

European Bioeconomy in Figures 2008 – 2015

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Executive summary

The bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and micro-organisms – to produce food, materials and energy. In 2016, a study conducted by nova-Institute on behalf of the Bio-based Industries Consortium (BIC) showed for the first time which macroeconomic effects are generated by these activities, e.g. turnover, employment etc. for the years 2008 and 2013. This study has now been updated with data for 2014 and 2015.¹

Eurostat was used as the main source of data for all sectors of the bioeconomy. Some sectors, such as the forest-based industry, are fully bio-based and thus fully accounted to the bioeconomy. For other sectors such as the chemical industry, the bio-based shares were estimated and included in the data.

The analysis of the Eurostat data of 2015 shows that the turnover of the total bioeconomy, including food and beverages and the primary sectors agriculture and forestry, results in 2.3 trillion € in the EU-28. Roughly half of the turnover is accounted for by the food and beverages sector, almost a quarter is created by the primary sectors, agriculture and forestry. The other quarter is created by the so-called bio-based industries, such as chemicals and plastics, pharmaceuticals, paper and paper products, forest-based industries, textile sector, biofuels and bioenergy.

The bioeconomy employs 18.5 million people in total. The primary biomass production, mainly agriculture plus forestry and fishery, generates a lot of employment (55%) but low turnover (20%). The data show clear differences between groups of Member States: e.g. the Eastern European countries Poland, Romania and Bulgaria apparently are stronger in less value added sectors of the bio-based economy that generate a lot of employment. In comparison, Western and Northern European countries generate much higher turnover compared to the employment generated. The countries with the highest ratio between turnover and employment are Ireland, Finland and Belgium.

As in the 2016 study, this update highlights the contribution of the often underrated bio-based industries, such as chemicals and plastics, pharmaceuticals, paper and paper products, forest-based industries, textile sector, biofuels and bioenergy to the bioeconomy. This sector shows considerable turnover of almost 700 billion € and 3.6 million employees in the EU-28 in 2015. In the bio-based chemical industry alone, turnover amounted to around 30 billion €.

The data show an overall slight increase in the bio-based share of the chemical industry in the EU-28 from about 6% in 2008 to 7% in 2015. The raw materials used by the chemical industry are about 50% organic (fossil and bio-based) and about 50% inorganic (minerals, metals).

Only taking the organic part into account, the overall bio-based share increased from 11% in 2008 to 14% in 2015. Denmark stands out as the one Member State with the highest bio-based share in the chemical industry in 2015, which is mainly due to the high production of enzymes. Latvia and Sweden follow primarily due to a large production volume of charcoal and tall oil.

For the first time, the study also looked at the contribution of the different chemical products to the total value and volume of bio-based chemicals. The study shows that odoriferous substances for the food or drink industries dominate in terms of bio-based production value while animal or vegetable fertilizers dominate in terms of production volume.

¹ The present report is a corrected version of the report published in February 2018, in which one group of chemical products, pyridine containing compounds, was erroneously assumed to be partly bio-based.

1 Introduction

The following is an assessment of turnover and employment of the European bioeconomy for the year 2015, using Eurostat² as the primary data source, as well as a comparison with results for 2008, 2013 and 2014 (Piotrowski et al. 2016).

This update with figures for 2015 is now possible thanks to updated statistical data. Furthermore, however, the statistical data for the previous years have also been slightly revised in the meantime. In order to be consistent, this update uses the most recent Eurostat data for all years. Due this fact, slight differences with the previous study are unavoidable.

Overall, the results show over the years a slight increase in turnover and a concomitant decrease in employment in most sectors of the bio-based economy and also for the manufacture of bio-based chemicals and plastics. The bio-based share in the manufacture of chemicals and chemical products has continuously increased from 2008 to 2015.

Note that the principle methodology has been developed in collaboration with the European Commission's Joint Research Centre (JRC). Hence, please see also the recent publications by Ronzon et al. 2017 and Ronzon et al. 2017a on this topic. However, due to slight differences in the details, data published simultaneously by JRC are not exactly the same. For the future, it is planned to harmonize these discrepancies.

² The Eurostat Dissemination Database provides official statistics on the European Union, EU member states and sub-state regions (<http://ec.europa.eu/eurostat/data/database>).

2 Sources and methodology

The main data source for all sectors of the bioeconomy shown in the following figures is Eurostat, and, more specifically, the two datasets PRODCOM (Eurostat 2017) for the production values and quantities of manufactured products and the Structural business statistics (Eurostat 2017a) for the turnover and employment at the NACE Class level.

For those sectors that can be fully attributed to the bioeconomy, the data on turnover and employment was directly obtained from the respective Eurostat datasets. These sectors comprise primary biomass production (agriculture, forestry and fishery) as well as the sectors food, beverages, tobacco, paper and paper products.

The sectors textiles and textile products, forest-based industry, chemicals (including enzymes) and plastics as well as pharmaceuticals only partly contain bio-based products. Therefore, the bio-based shares of these sectors need to be estimated and only these estimated shares are accounted for in the following figures. The sector forest-based industry includes wood products, that are considered fully bio-based, but also furniture, which is only partly bio-based (based on wood and/or natural fibres).

The sectors chemicals and plastics and pharmaceuticals include a multitude of fully bio-based (e.g. natural dyes and pigments, enzymes, fatty acids) and partly bio-based products (different chemicals and plastics that are traditionally petro-based but in recent years also partly bio-based). Currently (2015), out of the 534 products in the NACE Division 20 (Manufacture of chemicals and chemical products), 110 are fully or partly bio-based. From these 110 products, 40% are 100% bio-based (e.g. tanning extracts of vegetable origin, sorbitol, tall oil), 24% products with a bio-based share of at least 10% (e.g. ethylene glycol, carboxylic acid, adipic acid) and 36% products of lower bio-based shares (e.g. acetic acid, methanol, epoxy resins). The majority of products, 424, is therefore currently non-bio-based. For those product groups that contain partially bio-based products, a percentage share has been calculated in order to provide realistic numbers on the effects of the bio-based economy. The shares have been developed and are continuously being fine-tuned in collaboration with several bio-based economy experts and nova-Institute.

Both biodiesel and bioethanol have dedicated product codes within the Eurostat production database PRODCOM. Therefore, their shares in the total production values of their respective NACE Classes were calculated and then the assumption was made that the same shares apply to employment and turnover.

In the case of bioenergy for heat and power (biogas and solid biomass), their shares in employment and turnover of total energy production have been estimated, taking into account a higher labour intensity of renewables due to the handling and more decentralised plants. While there are other data sources available for bioenergy and biofuels (mainly the annual reports of EurObserv'ER³), these sources are not compatible with Eurostat since they include both direct and indirect jobs and there is no clear indication how to separate both.

The graphs provided in this study differentiate between the overall bioeconomy (incl. primary production as well as food & feed), the bioeconomy excl. food & feed as well as the narrower so-called “bio-based economy” which excludes also primary biomass production. This is a usual categorisation in order to illustrate different effects and characteristics, since the food market for example follows a different dynamic than the chemical industry.

³ <http://www.eurobserv-er.org>

3 Results

3.1 Turnover

Turnover in the EU bioeconomy (EU-28, 2008-2015)

The analysis of the Eurostat figures from 2008, 2013, 2014 and 2015 shows that the turnover of the total bioeconomy (including food and beverages and the primary sectors agriculture and forestry) in the EU-28 increased continuously from 2.09 trillion Euro to 2.28 trillion Euro.⁴

Roughly half of this comes from the food and beverages sector, almost a quarter of the turnover is produced by the primary sectors (agriculture and forestry), while the other quarter is produced by the so-called bio-based industries (such as chemicals and plastics, pharmaceuticals, paper and paper products, forest-based industries, textile sector, biofuels and bioenergy). Noticeable contributor to the increase in turnover was especially the food sector.

Turnover in the bioeconomy in the EU-28, 2008-2015

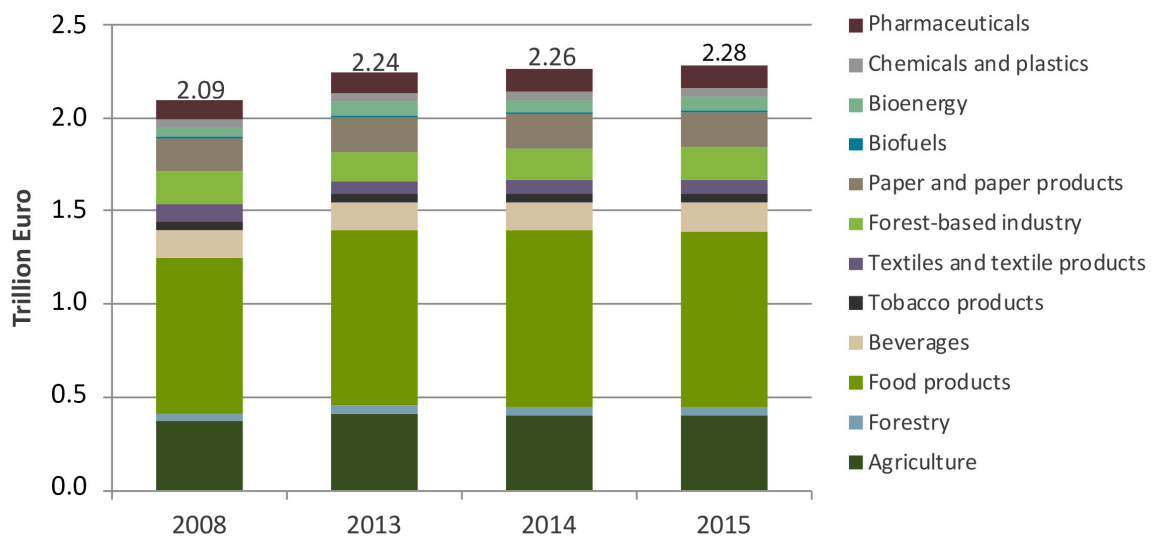


Figure 1: Turnover in the bioeconomy in the EU-28, 2008-2015

⁴ Note that results for 2008 and 2013 differ slightly from previous studies due to a re-evaluation of bio-based shares for the sectors chemicals and plastics and pharmaceuticals. This re-evaluation has taken place in several projects of nova-Institute, e.g. in collaboration with the Commission's JRC and EuropaBio as well as other industry experts.

Turnover in the EU bio-based sector (EU-28, 2008-2015)

If the sectors food, beverages and tobacco products are excluded, the analysis still shows an increase from 1.05 to 1.14 trillion Euro over the same period.

Turnover in the bioeconomy in the EU-28, 2008-2015*

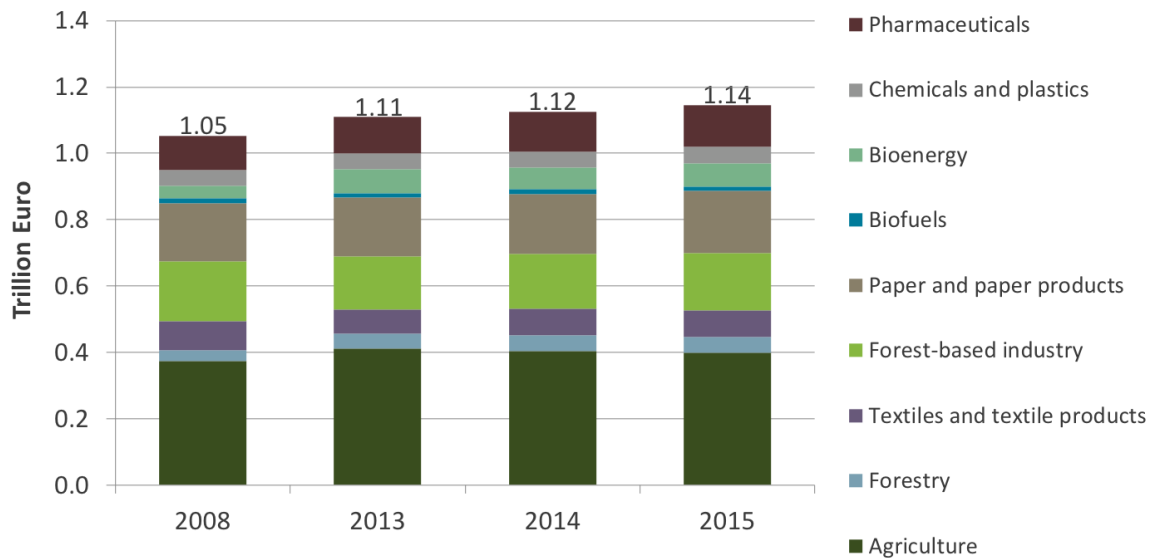
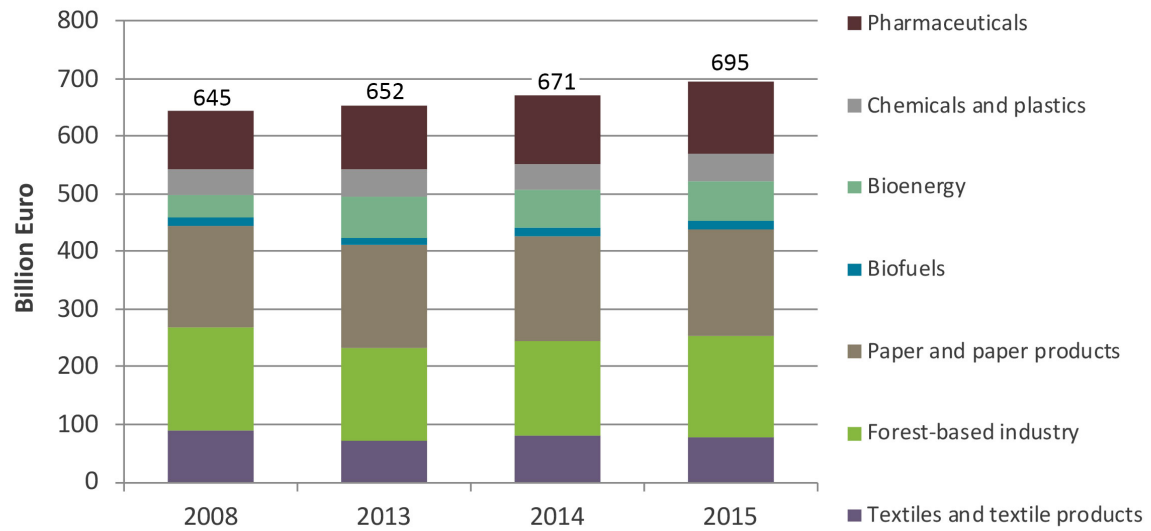


Figure 2: Turnover in the bioeconomy (excl. Food products and Beverages) in the EU-28, 2008-2015

When also the primary biomass production/extraction is excluded, the analysis shows that biofuels and bioenergy together accounted for roughly 12% of the turnover of the EU industrial sectors that are referred to as ‘bio-based economy’, which corresponds to a total amount of approximately 80 billion Euro.

The sectors paper and paper products (27%) and forest-based industry (wood products and furniture, 25%) make up for the largest shares of turnover: together this amounts to roughly 360 billion Euro. Bio-based chemicals and plastics accounted for 50 billion Euro. The total turnover of the bio-based industries reached 671 billion Euro in 2014 and 695 billion Euro in 2015 (Figure 3).

Turnover in the bio-based economy in the EU-28, 2008-2015*



*excluding Agriculture, Forestry, Fishery, Food products and Beverages

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Figure 3: Turnover in the bio-based economy in the EU-28, 2008-2015

3.2 Employment

Employment in the EU bioeconomy (EU-28, 2008-2015)

This chart shows the distribution of total employment in the EU bioeconomy for the same sectors as the bar chart for total turnover, using the same methodology as for that chart. The comparison of both charts shows clearly that the primary biomass production, mainly agriculture, generates a lot of employment but low turnover (compare Figure 1).

Employment in the bioeconomy in the EU-28, 2008-2015

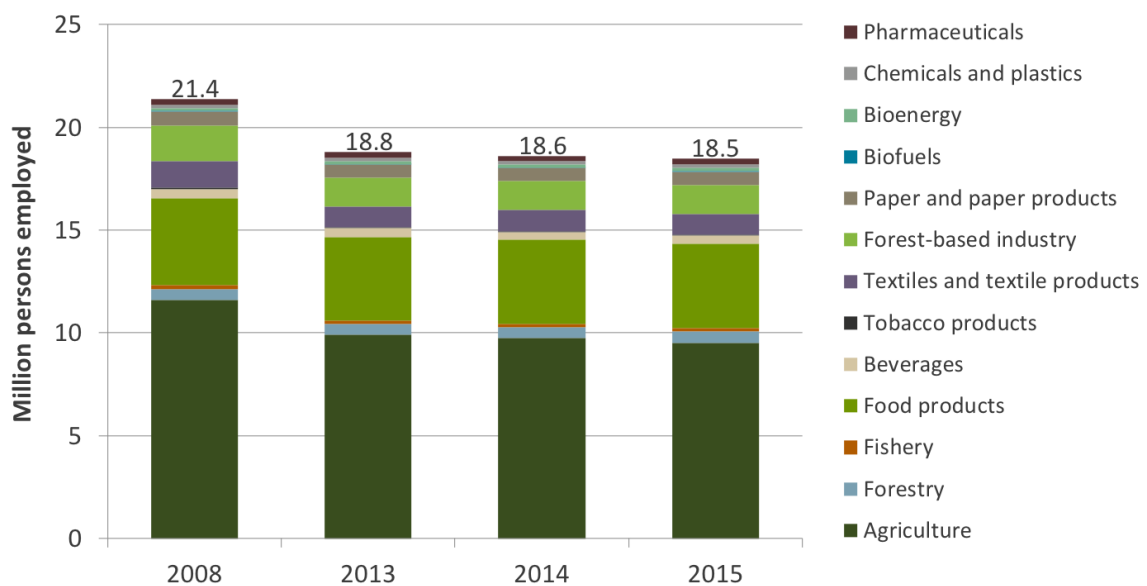


Figure 4: Employment in the bioeconomy in the EU-28, 2008-2015

Employment in the EU bio-based sector (EU-28, 2008-2015)

For this chart, the sectors food, beverages and tobacco products have been excluded. The total employment results in 13.9 million jobs with about 3 quarters in the primary sector. There is a continuous decline in employment from 2008 to 2015, especially due to the agricultural sector.

Employment in the bioeconomy in the EU-28, 2008-2015*

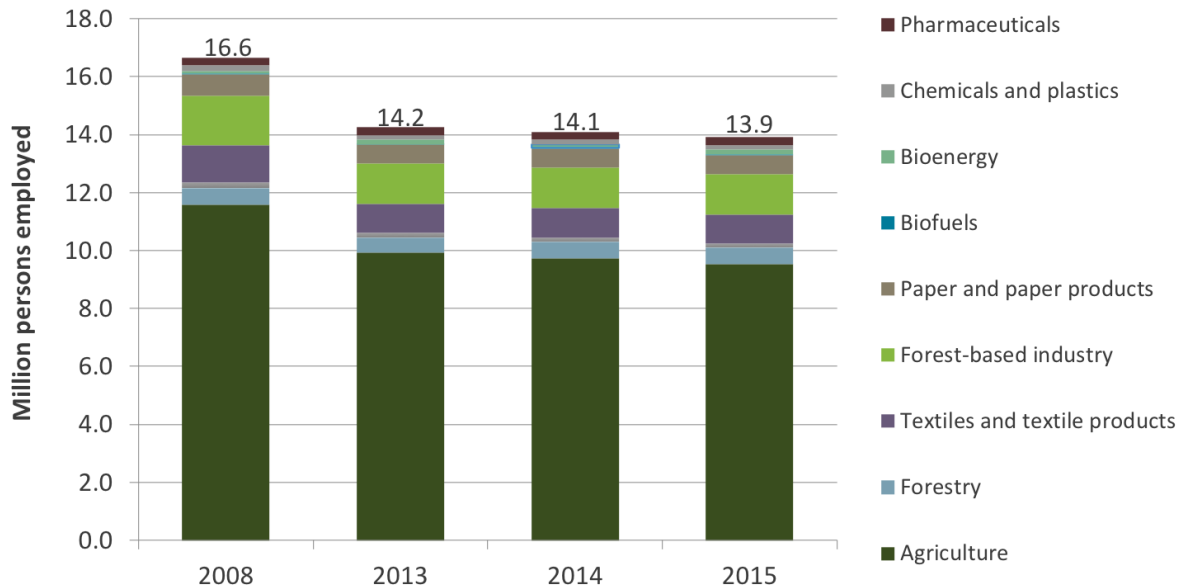


Figure 5: Employment in the bioeconomy (excl. Food products and Beverages) in the EU-28, 2008-2015

If only the “industrial sectors” are analysed (so excluding also the primary biomass production/extraction), the total employment is 3.6 million jobs in 2015. The most prominent sectors are the forest-based industry, paper and paper products, and the textile industry. In the period between 2008 and 2013, there was apparently a strong decrease in the employment in the forest-based industry and the textile industry, which can be due to the overall crisis following the year 2008, and partly to increases in productivity.

Employment in the bio-based economy in the EU-28, 2008-2015*

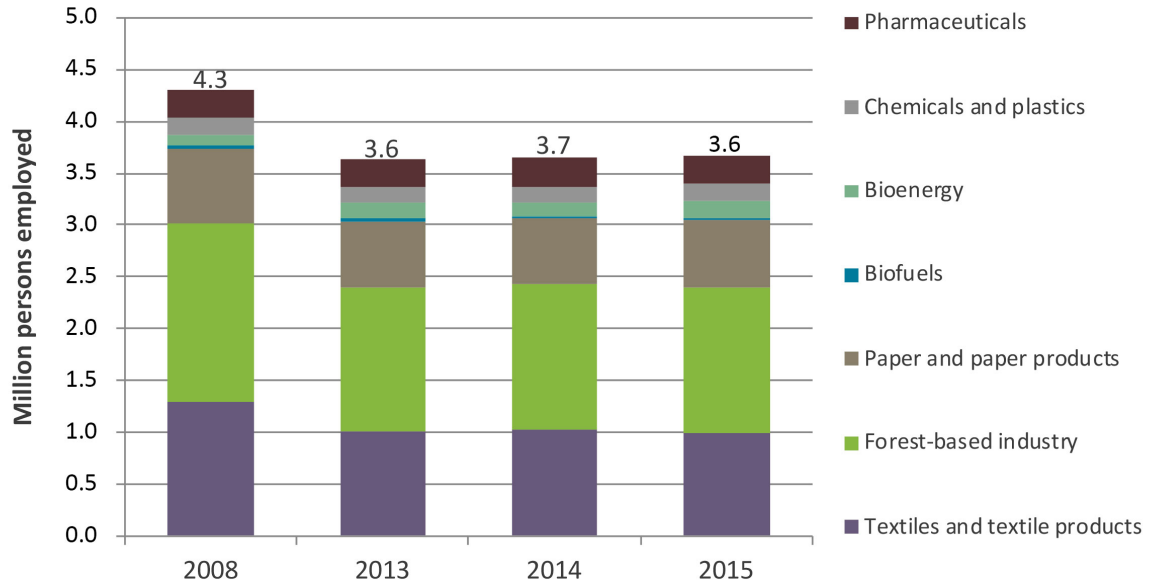


Figure 6: Employment in the bio-based economy in the EU-28, 2008-2015

3.3 Turnover and employment in the EU bio-based economy per Member State (EU-28, 2015)

The following bar chart compares the total turnover and employment of the bio-based economy (excl. agriculture, forestry, fishery, food, beverages and tobacco products) for each Member State of the EU-28 in 2015. The figure shows clear differences between groups of Member States, e.g. the Eastern European countries Poland, Romania and Bulgaria apparently are stronger in less value-added sectors of the bio-based economy that generate a lot of employment.

In comparison, Western and Northern European countries generate much higher turnover compared to the employment generated. The countries with the largest relative differences between turnover and employment in 2015 are Ireland, Finland and Belgium.

Turnover and employment in the EU bio-based economy* (2015)

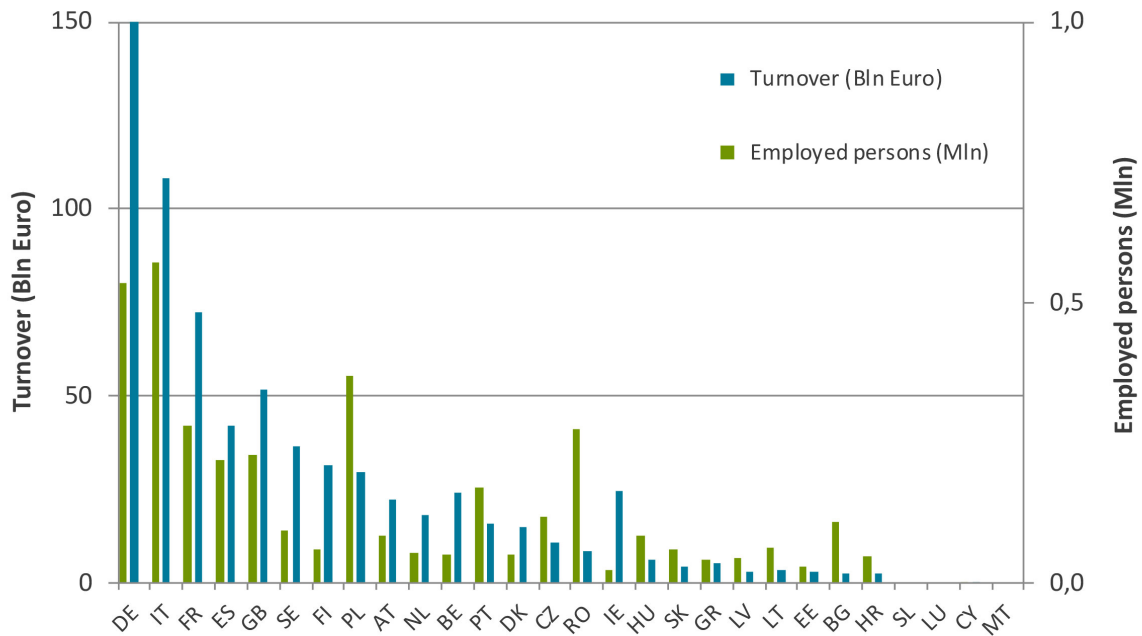


Figure 7: Turnover and employment in the EU bio-based economy per Member State 2015

3.4 Employment per turnover in sectors of the bio-based economy (EU-28, 2008-2015)

The following figure compares the number of employed persons per 1 million Euro of generated turnover for the bio-based sectors textiles and textile products, forest-based industry (wood products and furniture), paper and paper products, chemicals and plastics, pharmaceuticals, biofuels and bioenergy over the period 2008, 2013, 2014 and 2015.

This analysis shows that bioenergy and biofuels generate relatively little employment compared to their turnover. The differences between the sectors shown in this figure can be well explained. The sectors textiles and textile products as well as forest-based industry are relatively labour-intensive sectors with comparably low value added. On the other hand, the production of bioenergy and biofuel products requires relatively little labour compared to their turnover. Note that employment and turnover here always only refer to the end product manufacturing stage, i.e. neither the employment and turnover in primary biomass production nor indirect effects in other sectors due to machinery purchases etc. is accounted for in any of the industrial sectors.

Chemicals and plastics as well as the pulp and paper sector can be found in an intermediate position. Their production requires more labour than bioenergy (more and more complex processing steps) but also generates more value added than textiles and textile products as well as forest-based industry. The overall decrease in the ratio from employment to turnover hints at improved productivity, indicating a continued competitiveness of Europe.

Employment per turnover in sectors of the bio-based economy, 2008-2015

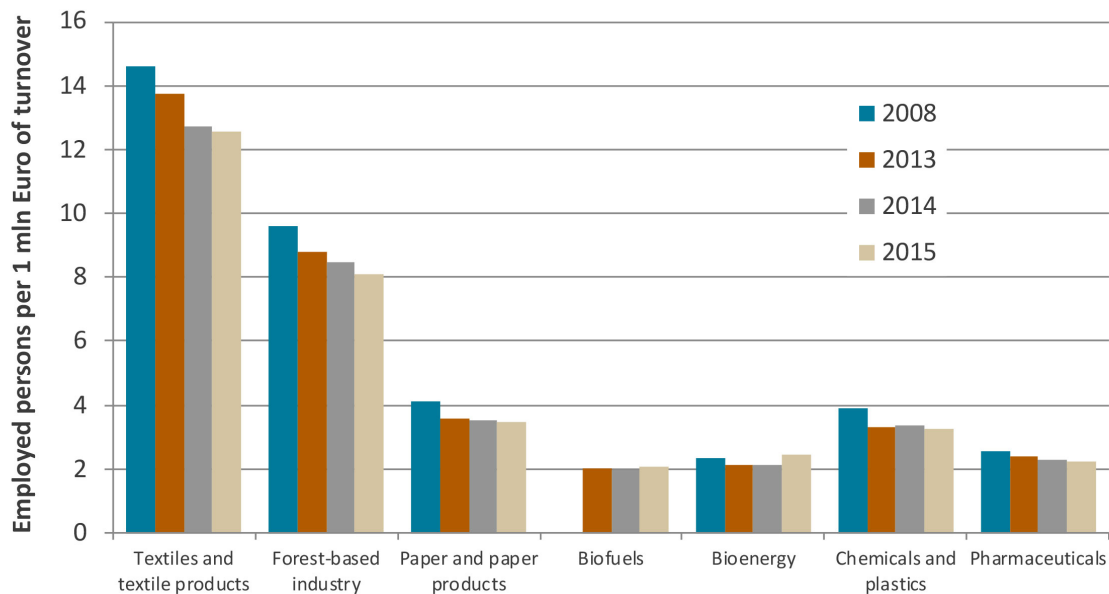


Figure 8: Employment per turnover in sectors of the bio-based economy, 2008-2015

3.5 Bio-based shares in the manufacture of chemicals and chemical products

The following figure compares the estimated overall bio-based share in the NACE Division 20 (Chemicals and chemical products) between 2008 and 2015 for the EU-28 as well as for the single Member States. Since it is very difficult to estimate changes in bio-based shares per product over years, for each product the same share has been assumed for all four years. Therefore, the differences result mostly from changing total production volumes.

The data show an overall increase in the bio-based share in the EU-28 from 5.5% in 2008 to 6.8% in 2015.⁵ The raw material for the chemical industry is about 50% organic (fossil and bio-based) and about 50% inorganic (minerals, metals). Only taking the organic part into account, the overall bio-based share increased from 11% in 2008 to 14% in 2015.

Denmark and Latvia stand out as the Member States with the highest bio-based share in all four years. In the case of Denmark, this is due to the important enzyme industry. In contrast, Latvia and Sweden are following primarily due to a large production volume of traditional products such as charcoal and tall oil. The extremely high bio-based share in Latvia in 2008 was due to the fact that the country did for most part produce charcoal, which is part of the Division 20.

Bio-based shares in the manufacture of chemicals and chemical products (NACE Division 20)*, 2008-2015

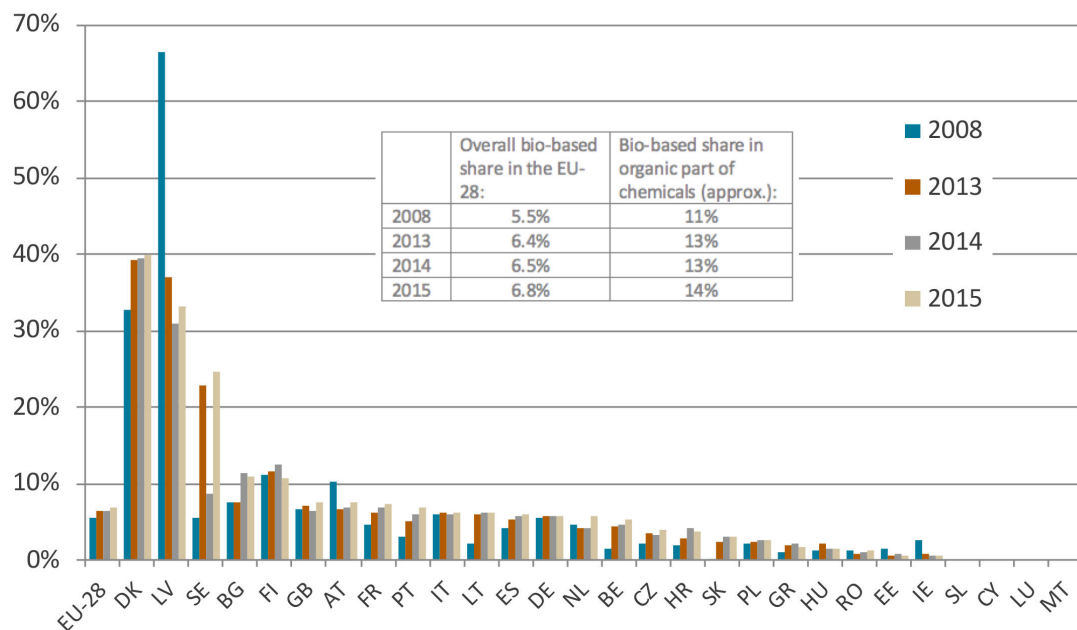


Figure 9: Bio-based shares in the manufacture of chemicals and chemical products, 2008-2015

⁵ In the first version of this report from February 2018, higher values were reported for 2015 and the previous years, due to the fact that one group of chemical products, pyridine containing compounds, was erroneously assumed to be partly bio-based. All values reported here for 2015 and the previous years are the corrected ones.

Figure 10 shows in more detail which NACE Classes have contributed to the overall increase of the bio-based share of the chemical industry. The picture illustrates how the bio-based product values of the different NACE Classes in Division 20 have added up the total bio-based product value in Division 20. Hence, the total product value of 27 bln Euro in 2015 is equal to the overall bio-based share of 6.8%.

Contribution of NACE Classes to the total product value of bio-based chemicals, EU-28, 2008-2015

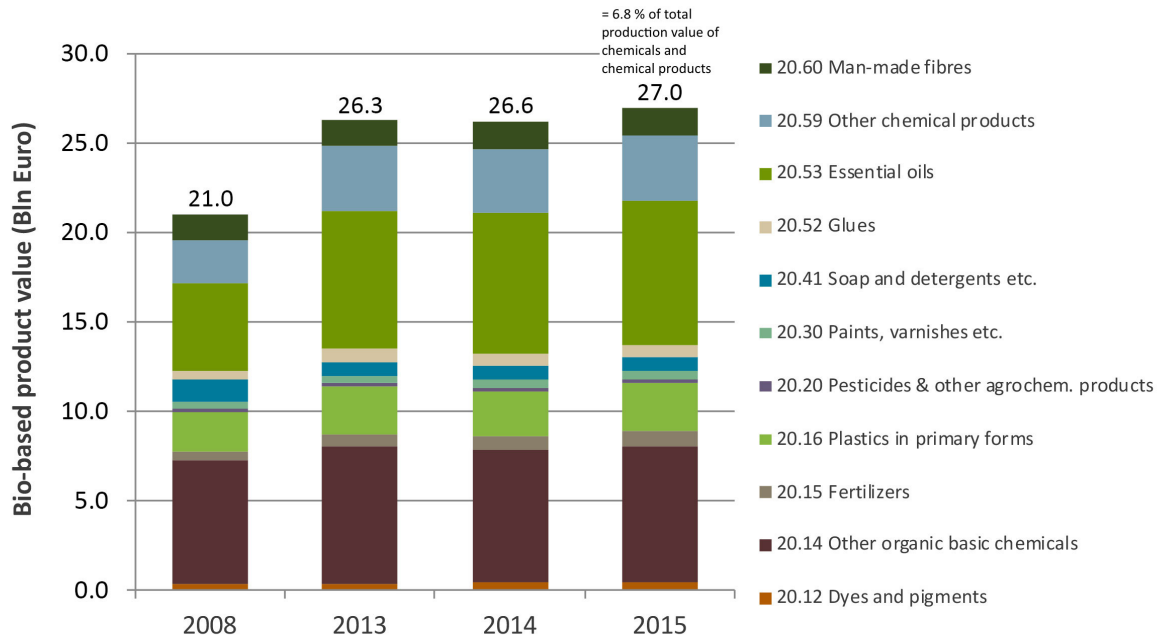


Figure 10: Contribution of NACE Classes to the total product value of bio-based chemicals, EU-28, 2008-2015

While Figure 10 indicates the total bio-based production value that the NACE Classes within Division 20 have contributed to the overall bio-based production value in the chemical industry, a deeper look is needed to understand, which products are responsible for this effect. Therefore, Table 1 shows the 20 partly or fully bio-based chemical products with their bio-based production value in 2015. It shows, for example, that odoriferous substances for food or drink industries alone contributed 4.9 bln Euro (18% of the total value of 27 bln Euro) to the bio-based production of value of Division 20 in 2015.

Table 1: The 20 partly or fully bio-based chemical products with the highest bio-based production value in the EU-28, 2015

PRODCOM-code	Name	Bio-based production value (bln Euro)
20.53.10.75	Mixtures of odoriferous substances of a kind used in the food or drink industries	4.90
20.53.10.79	Mixtures of odoriferous substances (excluding those of a kind used in the food or drink industries)	2.11
20.14.64.70	Enzymes; prepared enzymes (excluding rennet and concentrates)	1.85
20.16.59.60	Natural and modified natural polymers, in primary forms (including alginic acid, hardened proteins, chemical derivatives of natural rubber)	1.10
20.16.59.40	Cellulose and its chemical derivatives, n.e.c., in primary forms	1.08
20.59.60.80	Gelatin and its derivatives; isinglass (excluding casein glues and bone glues)	1.07
20.14.32.80	Lauric acid and others; salts and esters	0.96
20.60.21.20	Artificial filament tow and staple fibres (not carded, combed or otherwise processed for spinning), of viscose rayon	0.90
20.53.10.20	Essential oils	0.86
20.15.80.00	Animal or vegetable fertilisers	0.80
20.59.59.94	Other chemical products, n.e.c.	0.71
20.14.21.00	Industrial fatty alcohols	0.57
20.14.34.73	Citric acid and its salts and esters	0.50
20.14.31.95	Industrial monocarboxylic fatty acids distilled (excluding stearic, oleic tall oil)	0.49
20.60.21.40	Artificial filament tow, of acetate	0.46
20.52.10.80	Prepared glues and other prepared adhesives, n.e.c.	0.45
20.30.11.70	Other paints, varnishes dispersed or dissolved in an aqueous medium	0.45
20.14.71.50	Rosin and resin acids; and derivatives; rosin spirit and oils; run gums	0.44
20.59.20.00	Animal or vegetable fats and oils chemically modified	0.41
20.12.22.70	Colouring matter of vegetable or animal origin and preparations based thereon (including dyeing extracts) (excluding animal black)	0.41

Finally, Figure 11 looks at the contribution of NACE Classes and products to the total product *volume* of bio-based chemicals. This kind of analysis in terms of production volume is not readily possible for all sectors of the bioeconomy because often, Eurostat reports production quantities in other units than mass, i.e. for example pieces (e.g. of furniture, clothings etc.), m² (e.g. textiles and fabrics) or m³ (e.g. forestry products). A conversion of all units to mass is in principle possible but would add a lot of uncertainty. This is the main reason why this study quantifies bio-based shares in the total production *value* instead.

Production of chemicals, however, is almost completely reported in tonnes (except e.g. industrial gases in m³), so that it is possible to show the same kind of analysis as in Figure 10 also in terms of volume. Interestingly, also in terms of production volume, Class 20.14 makes a large contribution. However, not surprisingly, as Table 2 shows, other products dominate in terms of bio-based production quantity. According to Table 2, animal and vegetable fertilisers alone contribute 6.4 mln t (33% of the total of 19.6 mln t) to the bio-based production volume of Division 20 in 2015.

Contribution of NACE Classes to the total product volume of bio-based chemicals, EU-28, 2008-2015

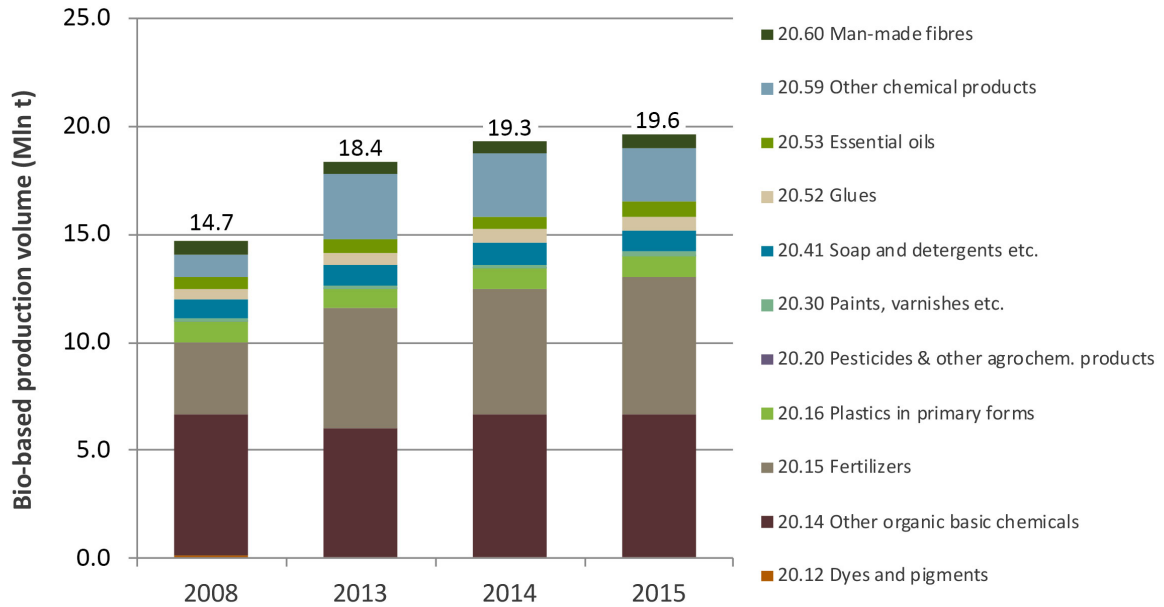


Figure 11: Contribution of NACE Classes to the total product volume of bio-based chemicals, EU-28, 2008-2015

Table 2: The 20 partly or fully bio-based chemical products with the highest bio-based production volume in the EU-28, 2015

PRODCOM-code	Name	Bio-based production volume (mln t)
20.15.80.00	Animal or vegetable fertilisers	6.40
20.59.59.94	Other chemical products, n.e.c.	0.96
20.14.23.33	D-glucitol (sorbitol)	0.80
20.59.20.00	Animal or vegetable fats and oils chemically modified	0.66
20.14.71.20	Activated natural mineral products; animal black	0.65
20.41.10.00	Glycerol (glycerine), crude; glycerol waters and glycerol lyes	0.51
20.14.31.95	Industrial monocarboxylic fatty acids distilled (excluding stearic, oleic tall oil)	0.51
20.60.21.20	Artificial filament tow and staple fibres (not carded, combed or otherwise processed for spinning), of viscose rayon	0.47
20.53.10.75	Mixtures of odoriferous substances of a kind used in the food or drink industries	0.46
20.14.71.30	Tall oil; whether or not refined	0.45
20.52.10.80	Prepared glues and other prepared adhesives, n.e.c.	0.42
20.14.34.73	Citric acid and its salts and esters	0.40
20.16.59.40	Cellulose and its chemical derivatives, n.e.c., in primary forms	0.40
20.14.32.80	Lauric acid and others; salts and esters	0.40
20.14.21.00	Industrial fatty alcohols	0.39
20.14.23.60	Glycerol (including synthetic; excluding crude, waters and lyes)	0.30
20.14.71.50	Rosin and resin acids; and derivatives; rosin spirit and oils; run gums	0.29
20.14.72.00	Wood charcoal whether or not agglomerated (including shell or nut charcoal)	0.28
20.14.31.97	Industrial monocarboxylic fatty acids (excluding stearic, oleic, tall oil, distilled)	0.26
20.14.64.70	Enzymes; prepared enzymes (excluding rennet and concentrates)	0.26

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