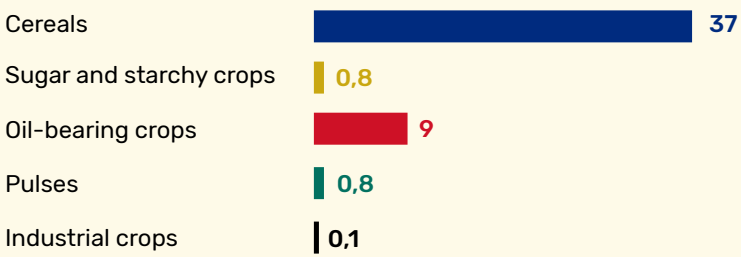
2.1.1 Agricultural residues

The JRC study on biomass production uses and flows (2023 edition) states that about 70% of both the economic produce and their residues (358 Mtdm/y and 295 Mtdm/y respectively) is produced in six Member States: France, Germany, Italy, Poland, Spain and Romania.

Romania is the fourth contributor to EU residues production whereas it only occupies the sixth place in terms of economic production. As a matter of fact, Romania is a large producer of maize that can produce large amounts of biomass in leaves and stems, even when grain yields are average or low. JRC estimates the residue production in Romania at 47.7 million tonnes dry matter / year (average in the period 2016-2020).

The approximate contribution of residue production per crop group, inferred from the JRC study graphs is shown in Fig.13 below.

Figure 13. Residue production per crop group (million tonnes dry matter per year, average 2016-2020, JRC)



2.1.2 Forestry residues

JRC estimates the fraction of residues as 20% in weight of the total wood felled[6], while other sources vary between 15%[7] and 30%[8]. Of course, the exact fraction depends on many factors, among which are tree species and age, climate, and logging practices. States: France, Germany, Italy, Poland, Spain and Romania.

Based on the above, an estimate of the available residues can be calculated from the values reported in Fig.9. Since the amount of wood removed is only available as volume, a conversion to weight is necessary. For this calculation, we use an average density of 600 kg/m³ for coniferous trees, and of 800 kg/m³ for deciduous ones.

Based on removal data (available in m³), this estimate shows (see Fig.14) that the available forest-based residues (coniferous and broadleaved) ranges between 1.5 and 3.3 million tonnes per year.

Figure 14. Forest residues availability (estimation from Eurostat 2022 provisional data)

Group of species	Removal (thousand cubic metres)	Estimated removal over bark (thousand tonnes)	Estimated residues (thousand tonnes)		
			15%	20%	30%
Coniferous	6.509	3.905	586	781	1.172
Broadleaved	11.855	9.484	1.423	1.897	2.845
Total			2.008	2.678	4.017

2.1.3 Waste from bio-based economic activities

No data available on other bio-based industrial activities, or on bio-waste other than the organic fraction of municipal solid waste (see next chapter).

[6] Camia A. et al., 2018, Biomass production, supply, uses and flows in the European Union, JRC

[7] Meuleman, B., L. Kuiper, G. J. Nabuurs, 2005, Effect: EU forest for renewable energy to mitigate climat, Ecofys, Utrecht

[8] Smith et al., 2009, Forest resources of the United States, 2007: a technical document supporting the forest service 2010 RPA Assessment.

2.1.4 Organic fraction of Municipal Solid Waste

The Organic Fraction of Municipal Solid Waste (OFMSW) is a potentially rich, albeit complex, source of biomass. The National Plan for Waste Management (*Planul Național de Gestionare a Deșeurilor*) calculates the total amount of OFMSW produced per year at 3.8 million tonnes, of which around two-thirds are landfilled. Figure 15. shows the Plan's projection for OFMSW use in 2020, under a 'business as usual' scenario.

From these figures it is possible to estimate a theoretical availability of around **2.4 million tonnes of organic residues per year** (the currently landfilled fraction). However, no data are available on the rate of sorting and separate collection of waste, which makes it difficult to estimate the amount that could be more readily available for conversion.

Figure 15. OFMSW use in 2020 (projection from 2017 data) (Eurostat, Annual detailed enterprise statistics for industry, tonnes/year)[9]

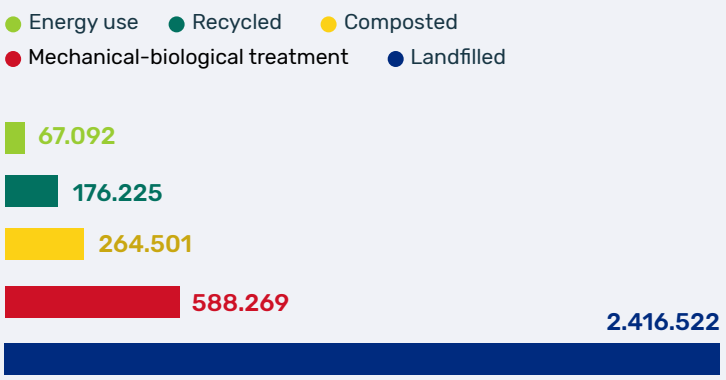


Table 12. Summary of available residual and waste streams

	Million tonnes /year
Agricultural residues	47,7
Forest residues	2-4
Waste from agri-food bio-based economic activities	NA
Waste wood-based	NA
Organic fraction of municipal solid waste	2.4
Total	52-54

[9] Planul Național de Gestionare a Deșeurilor (2017).

2.2. Bioeconomy strategies and programmes

2.2.1 National strategy

Romania published in July 2023 a new National Strategy for Research, Innovation and Smart Specialisation 2022-2027.

The document contains detailed steps to realise Romania's Vision 2030. These aim to support, recognise and reward excellence in fundamental and applied research; to stimulate the collaboration between the public and the private sectors; to address economic and societal challenges; and to make science, innovation, and entrepreneurship successful models for the sustainable development of Romania in the local, national and international context.

A key part of these steps is to stimulate innovation entrepreneurship through partnership between industry and public research organisations to develop new products and services. This partnership should progress Romania from emerging innovator to moderate innovator on the **European Innovation Scoreboard**.

The national strategy for research, innovation and intelligence specialisation is structured around four general objectives:

- GO1 Development of the research, development and innovation system
- GO2 Supporting innovation ecosystems associated with smart specialisations
- GO3 Mobilising for innovation
- GO4 Increasing European and international collaboration

As part of GO2, bioeconomy has been identified as the top smart specialisation area, with its sub-areas:
1.1 Technologies for the blue economy
1.2 Seed and breed improvement
1.3 Technologies for organic farming, agro-ecology and forestry
1.4 Agriculture 4.0
1.5 Safe and sustainable food for a healthy diet

A government-funded project by INCDSB (National Institute of Research and Development for Biological Sciences) is presently ongoing, aiming at '*substantiating, elaborating, finalising and communicating the priorities for the development of bioeconomy in Romania for the period 2016-2030 by (i) assessing the R & D potential and the industrial potential in the bioeconomic field; (ii) identifying priorities for the integration of national economic sub-systems into European bio-economic development, and (iii) establishing the main actions needed to achieve identified priorities*'.

The **Rural Development Programme (RDP)** for Romania adopted by the European Commission in 2015, outlines the priorities and measures to invest nearly €9.5 billion that is available for the 7-year period 2014-2020.

The RDP will support investments in the modernisation of farms and cooperatives. There is a particular emphasis on promoting association between small farmers to improve competitiveness. In the forestry sector, there will be investments to expand the current network of forest roads by over 900 km.

According to the provisions of the RDP, Romania has allocated €320 million to increase the competitiveness and enable restructuring of the fruit growing sector. Support is given for the setting-up of new orchards, reconversion of the old ones, fruit processing, cooperation projects, and the setting-up of producer groups within the sector.

For the development of the agri-food value chain, the RDP aims to support investments in about 300 food processing units, and it aims to stimulate the setting up of new producer groups as well as cooperation projects (e.g., in short supply chains or local markets). Farmers could also use risk mitigation instruments against the effects of adverse climate and other risks.

To counterbalance the high rate of rural inhabitants involved in agriculture, the RDP aims to promote and invest in projects meant to diversify the rural economy and create of new job opportunities that increase rural incomes. The RDP targets include 3,000 projects supported for setting-up/developing non-agricultural businesses in rural areas and almost 27,000 jobs created.

2.2.2 International cooperation in Central Eastern Europe

Romania is among the countries that regularly meet with the **Visegrád group** consisting of Poland, Czech Republic, Slovakia, and Hungary (V4). Other countries that join these meetings include Bulgaria, Croatia, Slovenia, and Estonia (V4+).

Ministers of Agriculture of the V4+ agreed in 2016 on setting up a common initiative, named **Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy (BIOEAST)**, aimed at establishing a common strategy on bioeconomy and at strengthening the links between the involved sectors across the borders.

In particular, BIOEAST identifies two linked gaps in the Central Eastern Europe macro-region: unlocking of excellence in low-performing research, development and innovation regions, and bringing specific research topics relevant to the CEE macro-region in Horizon 2020 work programmes. These gaps hinder the promotion of synergies with the European Agricultural Fund for Rural Development (EAFRD), the European Maritime Fisheries and Aquaculture Fund (EMFAF) and the European Structural and Investment Funds (ESIF).

The objectives of BIOEAST include the development of knowledge-based policies to facilitate joint actions; to identify and validate common challenges and research topics to address common CEE challenges; to create a cross-sectoral approach to facilitate national circular and bioeconomy strategies; to improve skills; and to pursue synergies by promoting regional, national, EU and international funding opportunities to develop innovative technologies and approaches. The purpose would be to boost the sustainable and circular economic growth of the European bioeconomy sectors and the conservation and upgrading of the regional environment, resources and cultural heritage.

BIOEASTsUP - Advancing Sustainable Circular Bioeconomy in Central and Eastern European Countries, is a project anchored on the BIOEAST initiative. It is a multi-stakeholder project with the objective to strengthen the strategic cooperation on circular economy in Central and Eastern Europe across borders and sectors. One of its outcomes will be the development of a Strategic Research Agenda to be implemented by the BIOEAST countries. The project is coordinated by the Institute of Soil Science and Plant Cultivation – National Research Institute, Puławy, Poland. Romania is also active in this project.

3. POTENTIAL USE/ VALORISATION OF BIO-BASED STREAMS

Romania has many key actors in industrial sectors that are relevant for a national bio-based industry and a bioeconomy. The country has an expanding economy with a very strong agriculture sector and significant industrial activities for food and beverages, food processing and wood processing, and a strong chemical industry.

In addition, Romania has broad and expanding academic and research support in bioeconomy fields. These are all essential components for an extensive bio-based industry in Romania.

The quantities of the different (residual) biomass streams in Romania shown in chapter 2[10] are sufficient to produce biochemicals at commercial levels[11]. However, currently, bio-based industrial activities are relatively low. There are not many biorefineries located in Romania and those present mainly use agriculture-based feedstock to produce mainly **biofuels and some chemicals**. Most of the attractive feedstock for bio-based operations and valorisation into added-value products and services are either unused, incinerated, landfilled, or achieves relatively low value.

The Bio-based Industries Consortium (BIC) offers some possible opportunities to local actors to expand industrial bio-based operations in the country through its strategic outreach programme. The assistance includes sharing knowledge and experience in successful projects that add value to comparable feedstocks as those available in Romania, by consortia of partners across industrial and academic boundaries. These projects can serve as examples to pursue opportunities for adding higher values to unused biomass and the residual streams and waste listed in chapter 2. The key objective is to assist the scale up and commercialisation of bio-based solutions in the country itself, on a local, regional or national basis.

This chapter focuses on granted projects of the Joint Undertaking between BIC and the European Union. This partnership started under Horizon 2020 (2014-2020) with the Bio-based Industries Joint Undertaking (BBI JU) and is continuing under Horizon Europe with the Circular Bio-based Europe Joint Undertaking (CBE JU).

The BBI JU achieved 142 granted projects at different technology readiness levels (TRLs) and Coordination and Support Actions (CSA). The total investment of €822 million of public money generated €2.8 of private investment for each €1 of public money.

The CBE JU first call for project proposals concluded in 2022 with 21 projects selected to receive a total of nearly €120 million CBE JU funding. Five more annual calls will be launched between 2023 and 2027 as part of the €2 billion partnership between BIC and the EU, of which €1 billion of public money is to generate €1 billion of private money.

The objective of the JU programme is to assist an accelerated commercialisation of excellent, innovative solutions for societal challenges towards a sustainable future. The commercialisation is to materialise in the country itself, on a local, regional or national basis.

[10] See Table 12 for estimates of annual residual streams.

[11] For example: with a sugar content of 60-70% (40% glucose as cellulose and 25% xylose as hemicellulose), wheat straw can produce around 230 kg of **bioethanol** per ton of dry material by fermentation. Bioethanol is a building block for chemicals, aside from its use in biofuels.

Actors in Romania participate in 7 of the 142 granted BBI JU projects: in 5 RIA projects (RIA projects end at TRLs 4-5, as pilot plants); 1 Innovation Action - demonstration projects (demonstration projects end at pre-commercial levels TRLs 6-7), and 1 Innovation Action - flagship project (flagship projects end at commercial levels TRLs 8).

Along with offering examples of projects based on comparable feedstock as those present in Romania, BIC also offers its European and international network events to assist local actors in establishing partnerships for bio-based activities, both in Romania and in Europe.

3.1. BBI projects of interest

Romania has substantial residual biomass available from agriculture; forestry; fisheries and aquaculture; manufacture of food products and beverages; and the organic fraction of municipal solid waste (OFMSW). The pulp and paper sectors provide substantial amounts of sludge, paper and wood wastes.

The following sub-chapters contain an outline of ongoing or completed BBI JU projects that utilise **the same or comparable biomass feedstock as those available in Romania**. These projects are to serve as examples to further increase utilisation and to show the potential of these streams in Romania.The selection is made on feedstock used, not on the actors in the projects' consortia. Actors in Romania participate in some of the listed projects.

3.1.1 Crop residues

Optisochem

Type of action : IA – Demo

Duration : 06/2017 - 05/2021

Overall budget : €16.3M

Pilot plant location(s) : Germany

OPTISOCHEM: Converting wheat straw into green chemicals

Project description

optisochem.eu

The goal of OPTISOCHEM is to demonstrate the performances, reliability (as well as environmental and socio-economic sustainability) of the entire value chains, for the transformation of excess wheat straw into bio-based isobutene (bio-IBN) derivatives. Working together to achieve these goals is a team of six partners, who are leaders in their field and originate from four EU-member states.

OPTISOCHEM showcases the technical accessibility and economical sustainability of the value chains, from wheat straw to two different families of chemicals derived from bio-IBN.These compounds, oligomers (DIB, TIB, TeIB) and polyisobutylenes (PIBs) are currently used in a wide range of applications such as lubricants, adhesives, sealants, flavours & fragrances and substituted phenols.
This large market is today supplied entirely by products derived from fossil-based isobutene. Products derived from bio-IBN, using the same process as fossil-based IBN, and with at least as good performance, would provide a renewable supply.

Coordinator : Global Bioenergies (France) | **Biomass(es) : Wheat straw** | **Process(es) : Biocatalysis**

Product(s) : Bio-Isobutene and derivatives: lubricants, adhesives, sealants, flavours and fragrances and substituted phenols

EXCORNSEED: Separation, fractionation and isolation of biologically active natural substances from corn oil and other side streams

Type of action : RIA

Duration : 06/2018 – 11/2021

Overall budget : €4.5M

Pilot plant location(s) : Italy, Slovakia

Project description

excornseed.eu

The EXCornsEED project will combine chemistry, biology, engineering and biotechnology tools and expertise to develop and validate processes for recovering a range of bioactive compounds from bioethanol and biodiesel refinery side streams, specifically corn oil/thin stillage from bioethanol and rapeseed meal.

It will valorise the potential of the side streams of these two growing sectors at a time when changes in legislation on liquid biofuels are likely to strongly increase demand for biofuels. By extracting proteins and bio-active compounds from these side streams for application in food, specialty chemicals and cosmetics, the project will maximise the value of biofuels production and make them more competitive.

Coordinator : Università degli studi di Roma La Sapienza (Italy) | **Biomass(es) : Corn oil, rapeseed meal, bioethanol stillage**

Process(es) : Separation, fractionation and isolation

Product(s) : Proteins, polyphenols, amino acids, fibers, lipid compounds, alkaloids and tannins

AGRIMAX: Converting crop and food residues into several products

Type of action : IA - Demo

Duration : 10/2016 – 09/2020

Overall budget : €15.5M

Pilot plant location(s) : Spain, Italy

Project description

agrimax-project.eu

Approximately one third of all food produced globally is wasted every year throughout the whole value chain- from farmers to consumers. To extract the significant amounts of valuable compounds contained in these wastes, AgriMax will combine affordable and flexible processing technologies (ultrasound assisted and solvent extraction, filtration, thermal and enzymatic treatments) for the valorisation of side streams from the horticultural culture and the food processing industry to be used in a cooperative approach by local stakeholders. Through the selection of case-scenarios previously developed to a pilot scale by the participating RTOs and their industrial transfer in new applications as food additives, packaging and agricultural materials among others, the project will disclose the holistic potential of four new agro-value chains (residues and by products from the culture and processing of tomato, cereals, olives, potato). Any by-products generated along the production cycle will be valorised in a cascade manner to reach over 40% of high-value use of the waste.

Coordinator : IRIS (Spain) | **Biomass(es) : Residues of tomato, cereals, olives, potato**

Process(es) : Ultrasound extraction, filtration and enzyme treatment

Product(s) : Primary products: food additives, packaging and agricultural materials / Secondary products: fibres, biogas and fertilisers

PROMINENT

Type of action : RIA

Duration : 01/2015 – 10/2018

Overall budget : €3.1M

Pilot plant location(s) : Finland

PROMINENT: Proteins from cereal side-streams

Project description

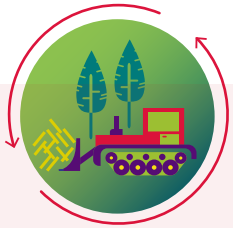
prominent-protein.eu

There is a global need, from sustainability, food security and also health perspective, to increase dietary intake of plant protein. Side streams from wheat and rice processing offer large under-exploited raw material potential. PROMINENT will work throughout the agro-industrial value chain to valorise that. The main aim of PROMINENT is to develop techno-economically and environmentally viable protein-based ingredients and foods from cereal processing side streams. The project concentrates on novel fractionation and extraction technologies, such as bioprocessing, supercritical carbon dioxide (SC- CO_2) extraction, thermo-mechanical technologies, wet and dry fractionation, and expanded bed adsorption as well as their combinations as novel hybrid processing technologies.

Coordinator : VTT (Finland) | Biomass(es) : Wheat, rice | Process(es) : Bioprocessing, supercritical carbon dioxide extraction, thermo-mechanical technologies, wet and dry fractionation, and expanded bed adsorption

Product(s) : Protein additives for pasta, biscuit, cake and beverage

3.1.2 Forest residues



SWEETWOODS

Type of action : IA - Flagship

Duration : 06/2018 – 05/2022

Overall budget : €43.2M

Pilot plant location(s) : Estonia

SWEETWOODS: High purity lignin and platform chemicals from wood-based sugars

Project description

sweetwoods.eu

The objective of the SWEETWOODS project is to demonstrate on an industrial level successful and profitable production of high purity lignin as well as C5 and C6 carbohydrates from hardwood by establishing a biorefinery having throughput capacity of 80 bone-dry tonnes/day. Unlike existing biorefinery concepts, SWEETWOODS plant utilises all the fractions of the biomass feedstock, with min. 95% of its initial carbon content utilised.

Coordinator : Graanul Biotech (Estonia) | Biomass(es) : Hardwood

Process(es) : Fractionation, enzymatic conversion

Product(s) : From lignin: elastomer foams for tube insulation, rigid polyurethane foam panels for insulation, and polymer compounds intended for injection moulding / From C5 and C6 sugars: glucose, xylose and fructose, bio-isobutene, xylitol

EXILVA: Microfibrillated cellulose from wood

Project description

h2020-exilva.com

Type of action : IA - Flagship

Duration : 05/2016 – 04/2019

Overall budget : €44.6M

Pilot plant location(s) : Norwegian

Microfibrillated cellulose (MFC) is a revolutionary product, with potential in a huge range of applications, including personal care, cosmetics, home care, pharmaceutical excipients, adhesives and sealants, composites and resins, agricultural chemicals, oil field, fish, bait, concrete, and CO capture. It also has the potential to replace many fossil-based products.

However, commercialisation of MFC has proved to be challenging, particularly making industrial quantities with sufficient running efficiency and stability. In addition, drying the MFC fibres in a cost-effective manner without losing significant performance is a major challenge.The EXILVA project sets out to change this, by transferring technology from the existing pilot production and eventually scaling up to commercial levels.

Coordinator : Borregaard (Norway) | **Biomass(es) : Wood (Norwegian spruce)**

Product(s) : From microfibrillated cellulose: adhesives, coatings, agricultural chemicals, personal care products, home care products, construction materials

3.1.3 Organic fraction of municipal solid waste (OFMSW)

PERCAL: Chemical building blocks from MSW

Project description

percal-project.eu

Type of action : RIA

Duration : 07/2017 – 06/2020

Overall budget : €3.4M

Pilot plant location(s) : Spain, Germany, Greece

PERCAL will use Municipal Solid Waste (MSW) as a feedstock for developing intermediate chemical products, producing high yield with high purity, making it attractive for industry. These will be complementary to the bioethanol (existing PERSEO Bioethanol® technology), thus creating a cascade of valorisation of the MSW components.

PERCAL aims to produce three main compounds: i) lactic acid, which can be used to make eco-friendly ethyl lactate. This can be used in cleaning products, in ink and for hot-melt adhesives for cardboard; ii) succinic acid, as an intermediate building block for the production of polyols for the polyurethane industry; and iii) biosurfactants from the remaining fraction of the MSW fermentation.

Coordinator : Industrias Mecanicas Alcudia (Spain) | **Biomass(es) : OFMSW** | **Process(es) : Enzymatic pre-treatment, fermentation, extraction via membrane electrolysis**

Product(s) : From lactic acid: solvents, inks, adhesives / From succinic acid: polyols / From proteins and lipids: biosurfactants

URBIOFIN – Conversion of MSW into chemical building blocks and biopolymers

Type of action : IA - Demo

Duration : 06/2017 – 05/2021

Overall budget : €14.6M

Pilot plant location(s) : Spain

Project description

urbiofin.eu

Today in Europe, each inhabitant generates 0.5 tonnes of MSW per year on average, increasing at an annual rate of 10%. Around 40-50% of it correspond to organic waste. This organic fraction contains mainly carbohydrates, proteins and lipids, which are all useful raw material that can be converted into valuable products. Its valorisation will help to solve environmental pollution but also contributes to the transition from a linear to a renewable circular economy. Digestion and composting have contributed to the reduction of the biodegradable fraction of MSW sent to landfill. The low economical value of compost and biogas is limiting the sustainable implementation of separate sourcing systems since increasing citizen environmental (waste) taxes is then needed to tackle important logistic costs. New bio-based products can help to improve the environmental and socio-economical sustainability of waste treatment.

The aim of URBIOFIN project is to demonstrate the techno-economic and environmental viability of the conversion at semi-industrial scale (10 tonnes/d) of the organic fraction of MSW (OFMSW) into: chemical building blocks (bioethanol, volatile fatty acids, biogas), biopolymers (polyhydroyalkanoate and biocomposites) or additives (microalgae hydrolisated for bio-fertilisers). By using the biorefinery concept applied to MSW (urban biorefinery), URBIOFIN will exploit the OFMSW as feedstock to produce different valuable marketable products for different markets: agriculture, cosmetics, etc.

Coordinator : Industrias Mecanicas Alcudia (Spain) | **Biomass(es) : OFMSW** | **Process(es) : Hydrolysis, fermentation**

Product(s) : Chemical building blocks (bioethanol, volatile fatty acids, biogas), biopolymers (polyhydroyalkanoate and biocomposites) or additives (microalgae hydrolisated for biofertilisers)

NEWFERT – Mineral fertilisers from bio-waste

Type of action : RIA

Duration : 07/2105 – 12/2018

Overall budget : €2.4M

Pilot plant location(s) : Spain

Project description

newfert.org

Most fertilisers currently rely heavily on fossil mineral resources for nutrient supply. The idea behind the NEWFERT project was to build up an innovative concept for the fertiliser industry that essentially turns ashes of different origins and livestock effluent into a new generation of fertilisers. Researchers identified and analysed more than 45 different types of bio-waste from different areas of Europe and selected 10 for introduction into the fertiliser production process based on their physical and chemical properties. Ashes containing high phosphorous or potassium content and nutrient availability were used directly for fertiliser production. In the case of ashes with insoluble nutrients, NewFert partners developed new biorefining technologies with low input and energy cost to increase nutrient recovery such as phosphate.

Furthermore, to free phosphate minerals (struvite) and nitrogen from pig slurry in a more cost-effective way, the scientists developed a new process. This reduced costs by substituting the traditional reagent with the action of bacteria that grow naturally in the medium and building a more efficient electrolysis cell for nitrogen recovery.

Coordinator : Fertiberia (Spain) | **Biomass(es) : Bio-waste of municipal and industrial origin**

Process(es) : Microbial electrolysis

Product(s) : Fertiliser

3.1.4 Food industry residues

GREENPROTEIN: Valorisation of vegetable processing industry residues into functional proteins

Type of action : IA – Demo

Duration : 09/2016 – 02/2021

Overall budget : €5.5M

Pilot plant location(s) : The Netherlands

Project description

greenproteinproject.eu

The economic costs of food waste is estimated at around €705 billion globally. There are also significant hidden environmental and social costs.RuBisCO protein is found in all green vegetables and plants and represents around 50% of the total protein content of green leaves.

GreenProtein is an industrial demonstration project that aims to produce high-added value, food grade proteins and other ingredients from vegetal food waste streams. The primary objective will be to extract and purify food-grade, fully functioning, RuBisCO protein isolate on an industrial scale using discards from the vegetal processing industry.

Coordinator : Royal Cosun (The Netherlands) | **Biomass(es) : Green residues from vegetable processing (mainly of sugar beet)**

Process(es) : Extraction

Product(s) : Food-grade functional RuBisCo protein and other ingredients

PULP2VALUE: Conversion of low value sugar beet pulp into chemicals and biomaterials

Type of action : IA - Demo

Duration : 07/2015 – 06/2019

Overall budget : €11.4M

Pilot plant location(s) : The Netherlands

Project description

pulp2value.eu

Europe produces around 13 million tonnes of sugar beet pulp each year. Currently, most of this pulp finds its way into low value feed, bio-fertiliser or is used for creating green fuel gas. By using multiple extraction techniques, PULP2VALUE will extend the high value products extracted from sugar beet side streams, isolating microcellulose fibres (MCF), arabinose (Ara) and galacturonic acid (GalA). The project will demonstrate an integrated and cost-effective cascading bio-refinery system to refine sugar beet pulp and identify applications for approximately 65% of its mass in high value markets, increasing its current value by as much as 20-50 times.

Coordinator : Royal Cosun (The Netherlands) | **Biomass(es) : Sugar beet pulp**

Process(es) : Extraction

Product(s) : From microcellulose fibres: rheology modifiers for detergents, paints and coatings, composites /From arabinose: flavours and food additives / From galacturonic acid: personal care and chemical products

PRO-ENRICH: Conversion of food industry side streams into food additives and chemical products

Project description

pro-enrich.eu

Type of action : RIA

Duration : 05/2018 – 04/2021

Overall budget : €4M

Pilot plant location(s) : Denmark

Pro-Enrich will develop a flexible biorefinery approach capable of processing a range of agricultural residues (rapeseed meal, olives, tomatoes and citrus fruits) in response to the increasing global demand for alternative sources of protein and phenolic product streams, tailored to the cross-sectoral requirements of industry.

Pro-Enrich will optimise existing biomass fractionation technologies and validate novel extraction approaches beyond the current state of the art (from TRL 2 through to TRL 4-5) to isolate and purify proteins, polyphenols, dietary fibres and pigments. The products being targeted are food ingredients, pet food, cosmetics and adhesives.

Coordinator : Danish Technological Institute | **Biomass(es) : Rapeseed meal, olives, tomatoes and citrus fruits**

Process(es) : Fractionation, extraction

Product(s) : Proteins, polyphenols, dietary fibres and pigments

3.2. Local actors already active in BIC/BBI

The **Gheorghe Asachi Technical University of Iași (TUIASI)** and **ICECHIM – Institutul Național de Cercetare – Dezvoltare Pentru Chimie și Petrochimie** are Associate Members of BIC.

Several other Romanian actors are or were active in BBI JU projects as partners: I.S.C. RO Technology, TRITECC, Katty Fashion, the University of agricultural and veterinarian sciences of Iași and the Universitatea Ștefan Cel Mare of Suceava.

3.3. Link to existing/emerging bio-based activities

3.3.1 Investment plan for Europe - the 'Juncker plan'

The European Commission launched the Investment Plan for Europe (also known as the Juncker Plan) in 2015, which aims to mobilise at least €315 billion of investment until 2020.

The Juncker Plan is a collective, coordinated effort at European and Member State level to encourage investment through three strategic targets:

- Boosting job creation and economic growth.
- Meeting the long-term needs of the economy and increasing competitiveness.
- Helping strengthen Europe's productive capacity and infrastructure.

In this view, the Investment Plan for Europe has operated through three main initiatives:

1. The European Fund for Strategic Investments (EFSI)

To overcome current market failures by addressing market gaps and mobilising private investment. It is jointly run by the European Investment Bank, the European Investment Fund, and the European Commission. It supports strategic investments in key areas such as infrastructure, education, research, and innovation, as well as risk finance for small businesses.

December 2020 saw the last approvals of projects by the EFSI Investment Committee. In 2022 InvestEU took over as the new long-term financing programme of the European Union, building on the success of EFSI.

2. The European Investment Advisory Hub (EIAH)

To strengthen support for project development and preparation across the Union. The EIAH supports projects which may be eligible for financing by the EIB (either under EFSI or otherwise), and it is not limited to EIB-financed projects.

3. The European Investment Project Portal (EIPP)

An online marketplace where worldwide investors and EU project promoters can meet. It offers EU-based private and public project promoters a convenient way to boost the visibility of their investment projects by filling in and submitting a project form. EIPP will showcase these projects aiming at attracting investors worldwide.

The Juncker Plan continues as InvestEU in the period 2021-2027. The new plan is expected to mobilise at least €650 billion in additional investment between 2021 and 2027. InvestEU will support the Green Deal Industrial Plan to enhance the competitiveness of Europe's net-zero industry and the fast transition to climate neutrality.

As of July 2020, over €500 billion in investments have been triggered EU-wide.

In Romania, €765 million were mobilised from the EFSI, which are expected to trigger €3 billion of additional investment. A total of **33 projects were approved in the country**.

Although none of the projects is categorised under 'bioeconomy', an example of a bioeconomy-related project by a Romanian company is the following:

Company MASPEX - GMW SP ZOO SP K

Type of business: Food industry

EIF Financing: EIB loan

Financial intermediary: -

Title: Food production modernisation

Description

The project includes investments in expansion, upgrading and modernisation of Maspex group's food and drinks production and storage facilities. The investments will be implemented in or in the vicinity of existing factories located in Lowicz, Lublin, Tychy, and Olsztynek (Poland), Vălenii de Munte, Giurgiu and Vatra Dornei (Romania), and Velingrad (Bulgaria).

The programme's overall cost is €94 million, of which €47 million is covered by the loan.

3.3.2 European Circular Bioeconomy Fund (ECBF)

The European Circular Bioeconomy Fund (ECBF) will provide access to finance, in the form of equity, debt or quasi-equity, to innovative circular bioeconomy companies and projects of various sizes. ECBF management will raise funds from public and private investors with a target fund volume of €300 million.

3.3.3 Country-specific EIF initiatives

EIF is advising, sponsoring or managing several equity Funds-of-Funds and guarantee/ debt funds on behalf of third-party investors, including national and regional governments, as well as private strategic investors.

In Romania, it is supporting the EAFRD Fund-of-Funds (EAFRD FoF) Romania based on a funding agreement signed between the EIF and the Government of Romania, represented by the Ministry of Agriculture and Rural Development. The EAFRD FoF Romania is financed by the European Agricultural Fund for Rural Development (EAFRD), through the National Rural Development Programme 2014-2020, together with resources form the national budget.

3.3.4 European Structural and Investment Funds (ESIF)

The ESIF includes five different funds, all covered by the Common Provisions Regulation – Regulation (EU) No 1303/2013 of the European Parliament and of the Council:

- The **European Regional Development Fund (ERDF)** provides financial support for developing and restructuring regional economies and aims to facilitate economic change, enhance competitiveness and boost territorial cooperation throughout the EU.
- The **European Social Fund (ESF)** supports workers and companies by boosting access to employment and participation in the labour market, focusing on social inclusion of disadvantaged people, combatting discrimination, and creating partnerships to manage employment reform.
- The **Cohesion Fund (CF)** aims to reduce economic and social disparities and promote sustainable development.
- The **European Agricultural Fund for Rural Development (EAFRD)** aims to strengthen the EU's agriculture, forestry sector and boost rural areas.
- The new (from 1 April 2021) **European Maritime Fisheries and Aquaculture Fund (EMFAF)** replaced the European Maritime and Fisheries Fund (EMFF) and has an ambitious support package for the implementation of the common fisheries policy (CFP), the Union's maritime policy and the EU's agenda for international ocean governance. EMFAF and some other funds and programmes are now managed by the new European Climate, Infrastructure and Environment Executive Agency (CINEA). The EMFF Unit of the Executive Agency for Small and Medium-sized Enterprises (EASME) became the Sustainable Blue Economy Unit of CINEA.

Funds related to the ERDF are managed locally according to the Smart Specialisation Strategy (S3) that each region in the EU has published. In the following pictures, regions with bioeconomy research and innovation (R&I) priorities in agriculture, waste processing and biorefineries during funding period 2014-2020 are highlighted.

Romania is eligible for projects under themes 'agriculture' and 'waste management'. No Romanian region has set 'biorefinery' as a theme in its S3.

Figure 16. EU Regions with Bioeconomy R&I Priorities

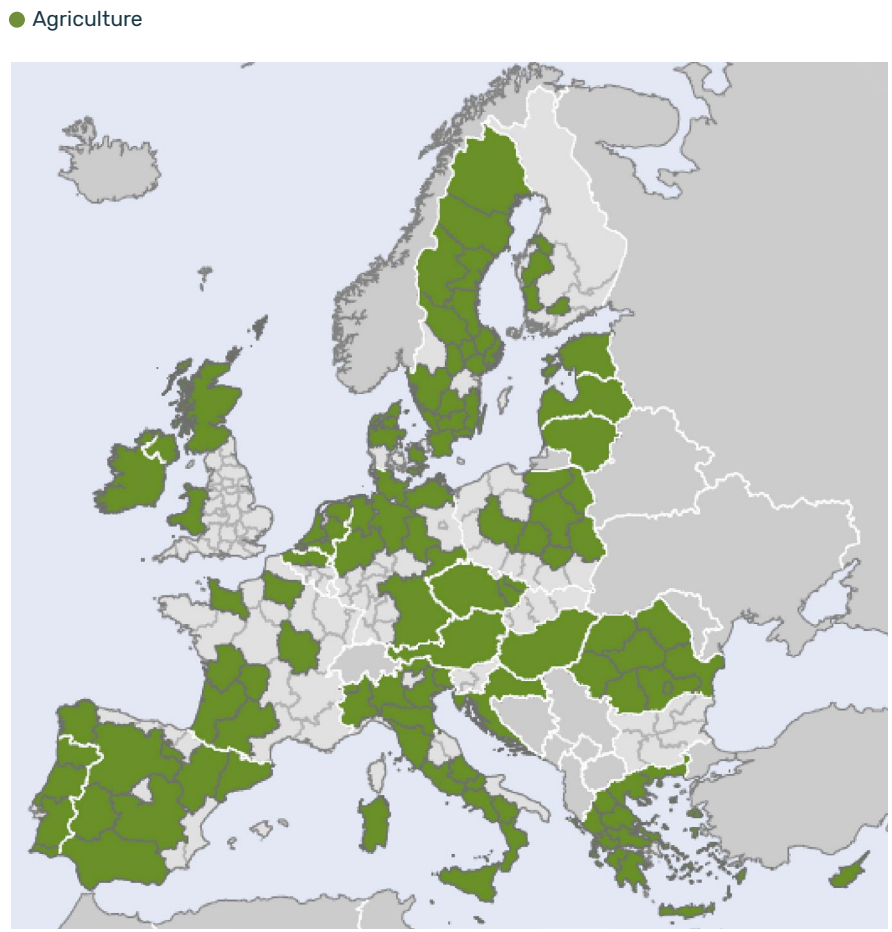
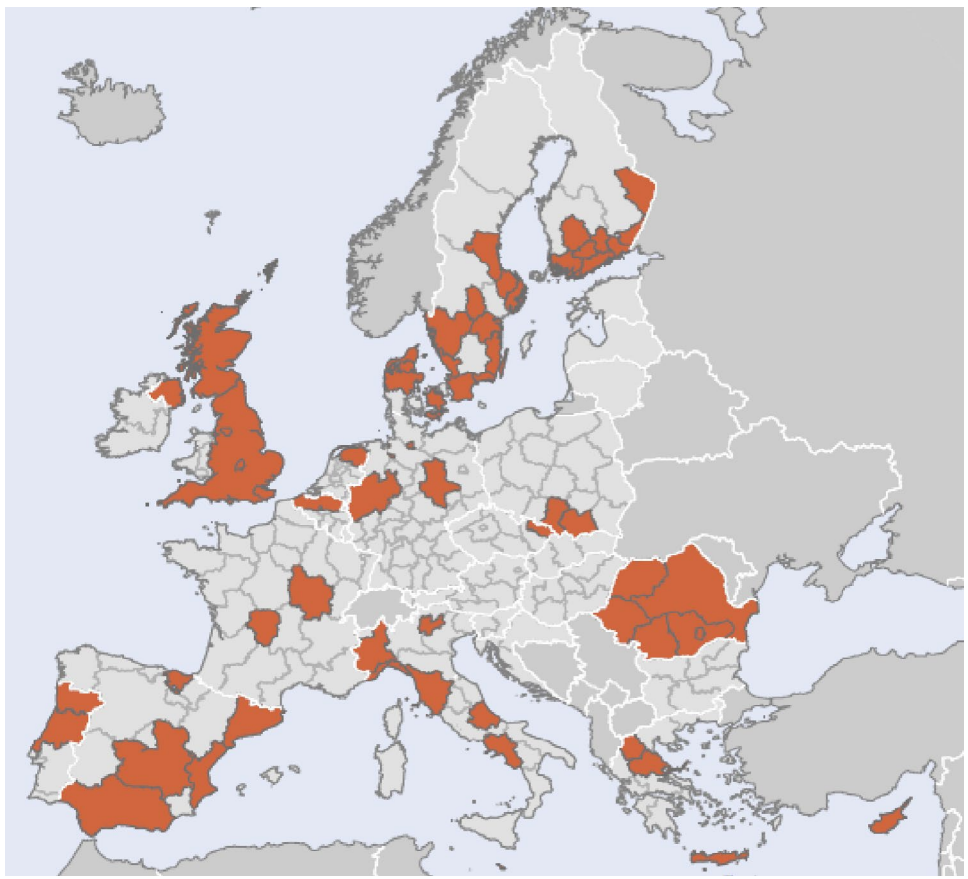
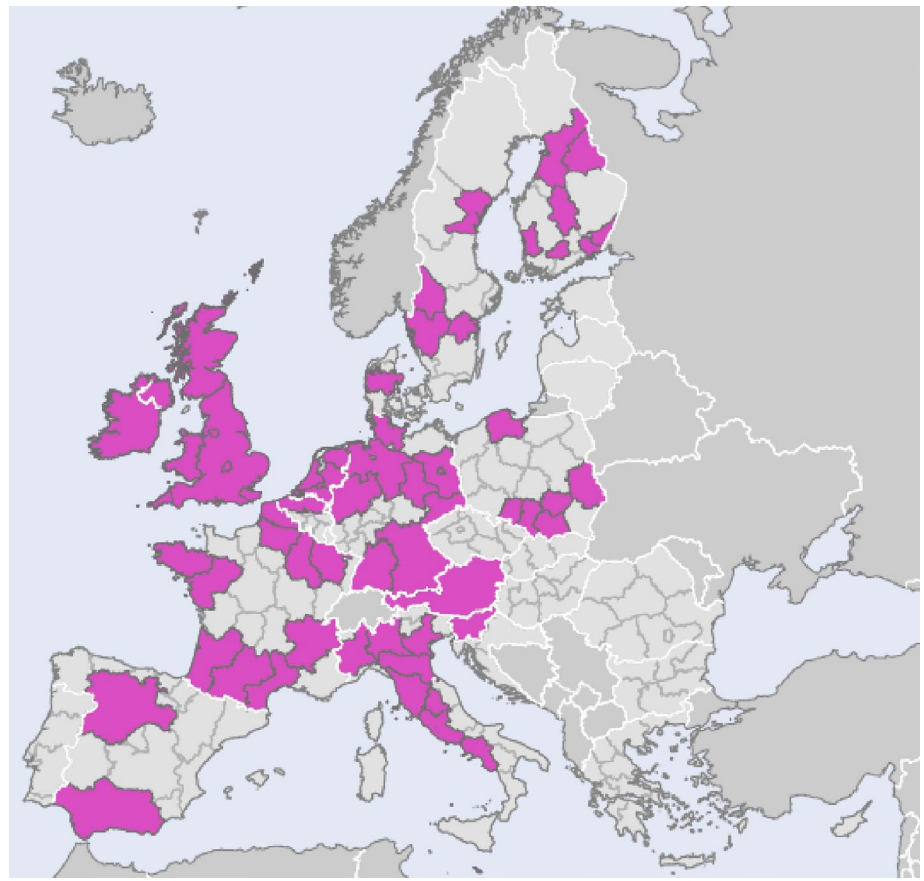


Figure 16. EU Regions with Bioeconomy R&I Priorities

● Waste Processing ● Biorefinery





3.3.5 European Bank for Reconstruction and Development (EBRD)

The European Bank for Reconstruction and Development (EBRD) is an international financial institution with a mandate to promote the transition to well-functioning market economies. The Bank finances projects and promotes policy dialogue in 37 countries from Central-Eastern Europe, Central Asia and the wider Mediterranean region.

In 2015, the Bank launched its **Green Economy Transition approach (GET)** to bolster innovative technologies by addressing market opportunities and failures related to resource use and environmental degradation.

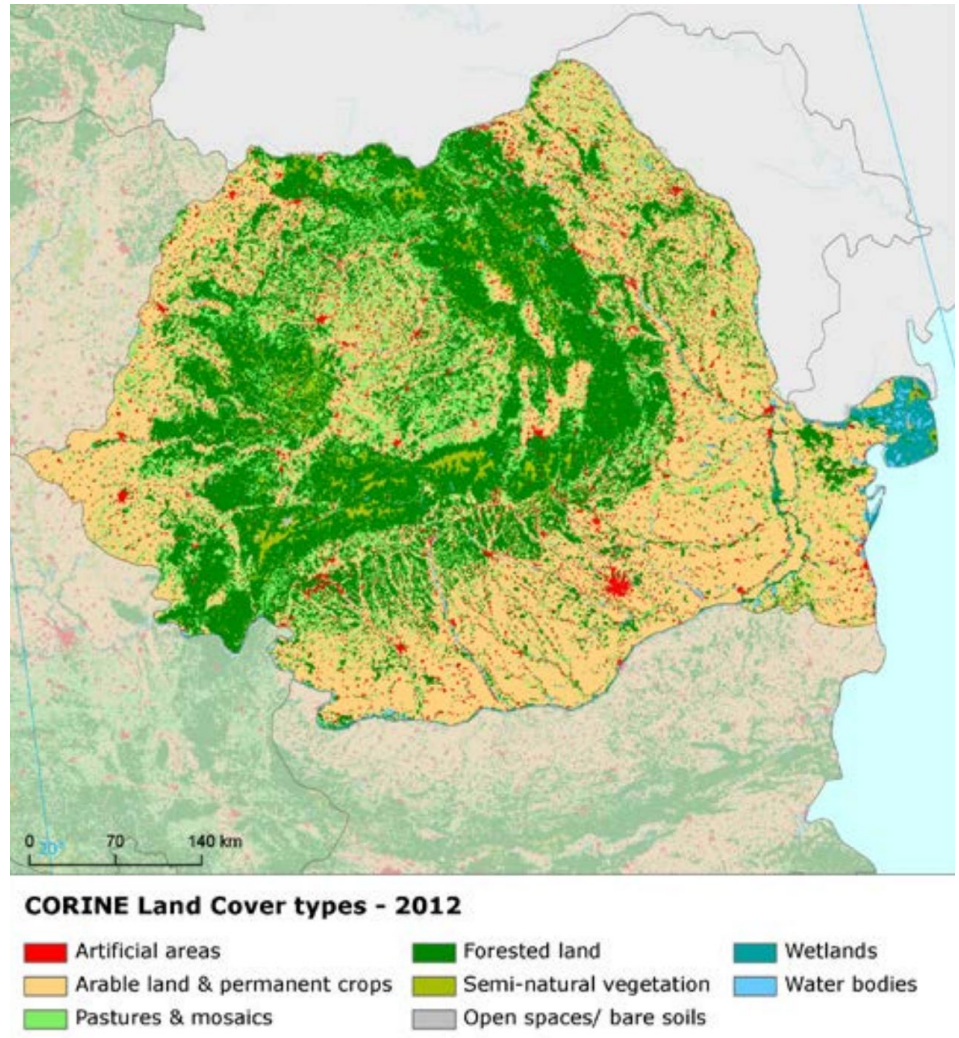
The EBRD can offer the bioeconomy sector:

- **A broad range of financial products** such as of loans, equity, guarantees or hybrid structures which are tailored to each client.
- **Technical expertise and resources for structuring and implementation support** such as technical feasibility and market studies, project design improvement, project management and implementation support, as well as potential concessional co-financing or grants drawn from donor support.
- **Rapid project scoping, approval, and delivery**, moulded around a business-oriented banking structure.

Romania is eligible for EBRD funds.

4. APPENDIX: TABLES AND FIGURES

Figure 17. Map of land use in Romania[12]



[12] CORINE: coordination of information on the environment; a European Economic Area (EEA) standard for georeferencing environmental data.

4.1. Agriculture

Table 13. Production of seasonal crops by area and tonnage (2022, Eurostat)[13]

Crops	Area (cultivation/ harvested/ production) (1000 ha), 2022	Harvested production in EU standard humidity (1000 t), 2022
Cereals (excluding rice)	**5.186,65**	**18.843,58**
Dry pulses and protein crops	76,52	118,76
Potatoes (including seed potatoes)	**80,77**	**1.345,78**
Sugar beet (excluding seed)	8,89	281,33
Other root crops n.e.c.	3,03	60,94
Plants harvested green from arable land	**848,42**	**4.340,38**
Brassicas	20,69	411,39
Vegetables cultivated for fruit (including melons)	44,43	739,46
Root, tuber and bulb vegetables	28,47	266,21
Oilseeds	1.701,33	3.584,48

Table 14. : Production of main crops per NUTS2 region (1000 tonnes; 2022, Eurostat)[14]

	Cereals for the production of grain (including seed)	Sugar beet (excluding seed)	Rape and turnip rape seeds	Sunflower seed	Soya
Nord-Vest	1.691,97	0,50	111,92	139,94	31,92
Centru	1.379,77	74,31	37,65	53,24	21,83
Nord-Est	2.176,24	201,63	79,78	283,15	44,55
Sud-Est	3.387,10	4,69	168,88	486,86	69,26
Sud-Muntenia	5.170,45	0,00	507,34	624,88	53,61
București-Ilfov	136,06	0,00	28,48	23,66	0,03
Sud-Vest Oltenia	2.929,92	0,00	116,28	393,38	8,87
Vest	1.989,16	0,20	179,21	101,48	28,46

[13] Eurostat, Crop production in EU standard humidity.
[14] Eurostat, Crop production in EU standard humidity by NUTS 2 regions.

Figure 18. Distribution of cattle livestock and pig livestock in Romania

North West North East West Centre South West South South East Bucharest region

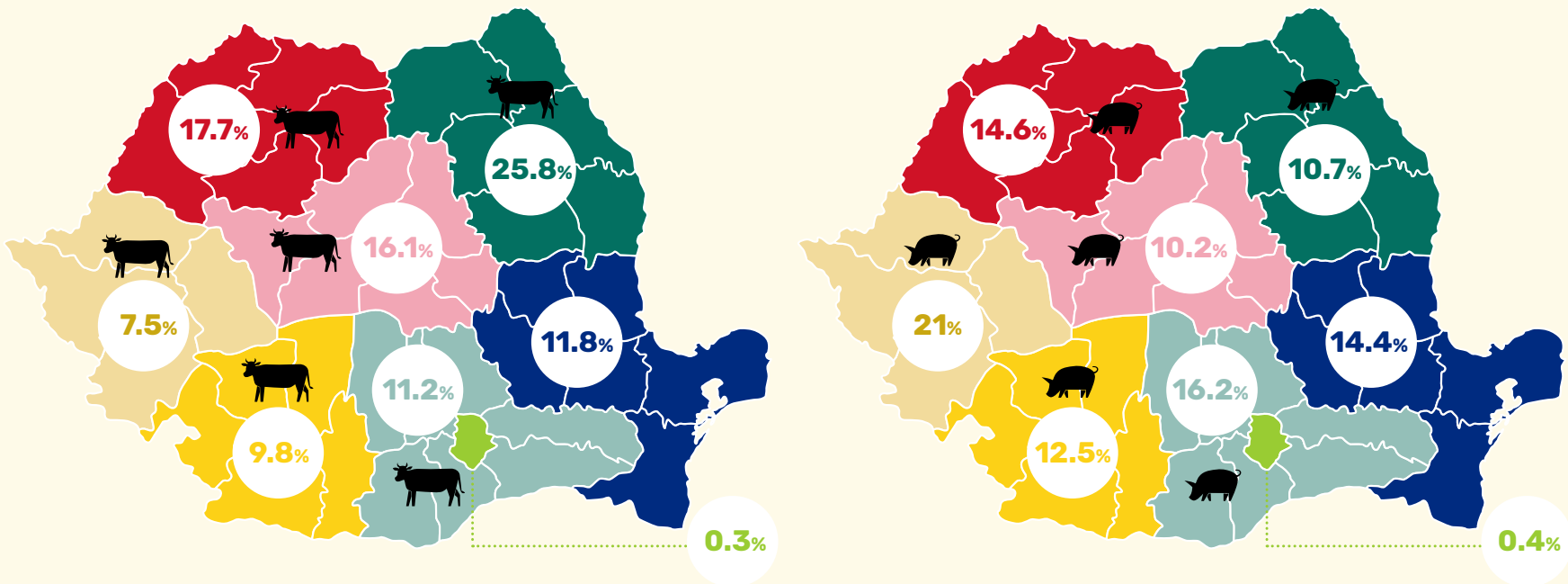


Table 15. Main livestock farming companies

Company	Sector & size (heads)	Location (Region)
Maria Trading	cattle 6000 sheep 50000	South
DN Agrar Group	cattle 3600	Centre and West
Carmolimp	cattle 2500	Centre
Racova Group	cattle 2000	North East
IAC Curtici	cattle 1100	West
Agroindaf	cattle 1000	Bucharest resgion
Agrointer	cattle 1000	South
Cris-Tim Group	cattle 1400	South
Agrimat Matca	cattle 1000	South East
Agroindustria Pantelimon	cattle 1000	Bucharest region
Agrisol International	poultry 18 million pigs	South
Avicola Buzău	poultry 300000	South East
Avi-Top	poultry 6.5 million	North East
Carmistin Group	cattle 2500	South and South West
Crinsuin	swine 25000	South
Emiliana West Rom	cattle 1400	West
Europig	swine 50000	Centre
Eurospatial	swine 24000	South West
Karpaten Meat	cattle 2500	Centre
Nutricom	swine 60000 poultry 300000	South
Nutrientul Group	swine 42000 poultry	Several lovations nationwide
Pigcom	swine 24000	South East
Porcellino Grasso	swine 23500	South West
Premium Porc	swine 380000	Several lovations nationwide
Safir Group	poultry 420000	Several lovations nationwide
Smithfield Group	swine 900000	West
Transavia	poultry 25 million	Several lovations nationwide

4.2. Forest

Table 16. Forest composition by tree species and region (2012)

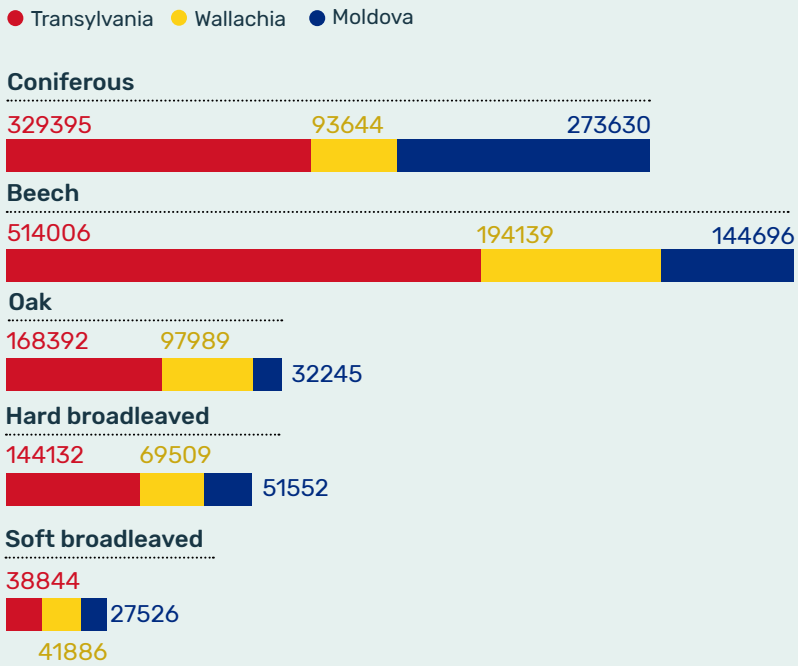


Table 17. Ownership of private forests (2011)

Ownership category	Number of owners	Total area (million ha)
Forest <10 ha	828000	0.85
Forest >10 ha	2200	1.35

4.3. Food and beverages

Figure 19. Main food industry sectors in (2017, Eurostat)[15]

Food industry by NACE code	Number of Enterprises	Turnover or gross premiums written (M€)	Production value (M€)
Processing and preserving of meat and production of meat products	**814**	**3114.8**	**2630.7**
Processing and preserving of fish, crustaceans and molluscs	31	108.7	85.7
Processing and preserving of fruit and vegetables	478	480.2	436.1
Manufacture of vegetable and animal oils and fats	124	1015.9	894.7
Manufacture of dairy products	524	1124.0	979.4
Manufacture of bakery and farinaceous products	4961	1822.7	1497.7
Manufacture of other food products	741	1244.2	1017.8
Manufacture of prepared animal feeds	153	364.5	344.8
Manufacture of beverages	**676**	**2627.4**	**2570.7**

Figure 20. Beverage industry (2016, Eurostat)[15]

Distilling, rectifying and blending of spirits	101	113.6	112.5
Manufacture of wine from grape	196	228.3	223.5
Manufacture of beer	26	870.6	855.6
Manufacture of soft drinks; production of mineral waters and other bottled waters	334	1274.7	1233.3

[15] Eurostat, Annual detailed enterprise statistics for industry.

4.4. Wood products

Figure 21. Manufacture of wood products (2016, Eurostat)[15]

- Enterprises - number
- Turnover or gross premiums written (M€)
- Production value (M€)

Sawmilling and planing of wood	2719	1099.2	1057.6
Manufacture of products of wood, cork, straw and plaiting materials	2296	6356.8	1799.7
Manufacture of furniture	3527	2153.0	2033.1

Figure 22. Manufacture of pulp & paper products (2016, Eurostat)[15]

Manufacture of paper and paper products	764	1235.8	1179.0

Table 18. Pulp and paper companies

Company	Location	Region	Sector
Vrancart	Adjud	South East	Tissue, cardboard, packaging
Petrocart	Piatra Neamț	North East	Tissue, cardboard
Ambro	Suceava	North East	Cardboard
Comceh (Sofidel Grpup)	Călărași	South	Tissue
Dunapack Rambox	Sfântu Gheorghe	Centre	Cardboard, packaging
Monte Bianco	Târgoviște	South	Tissue
Rondocarton	Târgoviște	South	Cardboard, packaging
Packaging	Salonta	North West	Packaging
Pehart Tec	Petrești	North West	Tissue
Ceprohart	Brăila	South East	Paper, packaging
Someș	Dej	North West	Paper, packaging
Sistelse	București	Bucharest region	Packaging
Letea	Ghimbav	Centre	Paper, cardboard, packaging
Ecopack - Ecopaper	Bacău	North East	Paper
Rondocarton	Cluj	North West	Cardboard
Elfi	Albota	South	Tissue
Rompaper	Cristian	Centre	Tissue

4.5. Bio-based research and other projects in Romania

The following list shows just some examples of bio-based projects in Romania. Some are still running; others have been finalised.

DIABOLO *- Distributed, integrated and harmonised forest information for bioeconomy outlooks*

Project duration 2015 - 2019

- The aim of DIABOLO was to establish a methodological framework for more accurate, harmonised and timely forest information e.g. on growing stock and stock changes; enable the analysis of sustainable biomass supply derived from multipurpose and multisource national forest inventories; and facilitate forest disturbance monitoring, e.g. on forest fires, storm, drought or insect outbreaks.
- Asociația Română Pentru Agricultură Durabilă was a partner of the project.

4D4F *– Data driven dairy decisions for farmers*

Project duration 2016 - 2019

- The project, running from 2016 to 2019, was focused on the role of animal and environmental sensors in collecting real time information to help make more informed decisions in dairy farming.
- Universitatea de Științe Agronomice și Medicină Veterinară din București was a partner of the project.

PROTEIN2FOOD *- Development of high-quality food protein through sustainable production and processing*

Project duration 2015 - 2019

- PROTEIN2FOOD's aim is to develop innovative, cost-effective and resource-efficient plant proteins–rich food sources with positive impact on human health, the environment and biodiversity. Proteins are obtained from nutritious seed crops (quinoa, amaranth and buckwheat), and legumes with high protein quantity (lupin, faba beans, pea, chickpea, lentil).
- Fundația Sătean was a partner in the project.

Data-Bio *– Data-driven bioeconomy*

Project duration 2017 - 2019

- DataBio proposed the deployment of a state of the art, big data platform for data collected in the bioeconomy sectors agriculture, forestry and fishery/aquaculture.
- TERRASIGNA SRL was a partner in the project.

ERIFORE *- Research Infrastructure for Circular Forest Bioeconomy*

Project duration 2016 - 2018

- ERIFORE aimed at strengthening cooperation among European forest research infrastructures and to establish new business models, novel products and services enabling sustainable growth.
- Institutul de Chimie Macromoleculară "Petru Poni" din Iași was a partner in the project.

BIOVoices *- Mobilisation of a plurality of voices and mutual learning to accelerate the bio-based sector*

Project duration 2018 - 2020

- BIOVoices aimed at engaging all relevant stakeholder groups 'voices' (policy makers, researchers, the business community and the civil society) in order to address societal, environmental and economic challenges related to bio-based products and applications
- Frontier Management Consulting was a partner in the project.

PANACEA *- A thematic network to design the penetration PAth of Non-food Agricultural Crops into European Agriculture*

Project duration 2017 - 2020

- The aim of the project was creating a network of stakeholders to support the introduction of dedicated non-food crops in European agriculture, by closing gaps in supply chains and policy frameworks.
- Asociația "Clusterul Agro-Food-Ind Napoca" was a partner in the project.

BE-Rural *- Bio-based strategies and roadmaps for enhanced rural and regional development in the EU*

Project duration 2019 - 2022

- The overall goal of BE-Rural was to realise the potential of regional and local bio-based economies by supporting relevant actors in the participatory development of bioeconomy strategies and roadmaps. The project implemented a series of regional Open Innovation Platforms to kick-start the co-creation process, bringing together key stakeholders from academia, policy, business and civil society to develop ideas and capitalise on this bioeconomy potential.
- Romanian Academy National Institute for Economic Research was a partner in the project.

BlueBio *– Unlocking the potential of aquatic bioresources*

Project duration 2018 - 2023

- The project (an ERA-NET Cofund) aimed to identify new and improve existing ways of bringing bio-based products and services to the market and find new ways of creating value in the blue bioeconomy.
- Unitatea Executiva pentru Finanțarea Invățământului Superior, a Cercetării, Dezvoltării și Inovării (UEFISCDI) was a partner in the project.

VOLATILE *- Biowaste derived volatile fatty acid platform for biopolymers, bioactive compounds and chemical building blocks*

Project duration 2016 - 2020

- The project developed an innovative Volatile Fatty Acids Platform for the bioconversion of municipal solid bio-waste fraction and sludgy biowaste from other industries. The volatile fatty acids were provided as feedstock / carbon source for value-added fermentation approaches such as biopolymer PHA to be tested in material applications; single-cell oil as precursor for oleochemical industry; as well as long-chain unsaturated health-promoting Omega-3 fatty acids to be used as food ingredient or nutraceutical.
- Compania Aquaserv SA and Tritecc SRL were partners in the project.

FORBIO *- Fostering Sustainable Feedstock Production for Advanced Biofuels on underutilised land in Europe*

Project duration 2016 - 2018

- The project developed a methodology to assess bioenergy production potential on available 'underutilised lands' in Europe (contaminated, abandoned, fallow land, etc.) at national and local level. The methodology was tested in selected case study locations in three countries, aiming to set the basis for building up local bioenergy value chain. The project ran from 2016 to 2018.
- Centrul pentru promovarea energiei curate și eficiente in România – Asociația ENERO, was a partner in the project.

Water2Return *- REcovery and REcycling of nutrients TURNing wasteWATER into added-value products for a circular economy in agriculture.*

Project duration 2017 - 2020

- Water2REturn built a full-scale demonstration process for integrated nutrients recovery from wastewater from the slaughterhouse industry using biochemical and physical technologies and a positive balance in energy footprint
- Slorom D&C Drăghiceni Srl was a partner in the project.

SmartAgriHubs *- Connecting the dots to unleash the innovation potential for digital transformation of the European agri-food sector*

Project duration 2018 - 2022

- SmartAgriHubs was dedicated to accelerating the digital transformation of the European agri-food sector. It consolidated, activated and extended the current ecosystem by building a network of Digital Innovation Hubs (DIHs) to boost the uptake of digital solutions by the farming sector. The heart of the project was formed by 28 flagship innovation experiments demonstrating digital innovations in agriculture, facilitated by DIHs from 9 Regional Clusters including all European member states.
- Federația Națională a Producătorilor din agricultură, industrie alimentară și servicii conexe din România – PRO AGRO, IQ Management Srl and SMARTRDI - Smart Research and Development International SRL were partners in the project.

LANDMARK *- LAND Management: Assessment, Research, Knowledge base*

Project duration 2015 - 2019

- LANDMARK is a pan-European multi-actor consortium of leading academic and applied research institutes, chambers of agriculture and policy makers that developed a coherent framework for soil management aimed at sustainable food production across Europe.
- The University of Agriculture and Veterinary Sciences of Cluj-Napoca was a partner in the project.

Bio-based Industries Consortium

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