



Bio-based Industries
Consortium

Mapping Portugal's bio-based potential

Country Report





CONTENTS

EXECUTIVE SUMMARY



1. CURRENT BASIS OF ECONOMIC ACTIVITIES



1.1. Agriculture →

1.2. Forest →

1.3. Fisheries, aquaculture and the blue economy →

1.4. Food and beverages →

1.5. Wood products; pulp and paper →

1.6. Chemical and pharmaceutical industry →

1.7. Biotech industry →

1.8. Other sectors →

1.9. Clusters & organisations →

1.10. Academia and research centres →

1.11. Research projects →

2. CURRENT OPPORTUNITIES FOR BIO-BASED ACTIVITIES



2.1. Bio-based residues: availability and use →

2.2. Bioeconomy strategies and programmes →

3. POTENTIAL USE/VALORISATION OF BIO-BASED STREAMS



3.1. BBI JU projects of interest →

3.2. Local actors already active in BIC or BBI JU projects →

3.3. Link to existing/emerging bio-based activities →

4. APPENDIX : FIGURES





EXECUTIVE SUMMARY

Portugal has the economic and innovation powers and the biomass feedstock to rapidly expand bio-based industrial activities on regional and national levels and become a strong partner in the European bioeconomy. On the European innovation [scoreboard 2020](#), Portugal moved from a moderate innovator to join the group of strong innovators. The country's bioeconomy already contributes almost **€20bn in turnover** annually placing it in prime position to lead Europe's bioeconomy transformation.

Despite its relatively small size, Portugal has a variety of climates and ecosystems, from the forested northern hills to the dry southern plains and from the Atlantic coast to the mountainous interior. The two island regions of Açores and Madeira add to the country's (bio)diversity. Portugal's exclusive economic zone, stretching from continental Portugal to Madeira and the Açores islands, includes a sizeable portion of the Central-North Atlantic Ocean. Furthermore, Portugal prepared a claim to the United Nations to extend its continental shelf. If accepted, this would increase its territory to 3.8 million km² (only 3% of which is terrestrial) becoming one of the largest countries in the [world](#).

Agri-food, forestry-based, marine-based (fisheries, algae and aquaculture) and chemical industries are among the strong drivers of Portugal's economy. In the bio-based processing sectors, the leaders in terms of production value are the food and beverages, pulp and paper and wood processing industries.

The presence of a well-organised innovation support infrastructure contributes to a significant list of ingredients for a sustainable bio-based sector. The Portuguese Government, through the Ministry of Environment and Climate Action, is currently preparing a national bioeconomy strategy: The Sustainable Bioeconomy Action Plan. This plan aims to promote a paradigm shift, accelerating the production of high-added-value products from biological resources (as an alternative to fossil-based materials). This plan is being developed while taking into account existing bio-based sectoral maps and with an understanding of the ecological limits of both the bioeconomy and the territories in question, providing considerable support for local, regional, and national bio-based operations.

While the country's Smart Specialisation Strategy does not feature a specific dedicated bioeconomy priority, it includes elements of bioeconomy in practically all its axes. Residual biomass is within the 'Commodities and materials' axis, while the axis 'Product and process technologies' has green chemistry as a topic. Biotechnology falls within the axis 'Natural resources and environment' and biomaterials are in the 'Health and wellbeing' axis.

The primary sectors and the subsequent processing sectors in Portugal have substantial bio-based residual streams and waste, most of which are generated in the processing stages. The pulp and paper industries are the most abundant source of residual biomass, followed by the food and beverage industries. The 2018 data show that less than 1% of the residual streams from the primary and processing sectors are routed to energy production, 82% is recovered and find mostly low-value applications and about 18% is disposed of. Excluding

current energy applications, this leaves over 1 million tonnes of residual streams that potentially could be routed to bio-based operations in the country, through which they can realise higher added-value in almost every market sector.

In addition, municipalities have significant quantities of bio-waste. The organic fractions thereof are estimated to total about 2.7 million tonnes in 2018, about 38% of which is landfilled. Since landfilling is being phased out, these quantities should find other destiny and the bio-based industry offers opportunities for conversion into value-added applications. It's not clear how the bulk of the organic fraction of bio-waste is managed. These streams are also relevant feedstocks for bio-based operations.

In recent years, Portugal has established itself as a rising force in biotech, thanks to the presence of several national and international actors and a healthy start-up ecosystem. There is a strong support towards high-tech university spin-offs and start-ups. The national agency FCT actively supports the creation of public-private cooperative hubs in which industry, academia, universities and research centres co-invest and co-create new products. The country has a well-established network of technology parks and incubators, the main ones are located in or close to universities; e.g., in Coimbra, Porto, Lisbon, Braga, Aveiro and Faro.

Several EU-funded research projects using biomass feedstock and biotechnologies have been running in Portugal in the last few years. Many Portuguese industrial and academic actors participate in European bio-based projects at all technology readiness levels. MULTI-STR3AM, a demonstration project receiving a €6.6



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 and offer assistance to increase these activities. Bio-based activities heavily depend on innovation, and hence are relatively low in ‘moderate/modest innovator’ 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 Bio-based Industries Initiative.

million grant from the **Bio-based Industries Joint Undertaking (BBI JU)**, is the first project at this scale in the BBI JU programme that is led by a Portuguese actor. Algae 4 Future (A4F) in Lisbon leads this project that started in May 2020 and will run till end of April 2024 with its operational site in Portugal. This demonstrates the interest and commitment for bio-based activities by the scientific and industrial communities in the country.

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, in an effort to use relevant available feedstock for higher values than currently is the case. After publication of the first draft in 2018, BIC representatives visited a number of key actors

in each of the primary sectors to discuss the report, seek more recent data and offer assistance for establishing cross-sectoral cooperation. Feedback received from these visits is incorporated in this new draft.

The Portuguese representative in the States Representatives Group of the BBI JU, A4F and Biotrend, both active BIC members, have provided significant assistance in collecting and reviewing data used in this updated report.

BIC will now redistribute this document via its website to local actors and stakeholders of the European bioeconomy, including the European Commission. Also, BIC will resume its follow-up contacts with actors in Portugal in our efforts to assist in setting up action plans with local industry, academia and governmental institutions for expanding the bio-based activities in the country.

The following chapters describe the current economic basis of Portugal, the potential for bio-based industrial operations and some examples of achieving high-value applications from comparable feedstocks in the country or elsewhere in Europe. The appendix contains additional figures related to the aforementioned chapters.





1.

CURRENT BASIS OF ECONOMIC ACTIVITIES

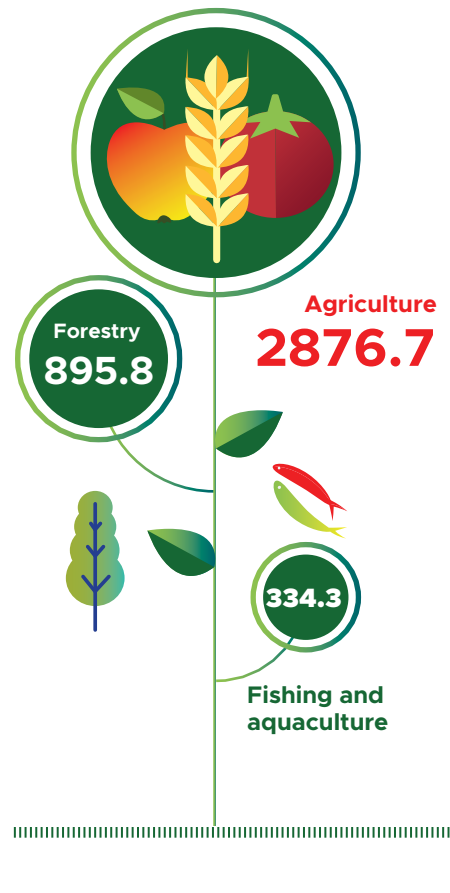
To establish or expand industrial bio-based activities in any country, its economic strength is of crucial importance. From a bio-based perspective, the presence and strength of the primary sectors, the conversion industries, the market demand of sustainable products and services, combined with the academic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

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

However, during the past few years, Portugal has been making significant strides forward in innovation performance. On the European innovation score board 2020, Portugal progressed from a moderate innovator to join the group of strong innovators. Portugal performs significantly better than many other EU countries in the fields of 'attractive research systems', 'innovation-friendly environment' and 'innovators' (SMEs). In some other fields it scores below EU average, among others notably 'public-private co-publications', 'private co-funding of public R&D expenditures' (in Linkages) and 'knowledge-intensive services exports' (in Sales impacts).

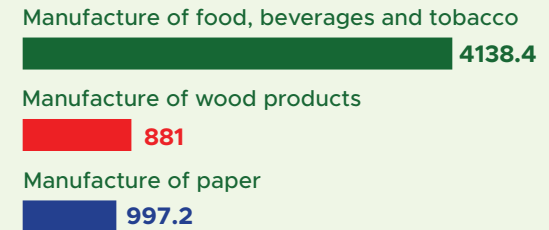
The country's bioeconomy already contributes almost €20 bn in turnover annually placing it in prime position to lead Europe's bioeconomy. The figures below demonstrate the relative importance of bio-based sectors in terms of Gross Value Added (GVA).

Figure 1. Gross Value Added of bio-based primary sector (M€*, Eurostat, 2017)



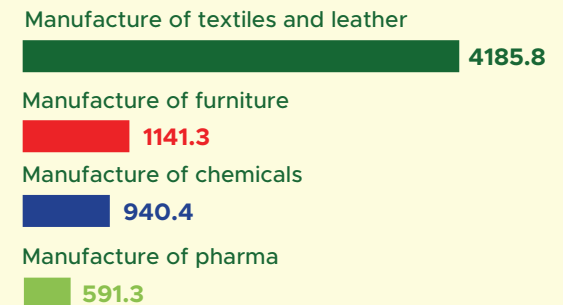
*M = million

Figure 2. Gross Value Added of bio-based manufacturing sector (M€, Eurostat, 2017)



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 3. Gross Value Added of partially bio-based manufacturing sector (M€, Eurostat, 2017)





Portugal has the industrial and economic base and the innovation power to rapidly expand bio-based activities. Since these activities start from sustainable feedstock, this report departs from describing the size and highlights of the primary sectors and their processing industries, followed by the chemical industry and academic centres.

Portugal features several different landscapes and climates enabling industrial activities in different primary sectors. The north (Norte) and central (Centro) parts of continental Portugal house mainly forestry, with a sizeable contribution from agriculture (in particular the dairy industry and vineyards). Forestry and the pulp and paper industries are major sectors in the national economy.

The central-southern region of Alentejo is largely agricultural with a major contribution on a national basis of:



80%
olive oil

60%
cereals

50%
livestock

This region also produces the largest part of cork, of which Portugal is the world leading producer.

The warmer climate of the Algarve region in the south is suitable for citrus production.

The fisheries industry is active along the whole Atlantic coast and in the archipelagos of Açores and Madeira, with the main hubs in the Porto and Lisbon areas.

These two areas also house the chemical industry, while the textiles and leather industries are in the north of the country, between Porto, Guimaraes and Braga.

This document uses the geographic division NUTS2, dividing continental Portugal in Norte, Centro, Area Metropolitana de Lisboa, Alentejo and Algarve. The Madeira and Açores archipelagos complete the country for this document (Figure 4.).

Figure 4. Portugal's NUTS2 (Source: INE)





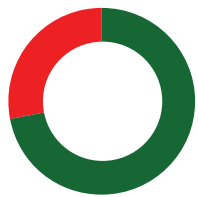
1.1. Agriculture

Portugal's Utilised Agricultural Area (UAA) is about 3.6 million hectares, 39% of its land surface, of which 30% are occupied by temporary crops, 20% by permanent crops and 50% by permanent grassland. 15% of the UAA is suitable for irrigation (2013 data), representing 58.5% of total farm holdings.

Farms

300000

of which



72%

<5 ha



4%

>50 ha,
occupying 67%
of the UAA



54.3%

of the agriculture production value comes from crop production, especially fruit and vegetables (60% of crop production)

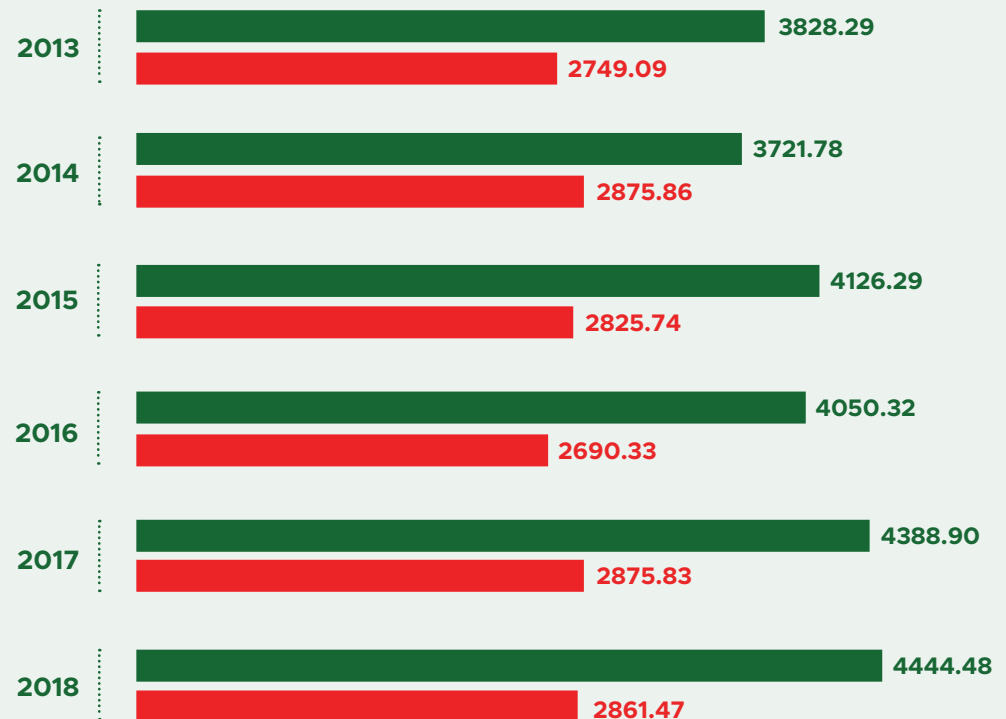


41.2%

comes from animal production, of which milk accounts for 25%

Figure 5. Agricultural production trends (M€, Eurostat)

● Crops ● Livestock





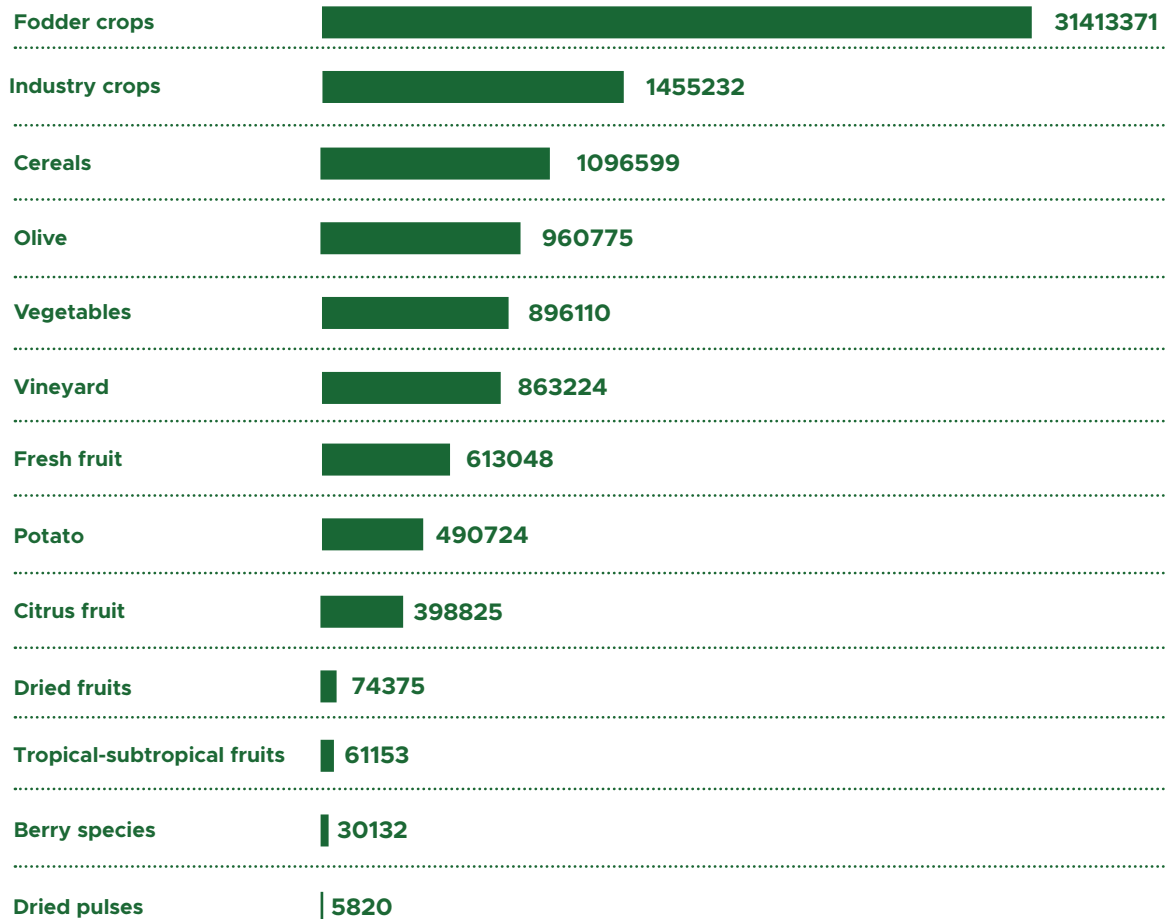
1.1.1. Crop production

Fodder crops, cereals and industry crops are the largest sectors followed by horticulture, vineyards and olives. Industry crops include tomatoes for processing, and tomatoes for consumption are included in horticulture.

Norte, Centro and Alentejo are the main agricultural regions and take the largest share of almost all main cultures, with a few exceptions. For example, Algarve is the main region for citrus fruits, and Madeira produces most of tropical fruits.

Fodder crops (maize and oat) are mainly grown in the Norte and Centro regions. Alentejo takes the lion's share of cereals, industry crops and olive cultivation, while vineyards are equally distributed between Norte, Centro and Alentejo. The Appendix contains crop production details per NUTS2 region.

Figure 6. Crop production (tonnes, 2019) (Source: INE)





Cereals



The overall production of cereals (2019)

1.1 Mt*

Maize represents more than half of it (more than 700 thousand tonnes). Rice production is also sizeable with around 160 thousand tonnes per year. Other cereals include wheat (68 thousand tonnes), barley (60 thousand tonnes) and oat (56 thousand tonnes).

Potatoes



Production of potatoes (2019)

490 Kt**

Fresh vegetables



Production of fresh vegetables (2019)

896 Kt

Cabbage, fresh tomatoes and carrots are the main produce, with 135, 103 and 92 thousand tonnes respectively.

Industry crops



Tomatoes for processing production (2019)

1.45 Mt

Tomatoes for processing make up over 98% of industrial crops. Sunflower accounts for 17 thousand tonnes.

Olive trees



Production of olives (2019)

961 Kt

725 thousand tonnes were olives for olive oil, and the remaining 13 thousand tonnes were for table olives. The production of olive oil reached 1 million hectolitres in 2018 with about 80% of the olive oil produced in Alentejo.

Mt = million tonnes
Kt = thousand tonnes



Vineyards



Production of grape from Portuguese vineyards (2019)

863 Kt

784 thousand tonnes thereof were wine grape, and 18 thousand tonnes table grape.



Wine production (2019)

6.5 Mhl*

The 2019 wine production was over 6.5 million hectolitres. The main production region is Norte with 2.6 million hectolitres, followed by Centro and Alentejo with 1.6 million hectolitres each. More than half the wines produced enjoy a protected designation of origin.

* Mhl = million hectoliters

** K = thousands

1.1.2. Livestock

Portuguese livestock production value (2015)

€2809.3M

39.7%

 of the overall value of agricultural production

1.9%

 Annual average growth rate (2010-2015)

Figure 7. Major contributors to the production value

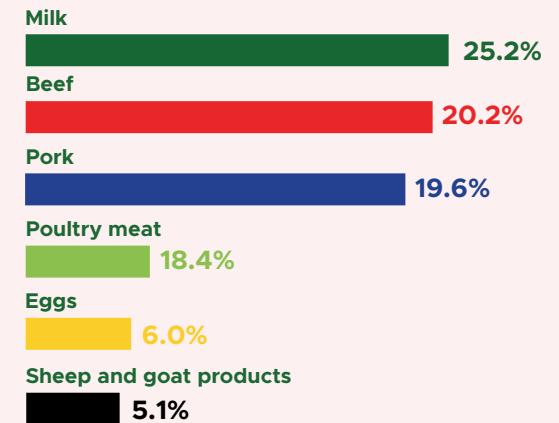


Figure 8. Animal headcount (K**, 2019)





1.2. Forest

Over one third of the country's territory is covered by exploited or exploitable forests, making forestry and the related value chains (pulp and paper, wood and cork) key segments of the primary sector. Current forest area totals 3.22 million hectares, with a great diversity of species, predominantly native species. The three most relevant tree species are eucalyptus, maritime pine and cork oak; oak (in particular evergreen oak) and chestnut are also present but have a lower economic impact.

Forest production value (2017)

€1.25 B

with hardwood for grinding accounting for 38.3% and cork for 33.2%. Figure 9. shows that the GVA of forestry has been between €845 – €900 million between 2013 and 2017 (most recent available data), with its peak in 2015.

The geographical distribution of tree species shows a clear predominance of eucalyptus and pine in the north and centre of the country, and cork and evergreen oak in the south. See Figure 9. and Figure 10. where in the latter North represents the Norte region; Centre the Centro and the metropolitan area of Lisbon; and South the Alentejo and Algarve areas. Forestry in the non-continental parts of Portugal is negligible.

91% of Portuguese forests are owned by private entities, around 6% are owned by local communities and **less than 3% by the State**. Portugal has the highest percentage of privately-owned forest in Europe.

Figure 9. Trend of the Gross Value Added of forestry (M€, Eurostat)

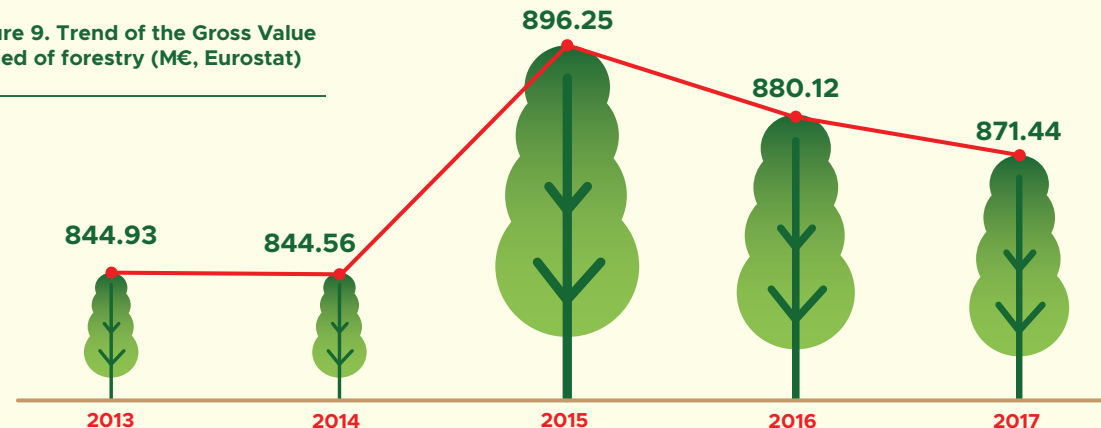
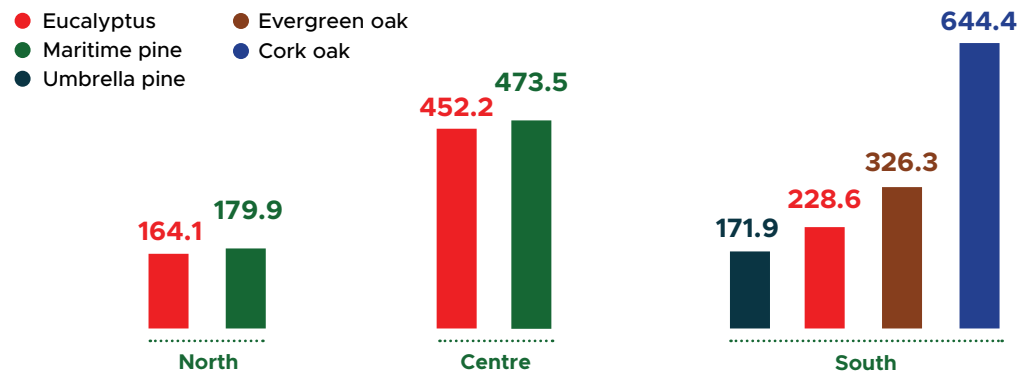


Figure 10. Distribution of tree species in Portugal, per region (thousand hectares)





1.3. Fisheries, aquaculture and the blue economy

The Blue Bioeconomy Roadmap for Portugal published in 2019, shows a dynamic sector. While at present most actors focus on fish as a resource (37%) and food as destination (47%), other resources and applications are gaining considerable attention.

17% of the actors use bacteria, 16% microalgae and 15% macroalgae; and for applications 19% of the actors work with pharma, 18% with cosmetics and 18% with feed and nutraceuticals industries.

The stakeholders involved in the underlying survey predict an increase in the 'new' applications in the years ahead.

Figure 11. Applications of marine biomass





1.3.1. Fisheries

Portuguese fishery has been decreasing in recent years both in terms of vessels (-1% year on year on average from 2016 to 2019) and employment (-5% year on year on average from 2016 to 2019). Despite this, the tonnage of fish caught is increasing. This is undoubtedly the result of higher efficiencies in the fisheries industry.

Catch by Portuguese fleet (2019)

188537_T

↑ 6% compared with previous year

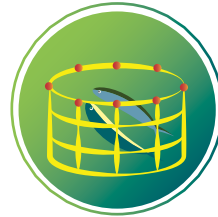


Value of fish caught (sold fresh & chilled, 2019)

€295M

1.3.2. Aquaculture

Aquaculture is still a relatively new and small (albeit growing) sector when compared with fishery.



Aquaculture production (2018)

13992_T

↑ 11.5% compared with previous year

Sea conditions of most of the continental Portuguese coast are not favourable for aquaculture due to the lack of bays or islands shielding installations from the ocean. As a result, aquaculture is largely confined to the estuaries and lagoons along the coast, and to the southern coast of Algarve where milder conditions exist. A new area for aquaculture may develop in Madeira, where water temperature and quality may be favourable.

1.3.3. Algae and other marine resources

The algae research and development and industrial activities are growing in Portugal with a number of actors leading the way.

Algaplus is the leading producer of macroalgae in Portugal, mostly for food use. The production method is partially based on a symbiosis with fish farms in inner waters where effluents from the fish tanks are feeding the algae.

Iberagar is Portugal's leading company in the production of agar, a food and pharmaceutical ingredient derived from algae. Iberagar does not cultivate its algae, but rather gathers wild algae from the sea.

The interest in microalgae is growing in Portugal. Established players include **A4F** (Algae for future), **AllMicroaelgae**, **Buggypower** and **Necton**.

A large research centre and pilot site (a total of 14 ha) named **ALGATEC - Eco Business Park** is currently in development near Lisbon. The centre, by far the largest in Europe, is managed by A4F in cooperation with Solvay and Green Aqua Company.

Other marine bioresources such as cyanobacteria, bacteria and fungi are also surfacing. Up to now they are mainly used by SMEs and research centres, with so-far limited market applications.



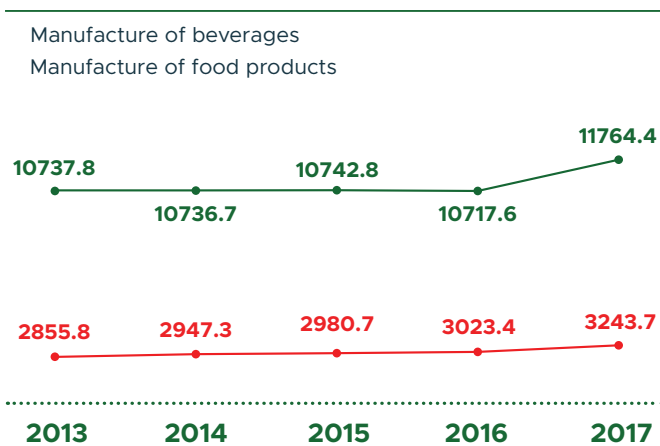
1.4. Food and beverages

The agro-food industry is the largest sector among the processing industries in terms of turnover and GVA and the second in terms of employment.

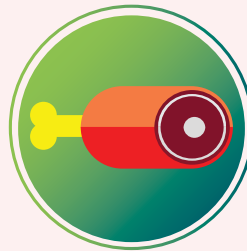
Figure 12. shows the production value of the food and beverage industry between 2013 and 2017 (most recent available data), steadily increasing year on year, with a higher growth in 2017 to exceed €15 billion.

The following sub-chapters highlight the key subsectors of food production in Portugal, each with a non-exhaustive list of main players. These subsectors and associated players can be instrumental in expanding bio-based activities in the country (see chapter 2).

Figure 12. Trend of Gross Value Added of food, beverages and tobacco production (M€, Eurostat)



1.4.1. Meat



Meat processing turnover (2015)

€2.3B

Meat processing is the second largest subsector of the food and beverage industry, representing 15% of the turnover of this industry, following the beverage subsector (Figure 12.) which represents around 20%.

Main players

- ✔ **Valouro:** a large agri-business group (largest in poultry), producing also feed and products for agriculture.
- ✔ **Euroeste:** a large agri-business group primarily active in beef and pork, but also producing feed and products for agriculture.
- ✔ **Lusiaves:** a large producer of poultry meat.
- ✔ **Zezerovo:** a large producer of eggs and poultry meat.

*B = billion



1.4.2. Fish and aquaculture products

With the growing focus on marine, aquatic and fisheries as sources for bio-based industrial activities, this subsector and its actors can play an important role.

The subsector 'processing & preserving fish, crustaceans and molluscs' turnover

€1.2 B



Companies (2015)

150

Main players

- ✓ **Docapesca**: the state-owned company managing the first sale of fish at fish markets.
- ✓ **Oceanic**: a large player in fresh fish.
- ✓ **Grupo Friip**: a producer of frozen food, in particular seafood, operating its own fishing fleet.
- ✓ **Freitasmar**: a fishing and fish processing company.
- ✓ **Frijobel**: a producer of frozen food, including seafood.
- ✓ **Nigel** and **Gelpeixe**: frozen fish producers.
- ✓ **Riberalves** and **Rui Costa e Sousa**: specialists in codfish preservation and distribution.

1.4.3. Beverages

The production of beverages is the leading subsector in the food and beverage industry. This subsector can also participate in new bio-based value chains and adding value to its residual streams.

Turnover beverage production (2015)

€3.1 B



Wine production
€1.6 B



Beer production
€900 M



Softdrinks production
€700 M

The beer market is dominated by two companies, **Superbock Group** (part of the Carlsberg group) and **Sociedade Central de Cervejas** (part of the Heineken group), who jointly own around 90% of the market.

Main players

- ✓ **Sumol+Compal**: the leading national soft drink producer.
- ✓ **Sogrape Vinhos**: a large producer of wine.
- ✓ **Symington**: a large producer of wine and Port wine.



1.4.4. Dairy products



Turnover (2015)

€1.4 B

Dairy production involves over 400 enterprises. Main dairy products are milk, cream, milk powder, yoghurts and cheese.

Main players

- ✓ **Lactogal** is the market leader in dairy products.
- ✓ Other large producers of dairy products include local branches of international groups, such as Bel, Nestlé, Danone and Parmalat, as well as local players **Insulac**, **Lacticínios do Paiva**, **Lactimaf** in the Açores, **Lacto Serra**, **Montiqueijo**, and **Queijaria da Avelada**.
- ✓ At local level, cooperatives unite dairy farmers in a given region. **Vila do Conde** in the Norte region, is one of the largest in the country.

1.4.5. Cereal-based foods, bakery, sweets

Bakery and cereal-based products annual turnover

€1.7 B



600

companies are registered under this sector (mostly small)

Main players

- ✓ **Sidul**, owned by American group ASR, is the largest sugar refinery in Portugal.
- ✓ **Grupo RAR**: a large sugar refinery, active also in other sectors of the agri-businesses.
- ✓ **Cerealis**: the leading producer of flour, baked products and cereals.
- ✓ **Ceres**: a mill and producer of baked products.
- ✓ Other companies include **Fima** (part of Unilever) and Spanish-based **Panrico**.

1.5. Wood products, pulp and paper

Portugal is the global leader in cork production, with 49% of the total global production.¹ The vast majority of Portuguese cork oak is grown in the southern region of Alentejo.

7M The Portuguese pulp and paper industry processes (m³ wood/year)



¹ data from APCOR – Associação Portuguesa da Cortiça



The main species used for papermaking is eucalyptus.¹ Paper mills are generally equipped with energy recovery from biomass residues and contribute significantly to the country's power generation.

According to Portugal's leading pulp and paper producer, the Navigator company, around 5% of the country's power originates from its biomass plants.²

The use of wood for construction and furniture is well represented too, with production mainly in the Norte region.

Main players

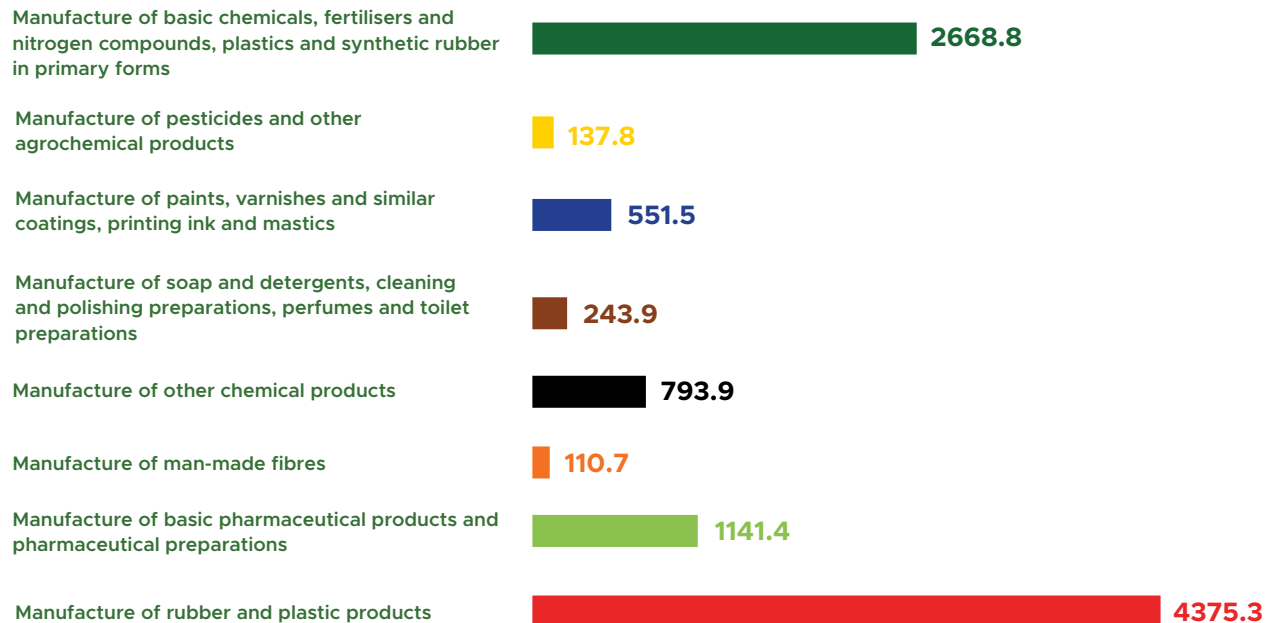
- ✓ **Amorim** is the global leader in manufacturing and processing of cork.
- ✓ **The Navigator Company** is the largest Portuguese stakeholder in the pulp and paper sector.
- ✓ **Altri** and **Renova** are Portuguese pulp and paper producers, with the former operating several paper mills in the country and the latter being a large producer of tissue, toilet paper and personal care products.
- ✓ A major kraftliner paper mill is the **Europac – Viana Paper Mill** in the Minho area, northern Portugal. The mill is part of the DS Smith group.

1.6. Chemical and pharmaceutical industry



Portugal has a significant chemical industry. It represents approximately 12% of total national exports and 20% of manufacturing industry's total expenditure in innovation.³ Basic chemicals, pharmaceutical preparations, rubber and plastics are the main subsectors.

Figure 13. Production value of the chemical sector (M€, Eurostat, 2017)



¹ data from CELPA - Associação da Indústria Papeleira

² Data from the Navigator company

³ Data from APQuímica



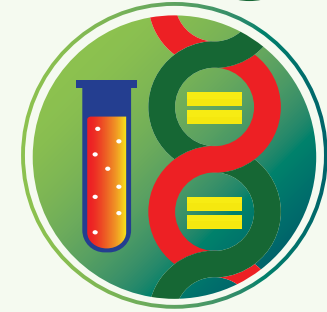
Main players

- ✓ **Bondalti Chemicals** (formerly CUF – Quimicos Industriais): the largest independent chemical industry group in Portugal. It produces both organic (aniline and derivatives) and inorganic (chlor-alkali) chemicals.
- ✓ **Iberol**: produces biodiesel, vegetable oils and bagasse from cereals and oil seed plants.
- ✓ **Hovione**: a large pharmaceutical industry with worldwide presence
- ✓ **Bial**: a global player in pharmaceuticals.
- ✓ **Artlant PTA**, a former European leading PTA producer, was taken over by Thai group Indorama Ventures, the main world producer of integrated PET. Its production site was back in operation in 2018.

Portugal also hosts local branches of international players, such as DOW, Repsol, Solvay and Fertiberia.

1.7. Biotech industry

Portugal has realised a growing industrial activity in biotech in recent years, with the turnover generated by the sector quadrupling from 2006 to 2014.



This performance is probably the result of the positive framework set by the Portuguese government, as well as in the business-oriented mindset of higher education institutions, most of which host incubators. The leading sub-sector is biotech for healthcare, followed by industrial biotechnologies.

Main players

- ✓ **Biocant**: a technology park dedicated to biotech companies and start-ups (see chapters 1.9 and 1.10), hosting 40% of the biotech industries in the country.
- ✓ **Biotrend**: an industrial biotech company focused on developing bioprocesses for several different applications.
- ✓ **Silicolife**: an industrial biotech company specialised in the rational design of microorganisms, providing services to some of the world's largest (bio)chemical multinationals.
- ✓ **73100**: develops a process for the production of innovative bacterial polysaccharides and its monomers.
- ✓ **CarboCode**: an innovation-focused start-up company dedicated to the technology development, production and commercialisation of glycosphingolipids and their precursors/intermediates in pharmaceutical, nutrition, dietary supplement, cosmetics and intermediate industries, with scale-up activities based in Portugal.
- ✓ **Converde**: an agro-biotech company producing and selling worldwide a plant protein-based bio-fungicide.
- ✓ **Tilray Portugal**: plant-based production of cannabinoids.
- ✓ **Amyris Bioproducts Portugal**: subsidiary of **Amyris** dedicated to exploiting its artificial intelligence and informatics platform to design genes for potential molecule development.
- ✓ **Stemmatters**: a spinoff from the University of Minho, develops biomaterials for biomedical applications, in particular in the area of cellular therapeutics.
- ✓ **Biomimetx** develops biodegradable antifouling additives for paints, starting from microorganisms.
- ✓ **TechnoPhage** produces biopharmaceuticals based on bacteriophages, (viruses that infect bacteria). The therapy is effective also on antibiotic-resistant bacteria.



1.8. Other sectors

Textile and leather goods

The textile industry is strong and concentrated in the northern part of the country (more than 60% of the sector turnover is generated in the districts of Braga and Porto). According to sector association ATP, it accounts for 10% of the country's export and **20% of the employment in the manufacturing sector**. Leather is a traditional industry, well established in the north of the country, in particular between Porto, Braga and Guimaraes.



Companies operating in the sector (Source: INE, 2018)

6729

Employees

98800

The leather and textiles industries are export-oriented, with shoes and car interiors as major end products. In 2012, M.J Ferreira concludes in an article that¹



the production of each pair of shoes results in 0.1 to 0.2 kg of leather residues (often contaminated with heavy metals).

If this ratio is unchanged, applying it to the 81 million pairs of shoes exported by Portugal in 2016,² the production of these shoes would have resulted in more than 8 thousand tonnes of leather residues.

Main players

- ✓ **Coindu**: a global manufacturer of textile components for the automotive sector, in particular seat covers, with over 6000 employees worldwide.
- ✓ **TMG**: a large producer of industrial textiles (for automotive) as well as semi-finished products for apparel and clothes.
- ✓ **Lameirinho** and **Riopele** produce fabrics for clothing, furniture and upholstery.

1.9. Cluster and organisations



Portugal has many significant clusters and organisations that support bioeconomy and bio-based research, innovation and industrial activities.

The following is a non-exhaustive list of major actors.

- ✓ **P-BIO** is the national association of biotech industries. Most of its members belong to the pharmaceutical and diagnostics sectors. Among them is BIOCANT Park, a biotechnology incubator located near Coimbra (see 1.7).
- ✓ **BlueBio Alliance** is a cluster of companies and research centres in the field of blue economy. Among its activities is the annual 'Blue Bio Value', a start-up accelerator programme assisting start-ups and young/small companies through mentoring and networking.
- ✓ Portugal also has two associations dedicated to circular economy, **BIOEC** and **CEP**.

¹ M.J. Ferreira, 2012, Contribuições para a Gestão de Resíduos de Couro Curtido com Crómio da Indústria do Calçado

² Data from AICCAPS



- ✓ The Portuguese government approved in 2015 the initiative **Coligação para o Crescimento Verde (Green growth alliance)**, grouping public and private stakeholders to advise the government on the implementation of the green growth commitment. The association has 10 working groups: water, waste, agriculture and forest, energy and climate, transport, industry, biodiversity, cities and landscape, sea, and tourism.
- ✓ **ANMPME – Associação Nacional das Pequenas e Medias Empresas**, is the national association grouping SMEs of all sectors.
- ✓ **IAPMEI - Agência para a Competitividade e Inovação**, is the public institution dedicated to supporting SMEs and promoting innovation and competitiveness. It has territorial branches covering continental Portugal.
- ✓ In 2017, four clusters from the Agri-food industry combined forces in an umbrella cluster, the **Portuguese AgroFood Cluster**. The four founding members are **Portugal Foods** (nationwide food industry cluster), **InovCluster** (farmers' cluster from Centro), **Agrocluster** (farmers' cluster from Ribatejo) and **Portugal Fresh** (nationwide fruit and vegetables producers' cluster). These organisations will continue as independent entities but will set up joint programmes and strategies. The new umbrella cluster will be an interlocutor for the government for drafting strategic agendas for the sector.
- ✓ The Maritime cluster **Oceano21** brings together the naval industry, sea transport and fisheries. The cluster also includes algae producers.
- ✓ **CentroHabitat** groups entities involved in energy efficiency in buildings, among whom are players from the forest (in particular cork) industry.
- ✓ **EnergyIn** focuses on renewable energy, including from biomass.
- ✓ The forest cluster **AIFF** groups all major players along four value chains: bark (in particular cork); wood; pulp and paper; and research and services.
- ✓ **SmartWaste** is the cluster of reference for waste management and conversion. Within SmartWaste, **Interfileiras** groups the organisations dedicated to recycling of specific material categories: wood, metal, paper and cardboard, plastics and glass.
- ✓ **AIPQR** is the cluster of (petro-)chemical industries.

At local level, SMEs often work with technological parks and incubators (see next chapter).
- ✓ **BICMINHO**, in the Norte region, is a regional cluster dedicated to development of local businesses. Together with their homologue in the Galicia Region (Spain), they launched the cross-border initiative Bio Investor to support bioeconomy investment by innovative SMEs.
- ✓ **BLC3** is both a cluster and a technology incubator in the Centro region, specifically for a bioeconomy and biorefineries. BLC3 was the coordinator of the CentroBio project (2014 – 2015), for a sustainable circular economy in the region. It has received several awards at European level, including the RegioStars Award for regional development.



1.10. Academia and research centres

Portugal also has several academic and research centres well-located in all regions of the country in support of bioeconomy and bio-based R&I and industrial activities. The major actors include:

BIOCANT (see also 1.7 and 1.9), located near Coimbra in the Centro region, is a Science and Technology Park entirely dedicated to Biotechnology. It hosts 30 companies.

UPTEC- Parque de Ciência e Tecnologia da Universidade do Porto, the Science and Technology Park connected to Porto University, is the largest of such institutions in the north of Portugal. It has four axes:

1. **Technology;**
2. **Creative industry;**
3. **Sea;**
4. **Biotech.**

It is linked to 205 enterprises (between resident and partners), including its own start-ups. The Biotech axis counts 18 enterprises. UPTEC is also the leading entity in **PortusPark**, the network of incubators in northern Portugal.

In Porto, also the **Catholic University of Porto (UCP)** hosts a renowned School of Biotechnology.

The **University of Minho** in the north of the country hosts **CEB - Centre of Biological Engineering**, a research centre working on four areas:

1. **Industrial Biotechnology and Bioengineering;**
2. **Food Biotechnology and Bioengineering;**
3. **Environmental Biotechnology and Bioengineering;**
4. **Health Biotechnology and Bioengineering.**

LISPOLIS is the Science and Technology Park of Lisbon. It includes 45 resident enterprises, 2 of whom belong to the biotech sector. LISPOLIS focuses on start-up incubation, but also on research spinoff, working in partnership with two departments of the University of Lisbon (the Instituto Tecnico and the Faculdade de Ciencias).

Besides LISPOLIS, Lisbon is home to several fablabs and start-up hubs that, according to the EU Start-ups magazine, is turning the city into '**one of the leading start-up hubs in Europe**'. **Startup Lisboa** groups several of these hubs.

TAGUSPARK, located in Oeiras in the Lisbon region, is home to 93 companies, 3 R&D centres, 1 university (the Instituto Superior Tecnico) and 26 start-ups. The **Agrotech Campus**, also located in Oeiras, is the first technology park in Portugal dedicated to agri, food and feed.

Coimbra, home to the oldest and most prestigious university in Portugal, University of Coimbra, hosts **Instituto Pedro Nunes (IPN)**. IPN is directly linked to the university and is one of the largest technology transfer centres in Portugal. The director informs that it was named Best Science Based Incubator in the world (in 2010) and the combined revenues of incubated and graduated **companies surpassed €120 million (in 2015)**. Also, in Coimbra the local Chamber of Commerce launched the **iPARQUE**.

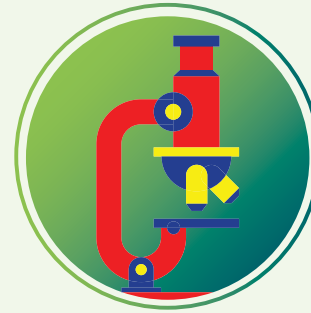


The University of Algarve in Faro also launched a start-up incubator named **CRIA**. Several of the 20 incubated companies operate in precision agriculture and aquaculture. **Sparos** provides research services to companies within the Aquaculture nutrition sector. The appendix includes other Science Parks and incubators in Portugal.

The Portuguese government launched a programme, labeled **INTERFACE**, having the objective of facilitating technology and competence transfer between academia, R&D centres and industry. Under the INTERFACE programme clusters and startups can showcase their areas of expertise and companies can post their open innovation challenges and recruitment offers. The programme also act as coordinator of the CoLab network (see below).

FCT, the national agency supporting scientific development, and ANI, the national agency for innovation, are promoting the creation of public-private entities dedicated to developing market-oriented research, called **Collaborative Laboratories** or CoLab. Several of them are related to the bioeconomy:

- **+Atlantic - Collaborative Laboratory for the Atlantic**
- **AlmaScience** - Cellulose for Sustainable Smart Applications
- B2E - Collaborative Laboratory for Blue Bioeconomy
- **BIOREF** - Collaborative Laboratory for the Biorefineries
- **CoLAB VINES&WINES** - Portuguese vines and wines, competitiveness and sustainability
- **CoLab4Food** - Collaborative Laboratory for Innovation in the Food Industry
- **CeCOLab** - Collaborative Laboratory Towards Circular Economy
- **ForestWISE** - Collaborative Laboratory for Integrated Forest and Fire Wise Management
- **Food4Sustainability CoLAB - I-Danha Food CoLAB**
- GreenCoLAB - Green Ocean Technologies and Products Collaborative Laboratory
- **InnovPlantProtect** - Innovative bio-based solutions for crop protection
- InovFeed - Innovative Feed Strategies for Sustainable Animal Production
- **SFCoLAB** - Smart Farm CoLAB
- **Value4Health.CoLAB** - Portuguese Value-Based Healthcare CoLab



1.11. 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 in designing and upscaling of sustainable and circular value chains. Academic and industrial partners from Portugal 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 Portugal 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 Portugal have been participating also 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:

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


Instituto politecnico de Bragança is a partner in the recently started BBI JU RIA project. In particular, this project explores the use of tree and shrub species cultivated on marginal lands.

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

 Project duration 2016 - 2021

Partners in the consortium include Instituto Superior De Agronomia and LusoSem Produtos Para Agricultura SA. 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.

ABACUS - Algae for a biomass applied to the production of added value compounds

 Project duration 2017 - 2020

Expert companies and organisations in Portugal are also participating in projects to explore and expand the use of algae as feedstock for biorefineries. ABACUS includes A4F as a consortium partner. The project will define market opportunities for algae-derived products and the necessary processing steps to get therefor lead applications in fragrances and nutraceuticals.

MAGNIFICENT - Microalgae As a Green source for Nutritional Ingredients for Food/Feed and Ingredients for Cosmetics by cost-Effective New Technologies


 Project duration 2017 - 2021

The BBI JU RIA project MAGNIFICENT includes Necton, Sparos, AllMicroalgae and Madebiotech as partners. The project will develop and validate processes for cultivation and processing microalgae, converting it into valuable ingredients for food, aquafeed and cosmetics applications.



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

RECOVER - Development of innovative biotic symbiosis for plastic biodegradation and synthesis to solve their end of life challenges in the agriculture and food industries

 Project duration 2020 - 2024


Ingredient Odyssey LDA is a partner in the consortium that will provide novel biotechnological solutions applying microorganisms, enzymes and insects to degrade conventional plastic packaging and agricultural films.

CAFIPLA - Combining carboxylic acid production and fibre recovery as an innovative, cost-effective and sustainable pre-treatment process for heterogeneous bio-waste

 Project duration 2020 - 2023

Biotrend participates in the recently started BBI JU RIA project. The project will develop a breakthrough pre-treatment cascade process for converting heterogeneous bio-waste such as municipal/urban bio-waste, sewage sludge, industrial residues, agricultural harvest residues, etc.

SMARTBOX - Selective Modifications of Aromatic through Biocatalytic Oxidations

 Project duration 2019 - 2023

Universidade Nova de Lisboa partners in the BBI JU RIA project. The project will deliver an advanced computational engineering platform specifically for oxidative enzymes, which can automatically screen for improved enzyme variants with minimal human intervention. This should reduce the time and costs associated with oxidative engineering. Oxidative engineering has the potential to substantially improve the economic and environmental sustainability of biorefineries.

WoodZymes - Extremozymes for wood-based building blocks: From pulp mill to board and insulation products

 Project duration 2018 - 2021

RAIZ and the Navigator Company are partners in the BBI JU RIA project. The objective is to select and apply extremozymes as bio-based replacements for petroleum-based chemicals in processes that require extreme conditions of heat and alkalinity.




AFTERLIFE - Advanced Filtration TEchnologies for the Recovery and Later conversion of relevant Fractions from wastEwater

 Project duration 2017 - 2021

NOVA.ID.FCT is a partner in the BBI JU RIA project. The project will deliver a flexible, cost- and resource-efficient process for recovering and valorising relevant fractions from wastewater. Making this possible and available for demonstration and flagship projects will assist in realising industry's goals of zero-waste and circular bio-based economy.

GRETE - Green chemicals and technologies for the wood-to-textile value chain

 Project duration 2019 - 2023

The BBI JU RIA project GRETE will develop technologies to use paper-grade pulps from softwood and hardwood sources as raw material for man-made textile fibres. Successful delivery of these technologies will widen the sustainable raw material basis for man-made cellulose fibres (wood-to-textile). Partners in the project include Universidade de Aveiro and Celbi (part of the Altri group).

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

NENU2PHAR - For a sustainable and European value chain of PHA-based materials for high-volume consumer products

 Project duration 2020 - 2024

Addressing the environmental issues of plastics, Biotrend participates in the BBI JU RIA project NENU2PHAR. The project will develop renewable, biodegradable polyesters based on polyhydroxyalkanoates (PHAs) for high-volume consumer products.

USABLE PACKAGING - Unlocking the potential of sustainable biodegradable packaging

 Project duration 2019 - 2022

Aiming at increasing the market share of bioplastics, is the BBI JU RIA project USABLE PACKAGING project. Sonae Mc and Nova.Id.FCT are partners in the consortium to develop new applications for bioplastics based on PHAs in a wide range of applications (rigid, semi-rigid and flexible packaging). The new value chain will create a loop between the food industry and the bioplastics industry by routing food industry waste to the bioplastics industry.



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 Portugal, 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 chains 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 Portugal, benefitting all.

2.1. Bio-based residue: availability and use

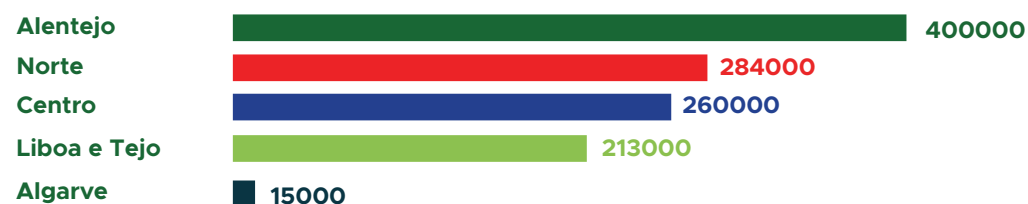
2.1.1. Agricultural residues

Updated statistics from the National Institute of Statistics (INE) are only available as aggregates of agriculture, forestry and fisheries. See chapter 2.1.3.

Detailed data on the composition and origin of residues from agriculture and forestry are available from the national project ENGASP, done in 2014. The project's objective has been to specify the potential calorific value of each biomass or residual stream from agriculture. Its report contains data that are not very recent, but they give an indication of the nature and geographic distribution of agricultural residues.

The following regions in Portugal produce the below-mentioned quantities of **agricultural residues (2014)**:

Figure 14. Agricultural residues per region (T/year, 2007)



The total amount of agricultural residues (waste) generated in Portugal (about 1172000 ton in 2014), shown in Figure 14. is not always available for use as biomass. Straw for example, are primarily used in animal feed and the manufacture of beds for livestock, thus achieving quite some commercial value.



Having been looked at for use in energy production primarily, these residues are now also being evaluated in research projects as a source for material production.

The dry residue per crop type differs as shown in Figure 15. depending on the annual production of each. Corn with the highest annual production also produces most residues.

Cultivation of olive and grape is significant in Portugal and hence also the associated residues quantities. Figure 16. shows the dry residues from the olive industry per region, with the peak in Alentejo, the region that dominates olives production.

Effluents and residues from olive oil production are disposed of at a cost and may pose environmental issues if not correctly managed.

The wine producing industry is more evenly spread across the country with resultant significant grape residues available in almost all regions as shown in Figure 17.

From the above it is clear that there are significant quantities of agricultural wastes in Portugal, but the current disposal of all these quantities is not clear, see Figure 14.

Figure 15. Agricultural residues per species, annual crops (T/year, 2012)

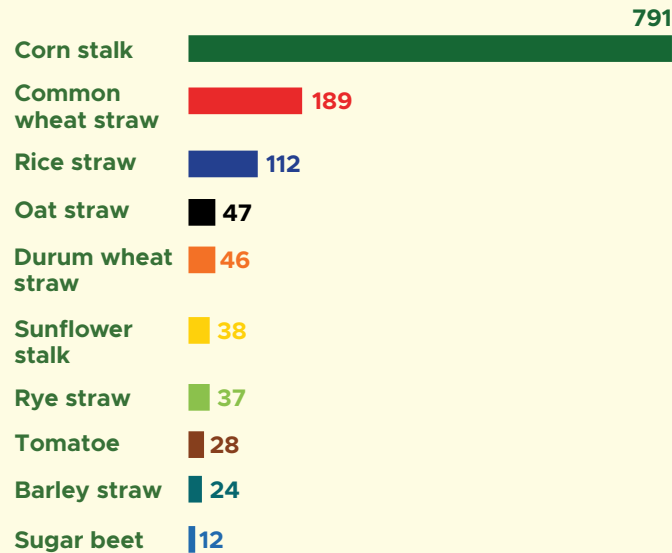
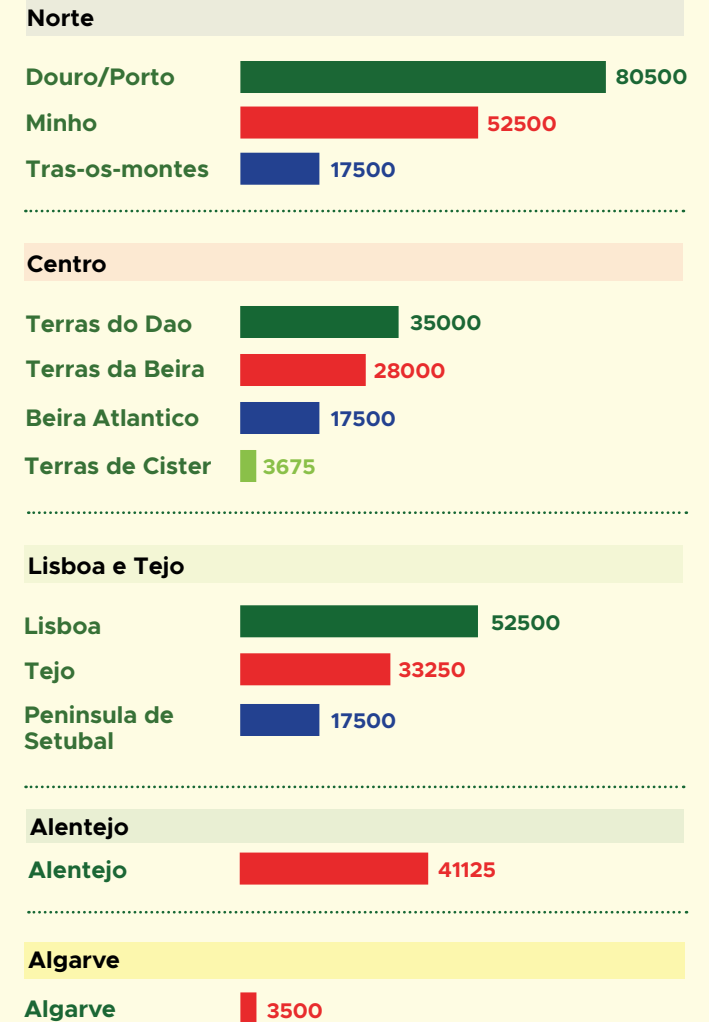


Figure 16. Olive residues per region (T/year, 2012)

Region	Olive oil districts	Dry residues
Norte	Entre Douro e Minho	528
	Tras-os-Montes	45159
Centro	Beira Litoral	8604
	Beira Interior	28401
	Ribatejo e Oeste	15324
Alentejo	Alentejo	98446
Algarve	Algarve	5039

Figure 17. Vineyard residues per region (T/year, 2012)





2.1.2. Forestry residues

The ENGASP project (published in 2014, see above) also provides quantities of the available residues from forestry, shown in Figure 18.

A more **recent publication by scholars at the University of Aveiro**, refers to the ENGASP project stating that the annual production of wastes from forest felling and wastes from wood processing varies from about 1.7 to 2.5 million dry tonnes per year. It also states that the wastes from forest felling represents about 47 to 58% of the total logging wastes available in the country (corresponding with the data in table 2.5).

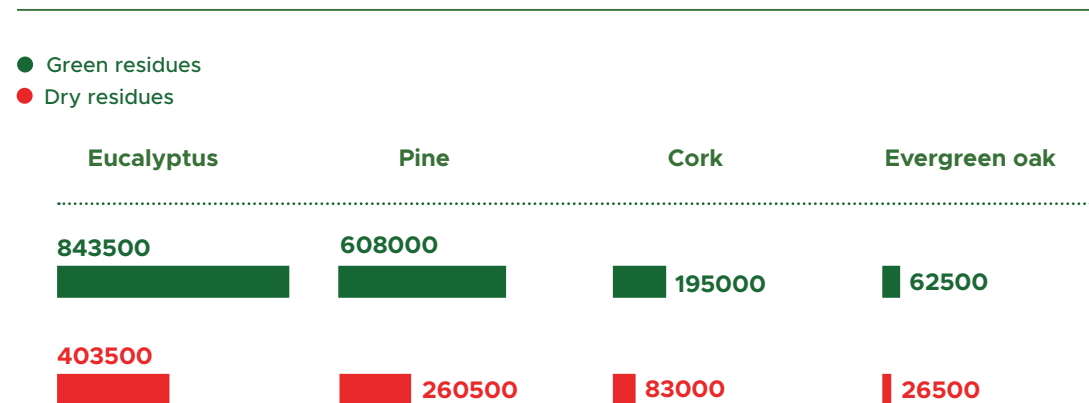
A decree-law in Portugal in 2010 encourages electricity production from forest waste to reduce greenhouse gas emissions, promote forest wastes harvesting and reduce wildfire hazard. In 2017, electricity from forest wastes accounted for about 2% of the installed capacity in Portugal. This share is expected to increase in the years ahead. The largest part of the forest wastes to electricity is from eucalyptus.

Even though electricity production is a big utilisation area for forestry residues, there are

significant opportunities to valorise (part of) these residues into products and services via the bio-based industry. See sub-chapter 2.1.3.

Specific and detailed information of residual streams from other primary sectors such as fisheries, aquaculture and horticulture are not available. However, fisheries are included in accumulated data on residues with agriculture and forestry. See sub-chapter 2.1.3.

Figure 18. **Forest residues per species (T/year, 2006)**





2.1.3. Current disposal of residues from bio-based activities

Data from the Statistics Portugal (INE) show that the waste streams result largely from the processing stages rather than at primary production. Figure 19. and Figure 20. provide an overview of quantities of residual streams from the primary sectors and their secondary value chains and their current disposal routes. The data includes both full and partial bio-based streams.

Figure 19. Different waste management and disposal routes by industrial sector (T, 2018) (Source: INE)

	Recovery			Disposal				
	To energy	Excluding energy	Other	Incineration	Landfill	Treatment on land or release into water bodies	Preparator and steps	Other
Agriculture, animal production, hunting, forestry and fishing	314	28478	29763	6	1373	0	201	939
Manufacture of food, beverages and tobacco	439	96142	135818	3728	17496	0	4513	9107
Manufacture of textiles and clothing, leather and related products	8	19515	92201	-	18994	0	625	5691
Manufacture of wood and of products of wood and cork (except furniture), manufacture of articles of straw and plaiting materials	19	36287	89182	0	4753	0	2572	4900
Manufacture of pulp, paper, cardboard and paper products, printing and reproduction of recorded media	1342	171040	271485	0	124967	0	4882	4157
Total	2122 0.18%	969911 82.06%						209903 17.76%



Figure 19. shows that considerable amounts of residual streams from all industrial sectors find other recovery routes than energy. In addition, other large amounts of these streams are disposed of, often at a cost. Figure 20. is a graphical representation of Figure 19.

Looking at ‘recovery excluding energy’ into more detail as shown in Figure 21. indicates that about 75% of these recovered streams are recycled to recover organic substances. It is not clear what the subsequent applications of these substances are. The pulp and paper and the food and beverages industries are the largest sources of residual streams. Most of the residual streams that are recovered but not used for energy, totalling about 386 thousand tonnes in 2018, can probably be considered as potential feedstock for the bio-based industry.

Figure 20. Waste disposal by industrial sector and end-of-life management – bioindustry only (T, 2018) (Source: INE)

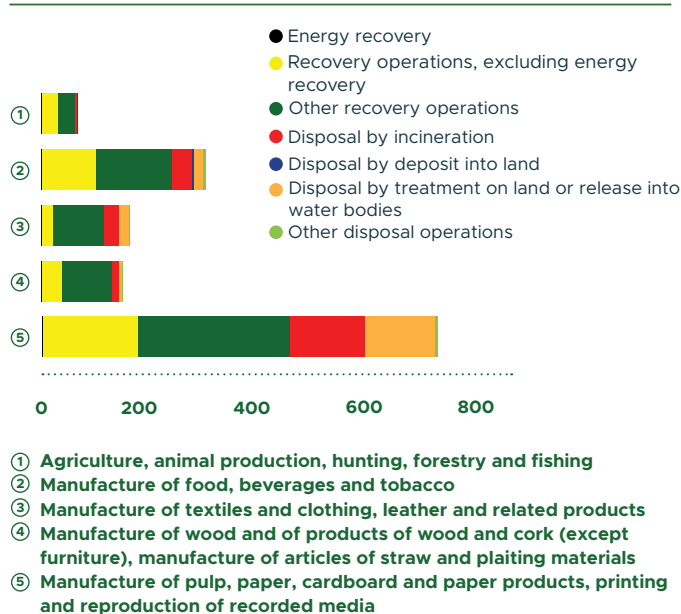


Figure 21. Details of t waste management ‘Recovery operations, excluding energy recovery’ (T, 2018) (Source: INE)

	TOTAL - Recovery operations, excluding energy recovery	Recycling/reclamation of organic substances which are not used as solvents	Oil re-refining or other reuses of oil	Land treatment resulting in benefit to agriculture or ecological improvement	Other operations
Agriculture, animal production, hunting, forestry and fishing	28478	11112	140	12972	4254
Manufacture of food, beverages and tobacco	96142	77505	953	11137	6547
Manufacture of textiles and clothing, leather and related products	19515	9561	17	107	9830
Manufacture of wood and of products of wood and cork (except furniture), manufacture of articles of straw and plaiting materials	36287	32072	17	390	3808
Manufacture of pulp, paper, cardboard and paper products, printing and reproduction of recorded media	171040	152161	90	4588	14201
Agriculture, animal production, hunting, forestry and fishing	34630	9047	413	412	24758
Total	386092	291458	1630	29606	63398
		75.49%	0.42%	7.67%	16.42%



2.1.4. Organic fraction of Municipal Solid Waste

While recycling and valorisation of waste have considerably improved over the last decade, landfill ('as is' or after treatment) is still the final destination for 58.3% of the total MSW generated; 16% goes to energy production, 12.9% to recycling, 8.4% to composting or anaerobic digestion and 4.3% to **other valorisation**.

The separate collection of organic fractions of municipal solid waste (OFMSW) has reached 115 thousand tonnes in 2016*, but most of OFMSW (918 thousand tonnes in 2016) **still end up in mixed streams and is landfilled**. There are large-scale anaerobic digestion plants, such as **Valorsul** and **Tratolixo**, both in the larger Lisbon area, which could provide opportunities for further carbon valorisation through the use of volatile fatty acids as fermentation carbon source.

CAFIPLA, a BBI JU project that started in June 2020 and will run till end of May 2023, will be applying this principle to create useable bio-waste for the bio-based industry. Biotrend is a partner in this project.

The statistics do not specify the organic fraction of the MSW. But analysing the average composition of MSW as reported by APA in Figure 23, it is possible to make an estimate of the OFMSW.

From this composition, it appears that 50,8% of the generated MSW is bio-based. Applying this percentage to the total MSW generated in 2018 yields 2.68 million tonnes OFMSW in that year.

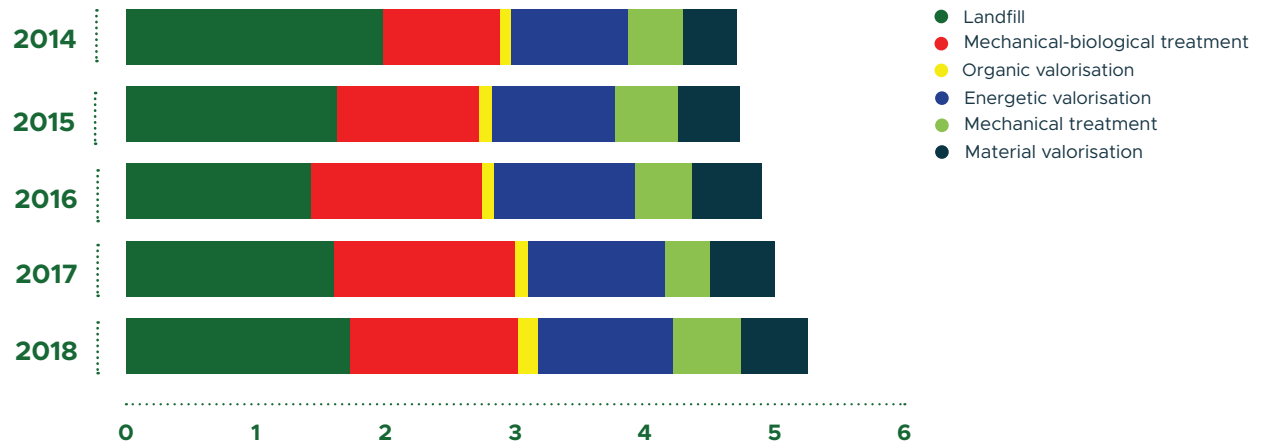
In 2018, 1.03 million tonnes of the OFMSW was landfilled representing 38.4% of the total generated OFMSW. Separately collected biodegradable MSW in 2018 is broken down as shown in Figure 24.

In 2018, total separately collected OFMSW totalled 304 thousand tonnes, only 13% of the total generated OFMSW. It is expected that this separate collection will increase because of the revised Article 22 in the **Waste Framework Directive**. The revised article requires that 'by 31 December 2023, bio-waste is either separated or recycled at source, or is collected separately and is not mixed with other types of waste'.

In July 2020, the government issued strategic guidelines for the OFMSW with the following objectives:

- ensure a transition to the selective collection of bio-waste and the use of installed composting capacity and anaerobic digestion, gradually replacing the sources of undifferentiated collection;
- promote the use of compost resulting from the valorisation of bio-waste;
- promote the installation of equipment that allows the recovery of biogas from anaerobic digestion facilities.

Figure 22. Trend in management of MSW (MT, 2018) (Source: APA)



* INEP, Resíduos urbanos recolhidos (t) por Localização geográfica (NUTS – 2013) e Tipo de material reciclável; Anual (5)



Figure 23. Average composition of MSW

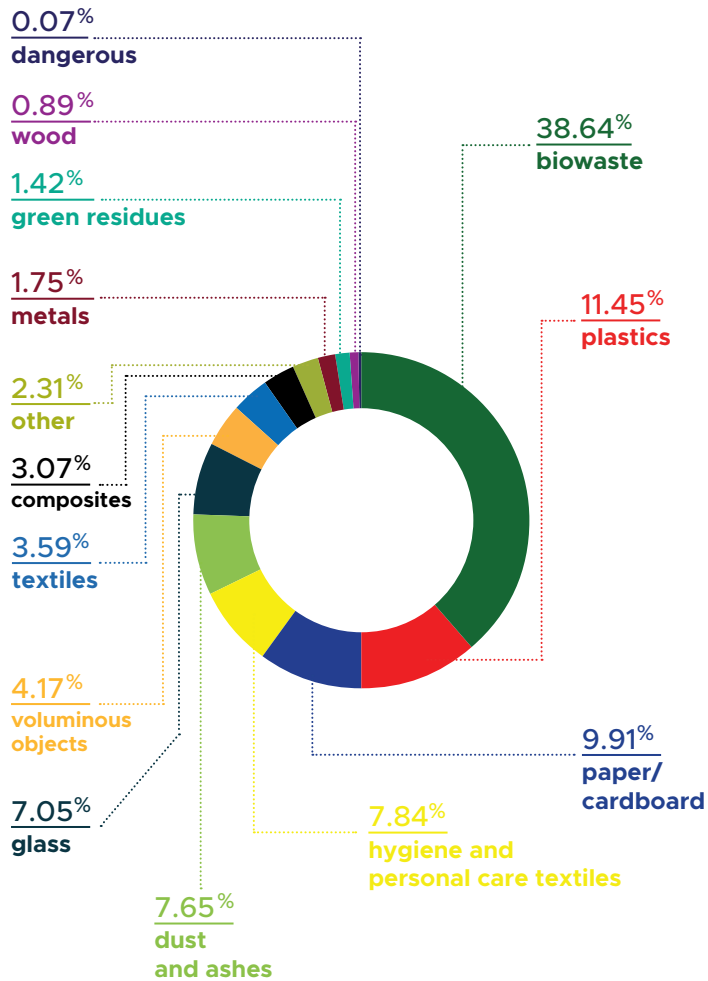
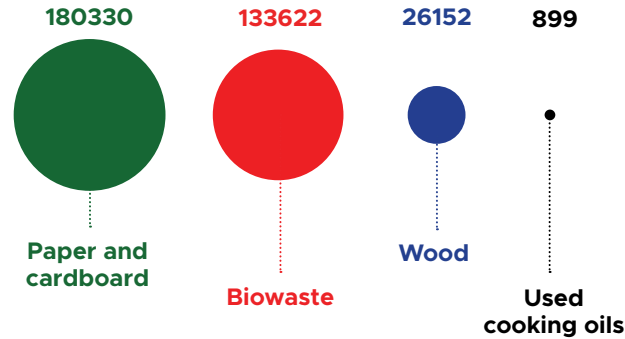


Figure 24. Bio-based fractions of MSW collected separately (T, 2018) (Source: INE*)



2.2. Bioeconomy strategies and programmes

2.2.1. National strategy

Portugal's **Smart Specialisation Strategy** published in 2015, with a multi-level structure of a national and seven regional strategies (for the seven Portuguese regions), does not have bioeconomy as one of the five axes nor of the 15 associated national priority themes. Neither does it specify the sources of 'residual biomass streams' (generally referred to as 'biomassa'). It mentions energy as the major use for these streams, with some references to biofuels and biomaterials.

But the strategy does include bioeconomy components under various themes in the axes.



Axis 1 'Commodities and materials', considers residual biomass from agriculture, forest and food processing mostly as a potential source of energy. Biofuels are mentioned as well, but no reference is made to biochemicals nor (advanced) biomaterials.

* INE, Resíduos urbanos recolhidos (t) por Localização geográfica (NUTS - 2013) e Tipo de material reciclável; Anual



Axis 2 'Product and process technologies', features a 'green chemistry' topic focusing on re-use of products and raw materials, energy efficiency and efficient chemical processes.



Axis 3 'Transport, space and logistics', mentions 'new fuels' as an innovation area.



Axis 4 'Natural resources and environment', includes topics on 'energy efficiency, reduction and reuse of rural residues' and 'advanced technologies (biotechnologies, synthetic biology)' under the Agro-food theme; topics on 'sustainable production of raw and derived materials from forest (including reduction of residues and re-use of biomass)' under the Forestry theme; topics on 'resource efficiency, valorisation of by-products and smart packaging' under the Marine theme. Waste is also treated under Axis 4, with a topic on waste treatment and valorisation systems.



Axis 5 'Health and wellbeing', has a reference to biomaterials both under the Health theme and under the Habitat theme.

The regional strategies include some elements of bioeconomy as smart specialisation priorities, with blue economy as a recurring theme:

- Açores: couple 'blue economy' with 'food industry';
- Alentejo: 'blue economy', 'agro and forestry' and 'food industry';
- Algarve: 'blue economy' and 'fisheries';
- Centro: 'agro industry' and 'blue economy';
- Lisboa: 'biotechnology' in addition to 'blue economy';
- Madeira: 'maritime bio-sustainability';
- Norte: 'maritime resources and environment' as one of its development lines, and 'biotechnology' as one of the priority areas;

The Ministry for the Environment and Climate Action is preparing a strategic document for **Sustainable Bioeconomy (the Sustainable Bioeconomy Action Plan)**, as foreseen in the Government Programme. As the promoter of this strategic document, the Ministry for the Environment and Climate Action actively promoted the integration of various economic sectors and public policies by establishing an inter-ministerial group which ensured articulation between different relevant ministries. In the context of the CAP (Common Agricultural Policy) the Ministry of Agriculture is also developing a bio-economy study on "Structuring and systematising strategic lines for the agroforestry sector. See also [overview on Portugal in JRC's database](#).

National Circular Economy Action Plan aims to develop new economically viable and ecologically efficient products and services, rooted in ideally perpetual cycles of conversion upstream and downstream. The goals are minimising resource extraction, maximising reuse, increasing efficiency and developing new business models.

The **Blue Bioeconomy Roadmap for Portugal**, endorsed by the Minister for the Sea and BlueBio Alliance, was published in 2019. It defines challenges, opportunities and development lines for the Portuguese marine bio-based economy until 2030.

National Plan for the Promotion of Biorefineries, is a strategy for 2030 to promote all types of advanced biorefineries, in the national territory, utilising a variety of feedstocks ranging from underutilised biomass to residual or low-valued streams, such as from agricultural and forestry sources.



3. POTENTIAL USE/VALORISATION OF BIO-BASED STREAMS

Portugal 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 very strong agriculture and forestry sectors and strong fishing and aquaculture sectors. Portugal's chemical and biotech industries are significant as well as other sectors like wood products, pulp and paper and textile.

With this economic power, Portugal also has the innovation power to rapidly expand bio-based industrial activities on regional and national levels and become a strong partner in the European bioeconomy. On the [European innovation scoreboard 2020](#), Portugal moved from a moderate innovator to join the group of strong innovators.

The quantities of the different residual biomass streams in Portugal shown in chapter 2 are sufficient to produce biochemicals on commercial levels*. However, [currently there are not many biorefineries located in Portugal](#) and those present mainly [use forestry-based feedstock](#) to produce [chemicals, composites and](#)

[fibres, and liquid biofuels](#). Most of the attractive feedstock for bio-based operations and valorisation into added-value products and services are either unused, incinerated, landfilled or achieve relatively low value.

The [Bio-based Industries Consortium \(BIC\)](#) offers assistance 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 Portugal, 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 the Bio-based Industries Joint Undertaking (BBI JU) programme, executing the strategic innovation and research agenda (SIRA) of BIC. The BBI JU is an industry-led PPP between BIC and the European Commission. BIC and the Commission agree on annual work programmes that will be opened as annual calls for proposals to any and all actors in the bioeconomy fields. BBI JU started under Horizon 2020 (2014-2020) and since 2014 and through the 2019 call there are 124 granted projects at different technology readiness levels (TRLs) and Coordination and Support Actions (CSA). The objective of the BBI JU programme is to assist an accelerated commercialisation of excellent, innovative solutions for societal challenges towards a sustainable future.

Actors in Portugal participated in 22 of 124 granted BBI JU projects so far (2014-2019):

14 RIA projects
RIA projects end at TRLs 4-5, as Pilot plants

5 demonstration projects

demonstration projects end at pre-commercial levels TRLs 6-7

3 CSA projects

Among the granted BBI JU demonstration projects, is [MULTI-STR3AM](#), the first project at this TRL that is coordinated and led by a Portuguese partner: A4F. This project will include major investments in Portugal.

Participating in international projects like the granted BBI JU projects provides the opportunity to contribute with relevant knowledge and expertise and gaining more insight in bio-based opportunities. These gained insights and partnerships across sectoral and geographical boundaries should enable actors in Portugal to step up bio-based activities at all levels in the country itself. A strong bio-based industry and sector in Portugal will also benefit Europe.

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

* [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.](#)

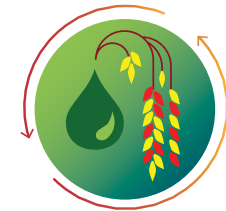


3.1. BBI JU projects of interest

Portugal has substantial residual biomass available from agriculture, forestry, fisheries, algae and aquaculture, manufacture of food and beverages and 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 Portugal. These projects are to serve as examples to further increase utilisation and to show the potential of these streams in Portugal. The selection is made on feedstock used, not on the actors in the projects' consortia. Actors in Portugal participate in some of the listed projects.

3.1.1. Crop residues



LIGNOFLAG: Converting wheat straw into bioethanol

Project description

lignoflag-project.eu

Type of action : IA - Flagship

Duration :
06/2017 - 05/2022

Overall budget :
€34.9M

Pilot plant location(s) :
Romania

The LIGNOFLAG project demonstrates an integrated and whole value chain-oriented approach to drive forth the bio-based production of ethanol as sustainable transport fuel or chemical building block. The project approach involves the collaboration of the relevant actors along the whole value chain – from feedstock (straw) supply and logistics via

process co-products (lignin as biochar, sludge as fertilizer) utilisation and valorisation to advanced bio-ethanol production and product distribution. The core part of the project is the first-of-a-kind commercial flagship plant for lignocellulosic feedstock to ethanol conversion (60000 tonnes/year) that serves to showcase the techno-economic viability of an innovative bio-refinery concept and shall boost EU bio-ethanol production.

Coordinator : Clariant (Germany) | Biomass(es) : Wheat straw | Process(es) : Enzymatic conversion

Product(s) : Primary product: bioethanol/ Secondary product: biochar, fertilisers



OPTISOCEM: Converting wheat straw into green chemicals

Project description

optisochem.eu

Type of action : IA – Demo

Duration :
06/2017 - 05/2021

Overall budget :
€16.3M

Pilot plant location(s) :
Germany

OPTISOCEM's goal 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-Isobutene (bio-IBN) derivatives. To achieve these goals a team of 6 partners, leaders in their field, originating from 4 EU Member States, will join efforts. OPTISOCEM consists in showcasing the technical accessibility and economical sustainability

of the value chains, from wheat straw to 2 different families of chemicals derived from bio-based Isobutene (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-based IBN, using the same process as fossil-based IBN, and with at least as good performances, 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

Project description

excornseed.eu

Type of action : RIA

Duration :
06/2018 - 11/2021

Overall budget :
€4.5M

Pilot plant location(s) :
Italy, Slovakia

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

Project description

agrimax-project.eu

Type of action : IA - Demo

Duration :
10/2016 – 09/2020

Overall budget :
€15.5M

Pilot plant location(s) :
Spain, Italy

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: Proteins from cereal side-streams

Project description

prominent-protein.eu

Type of action : RIA

Duration :
01/2015 – 10/2018

Overall budget :
€3.1M

Pilot plant location(s) :
Finland

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, and we will work throughout the agro-industrial value chain to valorise that. The main aim of PROMINENT is to develop

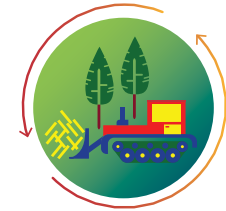
techno-economically and environmentally viable protein-based ingredients and foods from cereal processing side streams. We will concentrate on novel fractionation and extraction technologies, such as bioprocessing, supercritical carbon dioxide (SC-CO₂) -extraction, thermo-mechanical technologies, wet 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: High purity lignin and platform chemicals from wood-based sugars

Project description

sweetwoods.eu

Type of action : IA - Flagship

Duration :
06/2018 – 05/2022

Overall budget :
€43.2M

Pilot plant location(s) :
Estonia

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 a 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 CO₂ capture. It also has the potential to replace many fossil-based products.

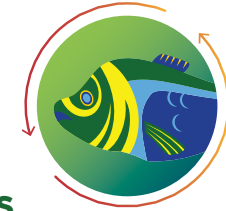
However, commercialisation of MFC has proved to be challenging, particularly making industrial quantities with sufficient running efficiency and stability. In addition, drying the MFC fibres in a cost-effective manner without losing significant performance is a major challenge. The EXILVA project sets 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. Fisheries, algae and aquaculture



MULTI-STR3AM - A sustainable multi-strain, multi-method, multi-product microalgae biorefinery integrating industrial side streams to create high-value products for food, feed and fragrance

Project description

multistr3am.eu

Type of action : IA – Demo

Duration :
05/2020 – 04/2024

Overall budget :
€9.1 M

Pilot plant location(s) :
Portugal

The project aims at demonstrating a multi-strain biorefinery based on microalgae, producing seven consumer products including lipids for edible spreads; protein, carbohydrates and lipids for feed ingredients for poultry, pigs and ruminants; and

protein and small organic compounds as building blocks for the fragrance industry. The main technical challenge of the project is to overcome the scale barriers that have so far prevented economically viable large-scale exploitation of microalgae as feedstock for the bio-based industry.

Coordinator : A4F (Portugal). Partners include : the Instituto de Biologia Experimental e Tecnologica (iBET) and Laboratorio Nacional de Energia e Geologia P.i (LNEG) | Biomass(es) : Microalgae

Process(es) : multi-strain, multi-method, multi-product biorefinery

Product(s) : Lipids for edible spreads; protein, carbohydrates and lipids for feed ingredients for poultry, pigs and ruminants and protein and small organic compounds as building blocks for the fragrance industry

NENU2PHAR – For a sustainable and European value chain of PHA-based materials for high-volume consumer products

Project description

nenu2phar.eu

Type of action : RIA

Duration :
09/2020 – 02/2024

Overall budget :
€5.0 M

Pilot plant location(s) :
France, Portugal, Belgium

The overarching objective of the project is to develop a viable alternative to existing petrochemical-based plastics that are sustainable and biodegradable.

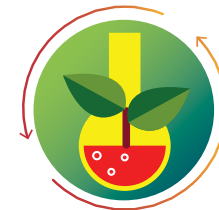
Among others, it will develop a competitive bio-source of PHAs polymers that are sustainable, from environmental and economic perspectives.

Coordinator : CEA (France) | Biomass(es) : Microalgae | Process(es) : multi-strain, multi-method, multi-product biorefinery

Product(s) : Biopolymers (PHA, starch), master batch compounds as well as several bioplastic products



3.1.4. 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

Project description

urbiofin.eu

Type of action : IA - Demo

Duration :
06/2017 – 05/2021

Overall budget :
€14.6M

Pilot plant location(s) :
Spain

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 (polyhydroxyalkanoate and biocomposites) or additives (microalgae hydrolysed 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 Alcludia (Spain) | **Biomass(es) :** OFMSW | **Process(es) :** Hydrolysis, fermentation

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



NEWFERT – Mineral fertilisers from bio-waste

Project description

newfert.org

Type of action : RIA

Duration :
07/2105 – 12/2018

Overall budget :
€2.4M

Pilot plant location(s) :
Spain

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) : Fertilisers



CAFIPLA – Combining carboxylic acid production and fibre recovery as an innovative, cost effective and sustainable pre-treatment process for heterogenous bio-waste

Project description

cafipla.eu

Type of action : RIA

Duration :
06/2020 – 05/2023

Overall budget :
€4.9M

Pilot plant location(s) :
Spain

The objective of CAFIPLA is to unlock the potential of currently un(der)used bio-waste as feedstock for the bioeconomy, by implementing a new pragmatic approach to biomass pre-treatment. As opposed to usual sugar/starch bio-economy schemes, the

CAFIPLA project relies on the combination of a Carboxylic Acid Platform (CAP) and a Fibre Recovery Platform (FRP), to valorise biomass into biochemicals, bioproducts, feed and biomaterials.

Coordinator : Fundació Tecnalia (Spain) | Biomass(es): heterogeneous bio-waste

Process(es) : Separation, conversion

Product(s) : From lignin: from the carboxylic acid platform: microbial protein, PHA and caproic acid biooil; from the fibre platform: fibres for packaging and insulation

3.1.5. Food industry residues



GREENPROTEIN: Valorisation of vegetable processing industry residues into functional proteins

Project description

greenproteinproject.eu

Type of action : IA – Demo

Duration :
09/2016 – 02/2021

Overall budget :
€5.5M

Pilot plant location(s) :
The Netherlands

The economic costs of food waste are reckoned to total 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 percent 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

Project description

pulp2value.eu

Type of action : IA - Demo

Duration :
07/2015 – 06/2019

Overall budget :
€11.4M

Pilot plant location(s) :
The Netherlands

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 it 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



FUNGUSCHAIN: Valorisation of mushroom offcuts to obtain high-value products

Project description

funguschain.eu

Type of action : IA-Demo

Duration :
11/2016 – 04/2021

Overall budget :
€8.1 M

Pilot plant location(s) :
Ireland

The FUNGUSCHAIN project aims to extract value from the agricultural offcuts of commercial mushroom farming. It seeks to process these offcuts into bio-based functional additives and biopolymers using a cascading approach to separate the valuable components into a spectrum of products. It also seeks to prove its industrial viability by building

a new biorefinery and modifying industrial current manufacturing lines. The biomolecules and building blocks isolated from the mushroom wastes will be validated for industrial production in three value chains for the European economy, notably food supplements for the elderly, plastic products and industrial film products such as bags and gloves.

Coordinator : BioDetection Systems BV | Biomass(es) : Mushroom offcuts

Process(es) : Extraction, saccharification, fermentation

Product(s) : Bio-based anti-microbial agents for household products, proteins for food supplements and bioplastics

3.2. Local actors already active in BIC or BBI JU projects

A4F and Biotrend are **BIC Full Members** active in several projects in BBI and other programmes. RAIZ, a research centre linked to the Navigator Company, is a **BIC Associate Member**.

Energia e Geologia, The Navigator Company, Ingredient Odyssey, Instituto Politecnico de Bragança, Universidade de Aveiro, Celbi, Lusosem, Valbopan, Necton, Sparos, AllMicroalgae, Madebiotech, Sonae, Universidade Nova de Lisboa, Nova Id FCT, CENTITVC, GLOBAZ are active in BBI projects.

Instituto Superior De Agronomia, Instituto de Biologia Experimental e Tecnologica, Laboratorio Nacional de



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 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 increase 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;

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 will find its continuation 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.

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



€2.6 B

Mobilised from EFSI in Portugal

€9.5 B

Additional investment expected to be triggered as a result

41

Projects approved in the country

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

Company : Riberalves

Type of business : Food industry

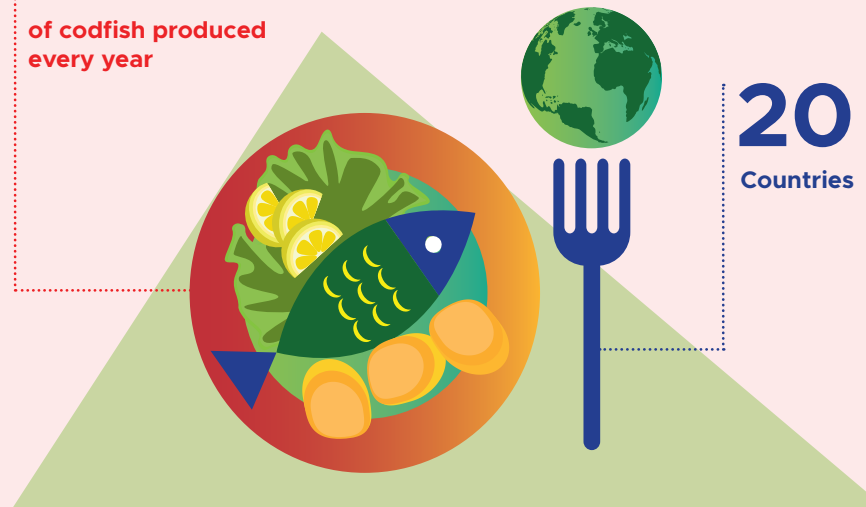
EIF Financing : InnovFin

Financial intermediary : BPI

Title : Expanding the codfish market

30000 T

of codfish produced every year



20 Countries

Description

Riberalves is a food-processing company in Portugal, looking for new ways to present the national dish – codfish – to consumers with the objective of expanding to new markets. The company produces more than 30,000 tons of codfish every year, equivalent to 8-10% of all codfish caught worldwide, and operates the largest industrial facility in the world exclusively devoted to codfish processing based in Moita, Portugal. To expand its production capacity, Riberalves secured a loan from Banco BPI, guaranteed by the Juncker Plan. The company's de-salted codfish now reaches customers in over 20 countries.



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 €250 million. Reaching the target fund volume was scheduled for a first close in Q1 2020.

3.3.3. Country-specific EIF initiatives

EIF is advising, sponsoring or managing a number of 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 Portugal, it is supporting the Portugal Growth programme together with the Portuguese national promotional institution, Instituição Financeira de Desenvolvimento (IFD). The programme represents a €100 million investment with EIF and IFD each contributing €50 million.

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 **European Maritime and Fisheries Fund (EMFF)**, supports the implementation of the reformed Common Fisheries Policy (CFP) and the EU Integrated Maritime Policy.

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 the funding period 2014-2020 are highlighted.

Portugal is eligible for projects under theme 'agriculture', while only Norte, Centro and the area of Lisbon are eligible for projects on waste management. No Portuguese region has set 'biorefinery' as a theme in its S3.



Figure 25. EU Regions with Bioeconomy R&I Priorities

● Agriculture ● Waste Processing

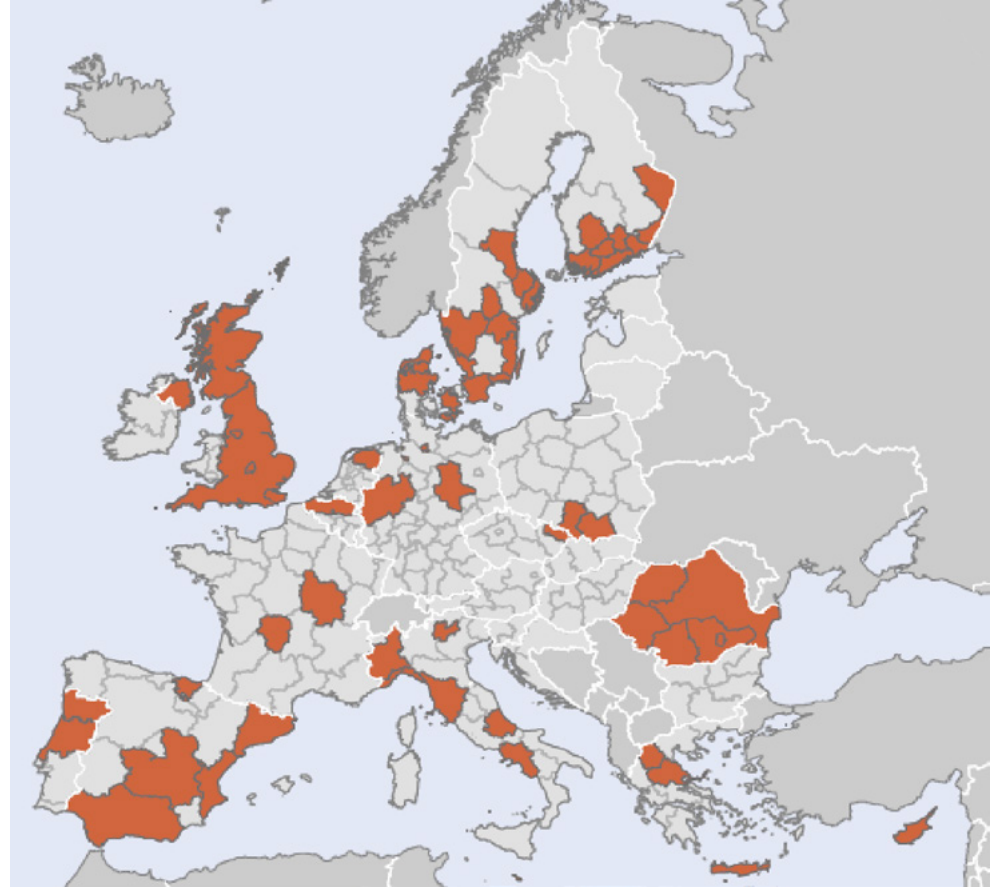
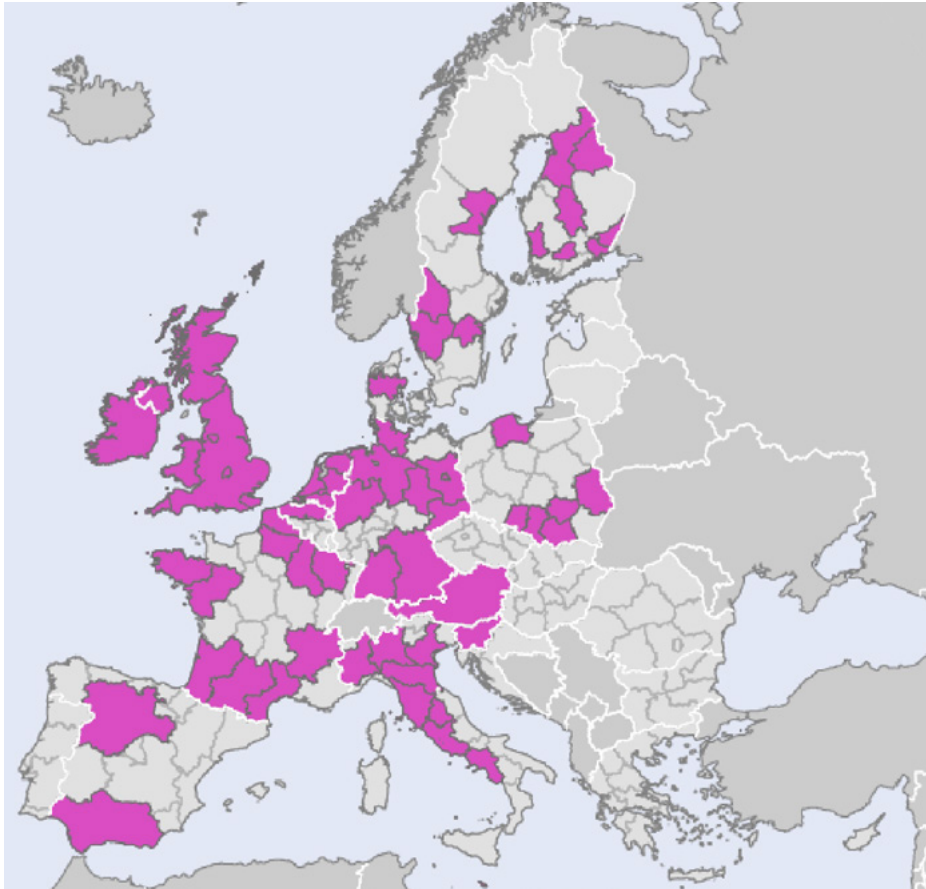




Figure 25. EU Regions with Bioeconomy R&I Priorities

● 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.

Portugal is eligible for EBRD funds.



4. APPENDIX: FIGURES

4.1. Agriculture

4.2. Food and beverages

4.3. Wood products and pulp & papers

4.4. Chemical and pharmaceutical industry

4.5. Technology parks

4.6. Bio-based research and other projects in Portugal

Figure 4.1. Map of land use in Portugal



CORINE Land Cover types - 2016

(CORINE: coordination of information on the environment, a European Economic Area (EEA) standard for georeferencing environmental data)

- | | |
|---------------------------------|---------------------------|
| ● Artificial areas | ● Semi-natural vegetation |
| ● Arable land & permanent crops | ● Open spaces/ bare soils |
| ● Pastures & mosaics | ● Wetlands |
| ● Forested land | ● Water bodies |



4.1. Agriculture

Figure 4.2. Agricultural production by region (T, 2018)

	Cereals	Dried pulses	Potato	Industry crops	Vegetables	Fodder crops	Fresh fruit	Berry species	Tropical-subtropical fruits	Citrus fruits	Dried fruits	Vine yard	Olive trees
Portugal	1103370	5054	431686	1243878	896110	3461525	528009	39568	57655	398825	60763	802082	738550
Norte	111716	1003	116531	18		1693738	125644		27097	6730	41587	256208	114773
Centro	282453	1020	145695	25507		906609	350412		6711	11959	4587	230964	63064
Área Metropolitana de Lisboa	53626	7	69548	335640		82899	5075		25	3079	43	62896	392
Alentejo	650643	2949	56354	882629		498941	30649		33	31944	12876	241499	558279
Algarve	4327	17	7390	-		38882	13169		33	339750	1452	4631	2042
Região Autónoma dos Açores	352	58	7320	85		238136	402		6001	4329	112	1817	-
Região Autónoma da Madeira	254	-	28848	-		2319	2658		17755	1035	106	4067	-



Figure 4.3. Production of cereals (T, 2018)

	Cereals TOTAL	Wheat	Rye	Oat	Barley	Triticale	Maize	Rice
Portugal / TOTAL	1103370	67749	16706	55779	60238	28244	713860	160794
Norte	111716	4873	12156	2226	175	435	91850	-
Centro	282453	5009	4406	3794	2737	924	235584	30000
Área Metropolitana de Lisboa	53626	1790	-	100	1341	228	21076	29092
Alentejo	650643	55164	134	48865	55559	26555	363884	100482
Algarve	4327	839	12	794	426	102	934	1220
Região Autónoma dos Açores	352	-	-	-	-	-	352	-
Região Autónoma da Madeira	254	74	-	-	-	-	180	-



Figure 4.4. Production of wine by region (hl, 2019)

	Portugal	Norte	Centro	Área Metropolitana de Lisboa	Alentejo	Algarve	Região Autónoma dos Açores	Região Autónoma da Madeira
Total	6526562	266563	158485	588008	1622332	13926	13246	38559
Generous wine by protected designation of origin	860581	786206	10437	26483	1479	0	195	35782
Wine by protected designation of origin	2857830	1634168	437993	188069	591241	685	4238	1437
Wine by protected geographical indication	2042220	36516	780976	324291	885060	12587	2718	73
Wine with grape varieties indication	27842	10012	16045	579	1062	145	0	0
Wine without certification	738089	198737	339403	48587	143490	509	6094	1268

Figure 4.5. Production of olive oil by region (hl, 2018)

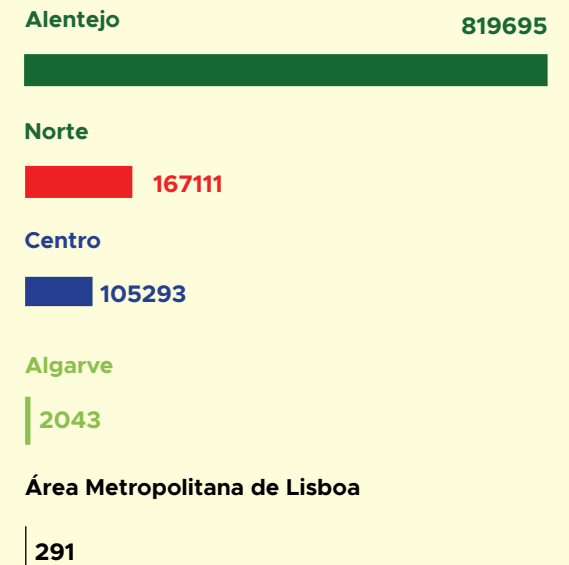




Figure 4.6. Livestock by region (K)

Geographic localisation (NUTS - 2013) (2)	Portugal	Norte	Centro	Área Metropolitana de Lisboa	Alentejo	Algarve	Região Autónoma dos Açores	Região Autónoma da Madeira
Cattle livestock (No.) by Geographic localisation (NUTS - 2013) and Category (cattle livestock); Semi-annual	1675	308	196	72	805	9	281	4
Pig livestock (No.) by Geographic localisation (NUTS - 2013) and Category (pig livestock); Annual (4)	2256	66	906	230	999	16	35	4
Sheep livestock (No.) by Geographic localisation (NUTS - 2013) and Category (sheep livestock); Annual (4)	2220	272	473	42	1382	45	3	3
Goat livestock (No.) by Geographic localisation (NUTS - 2013) and Category (goat livestock); Annual (4)	316	76	107	8	99	14	7	6



4.2. Food and beverages

Figure 4.7. Main data of the food industry sector (Eurostat, 2017)

	No of enterprises	Turnover of gross premium written (M€)	Production value (M€)	Persons employed
Manufacture of beverages	1885	3362.3	3243.7	15789
Processing and preserving of meat and production of meat products	690	2811.7	2575.5	17257
Manufacture of bakery and farinaceous products	6137	1819.3	1705.4	43635
Manufacture of dairy products	451	1580.5	1561.0	7009
Manufacture of other food products	706	1554.7	1278.5	8722
Manufacture of prepared animal feeds	118	1432.7	1322.9	3572
Manufacture of vegetable and animal oils and fats	458	1358.3	927.7	2003
Processing and preserving of fish, crustaceans and molluscs	168	1285.8	996.1	7668
Processing and preserving of fruit and vegetables	410	950.4	893.9	5463
Manufacturing of grain mill products, starch and starch-based products	189	639.3	503.5	1939
TOTAL	11212	16795	15008	113057



Figure 4.8. Production of beverages (Eurostat, 2017)

	No of enterprises	Turnover of gross premium written (M€)	Production value (M€)
Manufacture of beverages	1885	3362.3	3243.7
Distilling, rectifying and blending of spirits	382	81.1	77.8
Manufacture of wine from grape	1330	1634.6	1653.4
Manufacture of beer	107	888.9	794.9
Manufacture of soft drinks; production of mineral waters and other bottled waters	57	741.2	700.8



4.3. Wood products and pulp & paper



Figure 4.9. Manufacture of wood products (Eurostat, 2016)

	Number of enterprises	Turnover or gross premiums written (M€)	Production value (M€)
Sawmilling and planing of wood	582	447.1	394.4
Manufacture of products of wood, cork, straw and plaiting materials (other than furniture)	4465	2581.4	2424.4
Manufacture of furniture	4414	1683.5	1589.6

Figure 4.10. Manufacture of pulp & paper products (Eurostat, 2016)

	Number of enterprises	Turnover or gross premiums written (M€)	Production value (M€)
Manufacture of paper and paper products	571	3895.8	3902.0

4.4. Chemical and pharmaceutical industry

Figure 4.11. Manufacture of chemical and pharmaceutical products (Eurostat, 2016)

	No of enterprises	Turnover of gross premium written (M€)	Production value (M€)
Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	194	2528.3	2371.3
Manufacture of pesticides and other agrochemical products	4	130.9	137.9
Manufacture of paints, varnishes and similar coatings, printing ink and mastics	121	548.9	508.8
Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	251	252.2	225.7
Manufacture of other chemical products	209	758.6	721.6
Manufacture of man-made fibres	12	100.7	101.7
Manufacture of basic pharmaceutical products and pharmaceutical preparations	141	1185.1	1065.0
Manufacture of rubber and plastic products	1072	4120.2	3942.1



4.5. Technology parks

Figure 4.12. Campus, incubators and technology parks

Entity	Town	Region
Oliva Creative Factory	São João da Madeira	Norte
Sanjotec	São João da Madeira	Norte
Nonagon	Lagoa	Açores
CEIM	Funchal	Madeira
Madeira Tecnopolo	Funchal	Madeira
INOVPOINT	Abrantes	Centro
Startup Alentejo	Beja	Alentejo
PACT	Évora	Alentejo
Sines Tecnopolo	Sines	Alentejo
Ualg CRIA	Faro	Algarve
Centro de Incubação de Aveiro	Aveiro	Centro
IEUA	Aveiro	Centro
Centro Incubador de Caldas da Rainha	Caldas da Rainha	Centro
BioCant	Cantanhede	Centro
ESA Business Incubation Centre	Coimbra	Centro
Instituto Pedro Nunes	Coimbra	Centro
iParque	Coimbra	Centro
Incubadora de Empresas da Figueira da Foz	Figueira da Foz	Centro
Incubadora D. Dinis	Leiria	Centro
OPEN	Marinha Grande	Centro
Feirapark	Santa Maria da Feira	Norte

Entity	Town	Region
Centro de Inovação Empresarial da Beira Interior	Covilhã	Centro
Parkurbis	Covilhã	Centro
Curia Tecnoparque	Curia	Centro
Parque Tecnológico Óbidos	Óbidos	Centro
Associação Empresarial da Região de Viseu	Viseu	Centro
Centro de Incubação de Lisboa	Lisboa	Lisboa e Tejo
Dock 38	Lisboa	Lisboa e Tejo
EDP Starter	Lisboa	Lisboa e Tejo
EggNEST SGPS	Lisboa	Lisboa e Tejo
Fábrica de Startups	Lisboa	Lisboa e Tejo
INOVISA	Lisboa	Lisboa e Tejo
LISPOLIS	Lisboa	Lisboa e Tejo
Madan Parque	Lisboa	Lisboa e Tejo
PLAY	Lisboa	Lisboa e Tejo
Startup Lisboa	Lisboa	Lisboa e Tejo
Teclabs	Lisboa	Lisboa e Tejo
Vodafone LABS Lisboa	Lisboa	Lisboa e Tejo
Taguspark	Oeiras	Lisboa e Tejo
Idea Atlantico	Braga	Norte
Startup Braga	Braga	Norte
Ave Park	Guimarães	Norte



Entity	Town	Region
Spin Park	Guimarães	Norte
Centro de Incubação da Maia	Maia	Norte
TecMaia	Maia	Norte
Centro de Incubação de Matosinhos	Matosinhos	Norte
Incubadora de empresas de Projectos do Quadra	Matosinhos	Norte
Cace Cultural Porto	Porto	Norte
Centro de Incubação do Porto	Porto	Norte
Centro de Incubação Portugal Global	Porto	Norte
INSerralves	Porto	Norte
NET	Porto	Norte
Ninho de Empresas da Fundação da Juventude	Porto	Norte
PortoDigital	Porto	Norte
Spin Logic	Porto	Norte
UPTEC	Porto	Norte
Fábrica Santo Thyrso	Santo Tirso	Norte
Centro de Incubação da Trofa	Trofa	Norte
Centro de Incubação de Vizela	Vizela	Norte
Instituto Empresarial do Tâmega	Amarante	Norte
In.cubo	Arcos de Valdevez	Norte
Oficina da Inovação	Braga/Viana do Castelo	Norte
Brigantia EcoPark	Bragança	Norte
inovagaia	Gaia	Norte
tecval	Paços de Ferreira	Norte
Incubadora do Tâmega e Sousa	Penafiel	Norte
Centro de Incubação da Póvoa do Varzim	Póvoa do Varzim	Norte
Régia-Douro Park	Vila Real	Norte
IEMinho	Vila Verde	Norte

4.6. Bio-based research and other projects in Portugal

Below are examples of bio-based projects in Portugal. Some are still running; others have been finalised.

A. Projects on the national level in Portugal

MultiBiorefinery



Project coordinated by the University of Aveiro together with five other research centres in the Centro region. The project's objective is to develop an integrated biorefinery for the valorisation of residual and side streams, applying innovative and sustainable industrial biotechnologies. The project focuses on residues from forest, agriculture and fish industry, with the objective of obtaining polymers and bioactive compounds at pilot scale.

BioCec



Project coordinated by Mistolin, a chemical industry producing household cleaning products, together with the University of Coimbra. The project aims at developing new, more environmentally friendly formulations of waxes and cleaning products, including bio-based ones.



BIIPP

Project duration

Project coordinated by Soporcel (now the Navigator company) and performed chiefly by its linked research centre RAIZ. The project studied the possibility of producing ethanol from the side streams of a Kraft pulp mill and the extraction of high value-added compounds (polyphenols and terpenes) from bark.

Bioblocks

Project duration

Project coordinated by Soporcel (now the Navigator company), aiming at integrated valorisation of residues and side streams from the pulp and paper process, into products such as biofuels, chemicals and polymers).

Rose4Pack

Project duration

Project coordinated by Centro de Estudos de Ciência Animal. The project developed a biodegradable food packaging material enriched with active compounds extracted from rosemary.

NMC – Novos Materiais Celulósicos (New Cellulosic Materials)

Project duration

Project coordinated by Portucel (now the Navigator company), studying micro or nano-fibrillated cellulose.

POTATOPLASTIC

Project duration

Project coordinated by the plastic industry Isolago . The project studied the feasibility of producing food packaging materials and films from starch and residual streams from the potato industry.

INPACTUS - Innovative Products and Technologies from Eucalyptus


Project duration

National project funded under the ‘Portugal2020’ structural funds promoted by the Navigator Company together with the Universities of Aveiro and Coimbra, it also involves partners from other EU countries (Fraunhofer, Innventia, RISE). The project aims to develop new solutions, such as cellulosic pulps with innovative features, new paper products with different specificities and functions, tissue paper with innovative properties, new bioproducts, biofuels and other materials obtained from the deconstruction and conversion of forest biomass and by-products from the pulp industry.




B. Projects on the international level

BlueBio – Unlocking the potential of aquatic bioresources

 Project duration 2018 - 2023


The project (an ERA-NET Cofund) aims 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. Fundação para Ciencia e a Tecnologia and Fundo Regional para a Ciencia e a Tecnologia (Açores) are partners of the project.

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

 Project duration 2016 - 2020


The project is developing an innovative Volatile Fatty Acids Platform for the bioconversion of municipal solid bio-waste fraction and sludgy bio-waste from other industries. The volatile fatty acids will be 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. Biotrend, Universidade do Minho and P A Residel are partners of 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 is building 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. Adventech - Advanced Environmental Technologies Lda is a partner of the project.

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

 Project duration 2017 - 2020

SmartAgriHubs is dedicated to accelerating the digital transformation of the European agri-food sector. It will consolidate, activate and extend the current ecosystem by building a network of Digital Innovation Hubs (DIHs) that will boost the uptake of digital solutions by the farming sector. The heart of the project is formed by 28 flagship innovation experiments demonstrating digital innovations in agriculture, facilitated by DIHs from 9 Regional Clusters including all European member states. Consulai - Consultoria Agroindustrial, Tekever li Autonomous Systems, Instituto Nacional De Investigação Agraria E Veterinaria, Edia-Empresa De Desenvolvimento E Intra-Estruturas Do Alqueva, Unparallel Innovation, Freedomgrow - Sistemas De Informacao are partners of the project.

MAGIC - Marginal lands for Growing Industrial Crops: Turning a burden into an opportunity

 Project duration 2017 - 2021

MAGIC aims to promote the sustainable development of resource-efficient and economically profitable industrial crops grown on marginal lands. The project foresees identification of the most suitable crop varieties and agronomic practices and the development of suitable harvesting strategies and logistics to optimise the biomass supply chains.



Bio-based Industries Consortium

Bio-based Industries Consortium (BIC)

European Forestry House
Rue du Luxembourg 66
Brussels 1000, Belgium



info@biconsortium.eu



[@biconsortium](https://twitter.com/biconsortium)



[linkedin.com/company/ Bio-based Industries Consortium](https://www.linkedin.com/company/bio-based-industries-consortium/)



[Bio-based Industries Consortium](https://www.youtube.com/Bio-based-Industries-Consortium)

www.biconsortium.eu



Explore our latest publications

