



Bio-based Industries
Consortium

Mapping Poland's bio-based potential



CONTENTS

EXECUTIVE SUMMARY

Poland offers enormous opportunities to expand bio-based industrial activities on regional and national levels. The country has potentially very large availabilities of unused, underutilised, and residual biomass available that can be converted to added-value products and services through the bio-based industry.

Spanning around 700 km latitudinally and 650 km longitudinally, Poland's landscape varies considerably from the sandy Baltic coastline in the north to the mountain ranges in the south, from the grassland plains in the west to the forested hills in the east. Around 30% of the country's area is covered by forests, while around 60% is agricultural land.

These industries are a sound basis for a bio-based industry in Poland. The presence of many international actors in the biotechnology sectors and a well-organised innovation support infrastructure contribute to a significant list of ingredients for a sustainable bio-based sector. Poland is an emerging innovator on the [European innovation scoreboard 2022](#), with its innovation performance growing faster than the EU average. The strong increase since 2015 is mainly due to high performance increase in the categories:

- Innovators (by SMEs);
- Finance and support (government support for business R&D); and
- Use of information technology (enterprises providing ICT training).

Themes related to bioeconomy appear prominently in Poland's 'Strategy for the Development of the Country 2020' and in the 'Roadmap of a Transition to a Circular Economy', awaiting an updated national bioeconomy strategy.

According to data from the National Statistical Office, agri-food and forestry produce over 3.7 million tonnes/year of waste, with an additional 3.6 million tonnes/year from the wood processing and pulp and paper value chains. These quantities are significant, but the total quantity of residual biomass will probably be much higher since they are not accounting for residual streams that find low-value applications. The separate collection of the organic fraction of municipal solid waste (OFMSW) has been growing in recent years, reaching 1.6 million tonnes/year in 2020. The OFMSW is also a relevant feedstock for bio-based operations in Poland.

Poland is strengthening its position as a regional hub for the pharmaceutical and biotech industries. It has an active infrastructure of technology clusters, universities, research centres and industries, with strong connections with the rest of Europe and globally. There is strong support for high-tech university spinoffs and start-ups. A network of technology parks and incubators has grown in recent years.



The country's bioeconomy contributes over €102 billion in turnover annually. In terms of turnover per employment in the bio-based economy (excluding agriculture, forestry, fisheries, food, beverages, and tobacco), Poland performs with about 55 thousand € per FTE, implying a large share of production of primary biomass. Agri-food, forest-based and chemical industries are among the strong drivers of Poland's economy. The pharmaceutical industry is also rising as a sector and Poland is the leading country in Central-Eastern Europe in this field.

Several EU-funded research projects using biomass feedstock and biotechnologies have been running in Poland in the last few years (including some under the Bio-based Industries Joint Undertaking programme – BBI JU). BIOMOTIVE, a demonstration project with a €10.7 million grant from BBI JU, was the first project at this scale in the BBI JU programme led by a **Polish actor**. Selena Labs in Siechnice led this project that started in June 2017 and ended in 2021, with its operational site in Poland. 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, to use relevant available feedstock for higher values than currently is the case. The Polish representative in the States Representatives Group of the BBI JU has provided significant assistance in collecting and reviewing data used in this report.

BIC will now share this document with local actors and seek to assist in setting up action plans with local industry and governmental institutions for expanding the bio-based activities in Poland.

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



This document is part of the ‘strategic outreach programme’ of the Bio-based Industries Consortium (BIC). The objective of the programme is to identify opportunities for bio-based industrial activities in European countries where these activities are relatively low.

Bio-based activities heavily depend on innovation, and hence are relatively low in ‘moderate/emerging innovators’ countries. This may be the result of insufficient knowledge of the potential for the bio-based industry in these countries, by actors in bio-based activities in these countries as well as by BIC.



Additionally, actors in these countries may not be fully aware of the opportunities offered by BIC and the Joint Undertaking it has with the European Union (the Bio-based Industries Joint Undertaking under Horizon 2020, and the Circular Bio-based Europe Joint Undertaking under Horizon Europe).

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.

Poland has traditionally strong agriculture, food processing and forestry sectors. The level of innovation in bio-based activities however is relatively low. This corresponds with the country's position in the European innovation scoreboard 2022. Poland performs as an 'emerging innovator' on this scoreboard. While almost all EU countries have improved their performance over the period 2015-2022, for two emerging innovators, Croatia and Poland, innovation performance has grown faster than the EU average.

Analysing the indicators of the innovation score, reveals that Poland scores above average on high performance increase in the categories Innovators (by SMEs), Finance and support (government support for business R&D), and Use of information technology (enterprises providing ICT training). On the other hand, performance in the categories Environment-related technologies, non-innovation expenditures, and Innovation expenditures per employee, show strong decreases since 2015.

The country's bioeconomy contributes over €102 billion in turnover annually. The abundant availability of biomass feedstock from its primary and secondary sectors provides Poland with a significant basis for expanding its bio-based activities. This expansion requires a stronger link between biomass owners and potential users and processors, at regional, national, and international levels, and a strong support for innovation from regional and national authorities.

The bio-based sector in Poland makes a significant contribution to the country's economy. The overall production volume of the Polish bioeconomy in 2014 amounted to €82 billion, which is 10% of the total production volume of the Polish economy. The sector generated about 6.5% of the Gross Value Added (GVA), employed almost

3 million people (19% of total workforce), contributed 15% of total exports and had a share of 10% of total imports¹. However, the sector's contribution to the GVA has been decreasing in the years 2000-2014 by about 2% per year. This has been the result of a decreasing contribution by agriculture. On the other hand, the contribution by food processing has been increasing. In 2014 food processing surpassed agriculture to become the largest factor of the Polish bioeconomy in terms of GVA².

Poland's territory spans over 700 km latitudinally and 650 longitudinally and includes different landscapes. Most of the country consists of plains and low hills, with two mountain areas (Sudetes and Carpathians) along its southern border. Around 60% of the country's surface is agricultural land and 30% is forest.

Poland has around 770 km of low and sandy coastline along the Baltic Sea. The two main ports of the country are Gdansk/Gdynia on the eastern side of the coast and Szczecin on the west side. Fisheries are present along the coast and in inland waters, but their contribution to the economy is still rather small.

The chemical industry is one of the largest industrial sectors in the Polish economy. Pharmaceuticals and biotech have been steadily growing in recent years.

¹ Wozniak E., T. Twardowski, 2018, The bioeconomy in Poland within the context of the European Union, *New Biotechnology* 40 (2018) 96–102.

² Wicki L., A. Wicka, 2016, Bio-economy sector in Poland and its importance in the economy, *Proceedings of the 2016 International Conference "ECONOMIC SCIENCE FOR RURAL DEVELOPMENT"* No 41 Jelgava, LLU ESAF, 21-22 April 2016, pp. 219-219.

Several parts of Poland (notably the Śląskie Voivodeship) have large post-industrial areas that are suitable for reclamation either as forest or for growing dedicated crops³. This is the subject of several research projects going on in the country (see section 1.10).

The figures below show the relative importance of bio-based sectors in terms of Gross Value Added (GVA). For sectors such as textiles and leather, chemicals, pharmaceutical and furniture it is not possible to distinguish between the bio-based and non-bio-based contributions. They are therefore shown in Figure 1. as 'partially bio-based'.

Figure 1. Gross Value Added of bio-based primary sector (current prices, M€, Eurostat, National accounts aggregates by industry, 2020)



The geographic unit chosen for this publication is Poland's NUTS2 subdivision, corresponding to Voivodeship (województwo), the regional administrative unit of Poland. The distribution of the 16 current voivodships is depicted in Figure 4. Figures 4.6 – 4.8 in the Appendix show details of agriculture and forest per voivodship.

Figure 2. Gross Value Added of bio-based manufacturing sector (current prices, M€, Eurostat, National accounts aggregates by industry, 2020)

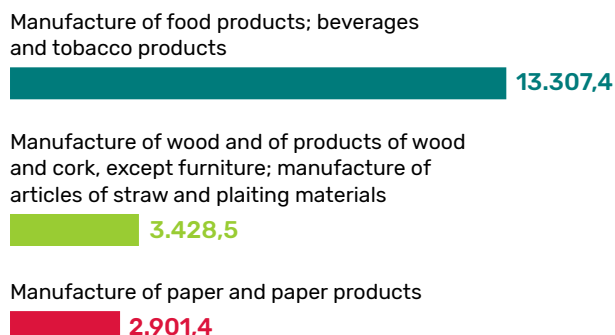


Figure 3. Gross Value Added of partially bio-based manufacturing sector (current prices, M€), (Source: Eurostat, National accounts aggregates by industry, 2020)



Figure 4. Voivodeships of Poland



³ Information provided by Polish experts during the preparation of this report.

1.1. Agriculture

Agriculture is by far the main biomass source. According to [JRC Data M](#), it accounts for 76% of the overall biomass input to economy (61 million tonnes per year of a total of 80 million tonnes per year). The remaining 24% comes from forestry.



€26.7B

Gross production value of agriculture (2020)



Livestock accounts for

55%

of agricultural production (by value)

The Polish agriculture takes the fifth position in EU27 by value, behind France, Italy, Spain, and Germany, just ahead of the Netherlands ([Eurostat 2020 data](#)). The gross production value of agriculture in 2020 was €26.7 billion, with a GVA of €11.7 billion. Polish agriculture is characterised by fragmentation: a little over half of the holdings (51%) is smaller than 5 hectares (ha), while only 5.2% occupy an area larger than 30 ha. Notwithstanding that, the latter account for 41.3% of the total agricultural area⁴.

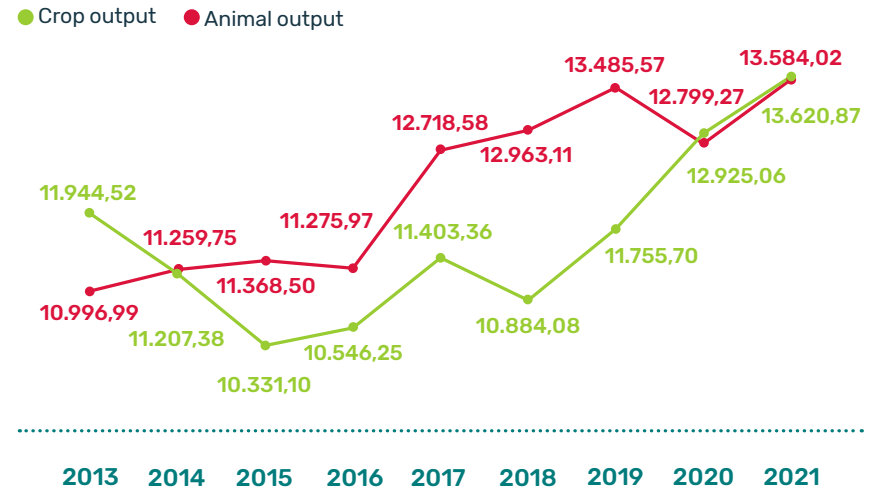
Plant cultivation is responsible for 40% of the total agricultural production (by value), while livestock accounts for approximately 55%.

Cereals dominate crop cultivation (73% of cultivated area). Other crops include rapeseed, maize, sugar beets and potatoes. The size of plantations is highly variable depending on the region: the regions having most large-surface farms are Wielkopolskie (13.9%), Mazowieckie (11.2%) and Lubelskie (10%). One third of the total volume of grain production comes from these three voivodships.

The largest livestock populations are in the Mazowieckie and Wielkopolskie voivodships. The leading regions for swine production are Wielkopolskie, Kujawsko-Pomorskie and Łódzkie, while the leading ones for cattle are again Wielkopolskie, Mazowieckie and Podlaskie.

The main agricultural regions are those in the central Polish Plain, spanning from Lubelskie and Podlaskie in the east, to Wielkopolskie in the west. In terms of crops, cereals are prevalent in Dolnoslaskie, Opolskie, Podlaskie, Pomorskie, Warminsko-Mazurskie and Zachodniopomorskie; Malopolskie has a prevalence of vegetables, while industrial crops (chiefly rapeseed) are present in various degrees across all regions. Central and north-eastern regions are the most significant in terms of livestock rearing, with swine the largest subsector, followed by poultry and cattle.

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



⁴ Ministry of Agriculture and Rural Development, Agriculture and Food Economy in Poland (2015).

1.1.1. Crop production

Polish agriculture is characterised by a high specialisation of agricultural production by region/province⁴.



Cereal is concentrated in: Dolnośląskie, Kujawsko-Pomorskie, Lubelskie, Łódzkie, Mazowieckie, Podlaskie, and Wielkopolskie.



Rapeseed in: Dolnośląskie, Kujawsko-Pomorskie, Opolskie, Pomorskie, Wielkopolskie and Zachodniopomorskie.



Sugar beet in: Dolnośląskie, Kujawsko-Pomorskie, Lubelskie, Opolskie and Wielkopolskie.



Potato in: Lubelskie, Łódzkie, Małopolskie, Mazowieckie, Podkarpackie and Wielkopolskie.

1.1.1.1 Cereals



Wheat takes the lion's share in terms of both area and tonnage. Triticale is also well represented due to its resistance to cold winters, as are barley, oats, and rye. Maize, a relatively new crop for the country, reached a production of 4.4 million tonnes/year in 2020.

€33.3Mt

Estimated grain production (2020/21)

↑ 15.5% over 2019/20

The higher grain production is a result of increased area planted, and higher average yields for all grain varieties⁵.

Main players

- ✓ **Cargill Poland** is the national branch of the multinational mother company a market leader in cereals. It employs 3,000 people in 23 locations in Poland.
- ✓ **Viterra Polska** is the national branch of the multinational mother company Glencore. It supplies grains, oilseed rape and related products from 10 production sites across the country.

1.1.1.2 Sugar beet



Between 2001 and 2017, the number of sugar refineries was reduced by more than 70%. However, this reduction did not significantly affect the sugar production since those who remained on the market increased production.

⁵ USDA, Grain, and Feed Update – Poland February 17, 2021.



€14.9Mt

Sugar beet harvest (2020),
the most produced crop by
tonnage

Main players

- ✔ **Krajowa Grupa Spożywcza**, (National Food Industry Group) operating with its brands Polskie Przetwory, Polski Cukier ('Polish Sugar'), and Frutuś is the largest sugar beet grower in Poland and the eighth in Europe. In 2016/2017 it had 41.2% of the total cultivated area in Poland⁶.
- ✔ **Pfeifer & Langen Polska**, operating under the brand Diamant, is the Polish branch of the German mother company with the same name. It has four production units across the country.
- ✔ **Südzucker Polska** is the local branch of Südzucker Group, the largest sugar producer in Europe. It has four production units in the country.
- ✔ **Nordzucker Polska** is the local branch of Nordzucker Group. It has two production units in Poland.

The Association of Polish Sugar Producers (Związek Producentów Cukru w Polsce), groups the main actors in the sector.

1.1.1.3 Rapeseed



Rapeseed makes up for

95%

of the total oilseed
production in Poland

Poland is one of the leading producers of rapeseed in Europe, following Germany, France, and the UK. Rapeseed makes up 95% of the total oilseed production in Poland. There is a high demand for rapeseed in the country for biodiesel production. The area for cultivation/harvested rapeseed plantations was 850,000 hectares in marketing year 2018/19 with a production of 2 million tonnes.

USDA post in Warsaw forecasted this area to increase to 880,000 hectares in MY 2019/20 because of firm prices following the production shortfall in the previous year (due to unfavourable weather conditions). The resultant production of rapeseed was estimated at 2.4 million tonnes⁷. The **Polish Association of Oil Producers (PSPO)**, representing 12 oil companies, reports a production of 3.28 million tonnes of rapeseed in 2020, superseding the 2019 record by 0.19 million tonnes. Bunge, the world leader in oilseeds processing, has

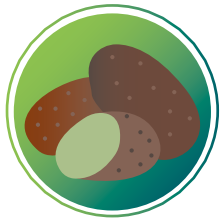
operated two production plants in Poland in partnership with **ZT Kruszwica** since 2002. In December 2021, **Bunge announced the consolidation of its businesses in Poland** under the Bunge name after the acquisition of ZT Kruszwica. It continues to be Poland's largest grower and processor of oilseeds and producer of vegetable oils.

The world's largest producer of edible oils, **Archer Daniels Midland (ADM)**, operates two plants in the country.

⁶ Polish Sugar Industry Development, March 2018: (Researchgate.net).

⁷ USDA, 2017, Poland – 2018 Annual Oilseeds and Products Report.

1.1.1.4 Potatoes



7.5Mt

Potato production (2018)

↓ 75% compared to 1990

Potato production in Poland has gone through drastic changes since 1990 mainly because of fragmented production, decreasing domestic consumption, and the presence of the potato disease ring rot, which caused export restrictions. Production in 2018 was approx. 7.5 million tonnes, down 75% compared to 1990.

The Polish government launched a special programme to eliminate the disease.

The [2020 data show](#) that production levels in Poland have increased again, making it the second largest producer in the EU. Germany leads the European production with 11.7 million tonnes (21.2% of the total), followed by Poland with 9.1 million tonnes (16.4%), France with 8.7 million tonnes (15.7%), and the Netherlands with 7 million tonnes (12.7%).

Poland is home to local branches of large international groups, such as [Agrico Polska](#) (subsidiary of Dutch company Agrico), [Solana](#) (part of French group Solana), [McCain](#) (subsidiary of the American company), as well as local actors such as [Pepees](#), [Zetpezet](#), [WPPZ](#), and [Nowamył](#).

1.1.1.5 Fibrous plants



80%

Increase in hemp cultivation area in Poland, since 2018

In recent years, the area dedicated to hemp cultivation has increased significantly in the EU from 19,970 hectares (ha) in 2015 to 34,960 ha in 2019 (a 75% increase). In the same period, the production of hemp increased from 94,120 tonnes to 152,820 tonnes (a 62.4% increase).

[France is the largest producer](#), accounting for more than 70% of EU production, followed by the Netherlands (10%) and Austria (4%).

[Hemp production in Poland has significantly increased](#) over the past five years. Since 2018, it has increased the cultivation area by almost 80%, from 1,300 ha to 3,000 ha. Poland has the potential to become one of the main producers of hemp products in Europe. The development of this industry may have a [positive impact on the entire economy](#).

Poland hosts in Poznan the [Institute of Natural Fibres and Medicinal Plants \(INFMP\)](#). This interdisciplinary research centre carries out complex research on the obtaining and processing of fibrous and herbal raw materials. The institute supports the growth of flax and hemp production worldwide and in Poland.

Data from the Institute show that fibrous plants such as linum usitatissimum (flax), cannabis sativa (hemp) and many medicinal plants are a source of biomaterials for different sectors of the economy, such as textiles, construction (e.g. insulation or noise absorbing panels), composites, automotive (e.g. collapsible areas in automobiles), as well as food, feed, supplement of diet and pharmaceuticals and biofuels.

Main players

- ✓ Main players in hemp production include **HemPoland**, the first company to obtain a license to grow cannabis sativa, and **Hemp Evolution**. The total turnover of companies processing industrial hemp stalks was about PLN 3 million (€0.6 million) in 2019, of which 83% accounted for by **paper and pulp processing**.
- ✓ Other key players in the flax and hemp sector in terms of cultivation, processing and use of fibre plants are: Ekotex in Kowalowice, Lenkon in Stęszew, DMS Technology in Oleszna, Farmtech in Białystok, Goflax in Dalaszew, Podlaskie Konopie, WFB Baird in Bolków, Naturlen in Kętrzyn, Świat Lnu Kamienna Góra, Madex Kościeleszki, Gospodarstwo Baborówko and Armix in Gródki.

1.1.1.6 Medicinal plants (herbs and spices)



2.390t

of packed pharmaceutical herbs (2018)

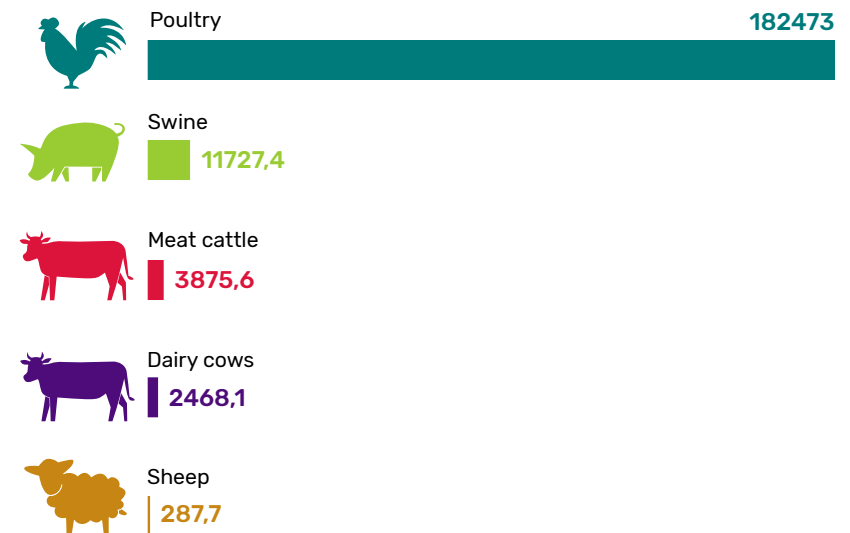
The main players in the sector of products based on medicinal plants (herbs) and spices are: Herbapol Lublin S.A. (in Lublin, Białystok, Gdańsk, Łódź), Herbapol Poznań S.A., Herbapol Wrocław S.A., Herbapol Kraków S.A., Herbapol Warszawa Sp. z o.o.

According to **Statistical Yearbook of Industry – Poland**⁸, the production in 2018 totalled 2,390 tonnes of packed pharmaceutical herbs. The Institute of Natural Fibres and Medicinal Plants plays a significant role in the R&D sector of medicinal plants (herbs and spices).

1.1.2. Livestock

Gross animal production amounted to €13.1 billion in December 2021. Animals for slaughter make up 55% of the value (cattle 11%, swine 22% and poultry 22%); milk accounts for 32%, eggs for 10%. The breakdown of the livestock in Poland at the end of 2020 is shown in Fig.6.

Figure 6. Livestock by type (animal headcount, thousand, GUS, Statistical Yearbook of Agriculture, 2021)



⁸ GUS, 2018 (Central Statistical Office in Poland).

1.2. Forest

Poland is among the countries with the highest percentage of forested area in Europe, estimated at 31% of Poland's territory. Forests circle the central plain on the north, west and south, whereas northern and western forests occupy lowlands or low hills, while southern forests include mountainous terrain. The western region of Lubuskie has the highest forest coverage, with nearly 50%.

31%

of Poland's territory is covered by forest

Coniferous species cover

72.8%

of the forest area in Poland

The national forest area (31% of the country's land area) totals 9,467.5 thousand hectares **as of end 2021**. This percentage varies from region to region with the Lubuskie voivodship having the highest percentage (51.7%) and Lodzkie having the lowest (22%). The most recent estimate of wood resources available (2017) is 2.7 billion m³. Coniferous species dominate 72.8% of the forest area in Poland. Of the coniferous species, pine occupies 61.8% of the forest area of all ownership forms.

Figure 7. Trend of the Gross Value Added of forestry (current prices, M€, Eurostat, National accounts aggregates by industry)

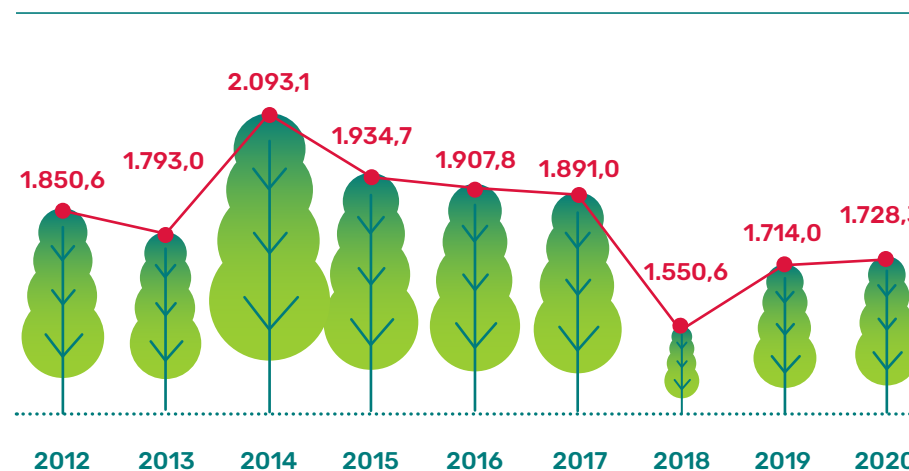
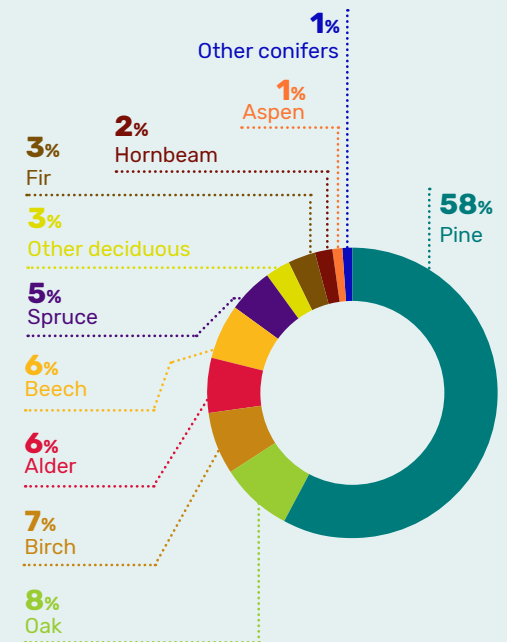


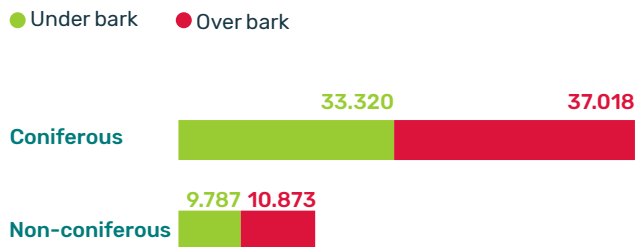
Figure 8. Area occupied by main tree species



Coniferous species are prevalent in all voivodeships with percentages as high as 81.1% in Lubuskie, 77.5 - 78% in Kujawsko-Pomorskie and Wielkopolskie, and 70 - 74% in Pomorskie, Mazowieckie, and Lodzkie; deciduous trees reach above 40% of the total area only in the south-eastern regions of Lubelskie, Malopolskie and Podkarpackie.

Ownership of forest is mostly public: publicly-owned forests amount to 80.7% of the total area, of which 77% is administered by the national state forest administration (Lasy Państwowe). 19.3% of the forests are private. The share of private forests is not uniform across voivodeships: it varies from 45% of Mazowieckie to 1.9% of Lubuskie.

Figure 9. Roundwood removals by type of wood and assortment (thousand cubic metres, Eurostat, 2021)⁹



The main use of forest-based biomass is to produce solid wood products and wood boards. **Poland is the 10th largest world producer and the 4th largest world exporter of furniture.** The 'pulp and paper' sector is well represented with several paper and board mills.

⁹ Eurostat, Roundwood removals by type of wood and assortment.
¹⁰ European Commission: Facts and figures on the Common Fisheries Policies – 2022.

1.3. Fisheries, aquaculture and the blue economy

With a total production of 6.2 million tonnes (2019), the EU ranks fifth worldwide (2.9% of total) in fisheries and aquaculture production, after China (38.7%), Indonesia (11.0%), India (6.2%) and Vietnam (3.7%). 78% of the EU production comes from fisheries and 22% from aquaculture. Spain, Denmark, and France are the largest producers in the EU.

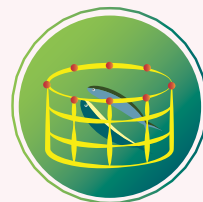
Poland borders the Baltic Sea in the north and has a coastline of 775 km. Fisheries represent a minor part of the Polish GDP. On total catches, Poland ranks 8th in fisheries in the EU¹⁰. Fish is caught both in sea and inland waters, while aquaculture is mainly done in fresh water.

1.3.1 Fisheries



Polish fisheries reported 821 registered fishing vessels (July 2021), providing 2252 full time equivalent jobs¹⁰. The total catch of the Polish fishing fleet was 199 thousand tonnes in 2019 (last available data, includes both sea and inland catches), the majority of which come from the Baltic Sea.

1.3.2 Aquaculture



Freshwater aquaculture has a long history in Poland, having been introduced in the Middle Ages. During the past five years, the aquaculture sector has been showing a 5.6% annual growth reaching 50.1 thousand tonnes in 2020, worth €117.3 million, and providing 4,757 full time equivalent jobs. Its contribution to the overall sector is about 20%.

1.3.3 Algae



The production of algae and algae-based products is marginal in the country. Nonetheless, some examples exist at R&D or small commercial scale.

As part of a research project, the chemical company **PKN ORLEN** has established an experimental station in Płock to develop a technology to produce biocomponents obtained from oil algae.

The Culture Collection of Baltic Algae, part of the University of Gdansk, does research on, and grows and sells strains of algae (both marine and freshwater species).

Some R&D units conducting investigations related to the cultivation and management of microalgae for bioproducts (e.g. bioplastics, biofuels, bio-coal) are the Institute for Sustainable Technologies at Łukasiewicz Research Network – Institute for Sustainable Technologies; the University of Warmia and Mazury in Olsztyn, the Lodz University of Technology, the Wrocław University of Science and Technology, and the Czestochowa University of Technology.

1.4. Food and beverages

€54B

Turnover¹¹



400,000

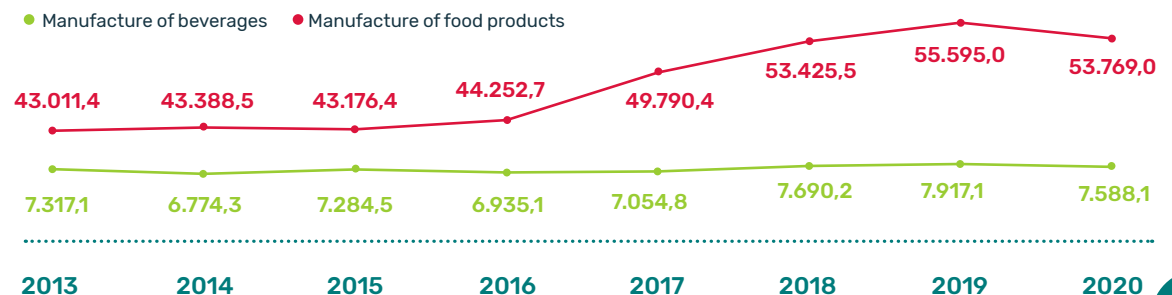
People employed by the food industry

Food production is the dominant subsector by turnover, production value and number of employees.

Production of bakery and farinaceous products is the sector with the most enterprises (more than twice as high as in food production), but its turnover and production values are comparatively low, hinting at a high fragmentation of the sector. Dairy products and beverages, in turn, feature comparatively high turnover and production values despite having a significantly lower number of enterprises, hinting at concentration of the sector. Figure 10. shows the production value of the food and beverage industry between 2013 and 2020 (most recent available data).

The following chapters highlight the key subsectors of food production in Poland, 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).

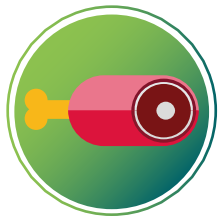
Figure 10. Trend of production value of food and beverages production (production value, M€, Eurostat, Annual enterprise statistics for special aggregates of activities, NACE Rev. 2)



¹¹ Eurostat, Annual detailed enterprise statistics for industry (NACE Rev. 2, B-E).

1.4.1 Meat

Poland is a significant producer of poultry, pork, and beef. It is one of the EU leading meat exporters, particularly of poultry, being the top producer of poultry in Europe.



2.98Mt

Production of poultry meat in Poland (2022) - an increase compared to the previous year.

Poland is a major exporter of poultry and beef in Europe. More than 80% of the beef produced and 50% of the poultry produced are exported.

The main export destination for Polish meat and meat products is EU countries. The largest recipient of Polish meat for many years has been Germany, to which 17.0% of Polish meat exports went in 2018. The next three recipients, Great Britain, Italy, and the Netherlands, purchased a total of nearly [26.3% of Poland's meat and meat product exports](#).

The number of companies involved in meat processing and production in Poland amounted to 3,249 as at the end of 2018, an increase of more than 13.7% compared to 2010.

The meat industry (processing and production of meat-based products) employs over 100,000 people in slaughter and processing and is the sector with the highest turnover and production values¹¹. The turnover totalled €17.8 billion in 2018. [Statistica Market Forecast](#) shows meat revenues to reach €14.2 billion in 2023.

Annual meat consumption per capita in Poland has been declining steadily since 2016, a trend seen in many other European countries.

Main players

- ✓ [Sokolow](#), owned by International Danish Crown, is a large meat (cattle, swine, and poultry) producer. It employs over 7,000 people in seven production facilities, 40 warehouses and 51 shops across the country. Its annual sales amount to €0.7 billion.
- ✓ [Cedrob Group](#) is a leader in the production of poultry and pork.
- ✓ [Animex Foods](#), owned by the multinational Smithfield Group, is a large producer of swine- and poultry-based products. It has eight production plants across the country and its annual revenues are close to €1 billion. It is the largest employer in the food sector with over 8,000 employees.
- ✓ [Indykpol](#) is a poultry company specialised in turkey products.
- ✓ [WIPASZ](#) is a producer of poultry meat and of animal feed, both for own consumption and for sale.
- ✓ [Drosed](#), part of the French group LDC, produces fresh and canned poultry products.
- ✓ [Tarczynski S.A.](#) is a Polish company operating in the meat industry. It produces cold cuts, kabanos sausages, wieners, and protein snacks.
- ✓ [SuperDrob S.A.](#) is one of the leading poultry producers in Poland, present on the market for 27 years. The company's offer includes both raw, ready-to-bake meat, baked sausages, and breaded ready-to-eat products.

1.4.2 Fish and aquaculture products



Over the past decade, Poland's fish processing sector has gone through a considerable transformation and is currently one of the largest in Europe. In 2020 this sector produced 616 thousand tonnes of product, worth €2.96 billion.

Main players

- ✓ **Mowi Polska**, part of the Marine Harvest Group, is a large fish processing industry based on the Baltic coast, in particular processing salmon meat largely imported from Scotland and Norway.
- ✓ The **Graal Group** is one of the leading companies in Polish fish processing.
- ✓ **Seko** is a large fish processing company, specialising in herring and mackerel.
- ✓ **Łosoś** is a large producer of canned fish.
- ✓ **Limito** processes salmon, mostly imported from Norway.
- ✓ **Herring Torun** also imports most of its feedstock – herring in this case – from Norway.
- ✓ **Lisner** produces packaged fish meals as well as ready meals based on vegetables.
- ✓ Other locally-owned fish processing companies include **Stanpol**, **SeaMor**, **Gadus**, **Abramczyk** and KGPR.
- ✓ **Stawy Milickie**, breeding and marketing of freshwater fish, including the traditional regional product: Milicz carp.

International players as King Oscar, MerAlliance, Friedrichs and Espersen are also present in Poland.

1.4.3 Vegetables and fruits



Vegetable production

The cultivation of vegetables in Poland in 2019 occupied 1.5% of the sown area, but the share of vegetables in the value of commodity agricultural production was 9%.

The development of Polish vegetable production has been favoured by relatively low labour costs, growing consumer purchasing power, a developed processing industry, a favourable geographical location for establishing trade contacts, and changing dietary trends.

In 2016, 73,000 farms cultivated ground vegetables and 9,000 farms cultivated vegetables under covers. The vegetable production in Poland has increasingly been modernised through the introduction of innovative technologies, production specialisation of farms and the cultivation of new and efficient varieties. In parallel, the vegetable production has been intensified on less area for ground vegetables with higher yields to counteract low labour supply and, in the case of cover crops, very rapidly rising energy prices. This cultivation area has dropped 14% from 208,000 to 178,000 hectares between 2004 and 2017 and this downward trend has continued since then.

Farms producing ground vegetables are located across Poland, but commodity production is mainly done in the voivodeships Mazowieckie, Kujawsko-Pomorskie, Wielkopolskie, Małopolskie, Łódzkie and Świętokrzyskie.

Greenhouses and plastic tunnels, with a production rate much higher than field crops, make it possible to provide consumers with a full range of fresh vegetables throughout the year. The acreage to grow vegetables under cover averaged 5,500 hectares between 2011 and 2017. An increasing part thereof is for plastic tunnels, due to their lower cost of construction and lower energy consumption than greenhouses. Greenhouse production uses soilless cultivation (fiberglass) technology, while the traditional cultivation of vegetables

in the ground or on an organic substrate dominates in foil tunnels. Vegetables produced under cover are for both direct consumption and seedlings of ground vegetables.

Poland ranks



3rd

in the EU as a vegetable producer, after Spain and Italy

Annual domestic production of vegetables between 2004 and 2019 ranged from 4.8 to 5.7 million tonnes and accounted for about 9% of the EU harvest.

In the EU, Poland ranks among the top producers of cabbage and red beet (1st), edible carrots and cucumbers (2nd), onions (3rd), cauliflowers (4th) and tomatoes (6th). Cabbage, carrots, and onions accounted for the largest share of the harvest.

The harvest of vegetables under cover from 2004 to 2019 increased from 0.7 to 1.1 million tonnes, and its share in the total vegetable harvest increased from 12% to 20%. Tomatoes (55-58%) and cucumbers (26-31%) were the most important in the cultivation of vegetables under cover.

Fruits production

Of the over 3,932 thousand tonnes of fruit produced in Poland (2019), over 90% of production is in 4 voivodeships: Lubelskie, Mazowieckie, Łódzkie and Świętokrzyskie.

The National Union of Juice Producers (KUPS) estimates



4.545Mt

Total fruit harvest (2021) of which over 4 million tonnes is fruit harvested from orchards, and 525,000 tonnes from berries and strawberry plantations.

The highbush blueberries have been growing in popularity, while the production of chokeberries and gooseberries have been decreasing despite their high health-promoting value. See chapter 4 (Appendix A) for more details on vegetables and fruits production.

Figure 11. Fruits production from orchards by type (thousand tonnes, 2021)

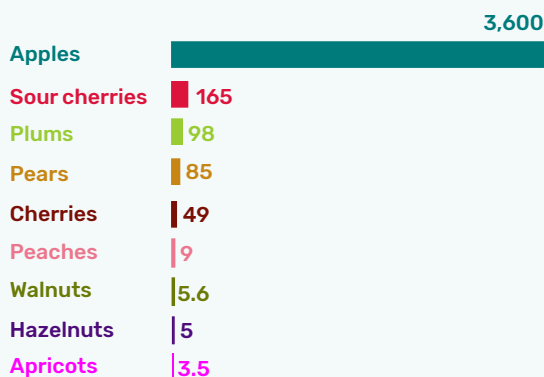
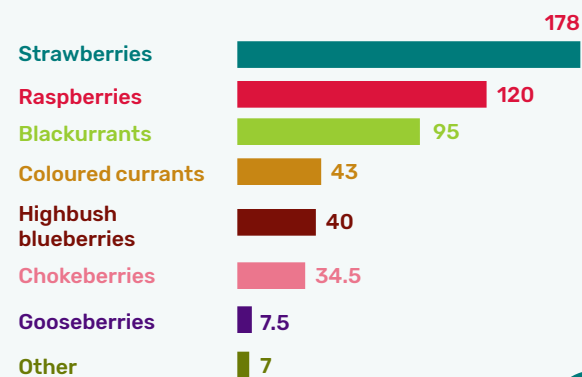


Figure 12. Berries and strawberries production from plantations by type (thousand tonnes, 2021)



1.4.4 Beverages



The beverage sector is second after meat in terms of turnover and production value.

It is the sector having the highest ratio turnover/number of companies, with less than 700 companies accounting for a turnover of over €7 billion.

Production of beer and spirits are equally important in terms of turnover, both being at €2.5 billion, but production of soft drinks is also relevant at €1.5 billion.

Main players

90% of the Polish beer market is in the hands of four concerns, with 18 breweries. Three are international concerns: Carlsberg, Heineken, and Asahi. The fourth is the Polish group Van Pur with six breweries. Less than 10% of the market are medium and regional breweries, while the remaining 1% are small, often craft breweries and on restaurant premises.

- ✓ **Kompania Piwowarska (KP)**, since 2017 a part of Japan's Asahi Group, is the leading producer of beer, with a domestic market share of 34%.
- ✓ **Zywiec**, part of the Heineken group, operates five breweries across the country.
- ✓ **Carlsberg Polska**, the Polish subsidiary of the Danish multinational, operates four breweries in the country.

- ✓ **Maspex** is a large group active primarily in the beverages sector, but also in pasta, sauces, ready meals, and processed vegetables. Its headquarters are in Poland, but it is active in all Central-Eastern Europe countries. Its 2016 turnover slightly exceeded €1 billion with a portfolio of 70 brands including among others Tymbark, Kubuś, Lubella, Łowicz, Krakus, and Kotlin.
- ✓ **PepsiCo** operates four factories, two dedicated to soft drinks and two to snacks, employing almost 3,000 people.
- ✓ **Victoria Cymes** is a bottling company producing fruit juices, soft drinks, and mineral water.
- ✓ **CEDC International** is a local producer of vodka and distributor of wines and spirits from mother company Russian Standard Corporation.
- ✓ **ZP Glubczyce**, Sulimar and Browar Jablonow are local breweries.
- ✓ Major players in the vodka market are **Maspex** Żubrówka, Soplita, Bols, Palace, Absolwent, Żytniówka, Royal, Aurora, Romanoff), **French Belvedere Group** (Krupnik, Sobieski, Starogardzka and Balsam Pomorski), **Pernod Ricard** (Wyborowa, Pan Tadeusz, Polska Wódka and Luksusowa), **Stock Spirits** (Żołądkowa Gorzka, Czysta de Luxe, Lubelska, 1906, Żubr and Spelled), **Polmos Siedlce** (Chopin, Wódka Czysta, Mazowiecka Żytunia). **Debowa** and **Akawit** are local distilleries producing vodka.
- ✓ **FoodCare** produces fruit juices and energy drinks.

1.4.5 Dairy products

The dairy sector is an important contributor to the overall food sector balance, with over €6.7 billion turnover.



Poland's dairy cow population in 2010 was 2,020 thousand heads, down from 2,538. In 2010, the purchase of milk by 302 units amounted to over 14.0 thousand tonnes (kt). Most milk is produced in the Podlaskie (over 2.7kt), Mazowieckie (over 2.6 kt) and Wielkopolskie (over 2.2 kt) provinces (CSO data).

€6.7B
Turnover

Poland is the 6th larger producer of milk in the EU after Germany, France, the Netherlands, Ireland, and Italy. The main dairy products are (in thousand tonnes): liquid milk (3,700); whey (1,729); yoghurt (735); cream (400); cottage cheese, rennet ripening cheese, butter (255); ice cream (224); skimmed milk powder (175); and whole milk powder (40).

Main players

Dairy producers are usually organised in the form of cooperatives.

- ✓ **Mlekovita** is one of the largest dairy companies in Poland. It has 16 production facilities and 30 distribution centres.
- ✓ **OSM Lowicz** is a dairy cooperative with 6,600 local milk suppliers and a daily output of 1.6 million litres of milk.
- ✓ **Polmlek** is the third dairy producer in Poland, employing over 3,000 employees in 8 production plants.
- ✓ **SM Mlekpól** is a large dairy cooperative operating 11 production facilities.
- ✓ **Bakoma** is a dairy company who focuses mainly on export.

1.4.6 Cereal-based foods, bakery, sweets



Bakery products account for the highest number of enterprises (almost 6,000) but are far from the top in terms of turnover (less than €4 billion).

6,000 Bakery products enterprises

Main players

- ✓ **Schulstad Bakery Solutions**, part of the Lantmannen Unibake group, operates two large bakeries in the country.
- ✓ **Mondelez** has seven production sites across Poland, in addition to a research centre in Wrocław (Dolnoslaskie).
- ✓ **E. Wedel**, part of the Lotte group, is a chocolate and snacks producer.
- ✓ **Colian** is a locally owned large producer of sweets, snacks, and soft drinks.
- ✓ **Baltyk** produces chocolates and sweets in three factories in Pomorskie.
- ✓ **Barbara Luijckx** is a producer of high-end chocolates.
- ✓ **Skawa** and **Jaskolka** are producers of biscuits and sweets.
- ✓ **Lesaffre Polska**, local branch of the Lesaffre group, produces yeast and bread ingredients for bakeries.
- ✓ **Wawel** is one of the oldest companies producing sweets in Poland (incl. chocolate bars, chocolate pastilles, chocolate soufflé, cocoa powder, etc.).

1.4.6 Other food products

- ✓ **Danone** is present with its own brand and with controlled company Nutricia.
- ✓ **Heinz, Associated British Foods, Unilever, Lorenz, Mc Cain, Zeelandia, Orkla, Vandemoortele, Barry Callebaut and Leiber** all have production sites in Poland.
- ✓ **Mars** operates in Poland with three brands (Mars Polska, Wrigley Poland and Royal Canin Polska) and seven factories dedicated to pet food, chocolate, chewing gum and candy.
- ✓ **Nestlé** has 9 plants employing over 5,000 people in Poland.
- ✓ **Hortex**, owned by international group Mid Europa Partners, is a large producer of frozen vegetables, fruit and fruit juices.
- ✓ **Bonduelle** has two factories in the country.
- ✓ **Makow** is a producer of frozen fruits and vegetables.
- ✓ **Unifreeze** is a producer of frozen food, mainly vegetables.
- ✓ **Iglotex** produces frozen food of various sorts for the catering industry and retail.
- ✓ **Pamapol** produces processed vegetables and ready meals.

1.5. Wood products



Wood industry generates

2%

of Poland's GDP

2M

People working in the
forestry and wood sector

The Polish wood industry accounts for a significant share of the economy, generating about 2% of Poland's GDP. The total revenues from the manufacturing of products of wood, cork, straw, and wicker, combined with the production of paper and paper products and of furniture amount to €31.5 billion in 2021.

About two million people benefit from working in the forestry and wood sector, directly or indirectly, in Poland. The wood processing market is very dispersed. According to the Polish Chamber of Timber Industry, 90% of wood processing companies (7,300 entities) use not more than 5,000 m³ of wood per year. In total, this group buys 23% of the raw material. There are only 32 companies, 0.4% of Polish wood processors, which use more than 100,000 m³ of round wood per year. In total, this group buys 28% of wood raw material.

The most important wood-based sectors include **sawmill** industry, **furniture** manufacturing, **cellulose-paper** industry, and **wood-based board** manufacturing. The years 2019 and 2020 were a period of significant reduction in wood harvesting in Poland (which resulted not only from slowing down of the entire economy due to the Covid-19 pandemic, but also from a relatively large increase in harvesting in previous years resulting from the necessity of management of wood from windfalls caused by the hurricane in 2017).

In 2020, 40.6 million m³ of roundwood were harvested, of which 11% was exported. The largest part of the export (96%) was for industrial processing, the rest for fuelwood. **On the other hand, Poland imported more than 3 million m³ of roundwood in 2020, more than twice as much as in 2019, 98% of which was industrial roundwood.**

Poland is the 10th largest world producer and the 4th largest world exporter of **furniture** (after China, Germany, and Italy). About 90% of Polish-made furniture goes to export. The furniture industry employs about 200,000 people. It ended 2021 with record sales of €12.6 billion. The industry is currently under threat because many customers have postponed purchases of furniture. But demand is expected to pick up again, latest in the second half of 2023, which could minimise loss of employment in the industry.

Thorough analyses and outlook by the Bank Pekao show that the wood, paper, and packaging industries have performed well over the past years but are facing several challenges to maintain and increase their contribution to the Polish economy.



Poland is the biggest EU producer of fibreboards, and the second producer of chipboards in the EU.

Secondary wood, e.g. from construction and demolition waste, can be mobilised as a resource for the bioeconomy. According to Eurostat, 84% of the construction and demolition waste is separately collected in Poland¹².

Hygienic and sanitary products made of paper (tissue), which include primarily toilet paper, paper towels and tissues, constitute a relatively large and fast-growing segment of the paper industry in Poland. Their domestic production in 2014-2015 reached a record level of just over 560,000 tonnes. In 2015, it accounted for nearly 13% of the total production of paper products in Poland. Its share in value was even greater (approx.17%).

Two key product categories manufactured in Poland are toilet paper (304,000 tonnes in 2015) and paper towels (214,000 tonnes). The production of the latter has developed particularly rapidly in recent years - between 2005 and 2015 its volume grew at an average annual rate of approx. 10%. It was the highest development dynamics among all large categories of paper and cardboard products manufactured in the country. At the same time, the production of toilet paper grew at a pace closer to that of the entire industry (4% on average per year). **The production of tissue products is growing, as the domestic demand is constantly increasing.**

Poland produces approx. 400,000 tonnes of toilet paper per year. **It is one of the largest exporters of this product in the world.** The total value of the toilet paper market in Poland is over €0.35 billion. This total includes branded products as well as private labels of retail chains. **The largest products and producers** include Velvet, Sofidel, Metsä Tissue and ICT.

Recently, the Polish company **Epicom Sp. z o. o.** has caught the attention in this segment, specialising in the production of the highest quality towels and toilet paper for retail chains in the private label formula. Thanks to its experience and commitment, it is one of the fastest growing companies in the tissue paper industry in Poland.

Main players

- ✓ **IKEA** employs over 3,000 people in 16 production facilities in Poland, which is its second production hub after China.
- ✓ **Pfleiderer Group** is a producer of chipboard and fibreboard.
- ✓ **Swiss Krono** has a factory in the Western part of Poland.
- ✓ **Kronospan**, multinational producer of wood-based panels, has a factory in Poland.
- ✓ **Mondi** operates 13 mills in Poland, producing paper, cardboard, industrial bags, and flexible packaging.
- ✓ **Arctic Paper** operates a mill in Poland.
- ✓ **International Paper** has a mill and a business service centre in Poland employing over 2,000 people.
- ✓ **Stora Enso** has a paper and board production facility in Mazowieckie region.
- ✓ **Forte SA** is a large manufacturer of furniture both for its own brand and for international brands, employing over 3,500 people.
- ✓ **Fabryka Papieru i Tektury Beskidy Sp. z o. o.** is a leading European manufacturer of towel paper, ZZ towels, solid cardboard with the addition of textile fibres and cardboard floor protection.

¹² Eurostat, Recovery rate of construction and demolition waste.

1.6. Chemical and pharmaceutical industry

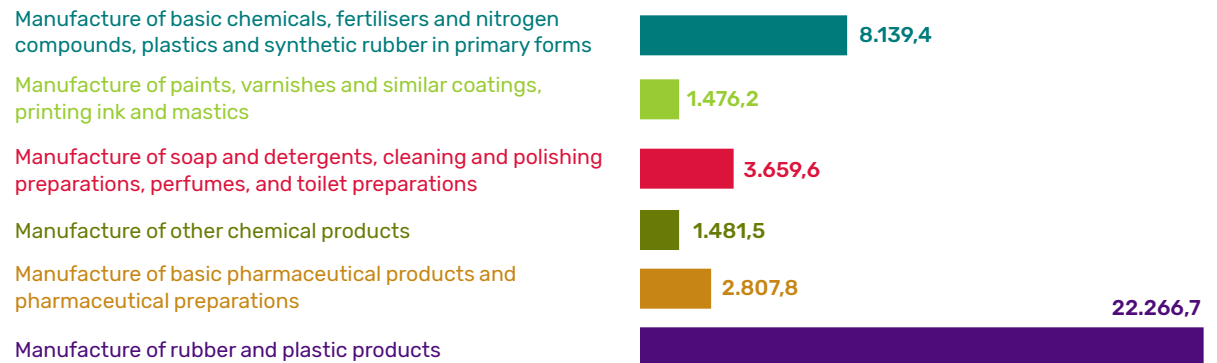


The chemical industry is a highly significant sector in Poland, as is the production of plastics and rubber. Statistics show that in 2020, 2,973 entities manufacture chemicals and chemical products, with a production value of close to €15 billion in 2017.

Moreover, 491 entities manufacture pharmaceutical products; over 8,753 manufacture rubber and plastic products; 143 manufacture coke and refined petroleum products; and 10,102 manufacture other non-metallic mineral products. The output value of the pharmaceutical sector in Poland grew from 2005 through 2017, dropped in 2018 but has been increasing again since 2019. The production value reached €2.8 billion in 2020.

A fast-growing market in Poland is the dietary supplements (vitamins, minerals, herbal teas, and other related products): growing from €1.1 billion in 2017 to €1.6 billion in 2022.

Figure 13. Production value of the chemical and pharmaceutical sector, M€, Eurostat, Annual detailed enterprise statistics for industry (NACE Rev. 2, B-E), 2020)



Main players

✓ **PKN Orlen** and **Lotus** are the largest petrochemical companies in Poland. **Orlen Południe**, belonging to the PKN Orlen group, brought on stream Poland's first and Europe's largest green propylene glycol production unit at its biorefinery in Trzebinia (Małopolskie Voivodeship). Orlen Południe also launched the first pilot installation in Poland to produce ecological lactic acid using microorganisms.

✓ **Grupa Azoty** is a producer of chemicals and fertilisers, with 8 production plants in the country. Grupa Azoty S.A. launched a pilot and production line to produce biodegradable thermoplastic starch with a production capacity of 300 tonnes/year.

✓ **Synthos** has three production sites in the country. Synthos, a leading supplier of synthetic rubbers to produce tyres and technical rubber products, is currently focusing on obtaining synthetic rubber from renewable raw materials.

This is possible thanks to the production of biobutadiene from bioethanol. [The strategy of the Synthos Group](#) assumes the development of the portfolio with such products - sustainable, resource-efficient, with a minimal environmental footprint.

[Synthos AGRO](#) is a key Polish producer and supplier of plant protection products, fertilisers and other agrochemicals, and a leading provider of formulation services in Europe.

- ✔ [Selena](#) is a large producer of construction chemicals and one of the four largest producers of polyurethane foam in the world. Currently it is opening a factory dedicated to biomaterials for the automotive industry in Dzierżoniów (Dolnoslaskie).
- ✔ [PCC Rokita SA](#) is a manufacturer of specialized chemical products and industrial formulations. Taking part in the green transformation of global chemical industry, the PCC Group offers a new product segment: [PCC Greenline®](#).
- ✔ Poland is one of the leading producers of pharmaceutical and cosmetic products in Central Europe. [The top-5 producers in 2022](#) are: [Polpharma](#), [TZMO](#), [Aflofarm](#), [Adamed](#), and [Nauca](#).
- ✔ Other major producers are Hasco-Lek, Ryvu Therapeutics, Mabion, Celon Pharma, and Biomed.
- ✔ A major player in dietary supplements is [Curtis Health Caps \(CHC\)](#).

1.7. Biotech industry



Despite being one of the fastest growing sectors in Poland, biotechnology is still an emerging sector. In the coming years further dynamic growth of the domestic biotechnological market is expected, largely thanks to innovative research projects carried out by the Polish biotech companies and academic institutions, as well as by the inflow of foreign investment into biotech sector.

[Key reasons why Poland attracts investors](#) is availability of highly qualified professionals and competitive labour costs.

Biotech companies and research institutes generally locate their activities in **one of six mature biotech clusters** (Warsaw, Lodz, Tri-City, Krakow, Wroclaw, Poznan).

In 2021, [173 firms conducted biotechnology activities](#), which constitutes a decrease by 2.3% in comparison to the previous year. Some 243 entities conducted research and development activities in the field of biotechnology. Internal financial expenditure on R&D in biotechnology amounted to €292 million an increase of 13.2%

over the previous year. Substantially more people are active in biotechnology research and development, reaching 8,202 people in 217 entities, over half of which are in the business enterprise sector.

The Polish Academy of Science, institutes of the Łukasiewicz Research Network, the Institute of Natural Fibres and Medicinal Plants are also conducting studies and educational activities in biotechnology and chemistry.

Main players

✓ The **Institute of Natural Fibres and Medicinal Plants** in Poznan, is an interdisciplinary research centre with international standing, involved in complex research on obtaining and processing of fibrous and herbal raw materials. The Institute works for agriculture, environment protection, textile, construction, transport, food and pharmaceutical industries and medicine.

✓ **Several Polish biotechnology companies**, including **Selvita**, **Captor Therapeutics**, **Molecure**, **Ryvu Therapeutics** and **Synektik**, and **BioMaxima** have a large market capitalisation and turnover value.

Selvita is active in assay development and screening, medicinal and synthetic chemistry, computer-aided drug design, structural biology, and in vitro pharmacology.

Biotechnika is an engineering and design company active in industrial biotechnology, focusing on biorefining primary and waste streams, the production of biofuels and bioenergy, and on biological waste and sewage management.

✓ **Institut Biotechnologii Surowic i Szczepionek BIOMED Spółka Akcyjna** is a company active in the production of biological medications, (biologicals), specific and non-specific bacterial vaccines, probiotic preparations, allergens, medical devices, in vitro microbiological diagnostic products and sterilisation control indicators.

✓ **BIOTON** is the world's eighth commercial manufacturers of recombinant human insulin.

✓ **BOWIL BIOTECH** the first bio-cellulose factory constructed in compliance with pharmaceutical GMP standards. Based on the innovative know-how, it has developed a unique technology for the bacterial cellulose production intended for medical devices. Each stage of production is strictly controlled by quality departments to guarantee the safety of users and the effectiveness of their bio products.

A network of clusters dealing with biotechnology exists in the country: see Figure 14.

1.8. Clusters and organisations

Table 1. List of Clusters and organisations active in the bioeconomy

NAME	LOCATION	VOIVODSHIP	MAIN MEMBERS
AgroFreshPark	TBD	Lodzkie	Announced January 2018, cooperation between Dutch and Polish stakeholders
AgroBioCluster	Radom	Mazowieckie	A 46 members including local agri-food companies (Skowronski, TB orchard, MB orchard, Polish pepper, Ozon food, Fogiel&Fogiel, Sorter)



NAME	LOCATION	VOIVODSHIP	MAIN MEMBERS
Association Bioeconomy Cluster	Lodz	Lodzkie	Registered in 2019. 21 members represented industrial and scientific institutions. Partners: Agros Nova; BIOTECHNIKA ICRI-BioM (TUL), Łukasiewicz Research Network: Łukasiewicz – Institute of Biopolymers and Chemical Fibers. The Institute of Innovation and Responsible Development INNOWO is a cooperation partner.
Food4Good	Warsaw	Mazowieckie	48 members, including 23 SMEs. It cooperates with two Romanian clusters: AgroTransilvania and Romalimenta
INNOWO	Warsaw	Mazowieckie	Is cooperating with various stakeholder groups such as scientists, government administration, decision makers, businesses and NGO's. Areas of activity: healthcare, circular economy, sustainable energy
Life Science Cluster, National Key Cluster	Krakow	Malopolskie	75 members
NutriBiomed Cluster	Wrocław	Dolnoslaskie	Farmaceutyczny Zakład Naukowo-Produkcyjny 'Biocheffa', P.W. 'Futurum', Technox
BioEcoChem Cluster	Gdańsk	Pomorskie	Polpharma, Lipopharm.pl, Bliirt, A&A Biotechnology
West Pomeranian Chemical Cluster 'Green Chemistry', National Key Cluster	Szczecin	Zachodniopomorskie	Fosfan, Zakłady Chemiczne Police (Grupa Azoty), Kemipol
Eco-Energetic Cluster EEI-Energy, Ecology, Innovation	Wrocław	Dolnoslaskie	Biotransformation Department, University of Wrocław
Bioenergy for the Region	Łódź	Lodzkie	Trimen Chemicals
Organic Food Valley	Lublin	Lubelskie	Owocowe Smaki, Barwy Zdrowia
Food Cluster	Kalisz	Wielkopskie	WPPH Elena Import-Export, Lazur Spółdzielnia Mleczarska, Ceko Sp. Z o.o
Biotechnology Cluster BIOPARK	Gdańsk	Pomorskie	Biomax, Nutri Pharmax



NAME	LOCATION	VOIVODSHIP	MAIN MEMBERS
Lublin Medicine–Medical & Wellness Cluster	Lublin	Lubelskie	VitaGenum
BTM (BioTechMed)	Warszawa	Mazowieckie	Celon Pharma, TriMen Chemicals
BioNanoPark	Łódź	Lodzkie	Laboratory services
Gdański Park Naukowo-Technologiczny (GPN-T)	Gdańsk	Pomorskie	Polpharma, Blirt
Poznan Science and Technology Park	Poznań	Wielkopolskie	DNA Research Centre, Future Synthesis, PolBiotech Laboratorium
You Nick Technology Park	Suchy Las	Wielkopolskie	SmartPharma
Polish maritime cluster	Gdynia	Pomorskie	75 members
sEaNERGIA Baltic Cluster	Kolobrzeg	Zachodniopomorskie	259 members including 156 companies
Waste Management and Recycling Cluster National Key Cluster	Kielce	Świętokrzyskie	40 industrial members
Polish Chamber of Flax and Hemp	Poznań	Wielkopolskie	15 members
Polish Cluster of Composite Technologies, National Key Cluster	Kraków	Małopolskie	Over 100 members
Polish Herbal Committee	Poznań	Wielkopolskie	105 members

1.9. Academia and research centres



The Polish Business and Innovation Centres Association, is the umbrella organisation grouping most business incubators and technology parks in the country.

It has over 50 individual and supporting members and is in permanent working contact with over 300 innovation and entrepreneurship centres, including most parks and technology incubators, technology transfer centres, business incubators, loan funds, training and consultancy centres.

Technology parks focusing with bioeconomy are:

- Kutno Agro-industrial Park, in the Lodzkie region.
- Wrocław Technology Park (coordinator of cluster NutriBiomed) in the Dolnoslaskie region.
- Łódzki Regionalny Park Naukowo-Technologiczny (coordinator of BioNanoPark) in the Lodzkie region.

The **International Centre for Research on Innovative Bio-based Materials (ICRI-BioM)** in Lodz is a cooperation between the Lodz University of Technology and the Max Planck Institute from Mainz, Germany.

The **Wrocław University of Environment and Life Sciences (UPWr)** in the lower Silesia region is a highly specialised university in the country with a research centre on environment, agribusiness, and innovative technologies in the food sector. It focuses on health and the quality of life.

1.10. Research projects



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

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

Academic and industrial partners from Poland have been contributing to these objectives of the BBI JU, CBE 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 systems to further upscale towards commercial levels (via Innovation

Actions – demonstration at TRL 6 – 7; and flagship at TRL 8).

The following list shows some examples of BBI JU RIA projects¹³ in which partners from Poland have been delivering significant contributions to advance 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 systems.

¹³ When writing this country report, CBE JU Programme Office is in the Grant Agreement Preparation and signature phase of the first call under CBE JU, and the granted projects have not been published.

2. Optimise efficient processing for integrated biorefineries through research, development, and innovation.
3. Develop innovative bio-based products for identified market applications.
4. 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 Poland have also been participating in these studies, but these are not covered in this report.

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

The **West Pomeranian Cluster of Green Chemistry Zielona Chemia** is a partner in the BBI JU Flagship project **FARMYNG** - *Flagship demonstration of industrial scale production of nutrient resources from mealworms to develop a bioeconomy new generation.*



Project duration 2019 - 2022

The project developed animal feed (especially pet food and feed for aquaculture) from invertebrates. These are abundant and renewable sources of proteins, and they can be fed with low-grade biomass.

Another project to unlock new sources of proteins was **PROTEIN2FOOD** - *Development of high-quality food protein through sustainable production and processing.*



Project duration 2015 - 2020

The project studied the production of plant proteins for human and animal consumption from nutritious seed crops (quinoa, amaranth and buckwheat), and legumes with high protein quantity (lupin, faba beans, pea, chickpea, lentil). The **Institute of Animal Reproduction and Food Research of the Polish Academy of Sciences** was a partner of the project.

The BBI JU RIA **COSMOS** - *Camelina & crambe Oil crops as Sources for Medium-chain Oils for Specialty oleochemicals*, of which the **University of Warmia and Mazury in Olsztyn** and former BIC member **Apeiron Synthesis** were partners.



Project duration 2015 - 2019

The project studied the use of camelina and crambe as sustainable, multipurpose, non-GMO European oil crops to produce oleochemicals, especially medium-chain fatty acids and medium-chain polymer building blocks.

The BBI JU Demo **Dendromass4Europe** - *Securing Sustainable Dendromass Production with Poplar Plantations in European Rural Areas.*



Project duration 2017 - 2022

Pulp-Tec is a partner and developed short-rotation coppice cropping systems (mainly based on poplar) on marginal land in central Europe, with the objective of planting 2500 hectares by project completion.

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



Project duration 2017 - 2021

The project, in which of which the **Institute of Natural Fibres and Medicinal Plants** is a partner, developed a database of the most suitable crop varieties and agronomic practices to grow crops on marginal lands.

HaloSYS - Integrated system of bioremediation - biorefining using halophyte species



Project duration 2018 - 2021

The project included the **Institute of Natural Fibres and Medicinal Plants** and **Olten** as partners. It demonstrated the cultivation of halophyte species on saline soils to develop new value systems to produce biocomposites, bioethanol and briquettes for energy purposes.

B. In the field of developing and applying innovative technologies for preparing and converting (new) biomass feedstock an example is:

The BBI JU Demo **B-FERST** - Bio-based fertilising products as the best practice for agricultural management sustainability



Project duration 2019 - 2024

The project features featuring the **Institute of Soil Science and Plant Cultivation - State Research Institute** as a partner, is developing innovative processes to valorise various kinds of bio-wastes into fertilisers.

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

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



Project duration 2017- 2021

The project is coordinated by **SELENA** and featuring **Institute of Heavy Organic Synthesis Blachownia, E-Office7, Leda Polymer**, and **Intap** as partners. It developed and manufactured at semi-industrial scale bio-based polyurethane foams and fibres for the automotive sector and tested these in representative environments.

The issue of biodegradable packaging is tackled by the BBI JU RIA **USABLE PACKAGING** - *Unlocking the potential of sustainable biodegradable packaging*



Project duration 2019 - 2022

The project had Poznanska Hodowla Roslin as one of its partners. It developed a mild biochemical process to turn food industry waste streams into rigid and semi-rigid packaging products.

Another project dealing with bio-based fibres and resins was the BBI JU RIA **ECOXY** - *Bio-based recyclable, reshapable and repairable (3R) fibre-reinforced EpOXY composites for automotive and construction sectors*



Project duration 2017 - 2020

The project developed bio-based fibre reinforced thermoset composites where both the epoxy resin and the fibres are bio-based. **Bergamo Technologie Spzoo** is a partner of the project.

D. In the field of education:

The BBI JU Coordination and Support (CSA) project **BIObec** project



Project duration 2017 - 2020

It aims to build bridges between the bio-based industry and the education system by interlinking universities, innovation labs, and R&D centres with industrial actors and regions. BIObec will establish the framework for the development of multi-level Bio-Based Education Centres (BBECs) to act as knowledge hubs bridging the gaps between academic institutions, students, innovation entities and policy makers.

Likewise, the BBECs will be flexible enough to answer the actual and future needs of the industry and surrounding ecosystem at local, regional, and national levels.

The project is coordinated by the Alma Mater Studiorum – Università di Bologna (UNIBO), and BIC associate member **Pro Civis Foundation for Education and Social Dialogue** is a project partner.

Pro Civis is responsible for the feasibility study and establishment of BBECs for Poland and other Central and Eastern European Countries.

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

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 systems 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 Poland, given their size and strengths (see chapter 1). In addition, relevant and attractive feedstock for the bio-based industry can come from the food and feed processing industries, wood-based industries, other bio-based industries (such as breweries) municipalities and relevant gaseous sources.

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

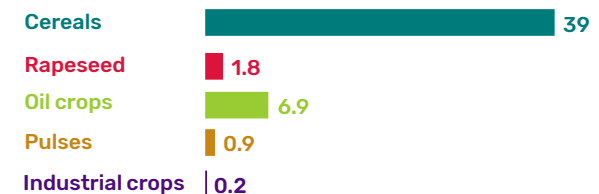
Supportive legislation and governmental programmes on regional and national levels can significantly add to the success of new bio-based activities in Poland, benefitting all.

2.1. Bio-based residues: availability and use

2.1.1 Agricultural residues

The JRC study on biomass production and flows (2023 edition) states that Poland ranks third for agricultural residues production in Europe (after France and Germany). It estimates a total of 48.8 million tonnes dry matter / year of agricultural residues in Poland (average 2016-2020). The approximate subdivision among crop groups, inferred from the JRC study graphs, are:

Figure 14. Residue production per crop group (million tonnes dry matter per year, average 2016-2020)



2.1.2 Forestry residues

JRC estimates the fraction of residues as 20% in weight of the total wood felled¹⁴, while other sources vary between 15%¹⁵ and 30%¹⁶. The exact fraction will obviously depend on many factors, among which are tree species, age, climate, and logging practices. Based on the above, an estimate of the available residues can be made from the removal quantities shown in Table 1.2. Since the amount of wood removed is only available as volume, a conversion to weight is necessary. For this calculation we use an average density of 600 kg/m³ for freshly cut coniferous trees, and 800 kg/m³ for deciduous ones.

Based on removal data (available in m³), this estimate shows (see table 2.3) that the available forest-based residues (coniferous and broadleaved) range between 7 and 14 million tonnes per year. It must be pointed out that this is an upper limit for the theoretical availability of residues; it does not consider the quantity of residues that need to be left on the ground for soil management purposes.



Table 2. Forest residues availability (estimate from Eurostat, 2021 data)¹⁷

Group of species	Removal (thousand cubic metres)	Estimated removal over bark (thousand tonnes)	Estimated residues (thousand tonnes)		
			15%	20%	30%
Coniferous	33.320	37.018	5553	7404	11105
Broadleaved	9.787	10.873	2175	2175	3262
Total	4017		9578	9578	14367

2.1.3 Waste from bio-based economic activities

The Polish National Statistical Office (GUS) offers statistics about the generation and use of waste streams from various economic sectors, among which at least two bio-based macro-categories (agri-food and wood-based) can be identified.

Unfortunately, the dataset suffers two drawbacks:

- The nature of waste streams is not specified, meaning that it's impossible to distinguish between bio-based versus non-bio-based ones. It is therefore also unclear if available waste streams from horticulture are included (i.e. waste streams after amounts used e.g. as feed for farm animals and for biogas production).

- The single items do not add up to the total, leaving a question mark on the management of a significant fraction of waste streams. In the following graphs this fraction is reported as 'waste not otherwise accounted for'.

¹⁴ Camia A. et al., 2018, Biomass production, supply, uses and flows in the European Union, JRC.

¹⁵ Meuleman, B., L. Kuiper, G. J. Nabuurs, 2005, Effect: EU forest for renewable energy to mitigate climate, Ecofys, Utrecht.

¹⁶ Smith et al., 2009, Forest resources of the United States, 2007: a technical document supporting the forest service 2010 RPA Assessment.

¹⁷ Eurostat, Roundwood removals by type of wood and assortment.

Table 3. Waste streams from agri-food sectors (thousand tonnes/year, GUS, 2019)

	Sector total							
	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing	Wastes from agriculture, horticulture, aquaculture, forestry, hunting, and fishing	Wastes from the preparation and processing of foodstuffs of animal origin	Wastes from preparation, processing of food products and stimulants and waste from vegetable origin	Wastes from sugar processing	Wastes from the dairy products industry	Wastes from the baking and confectionery industry	Wastes from the production of alcoholic and non-alcoholic beverages (except coffee, tea, and cocoa)
Total	2497,2	180,4	439,3	532,6	556,8	335,9	51,4	400,8
Waste recovered	226,0	19,3	-	22,6	98,8	40,9		44,4
Waste treated	9,3	-	6,5	1,3	-			1,5
Waste treated thermally	6,4	-	6,4	-	-			-
Waste treated through landfilling	-	-	-	-	-			-
Waste temporarily stored	71,7	8,7	5,7	6,8	50,5			-
Waste landfilled up to now (accumulated)	40,0	-	7,6	-	32,4			-
Waste not otherwise accounted for	2143,8	152,4	413,1	501,9	375,1	295	51,4	354,9

Table 4. Waste streams from wood-based sectors (thousand tonnes/year, GUS 2019)

	Sector total		Subsectors	
	Wastes from wood processing and the production of panels and furniture, pulp, paper, and cardboard	Wastes from wood processing and the production of panels and furniture	Wastes from pulp, paper and cardboard production and processing	
Total	2405,3	1318,7	1086,5	
Waste recovered	640,5	387,2	253,3	
Waste treated	33,1	23,9	9,2	
Waste treated thermally	23,9	23,9	-	
Waste treated through landfilling	9,2	-	9,2	
Waste temporarily stored	40,8	12,4	28,4	
Waste landfilled up to now (accumulated)	233,1	0,3	232,8	
Waste not otherwise accounted for	1424,7	871	553,6	

2.1.4 Organic fraction of Municipal Solid Waste

In 2020, 61% of MSW was collected separately (4.9 million tonnes out of 8.1 million tonnes generated). The biodegradable fraction, i.e. OFMSW, was the largest separately collected fraction by weight, with a collection of 1.6 million tonnes in 2020.

It is worth noting that the volume of separately collected OFMSW has been steadily growing in recent years.

Figure 15. Trend in separate collection of OFMSW (thousand tonnes)

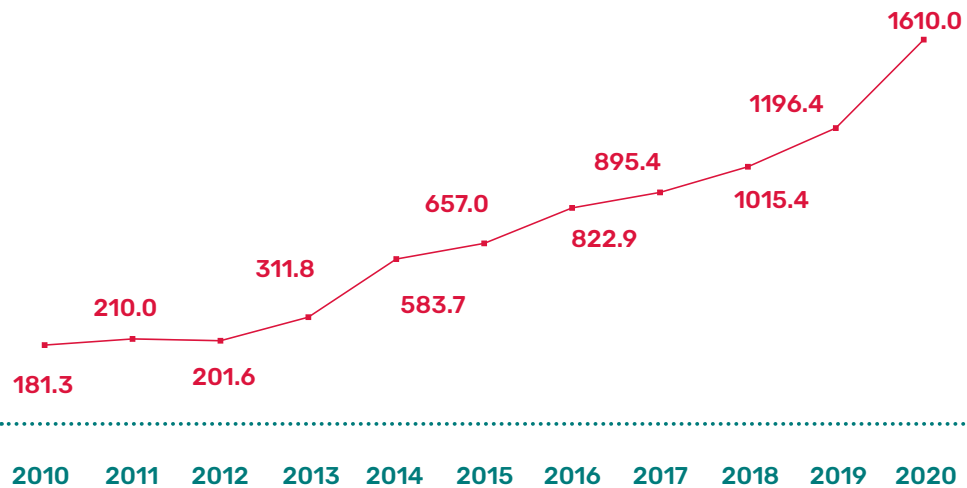


Table 5. Summary of available residual and waste streams

Million tonnes/year	
Agricultural residues	48.8
Forest residues	7 – 14
Waste from agri-food bio-based economic activities	2.5
Waste wood-based	2.4
Organic fraction of municipal solid waste	1.6
Total	62 – 69



2.2. Bioeconomy strategies and programmes

2.2.1 National strategy

Key official documents that refer to bioeconomy are:

- Roadmap towards the Transition to Circular Economy ([September 2019](#))
- National Science Policy ([July 2022](#))
- National Smart Specialisation Strategy ([February 2023](#))

The Roadmap towards the Transition to Circular Economy (CE Road Map) is a strategic project of the 2017 '[Strategy for Responsible Development](#)' (SRD), and thus fits into the overall vision of the country's development. It seeks to implement the main objective of the SRD, i.e. to create conditions for the growth of income of the Polish population while simultaneously increasing social, economic, and territorial cohesion.

The actions proposed in the CE Road Map should also contribute to the implementation of the four Polish priorities mentioned in a non-paper (2015) which identifies Poland's main priorities in the field of CE:

1. Innovation, strengthening of cooperation between industry and the science sector, and implementing of innovative solutions in the economy as a result.
2. Creating a European market for secondary raw materials.
3. Ensuring availability of high quality secondary raw materials.
4. Development of the service sector.

The bioeconomy is one of the four chapters of the Road Map CE, apart from sustainable industrial production and sustainable consumption.

Chapter III of the CE Road Map, 'Bioeconomy', focuses on creating conditions for the development of the bioeconomy in Poland and on activities concerning the development of bioeconomy in selected areas, specifically in creating local industrial value systems.

The chapter segments are:

1. Key actions for creating conditions for the development of the bioeconomy.
2. Actions to build local value systems and raw materials base.
3. Actions to prioritise the cascading use of biomass, including recycling and only final stage residues for energy.
4. Activities to promote the application of biotechnology and the cascading use of biomass in industry.

Poland is one of the 19 countries registered on the [Smart Specialisation Platform](#), with five S3 (Smart Specialisation Strategy) priorities including one on bioeconomy.

Other strategies related to the bioeconomy are the Strategy for Innovation and Efficiency of the

Economy, the Strategy of Energy Safety and Environment, and the Strategy for Sustainable Development of Agriculture, Rural Areas, and Fisheries. A new strategy in the field of environment, i.e. 2030 ecological policy of the state - development strategy in environment and water management (PEP2030) was also prepared by the Ministry of the Environment and adopted by the Council of Ministers on 16 July 2019. A further relevant document is the National Programme for the Development of a Low-Emission Economy, published in 2015.

The Strategy for Sustainable Development of Rural Areas, Agriculture and Fisheries 2030 was adopted by the resolution of the Council of Ministers on October 16th, 2019. The key specific goals of the strategy, i.e. 1) increasing viability of agricultural production, 2) improvement of the quality of life and environment in rural areas and 3) business development and jobs growth, will be implemented by various activities concerning bioeconomy as well, for example:

- Disseminating circular economy model in rural areas.
- The uptake of circular bioeconomy with focus on cascading use of agricultural biomass and new business development.

- Increase of renewable and biological resources use for new bio-products.
- Creating new value chains using local advantages in rural areas.
- Promoting the solutions of food waste, preventing and valorisation of food losses.
- Water management based on water retention.

National legislation is particularly restrictive regarding the use of genetically modified organisms (GMO). Genetic engineering and cultivation of GM plants are explicitly banned from agriculture. The use of livestock feed based on genetically modified (GM) crops is banned as well; the ban on feed was suspended until 1 January 2021¹⁸ as Poland is highly dependent on imports of GM soy. This is due to ongoing dependency and the difficulty of making domestic non-GM alternatives available.

There is currently no specific legislation regulating innovative biotechnologies. To date, these techniques are treated as genetic engineering. This is allegedly prompting Polish scientists to be extremely cautious in the [application of biotechnologies](#).

The State Science Policy (PNP), a strategic document that indicates the priorities for the functioning of the higher education and science system, was adopted by the resolution of the Council of Ministers in 2022. It covers seven priorities: Priority I: Development of the higher education and science system, Priority II: Poland's role in global development, Priority III: Natural resources and environment Priority IV: Digital technologies in the economy and society, Priority V: Society and quality of life, Priority VI: Community, culture, tradition, Priority VII: National defense and security.

Priority 3 covers three main thematic areas:

1. Resources and biodiversity
2. Food and bioeconomy
3. Energy and climate

[Scientific research in area II](#) focuses on :

- Bioeconomy resources in agriculture, aquaculture and forestry and their productivity in the context of bioeconomy development.
- The production and use of bio-waste from agriculture, aquaculture and forestry and bio-waste from the municipal sphere, due to their importance in a closed cycle, including in the production of bioenergy.
- The potential for biomass production from various sources, including waste, and its use for bioenergy production - the use of natural resources, in particular lignocellulosic raw materials.
- The impact of bioeconomy on climate protection, water, and air quality.
- Waste management and resource efficiency (waste collection, recycling, circular economy) and issues related to the development of waste prevention infrastructure and the development of a system for selective collection of municipal waste, which will ensure the acquisition of recyclable waste, and the development of installations for the processing of bio-waste.

The National Smart Specialisation (NSS) is an open document, subject to constant verification and updating, based on the monitoring system of

the entrepreneurial discovery process and the analysis of socio-economic changes taking place on a national and global scale. The last update of the document is dated February 13, 2023, and covers thirteen NSSs. Two specialisations, such as NSS 2 'Modern Agriculture, Forestry and Food', and NSS 3 'Sustainable (BIO) Products, (BIO) Processes and Environment', are to a large extent related to the area of bioeconomy.

On November 23, 2021, representatives of the government administration and stakeholders of the biogas and biomethane sector signed the "Agreement on cooperation for the development of the biogas and biomethane sector".

The aim of this initiative is to support the development of the biogas and biomethane sector in Poland, to maximise the so-called local content, i.e., the participation of Polish entrepreneurs and technologies in the supply chain for the purposes of construction and operation of domestic biogas and biomethane plants, as well as market development and widespread use of biogas and biomethane in the economy.

The parties to the Agreement are representatives of the government administration: Minister of Climate and Environment, Government Plenipotentiary for Renewable Energy Sources, Minister of Funds and Regional Policy, Minister of Agriculture and Rural Development, Minister of State Assets, Minister of Economic Development and Technology, Minister of Education and Science, as well as representatives of investors,

¹⁸ According to the currently binding law on feed of 22 July 2006 (Journal of Laws of 2019 item 269) the use of GMOs in feeding animals will be banned from January 1, 2021.

entities participating in the supply chain for the biogas and biomethane sector, business environment organizations, financial and insurance institutions and representatives of the world of science.

The [Agreement](#) is a permanent platform of cooperation between the Parties for the development of the biogas sector and the construction and development of the biomethane sector in Poland, with an emphasis on strengthening domestic economic, economic, environmental, technological, energy and social benefits.



2.2.2 International cooperation in Central Eastern Europe

Poland is among the founders of the Visegrad group (V4), together with Czech Republic, Slovakia, and Hungary. The group was recently enlarged to include Bulgaria, Romania, Croatia, Slovenia, and Estonia (V4+).

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

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

[BIOEASTsUP - Advancing Sustainable Circular Bioeconomy in Central and Eastern European Countries](#), is a project anchored on the BIOEAST initiative. It is a multi-stakeholder project with the objective to strengthen the strategic cooperation on circular economy in Central and Eastern Europe across borders and sectors. One of its outcomes will be development of a Strategic Research Agenda to be implemented by the BIOEAST countries. The project is coordinated by the Institute of Soil Science and Plant Cultivation – National Research Institute, Puławy, Poland. The Ministry of Agriculture and Rural Development, the Institute of Agricultural and Food Economics – National Research Institute and the European Rural Development Network (Poland-based international research association, NGO) are Polish partners in the project consortium.

Poland is a member of the European Industrial Hemp Association (EIHA), which is a consortium of the hemp-processing industry representing the common interests of industrial hemp farmers and producers, in the industrial hemp sector in Europe. EIHA joined the European Commission 'Bioeconomy Panel' and the working group 'Sustainable Bioresources for a Growing Bioeconomy' of the EU Standing Committee on Agricultural Research.

Moreover, Poland is a member of the European Technology Platform for the Future of Textiles and Clothing. The ETP's mission is to ensure the long-term competitiveness of the European textile and clothing industry and to reinforce Europe's leading player in the development and manufacturing of fibres, textiles, textile-based products, and apparel.

For 20 years, the [Central European BioForum](#) has been organising internationally renowned conferences for the biotechnology sector. Every year, over 100 exhibitors and about 2,000 participants take part in them. Thus, CEBioForum supports the development of the Polish biotech-pharmaceutical sector, supports the development of diagnostics and breakthrough therapies, helps in establishing international cooperation and is a meeting place for academic and business communities.

3.

POTENTIAL USE/ VALORISATION OF BIO-BASED STREAMS

The quantities of the different residual biomass streams in Poland shown in chapter 2 (see Fig.19) are sufficient to produce biochemicals on commercial levels¹⁹. However, currently there are not many **biorefineries located in Poland** and those present mainly use agriculture-based feedstock. 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 some possible opportunities for adding higher values to unused biomass and the residual streams and waste listed in chapter 2. These opportunities can be derived from successfully completed or running projects using similar or comparable feedstocks as those present in Poland.

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

The BBI JU achieved 142 granted projects at different technology readiness levels (TRLs) and Coordination and Support Actions (CSA). The total investment of €822 million public money generated €2.80 private investment for each €1 public money.

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

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

Actors in Poland participate in many granted BBI JU projects ranging from RIA projects (RIA projects end at TRLs 4-5, as Pilot plants); Innovation Action - demonstration projects (demonstration projects end at pre-commercial levels TRLs 6-7), and Innovation Action - flagship project (flagship projects end at commercial level TRL 8) and CSA projects (studies).

Among the granted BBI JU demonstration projects, is **BIOMOTIVE** the first project at this TRL that has been coordinated and led by a Polish partner: Selena Labs Sp. z.o.o.

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 Poland to step up bio-based activities at all levels in the country itself. A strong bio-based industry and sector in Poland will also benefit Europe.

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

¹⁹ For example: 270 thousand tonnes/year of wheat straw can yield 40 thousand tonnes/year of bioethanol.

3.1. BBI Projects of interest

Poland has abundant residual biomass available from crops (cereals, sugar beet and rape), forest, the organic fraction of municipal solid waste (OFMSW) and food industry (meat, beverages, dairy and bakery products). 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 Poland. These projects are to serve as examples to further increase utilisation and to show the potential of these streams in Poland. The selection is made on feedstock used, not on the actors in the projects' consortia.

3.1.1 Crop residues



Type of action : IA - Flagship

 Duration :
06/2017 - 05/2022

 Overall budget :
€34.9M

 Pilot plant location(s) :
Romania

LIGNOFLAG: Converting wheat straw into bioethanol

Project description

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



Type of action : IA - Demo

Duration :
06/2017 - 05/2021

Overall budget :
€16.3M

Pilot plant location(s) :
Germany



Type of action : RIA

Duration :
06/2018 - 11/2021

Overall budget :
€4.5M

Pilot plant location(s) :
Italy, Slovakia

OPTISOCHEM: Converting wheat straw into green chemicals

Project description

OPTISOCHEM'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. OPTISOCHEM consists in showcasing the technical accessibility and economical

sustainability of the value chains, from wheat straw to two different families of chemicals derived from bio-based Isobutene (IBN). These compounds, oligomers (DIB, TIB, TelB) 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

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



Type of action : IA - Demo

 Duration :
10/2016 - 09/2020

 Overall budget :
€15.5M

 Pilot plant location(s) :
Spain, Italy

AGRIMAX: Converting crop and food residues into several products

Project description

Approximately one third of all food produced globally is wasted every year throughout the whole value chain from farmers to consumers. To extract the significant amounts of valuable compounds contained in these wastes, AgriMax will combine affordable and flexible processing technologies (ultrasound assisted and solvent extraction, filtration, thermal and enzymatic treatments) for the valorisation of side streams from the horticultural

culture and the food processing industry to be used in a cooperative approach by local stakeholders. Through the selection of case-scenarios previously developed to a pilot scale by the participating RTOs and their industrial transfer in new applications as food additives, packaging and agricultural materials among others, the project will disclose the holistic potential of four new agro-value chains (residues and by products from the culture and processing of tomato, cereals, olives, potato). Any by-products generated along the production cycle will be valorised in a cascade manner to reach over 40% of high-value use of the waste.

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

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

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

PROMINENT

Type of action : RIA

 Duration :
01/2015 - 10/2018

 Overall budget :
€3.1M

 Pilot plant location(s) :
Finland

PROMINENT: Proteins from cereal side-streams

Project description

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

Type of action : IA - Flagship

 Duration :
06/2018 – 05/2022

 Overall budget :
€43.2M

 Pilot plant location(s) :
Estonia

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

Project description

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

OXILVA PROJECT

Type of action : IA - Flagship

 Duration :
05/2016 – 04/2019

 Overall budget :
€44.6M

 Pilot plant location(s) :
Norwegian

EXILVA: Microfibrillated cellulose from wood

Project description

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

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

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

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

3.1.3 Organic fraction of municipal solid waste (OFMSW)



PERCAL

Type of action : RIA

 Duration :
07/2017 – 06/2020

 Overall budget :
€3.4M

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

PERCAL: Chemical building blocks from MSW

Project description

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

Newfert

Type of action : RIA

 Duration :
07/2105 – 12/2018

 Overall budget :
€2.4M

 Pilot plant location(s) :
Spain

NEWFERT – Mineral fertilisers from bio-waste

Project description

Most fertilisers currently rely heavily on fossil mineral resources for nutrient supply. The idea behind the NEWFERT project was to build up an innovative concept for the fertiliser industry that essentially turns ashes of different origins and livestock effluent into a new generation of fertilisers. Researchers identified and analysed more than 45 different types of bio-waste from different areas of Europe and selected 10 for introduction into the fertiliser production process based on their physical and chemical

properties. Ashes containing high phosphorous or potassium content and nutrient availability were used directly for fertiliser production. In the case of ashes with insoluble nutrients, NewFert partners developed new biorefining technologies with low input and energy cost to increase nutrient recovery such as phosphate.

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

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

Process(es) : Microbial electrolysis

Product(s) : Fertiliser



Type of action : IA - Demo

Duration :
06/2017 – 05/2021

Overall budget :
€14.6M

Pilot plant location(s) :
Spain

URBIOFIN – Conversion of MSW into chemical building blocks and biopolymers

Project description

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 Alcudia (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)

3.1.4 Food industry residue



Type of action : IA - Demo

Duration :
09/2016 – 02/2021

Overall budget :
€5.5M

Pilot plant location(s) :
The Netherlands

GREENPROTEIN: Valorisation of vegetable processing industry residues into functional proteins

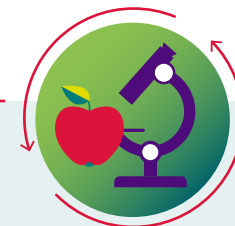
Project description

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

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

Type of action : IA - Demo

 **Duration :**
07/2015 – 06/2019

 **Overall budget :**
€11.4M

 **Pilot plant location(s) :**
The Netherlands



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

Project description

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

Type of action : RIA

 **Duration :**
05/2018 – 04/2021

 **Overall budget :**
€4M

 **Pilot plant location(s) :**
Denmark

3.2. Local actors already active in BIC/BBI

IAPAN - Institute of Agrophysics of the Polish Academy of Sciences, Foundation for Education and Social Dialogue 'Pro Civis', Institute of Agricultural and Food Biotechnology, Łukasiewicz R&D Network - Automotive Industry Institute, Łukasiewicz Research Network - New Chemical Syntheses Institute, Łukasiewicz Research Network – Institute of Industrial Organic Chemistry, Poznan University of Technology, The Association West Pomeranian Chemical Cluster 'Green Chemistry', UPWr - Wrocław University of Environmental and Life Sciences, Wrocław University of Science and Technology, Łukasiewicz Research Network – Institute of Heavy Organic Synthesis "Blachownia" are current [BIC Associate Members](#).

Selena is coordinator of the BBI JU project BIOMOTIVE.

The following entities are partners in BBI JU projects: Łukasiewicz Research Network – Institute of Heavy Organic Synthesis "Blachownia", E-Office7 Spółka z ograniczoną odpowiedzialnością, Leda Polymer Sp Zoo, Intap Tobik Spolka Jawna, Stowarzyszenie Zachodniopomorski Klaster Chemiczny Zielona Chemia, Fundacja Uniwersytetu im. Adama Mickiewicza w Poznaniu, Pulpack Spółka z ograniczoną odpowiedzialnością Spółka Komandytowa, Poznanska Hodowla Roślin Spółka z ograniczoną odpowiedzialnością, Bergamo Technologie Sp. z o.o., Instytut Uprawy Nawożenia i Gleboznawstwa - Państwowy Instytut Badawczy.

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. As of October 2018, this plan had reached €344.4 billion of investment mobilised.

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:



The European Fund for Strategic Investments (EFSI)

To overcome current market failures by addressing market gaps and mobilising private investment. It is jointly run by the European Investment Bank, the European Investment Fund, and the European Commission. It supports strategic investments in key areas such as infrastructure, education, research, and innovation, as well as risk finance for small businesses. December 2020 saw the last approvals of projects by the EFSI Investment Committee. In 2022 [InvestEU](#) took over as the new long-term financing programme of the European Union, building on the success of EFSI.

2. The European Investment Advisory Hub (EIAH)

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

3. The European Investment Project Portal (EIPP)

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

The Juncker plan 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. InvestEU will support the Green Deal Industrial Plan to enhance the competitiveness of Europe's net-zero industry and the fast transition to climate neutrality.

As of July 2020, **over €500 billion in investment have been triggered EU-wide**. The **total financing under EFSI in Poland** amounts to €4.4 billion and is set to trigger €22.3 billion in additional investments.

One of the approved projects in Poland is categorised under 'Bioeconomy':



Company : MASPEX - GMW SP ZOO SP K

Type of business : Food industry

EIF Financing : EIB loan

Financial intermediary : -

Title : Food production modernisation

Description

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

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

3.3.2 European Circular Economy Fund (ECBF)

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

3.3.3 Country-specific EIF initiatives

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

In Poland, it is supporting the Polish Growth Fund of Funds (PGFF) / Polski Fundusz-funduszy Wzrostu (PFFW) together with Bank Gospodarstwa Krajowego (BGK). The programme combines a €30 million commitment from EIF with €60 million from BGK to stimulate equity investments into growth-focussed enterprises in Poland.

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.

Figure 16. EU Regions with Bioeconomy R&I Priorities

● Agriculture ● Waste Processing

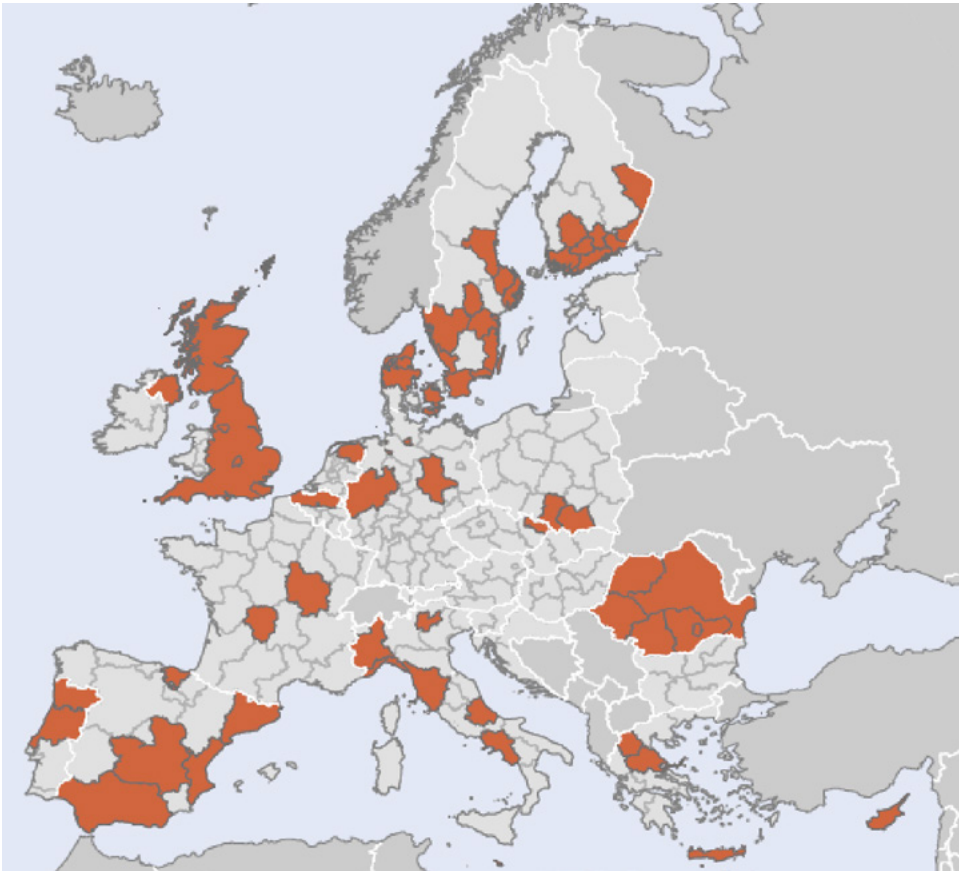
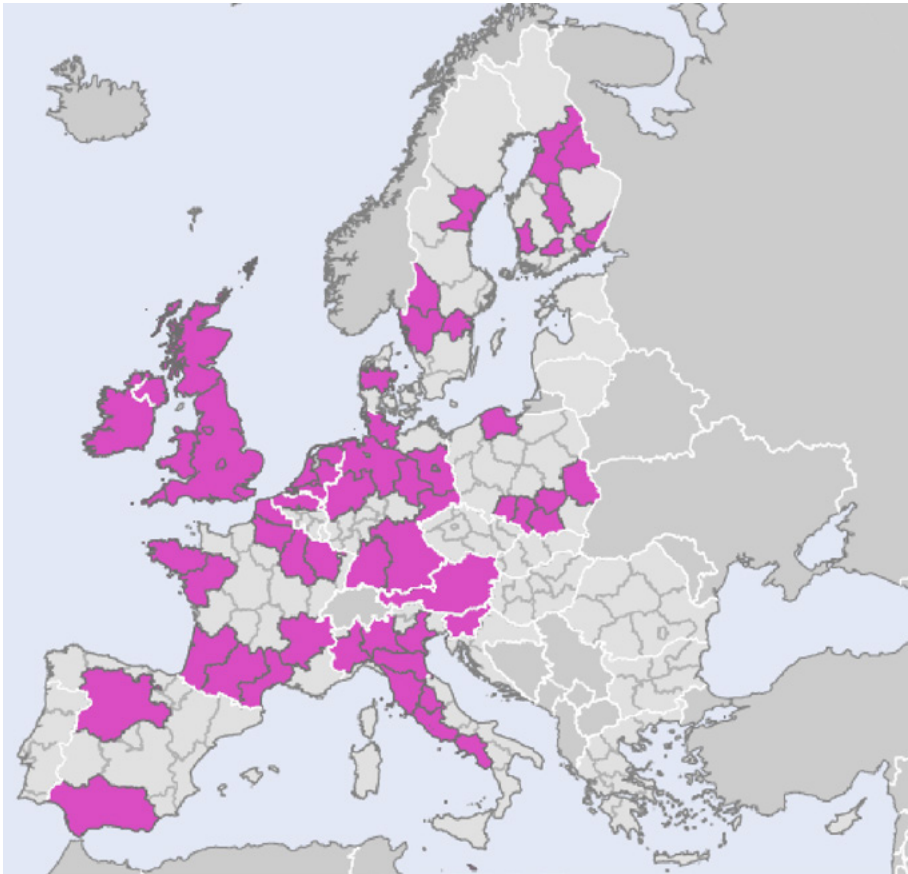


Figure 16 (continued). EU Regions with Bioeconomy R&I Priorities

● Biorefinery



Regions Warminsko-Mazurskie, Podlaskie, Mazowieckie, Lubelskie, Swietokrzyskie, Lodzkie and Wielkopolskie are eligible for projects under theme 'agriculture'; Malopolskie, Slaskie and Podkarpacie are eligible for projects on waste management; and Pomorskie, Lubelskie, Swietokrzyskie, Malopolskie, Slaskie and Opolskie are eligible for projects under the theme '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:

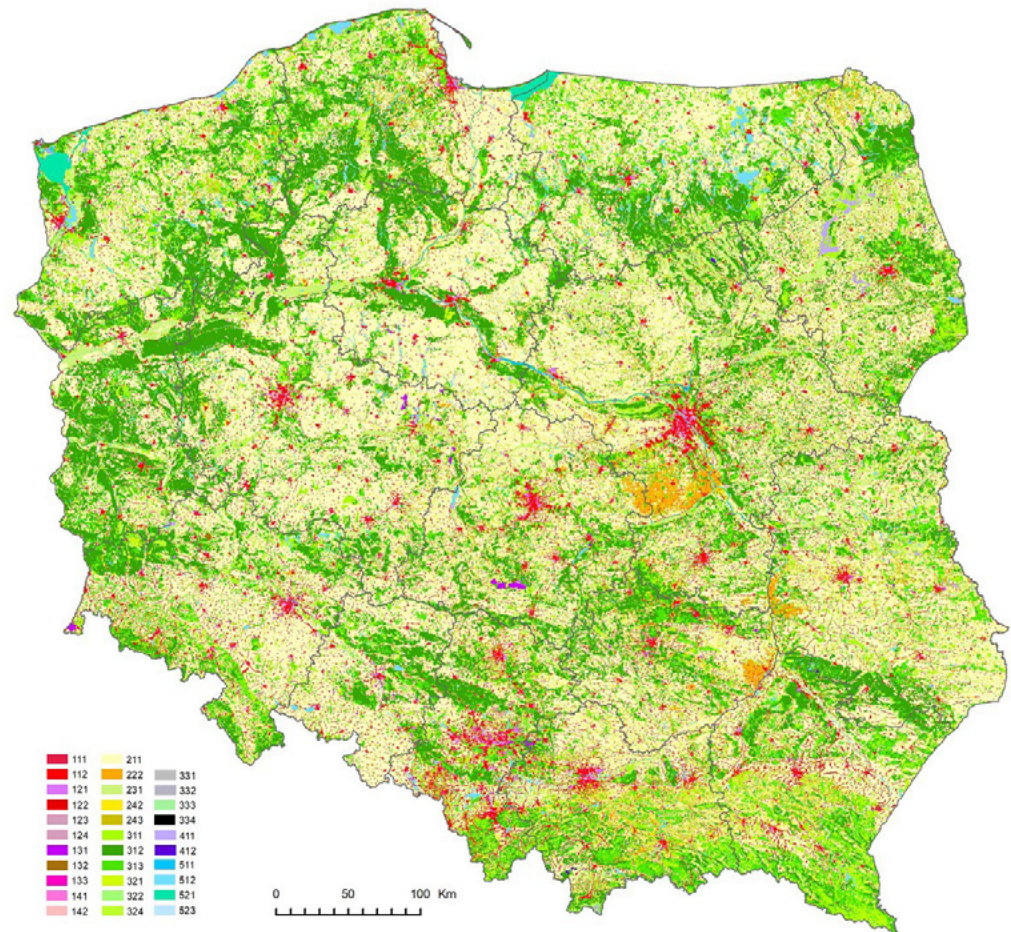
- **A broad range of financial products** such as of loans, equity, guarantees or hybrid structures which are tailored to each client.
- **Technical expertise and resources for structuring and implementation support** such as technical feasibility and market studies, project design improvement, project 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.

Poland is eligible for EBRD funds.

4.

APPENDIX: FIGURES

Figure 17. Map of land use in Poland ²⁰



²⁰ The standard CORINE LAND COVER nomenclature includes 44 land cover classes. These are grouped in a three-level hierarchy. The five main (level 1) categories are: 1) artificial surfaces, 2) agricultural areas, 3) forests and semi-natural areas, 4) wetlands, and 5) water bodies.

4.1. Agriculture



Figure 18. Agricultural production in Poland (2004 - 2014)

- Animals for slaughter
- Industrial
- Cereals
- Potatoes
- Cow milk
- Fruit
- Other plant products
- Hen eggs
- Vegetables
- Other animal production

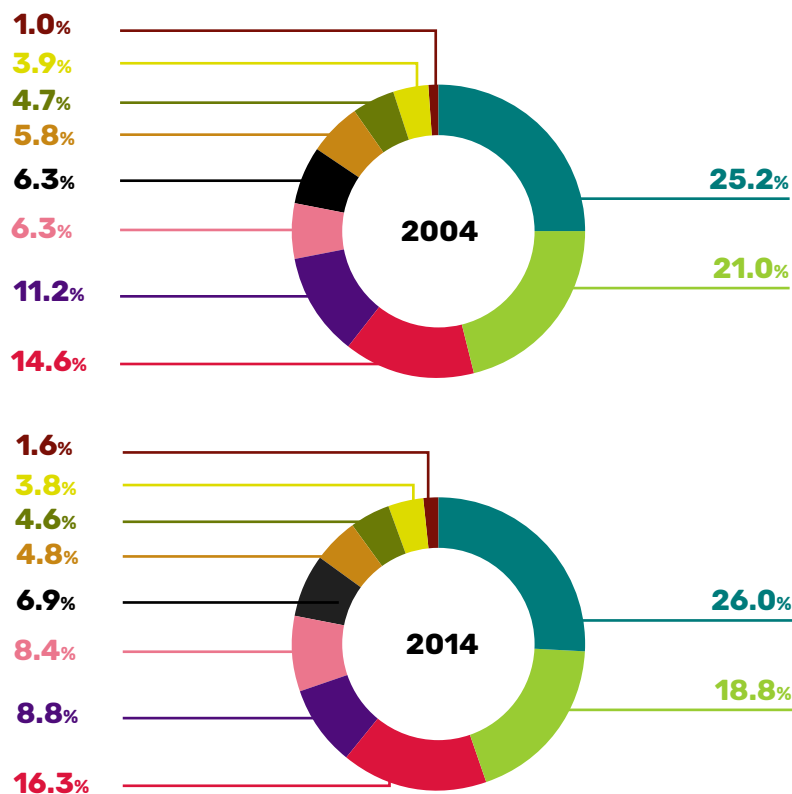


Table 6. Agricultural land in Poland per voivodship (thousand ha, GUS, Statistical Yearbook of Agriculture, 2020)

Voivodship	Agricultural land (thousand ha)
Dolnośląskie	898
Kujawsko-pomorskie	1052,6
Lubelskie	1371,8
Lubuskie	420,4
Łódzkie	975,5
Małopolskie	548,9
Mazowieckie	1961,8
Opolskie	516,4
Podkarpackie	562,4
Podlaskie	1069,8
Pomorskie	762,9
Śląskie	387,3
Świętokrzyskie	493,4
Warmińsko-mazurskie	1016,6
Wielkopolskie	1736869
Zachodniopomorskie	837144

Table 7. Agricultural output in voivodships (%)

	Crop output								Animal output					
	Total	Subtotal	of which						Subtotal	of which				
			Cereals	Industrial crops	Potatoes	Vegetables	Fruit	Other		Beef for slaughter	Pork for slaughter	Cows milk	Hen eggs	Other
Poland	100	41.5	13.5	6.3	3.1	9.4	6.2	3	58.5	5.8	14.7	18.3	5.4	14.3
Dolnośląskie	100	73.5	43.6	17.6	3.3	6.3	1.7	1	26.5	2.5	2.5	6.2	6.2	9.1
Kujawsko-pomorskie	100	40.5	14.8	10.8	2.3	10	1.8	0.8	59.5	5.8	24.5	17	2.6	9.6
Lubelskie	100	62.1	12.2	8.8	1.9	14.5	20.7	4	37.9	3.5	12.1	12.9	1.8	7.6
Lubuskie	100	49.5	20.9	6.6	1.7	9.6	3.8	6.9	50.5	2.2	9.2	7.1	5.9	26.1
Łódzkie	100	38.8	5.9	1.8	7.9	13.4	9.1	0.7	61.2	7.3	18.8	17.6	5.3	12.2
Małopolskie	100	52.9	8.3	2.2	6.4	23.5	9.6	2.9	47.1	6.8	11	13.7	7.8	7.8
Mazowieckie	100	39.2	6.1	1.8	3.9	12	10.7	4.7	60.8	5.8	8.3	21.8	4.8	20.1
Opolskie	100	60.7	31.8	21.6	2	4.3	0.6	0.4	39.3	2.4	14.1	12.9	1.8	8.1
Podkarpackie	100	45.8	15.1	8	1.2	13.4	6.8	1.3	54.2	3.4	14.4	18	6.2	12.2
Podlaskie	100	9.2	4.5	0.5	1.1	2	0.8	0.3	90.8	12.3	9	58.1	1.3	10.1
Pomorskie	100	36.7	17.3	8.2	5.2	2.8	1.2	2	63.3	4.9	28.2	12.1	3.3	14.8
Śląskie	100	40.3	13.6	4	3.6	8.9	1.7	8.5	59.7	6	13.7	13.3	7.2	19.5
Świętokrzyskie	100	56.7	8.7	3.2	2.7	18.3	20.4	3.4	43.3	8.2	11.6	10.7	2.4	10.4
Warmińsko-mazurskie	100	29	16.5	5.4	1.2	2.8	1.4	1.7	71	4.5	13.1	28.1	2.2	23.1
Wielkopolskie	100	30.7	10.6	5	1.7	7.6	1.5	4.3	69.3	7	21.2	14.8	12.4	13.9
Zachodniopomorskie	100	56.9	31.4	14	2.8	2.4	3.4	2.9	43.1	1.8	8.6	6.8	3.3	22.6

Figure 19. Agricultural land in Poland (thousand ha)

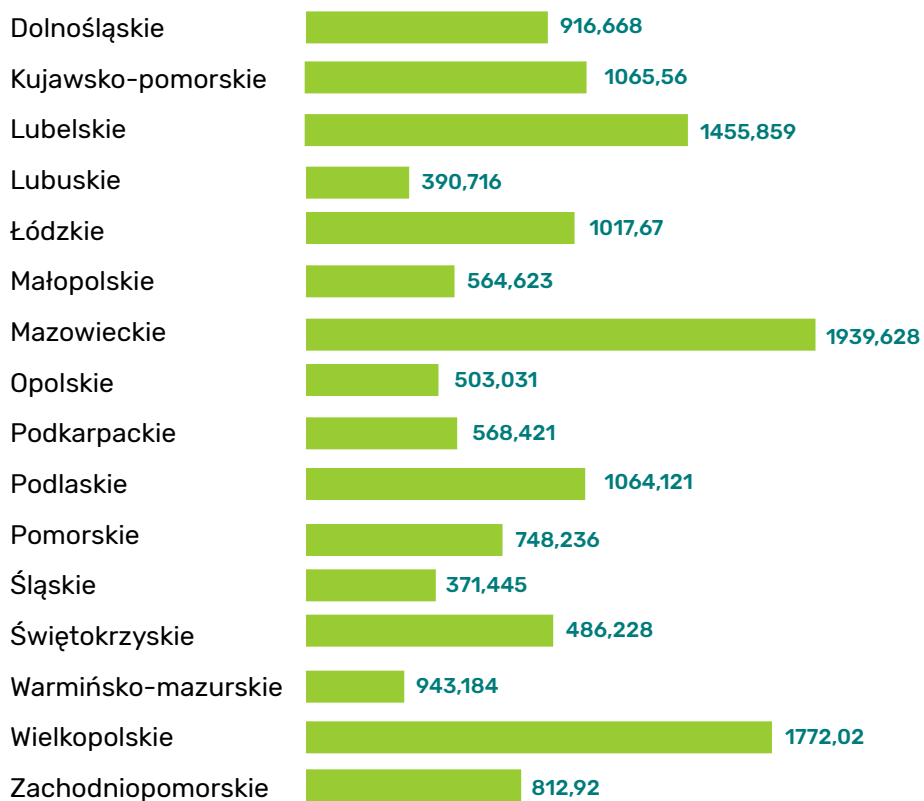


Figure 20. Agricultural output in voivodships (%)

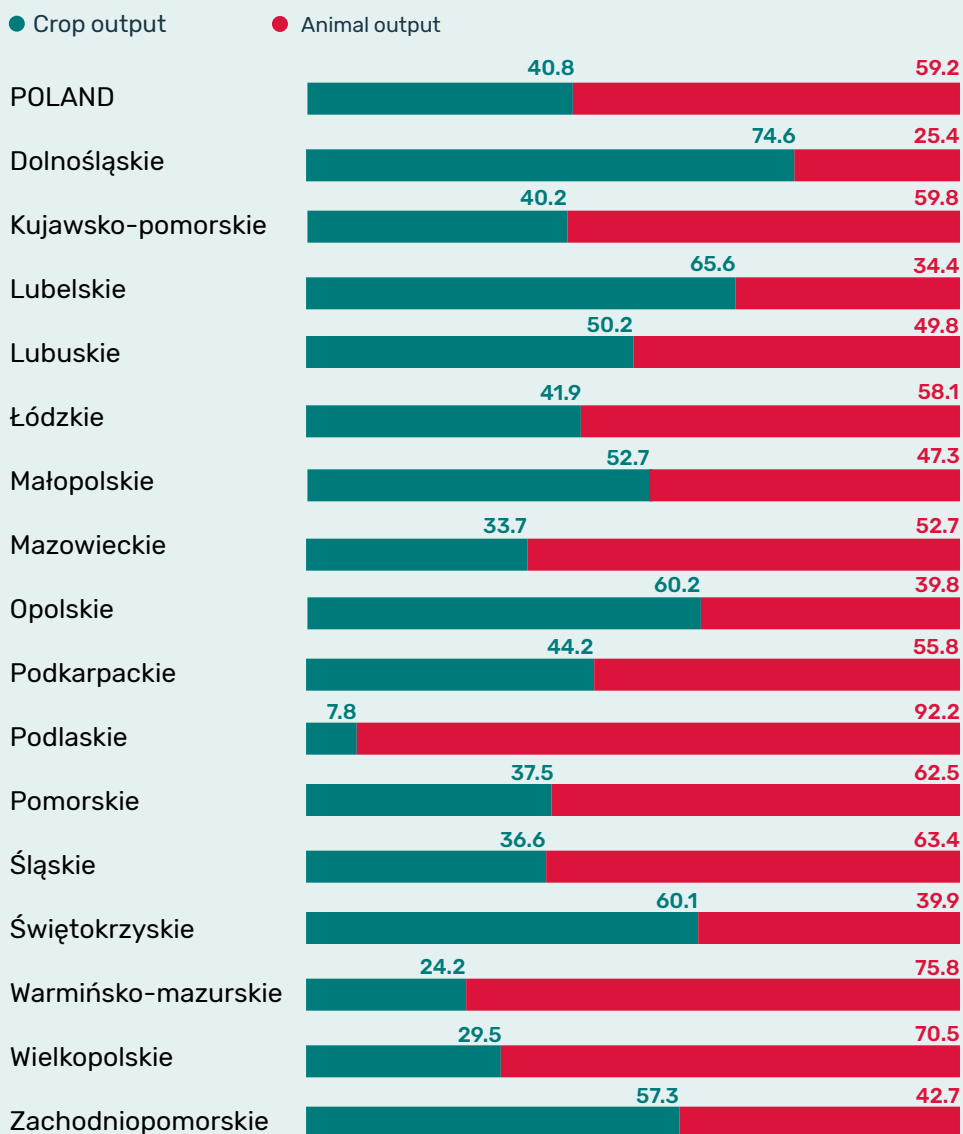


Figure 21. Main agricultural regions by crop (Polish Ministry of Agriculture)

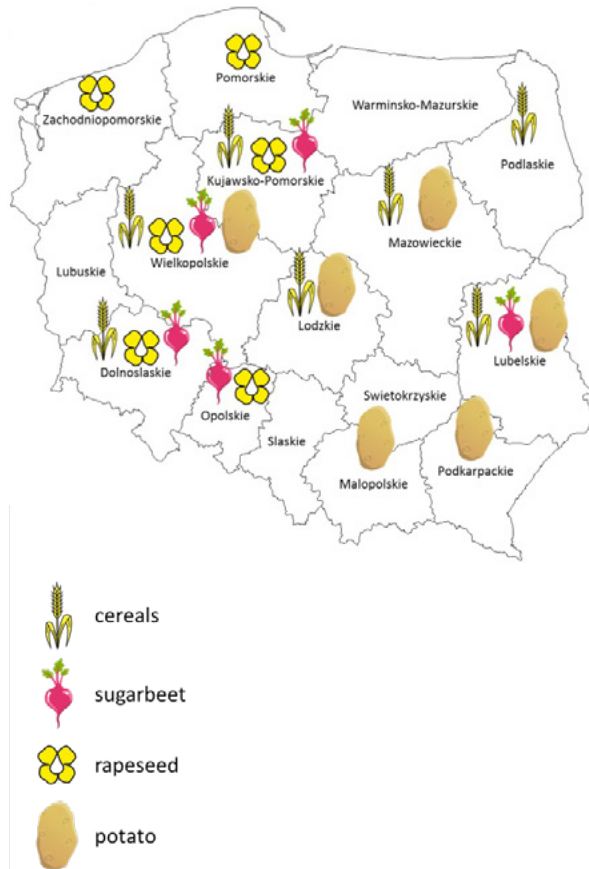


Figure 22. Crop output in Poland and in voivodships (%)

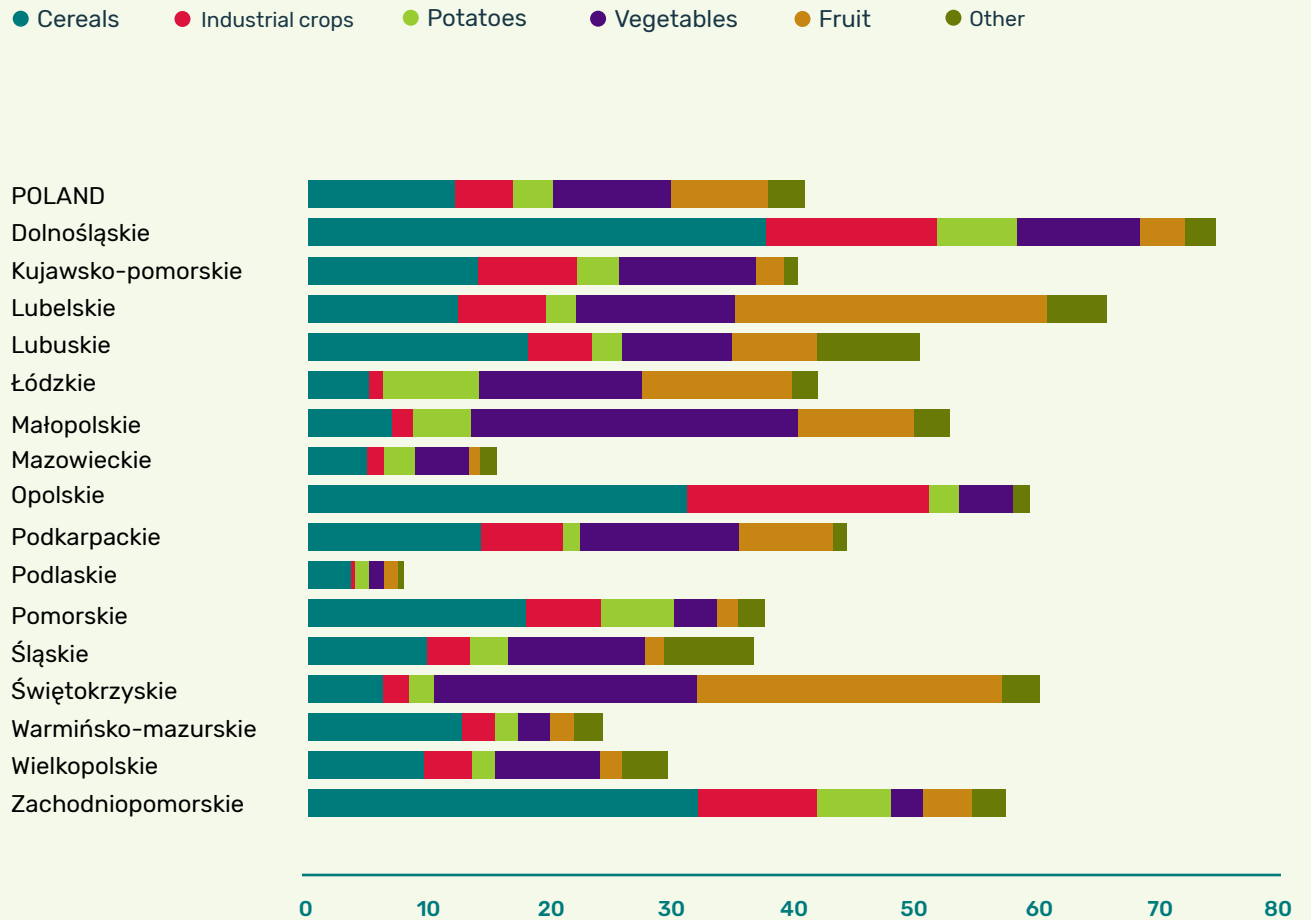


Figure 23. Production of main crops per NUTS2 region (Eurostat, 2017)

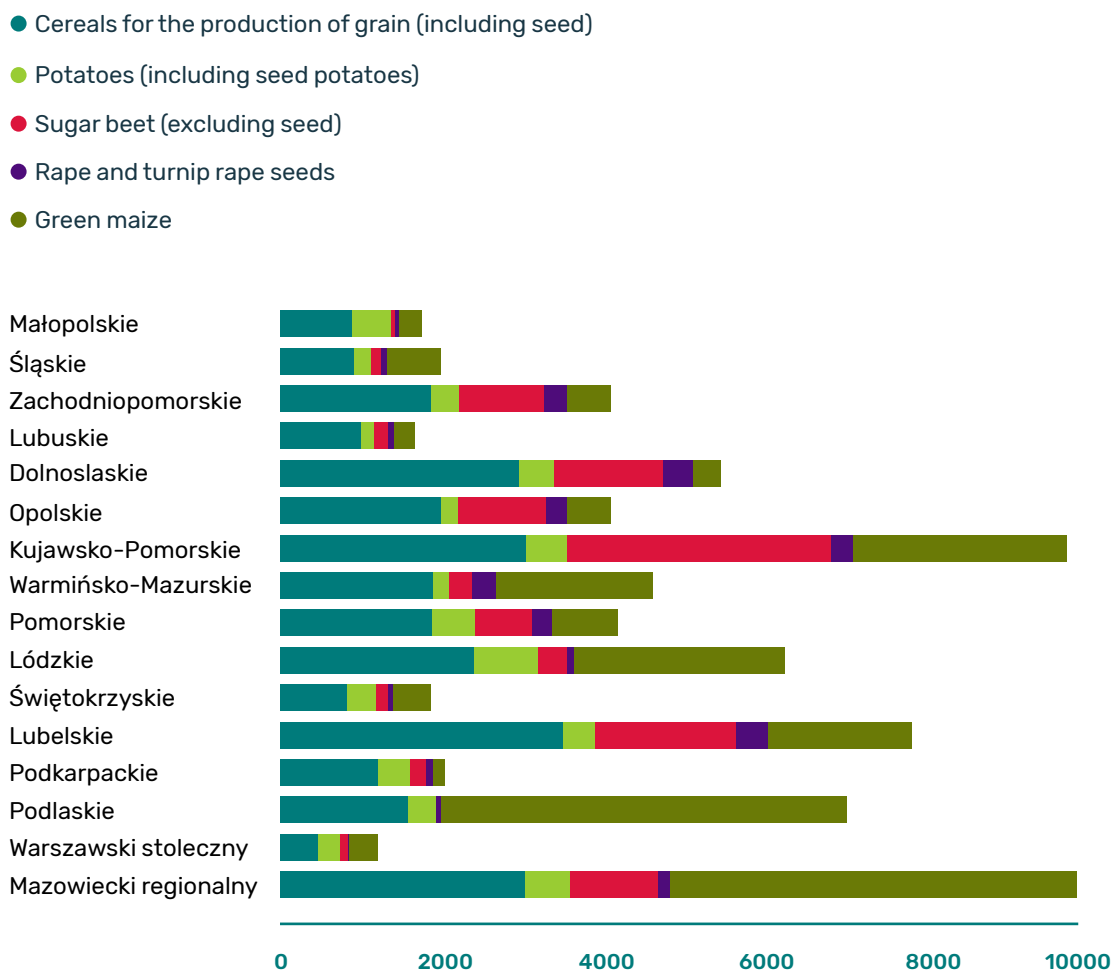


Table 8. Poland's cereal production data (Eurostat, 2018)

Crop	Area (cultivation/harvested/production) (1000 ha)	Harvested production in EU standard humidity (Kt)
Common wheat and spelt	2417.23	9637.62
Rye	893.96	2126.57
Barley	975.74	2991.56
Oats and spring cereal mixtures (mixed grains other than maslin)	1412.80	3390.18
Grain maize and corn-cob-mix	645.41	3792.14
Triticale	1287.97	4009.66

Figure 24. Production of main crops per NUTS2 region (Kt, Eurostat,2017)

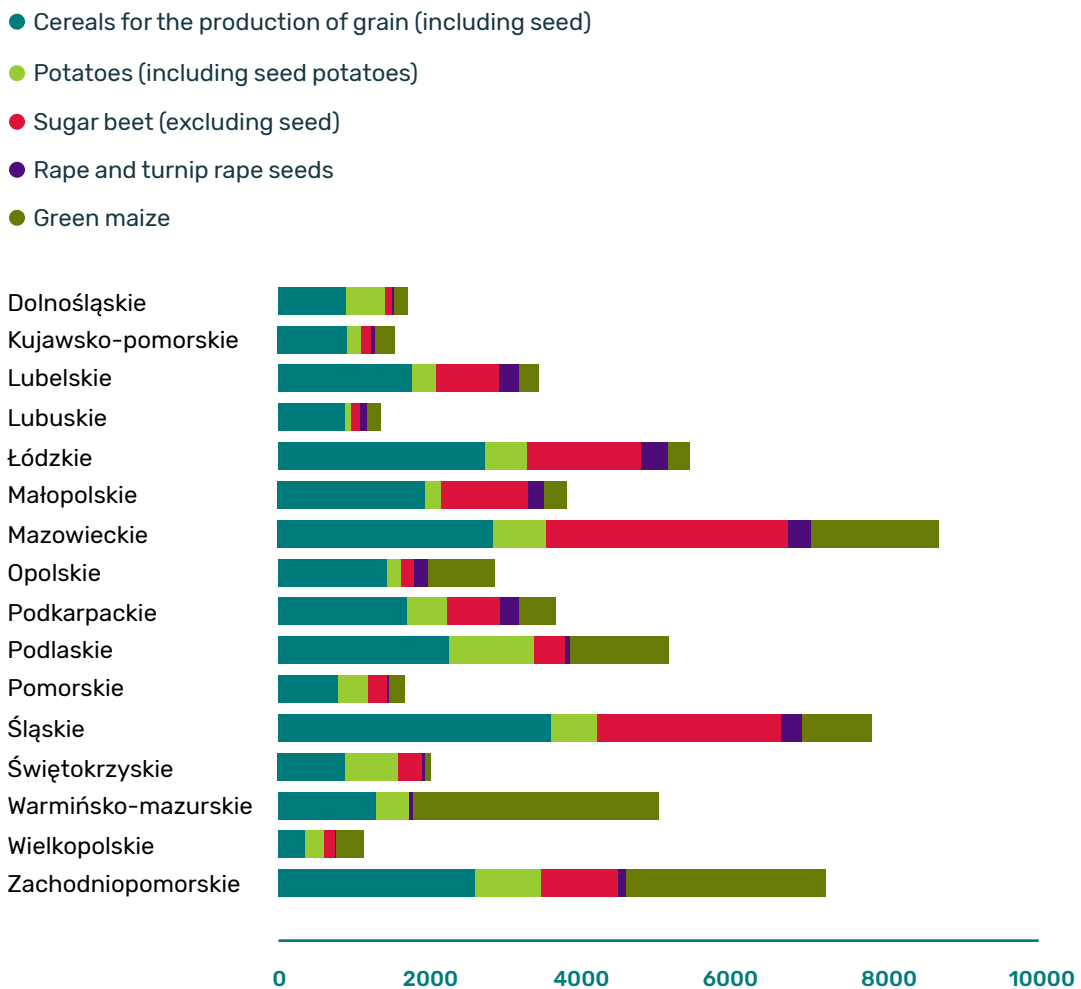


Table 9. Production data for main crops in Poland (Eurostat,2022)

	Cereals	Potatoes	Industrial crops
Area (1000 ha)	7150.17	196.11	1203.97
Harvested production (Kt)	35272.26	6030.93	NA
Production value at basic price (M€)	7771.36	854.50	3183.73
	Plants harvested green from arable land (including forage)	Fresh vegetables (including melons)	Fruits, berries, and nuts
Area (1000 ha)	1494.79	191.30	320.20
Harvested production (Kt)	50954.29	5521.10	5172.80
Production value at basic price (M€)	729.43	2676.30	1641.52 ²¹

The area of cultivation of flax and hemp is steadily increasing in Poland. Flax is cultivated in a few regions of Poland: Dolnośląskie, Lubelskie, Lubuskie, Podkarpackie, Wielkopolskie, Zachodniopomorskie. Hemp is instead cultivated in all regions of Poland.

²¹ This value may be underestimated as it does not include berries and nuts.

These two species of fibrous plants are cultivated for various economic uses, mainly for seed production, production of extracts, essential oils, as well as fibre for textile and technical application including composites. Harvested hemp and flax deliver lignocellulosic biomass, which is a by-product with valuable components suitable to application in different sectors of economy.

Approximately 40-50 thousand tonnes of fibrous plants biomass may be available annually in Poland. This raw material can be used to produce biodegradable composite materials, building materials, various types of paper, and as a source of renewable energy, e.g. for the production of biofuels. In 2017, flax textile fibres extracted from the plants allowed for production approximately of 4,810 t of yarn and 1.9 km² of linen woven fabrics in Poland.

The 'flax and hemp sector' in Poland is supported by R&D centre Institute of Natural Fibres and Medicinal Plants in Poznań, which covers fibrous plants exploration in holistic approach from biotechnology via cultivation, processing technologies and products.

Other R&D organisations, which partially deal with fibrous plants: Łódź University of Technology, Poznań University of Technology, Łukasiewicz Research Network – New Chemical Syntheses Institute in Puławy (one of few institutions in Poland which have the permit granted by Chief Pharmaceutical Inspectorate for the extraction of dried industrial hemp (*Cannabis sativa* L.) and production of CBD extracts including the possibility of commercial analytical services), Polytechnic University Lublin, University of Life Sciences in Poznań, Wrocław University of Environmental and Life Sciences.

Figure 25. Agricultural crops of oil flax, fibre flax, hemp (2017)

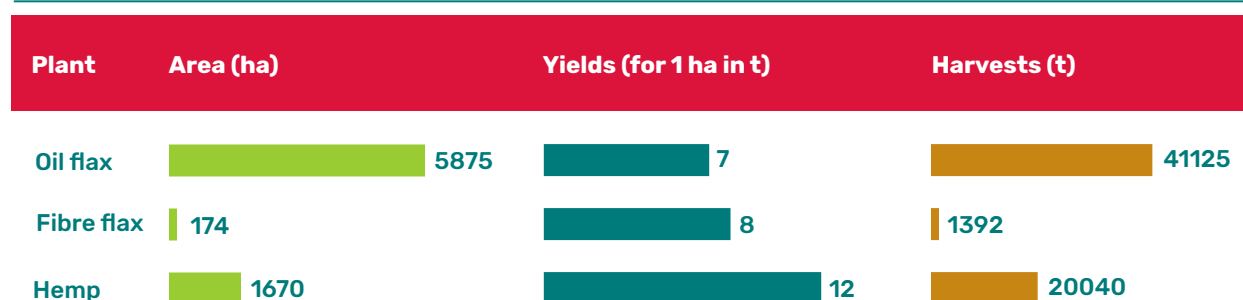


Figure 26. Agricultural crops of herbs and spices in 2017 (MRiRW, GUS 2018)

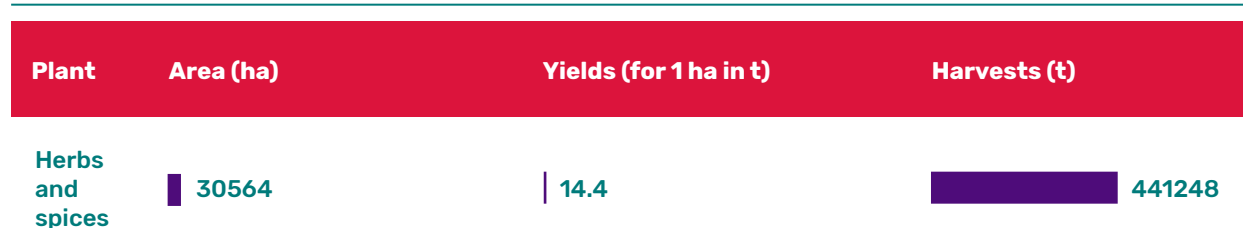


Figure 27. Main livestock regions by animal (Ministry of Agriculture)

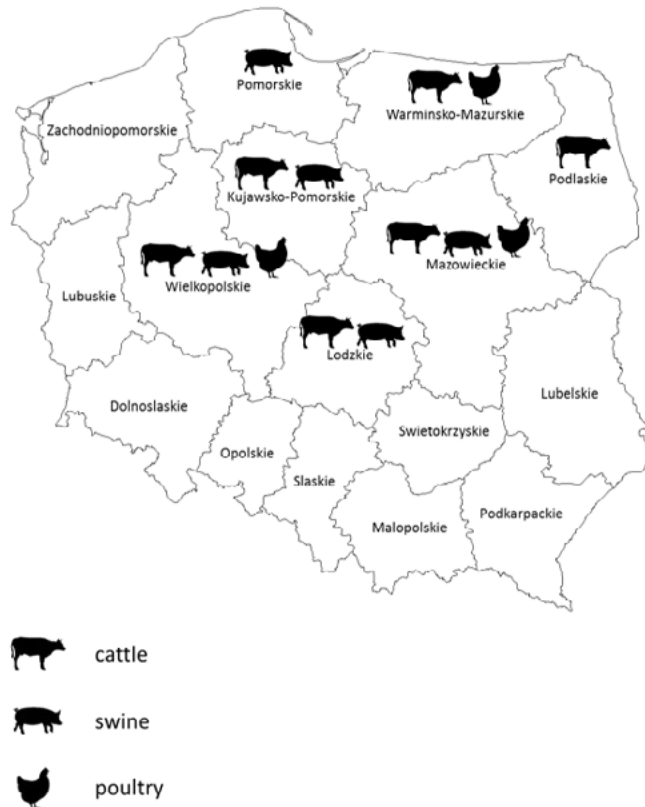
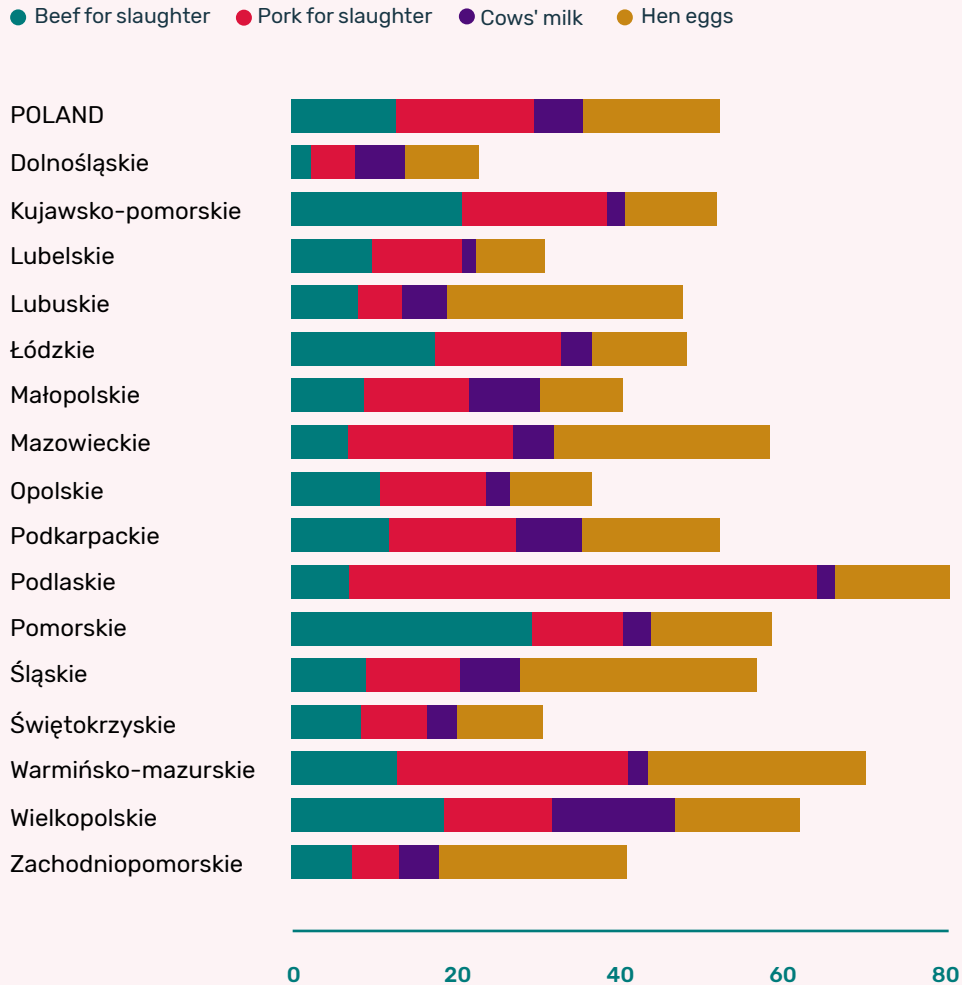


Table 10. Livestock in Poland (thousand heads, Eurostat, 2016)

	Live bovine animals	Live swine, domestic species
Poland	5970.2	11106.7
Region Centralny	1571.7	2054.2
Lódzkie	473.2	1119.8
Mazowieckie	1098.5	934.4
Region Południowy	300.8	412.2
Małopolskie	178.1	168.7
Śląskie	122.7	243.6
Region Wschodni	1582.5	1247.1
Lubelskie	371.8	550.2
Podkarpackie	84.4	166.8
Świętokrzyskie	166.5	209.5
Podlaskie	959.8	320.6
Region Północno-Zachodni	1168.7	4395.5
Wielkopolskie	1003.3	3959.3
Zachodniopomorskie	92.5	283
Lubuskie	73	153.2
Region Południowo-Zachodni	225.4	587
Dolnośląskie	102.5	196
Opolskie	122.9	391
Region Północny	1,121	2410.6
Kujawsko-Pomorskie	492.6	1197.4
Warmińsko-Mazurskie	419.1	466.9
Pomorskie	209.4	746.3

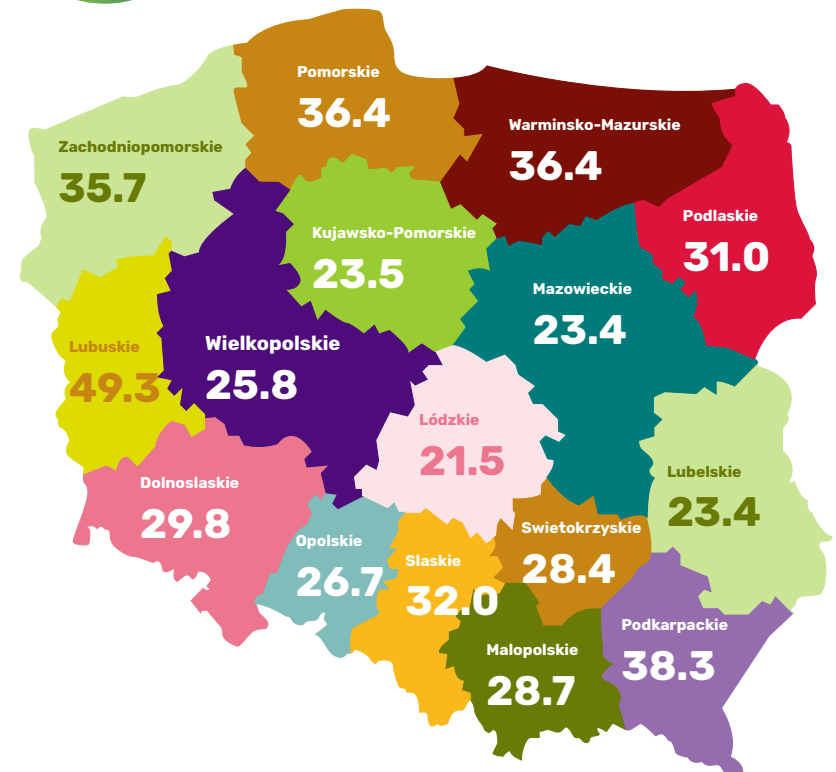
Figure 28. Animal output in Poland and in voivodships (%)



4.2. Forest



Figure 29. Percentage of land occupied by forest in Polish Voivodships



4.3. Food and beverages



Table 11. Main data of the food industry sector (Eurostat, 2016)

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

Food industry sector	Enterprises - number	Turnover or gross premiums written (M€)	Production value (M€)
Manufacture of food products	13671	49199.3	44252.7
Processing and preserving of meat and production of meat products	2684	15608.2	14179.0
Processing and preserving of fish, crustaceans and molluscs	304	2615.3	2420.7
Processing and preserving of fruit and vegetables	1127	4636.1	4117.9
Manufacture of vegetable and animal oils and fats	177	1261.5	959.9
Manufacture of dairy products	667	6702.0	6158.0
Manufacture of bakery and farinaceous products	5923	4227.2	3976.0
Manufacture of other food products	1757	7579.6	6925.8
Manufacture of prepared animal feeds	472	4838.2	3952.9
Manufacture of beverages	654	7130.6	6936.1

Figure 30. Open field vegetables production in Poland in 2019 (tonnes)

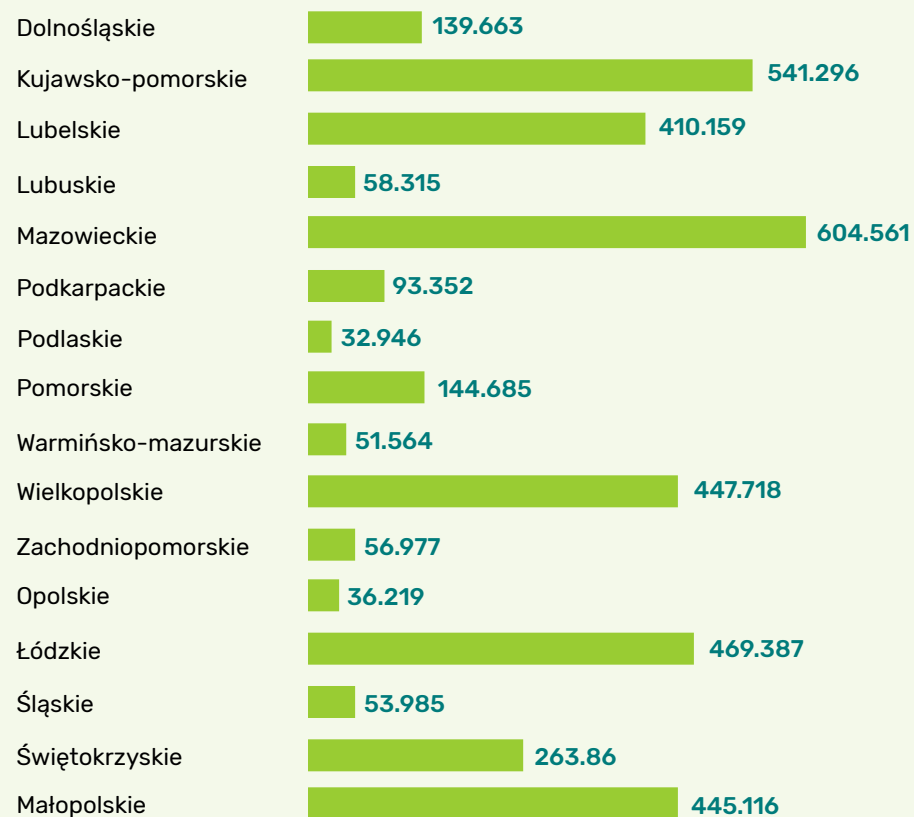
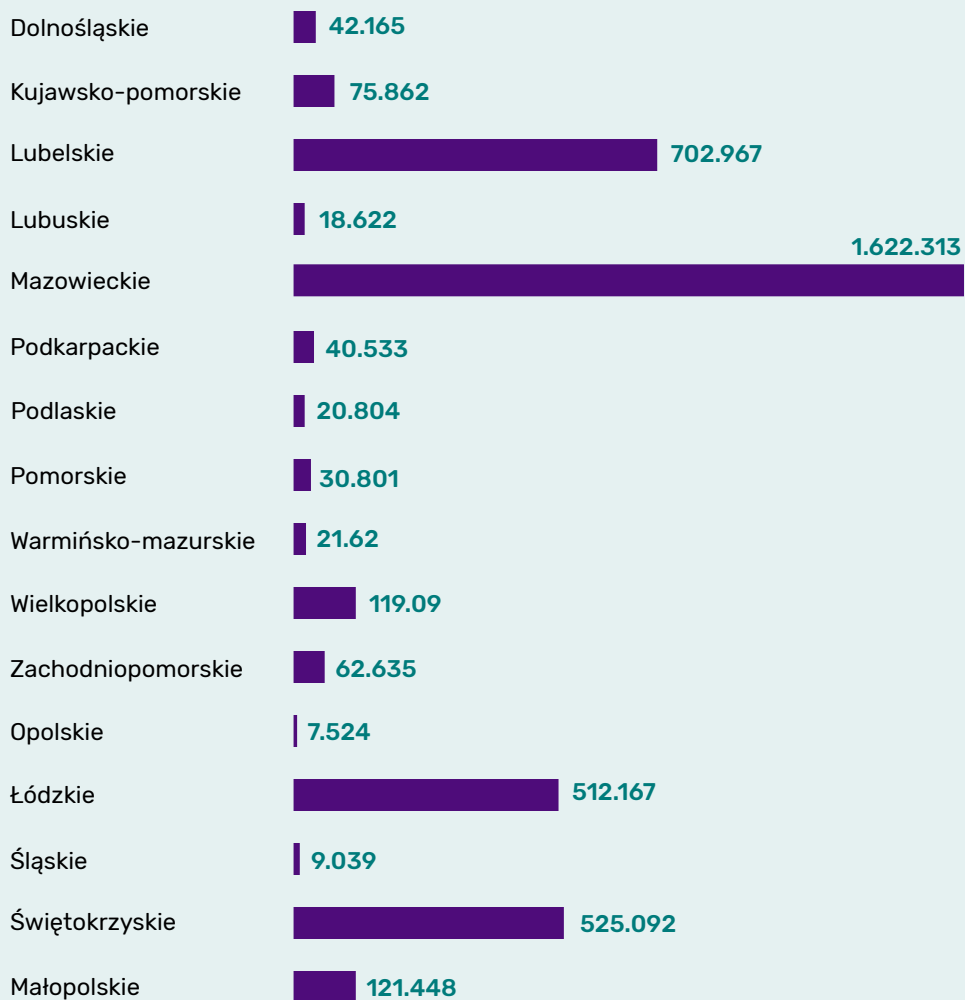


Figure 31. Fruits production in Poland in 2019 (tonnes, GUS)



Consumption of fruit and vegetables in Poland

According to information published by the Central Statistical Office (CSO), in 2019, the average person in Poland consumed around 1.35 kg of food items per day, of which 375 grams of fruit and vegetables and 90 grams of potatoes were included, making a total of 465 grams of fruit and vegetable products and accounting for around 34% of the daily ration.

Figure 32. Sources of vegetables in Poland 2018 – 2020 (thousand tonnes, GUS)

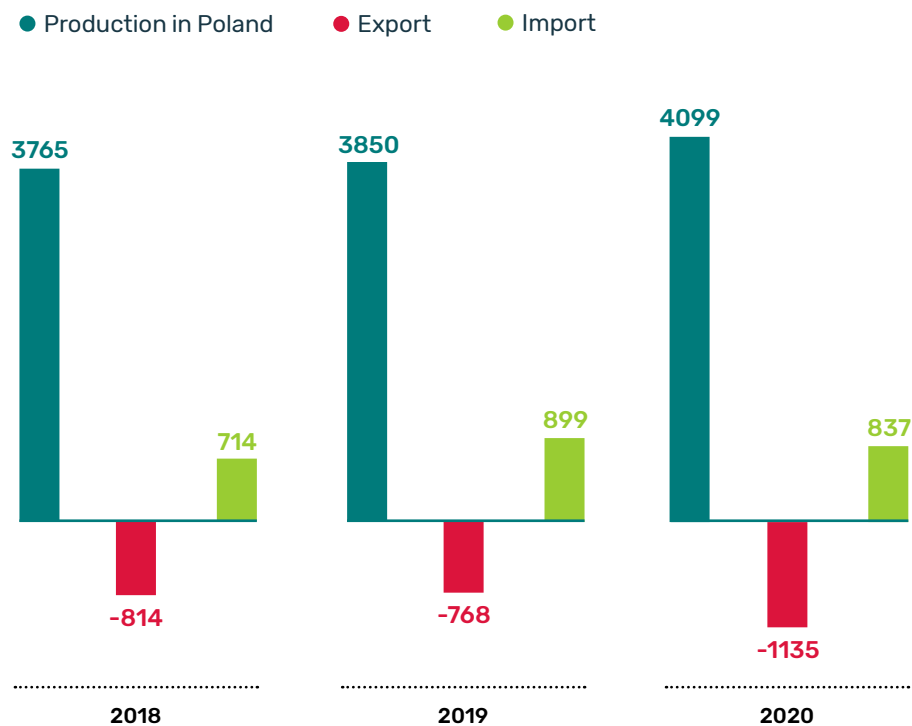


Figure 33. Production of vegetables from under cover in Poland 2019 (thousand tonnes)

● Total ● Green glass houses ● Plastic covers ● Low glass frames

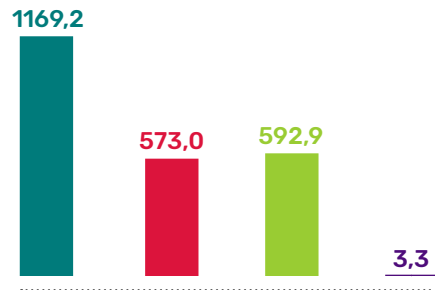
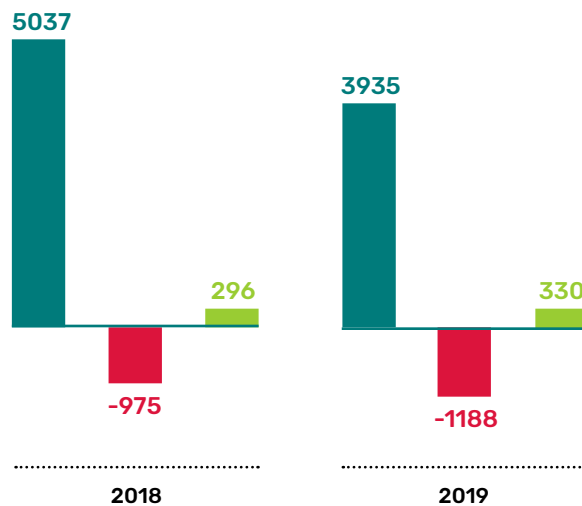


Figure 34. Sources of fruits in Poland 2018 – 2019 (thousand tonnes) (Source: GUS)

● Production in Poland ● Export ● Import



4.4. Wood products



Table 12. Manufacture of wood products (Eurostat, 2016)

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

	Enterprises - number	Turnover or gross premiums written (M€)	Production value (M€)
Sawmilling and planing of wood	5304	1969.9	1776.4
Manufacture of products of wood, cork, straw and plaiting materials	11685	6356.8	5839.8
Manufacture of furniture	17137	10122.8	9400.7

Table 13. Manufacture of wood products (Eurostat, 2016)

	Enterprises - number	Turnover or gross premiums written (M€)	Production value (M€)
Manufacture of paper and paper products	2830	8891.1	8563.9

4.5. Chemical and pharmaceutical industry



Table 14. Chemical, pharma and plastic sectors (Eurostat, 2016)

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

Food industry sector	Enterprises - number	Turnover or gross premiums written (M€)	Production value (M€)
Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics, and synthetic rubber in primary forms	858	7781.4	7261.6
Manufacture of basic pharmaceutical products and pharmaceutical preparations	372	4016.6	3551.3
Manufacture of rubber and plastic products	8385	19793.5	18728.8

4.6. Bio-based research and other projects in Poland

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

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

 Duration : 2018-2022

The project 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. Instytut Chemii Bioorganicznej Polskiej Akademii Nauk, Cybernetic Technologies Netictech, Wielkopolski Ośrodek Doradztwa Rolniczego W Poznaniu and Uniwersytet Przyrodniczy W Poznaniu are partners of the project.

Data-Bio – Data-driven bioeconomy

 **Duration : 2017-2019**

The project proposed to deploy a state-of-the art, big data platform for data collected in the bioeconomy sectors agriculture, forestry, and fishery/aquaculture. Instytut Chemii Bioorganicznej Polskiej Akademii Nauk was a partner of the project.

POWER4BIO – emPOWERing regional stakeholders for realising the full potential of European BIOeconomy

 **Duration : 2018-2021**

The project is developing a methodology based on a 3-steps approach (stakeholders' engagement, regional analysis and strategy development) to guide European regions when preparing and reviewing their regional bioeconomy strategy and its associated implementation plan. Mazowiecka Agencja Energetyczna is a partner of the project.

InnProBio – Forum for Bio-Based Innovation in Public Procurement

 **Duration : 2015-2018**

The project built a community (and related services) of public procurement practitioners interested in Public Procurement of Innovation with Bio-Based Products and Services. The Lodz University was a partner of the project.

BIOECON – New Strategies on Bioeconomy In Poland

 **Duration : 2015-2020**

The project is an ERA Chairs action coordinated by the Institute of Soil Science and Plant Cultivation. Its objective is to first analyse the prospects for bioeconomy in Poland and then take action to promote its development with local stakeholders.

STAR-ProBio – Sustainability Transition Assessment and Research of Bio-based Products

 **Duration : 2017-2020**

The objective was to promote a more efficient and harmonised policy regulation framework, needed to promote the market-pull of bio-based products via standards, labels, and certifications for bio-based products. University of Warmia and Mazury in Olsztyn was a partner of the project.

BE-Rural – Bio-based strategies and roadmaps for enhanced rural and regional development in the E

 **Duration : 2019-2022**

The project is engaging relevant actors across Europe in the participatory development of bioeconomy strategies and roadmaps. The project will implement a series of regional Open Innovation Platforms to kick-start the co-creation process, bringing together key stakeholders from academia, policy, business, and civil society to develop ideas and capitalise on this bioeconomy potential. The National Marine Fisheries Research Institute is a partner of the project.

Bio-based Industries Consortium (BIC)

Square de Meeûs 38/40, 4th floor
Brussels 1000, Belgium

