European Bioeconomy in Figures 2008–2018

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1 Executive summary

The bio-based industries continue their ascent marking a total contribution of 780 billion EUR, a notable increase of 30 billion EUR (+4 %) compared to 2017. This also marks a more than 20 % increase compared to 2008, which is the earliest data taken into account in this series of reports by nova-Institute. The first report of the series was first commissioned by the Bio-based Industries Consortium (BIC) in 2017. Figures for the bio-based chemical industry (including plastics) alone reveal a turnover of around 54 billion EUR, with the bio-based share relatively stable at around 15 %, up from 7.5 % in 2008.

The analysis of the 2018 Eurostat data shows that the turnover of the total bioeconomy*, including food and beverages and the primary sectors of agriculture and forestry, amounts to just over 2.4 trillion EUR in the EU-27 and the United Kingdom, an increase of around 25 % since 2008. The food and beverage sector accounts for about half of the turnover, the bio-based industries, such as chemicals and plastics, pharmaceuticals, paper and paper products, forest-based industries, textiles, biofuels and bioenergy account for roughly 30 %, while almost another 20 % are generated by the primary sectors of agriculture and forestry.

In contrast to the rising turnover figures, employment in the European bioeconomy has continued to decline from 18.5 million people in 2017 to a total of 18.4 million people in 2018, continuing the downward trend of recent years, largely due to efficiency increases in production. The primary biomass production, mainly agriculture, provides a majority of the entire employment (54 %) but a comparative low turnover (20 %).

The data also demonstrates clear differences between groups of Member States. For example, the Central and Eastern European countries of Poland, Romania and Bulgaria are more represented in the lower value-added sectors of the bio-based economy, which create many jobs. This indicates a strong agricultural sector that tends to be labour-intensive compared to the high value-added sectors. In comparison, Western and Northern European countries generate much higher turnover relative to employment, indicating a larger share of refining and value-added industries. The countries with the highest turnover-to-employment ratios are Finland, Belgium and Sweden.

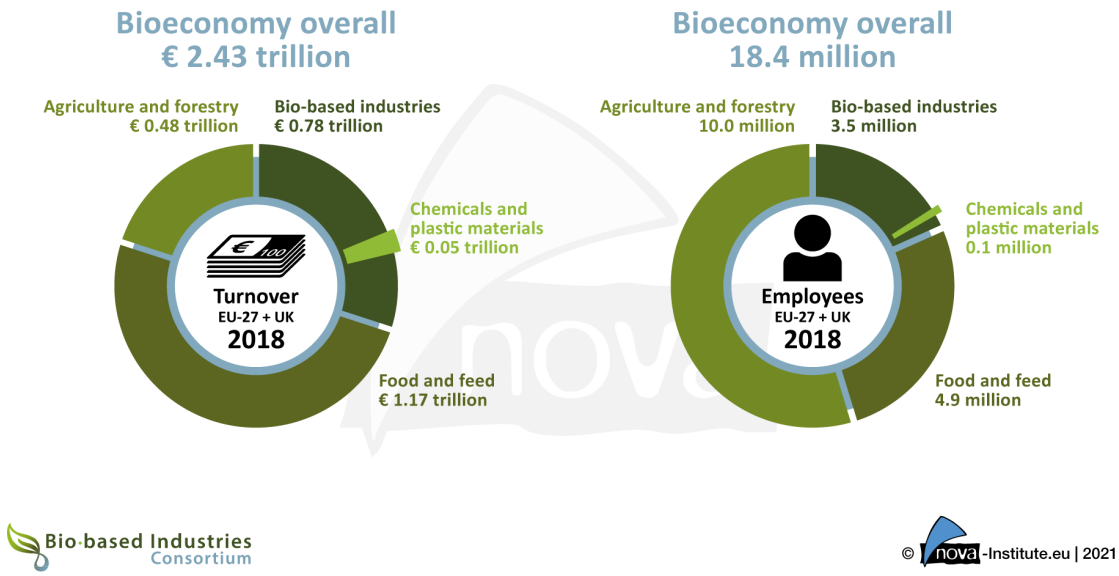

Figure 1 Overall turnover and employment of the bioeconomy and its bio-based industries in the EU-27 (+UK) in 2018

Considering the raw material composition in the chemical industry, it consists of about 50 % organic (fossil and bio-based) and about 50 % inorganic raw materials (minerals, metals). Taking into account only the organic share, which can be replaced by biomass, the total bio-based share of chemical products increased to 15 % in 2018, based on the production value, a steady increase compared to the previous bio-based share of 11% in 2008.

Looking ahead, it will be interesting to see what impact the European Green Deal, introduced in 2019, will have on the European bioeconomy. In general, the policy framework in which the bioeconomy operates is currently the subject of many revisions, changes and even additional measures. In its effort to reduce CO_2 emissions by 55 % by 2030 through the so-called "Fit for 55 package", the EU is introducing significant changes within its regulatory framework. How these changes will affect the bioeconomy and whether the slowly but steadily growing bioeconomy in the EU will flourish even more will be a highly anticipated outcome of nova's upcoming reports.

The nova-Institute's market report is commissioned by the Bio-based Industries Consortium (BIC) and was first published in 2016, demonstrating for the first time the macroeconomic effects generated by the bioeconomy, e.g., turnover and employment for the years 2008 and 2013. Since then, the report has been updated on an annual basis. The latest version covers the period from 2008 to 2018.

**The primary sectors (agriculture, forestry, and fisheries) and the food, beverage, tobacco and paper and paper products can be considered fully bio-based and are thus fully accounted for in the bioeconomy. For other manufacturing sectors such as chemicals, pharmaceuticals and textiles, the bio- based shares were estimated and included in the report's assessment.*

Due to significant data gaps provided by the official data sources that are used for this report the figures had to be corrected and improved at times. Also, the methodologies applied to the data have seen improvements over time resulting in differences compared to the previous reports. Please see the chapter “ANNEX I” for further information and the specific changes that had to be made.

2 Introduction

The report consists of an assessment of turnover and employment data of the European bioeconomy for the years 2008-2018, using Eurostat's databases as the primary data source.

This update of the previous versions of this study, including figures for 2018, has been made possible thanks to updated statistical data provided by the EU member states and gathered by Eurostat. However, note that in the meantime the statistical data for the previous years in some cases has also been possibly updated and revised by Eurostat. In order to be consistent, this update uses the most recent Eurostat data for all years. Due to this fact, small differences with the previous studies are unavoidable. Also, for various products, 2018 data is not completely available yet in the Eurostat database. This alters the representativeness of some values and is annotated where necessary. Furthermore, since it is very difficult to estimate changes in product level bio-based shares over the years, for each product the same share has been assumed for all years. Therefore, the differences in the results of our annual reports stem from changing total production volumes as well as from the recent revision of the bio-based shares.

Note that the principal methodology has been developed in collaboration with the European Commission's Joint Research Centre (JRC). Hence, please also see the publication by Ronzon et al. from 2020. However, due to slight differences in the details, data published simultaneously by the JRC are not exactly the same. There have been attempts to further harmonise the approaches, but these have not been completely fruitful, due to differences in objectives and in some of the assumptions made. That said, the differences do not impact the overall conclusions in any significant manner.

3 Sources and methodology

The main data source for all sectors of the bioeconomy shown in the following figures is Eurostat, more specifically the two databases PRODCOM (Eurostat 2021) and the Structural Business Statistics (SBS, Eurostat 2021a). PRODCOM contains for all Member States data for the production quantity and production value of about 3,900 manufactured goods. These goods are classified based on the European Classification of Products by Activity (CPA) system, where the first four digits indicate the division, group and class to which the product belongs according to the NACE classification of economic activities in the European Community (NACE stands for Nomenclature statistique des activités économiques dans la Communauté européenne).

As the production and employment data of 2018 is the most recent data available in the official EUROSTAT databases, the United Kingdom is still included in the scope of the report as part of the EU. This will change in the future as soon as data after the UK leaving the EU will be analysed.

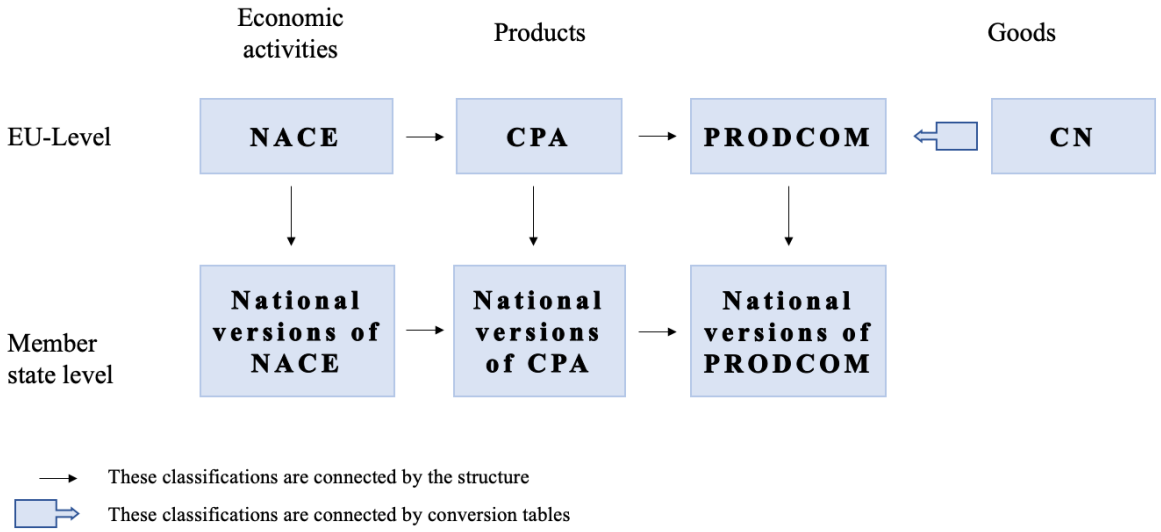

Figure 2 Relation of NACE and CPA classification

Further economic indicators, such as employment and turnover, are only contained in the SBS and other databases at higher levels of aggregation, i.e. the NACE class and division level. The SBS also contain production values at the NACE class level. However, these production values at the NACE class level are strictly speaking not identical to the PRODCOM production values of products summed up to the same NACE class. This is due to the fact that NACE classifies enterprises according to their *main* activity, even though they may also produce products belonging to other classes. However, a comparison of both NACE class level production values shows in most cases that the deviation is negligible.

In order to derive economic indicators for the partially bio-based sectors, the principal approach of the methodology is to first estimate product-level bio-based shares for all products in the PRODCOM list. These shares can then be applied to the product-level production value and the resulting bio-based shares in production value can be aggregated to the sector level (NACE classes or higher) and applied to various economic indicators (such as turnover, employment and value added). 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 food, beverages, tobacco, paper and paper products' sectors.

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** as well as **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 (2018, out of the 534 products in the NACE division 20 (Manufacture of chemicals and chemical products), 110 are fully or partly bio-based. The majority of products, 424, is therefore currently non-bio-based.

Out of the 110 bio-based products, 40 % are fully bio-based (e.g. tanning extracts of vegetable origin, sorbitol, tall oil), 24 % products have 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). For those product groups that contain partially bio-based products, a percentage share has been estimated in order to provide realistic numbers on the effects of the bio-based economy, same as for the partially bio-based products in the textiles or forest-based industries. The approach to all partially bio-based sectors is the same. The shares have been developed and are continuously being fine-tuned in collaboration with several bio-based economy experts and nova-Institute. Any expert knowledgeable in a field of the EU bioeconomy is welcome to provide feedback and information to further improve the shares in collaboration with the authors of this report.

Both biodiesel and bioethanol have dedicated product codes within NACE division 20 (chemicals and chemical products). In order to evaluate the economic effects of biofuels separately from other chemical products, the shares of biodiesel and bioethanol on product level in the total production values of their respective NACE classes (20.14 and 20.59) were therefore calculated and then the assumption was made that the same shares can be applied to the total employment and turnover of these two classes.

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'ER[1]), 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.

4 Results

4.1 Turnover

Turnover in the EU bioeconomy (EU-27 (+UK), 2008–2018)

Figure 3 first shows the turnover development of the total bioeconomy (including food and beverages and the primary sectors agriculture and forestry) over the period 2008–2018. Apart from the recession in 2009, the data show a continuous increase from less than 2 trillion Euro in 2008 to more than 2.43 trillion Euro in 2018, with the food sector being the largest contributor.

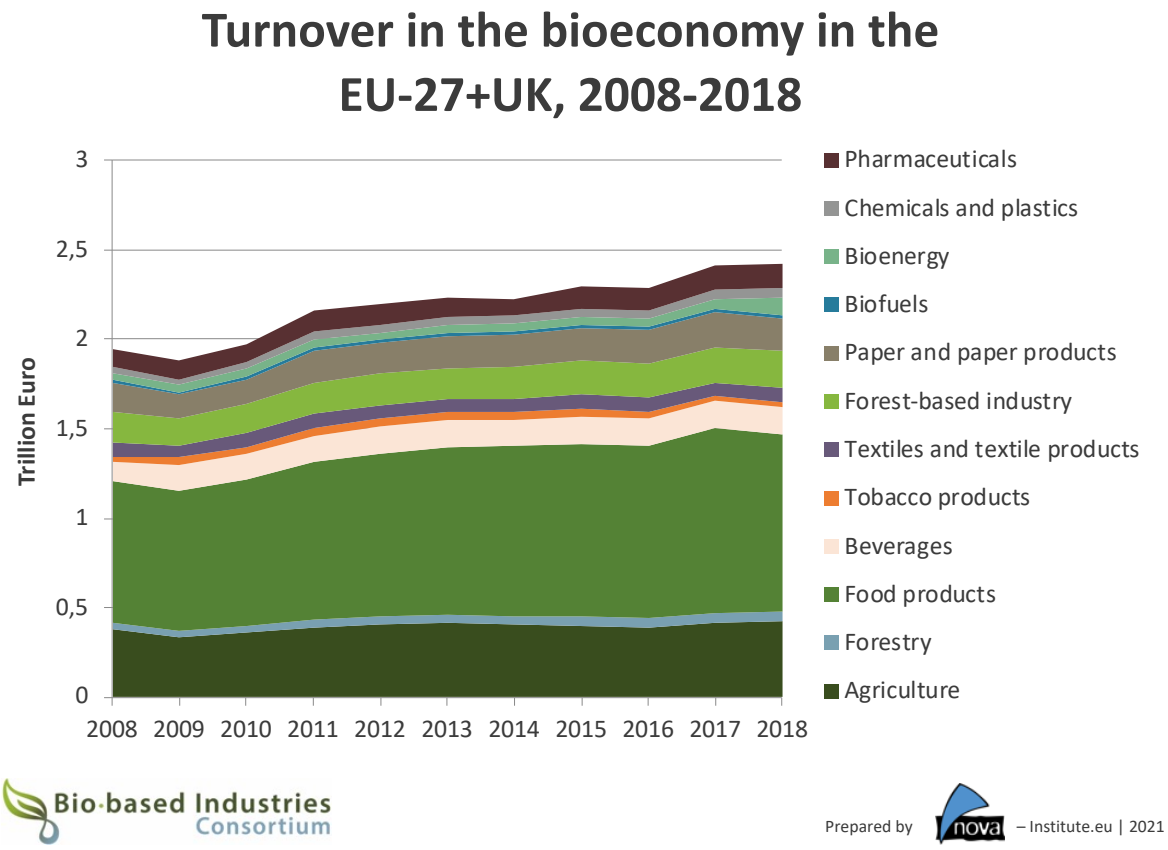

Figure 3 Turnover in the bioeconomy in the EU-27 (+UK), 2008–2018

About half of the 2.43 trillion Euro in 2018 (see Figure 4) comes from the food and beverage sector (47 %), 1% from tobacco products and 20 % of the turnover is generated by the primary sectors (agriculture and forestry) The rest is attributed to the so-called bio-based industries (which includes chemicals and plastics, pharmaceuticals, paper and paper products, forest-based industries, textiles and textile products, biofuels and bioenergy).

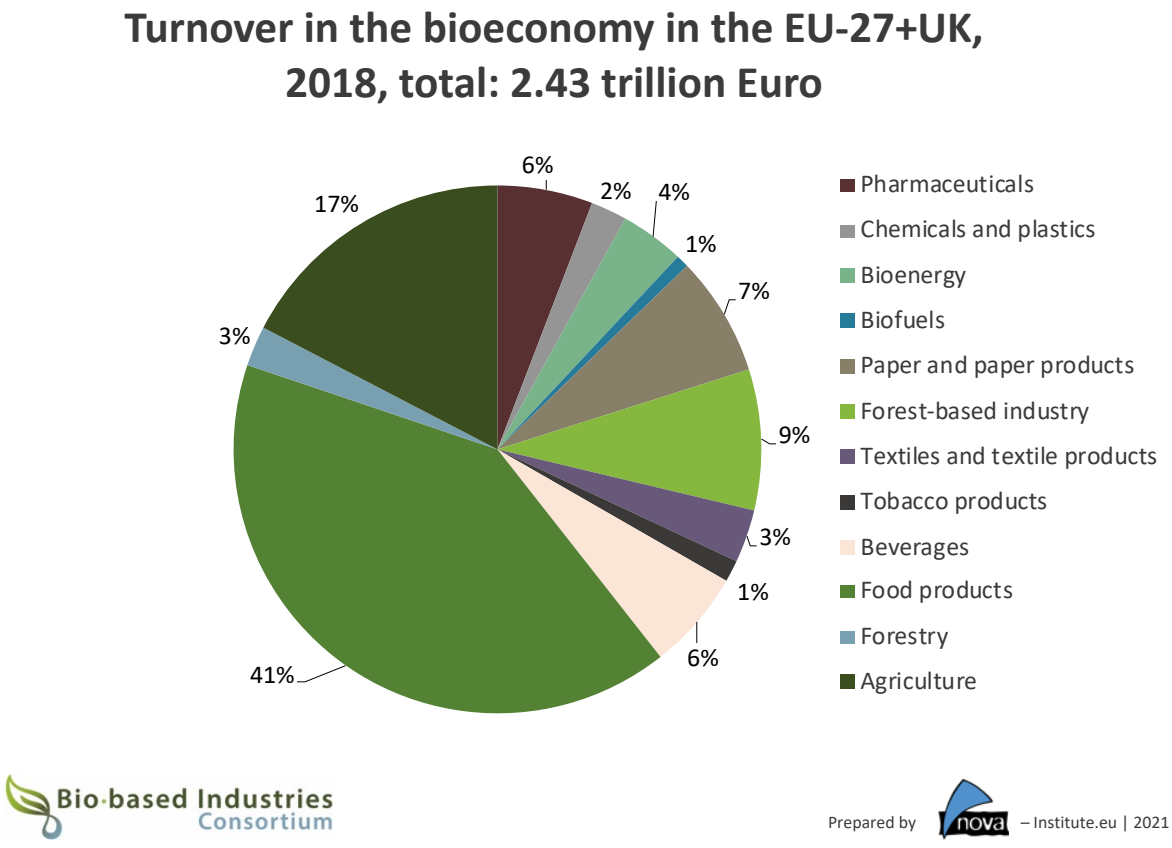

Figure 4 Turnover in the bioeconomy in the EU-27 (+UK), 2018

Turnover in the EU bio-based sector (EU-27 (+UK), 2008–2018)

The turnover of only the EU industrial sectors referred to as the "bio-based economy" is shown in Figure 5. The analysis shows that biofuels and bioenergy together account for about 15 % of turnover, which corresponds to a total of about 114 billion Euro.

The paper and paper products sector (23 %) and the forest-based industry (wood products and furniture) (27 %) account for the largest shares of turnover. Together they amount to about 387 billion Euro. Bio-based chemicals and plastics account for 54 billion Euro (7 %). The total turnover of the bio-based industries reached around 776 billion Euro in 2018, up from around 600 billion in 2008 (Figure 6).

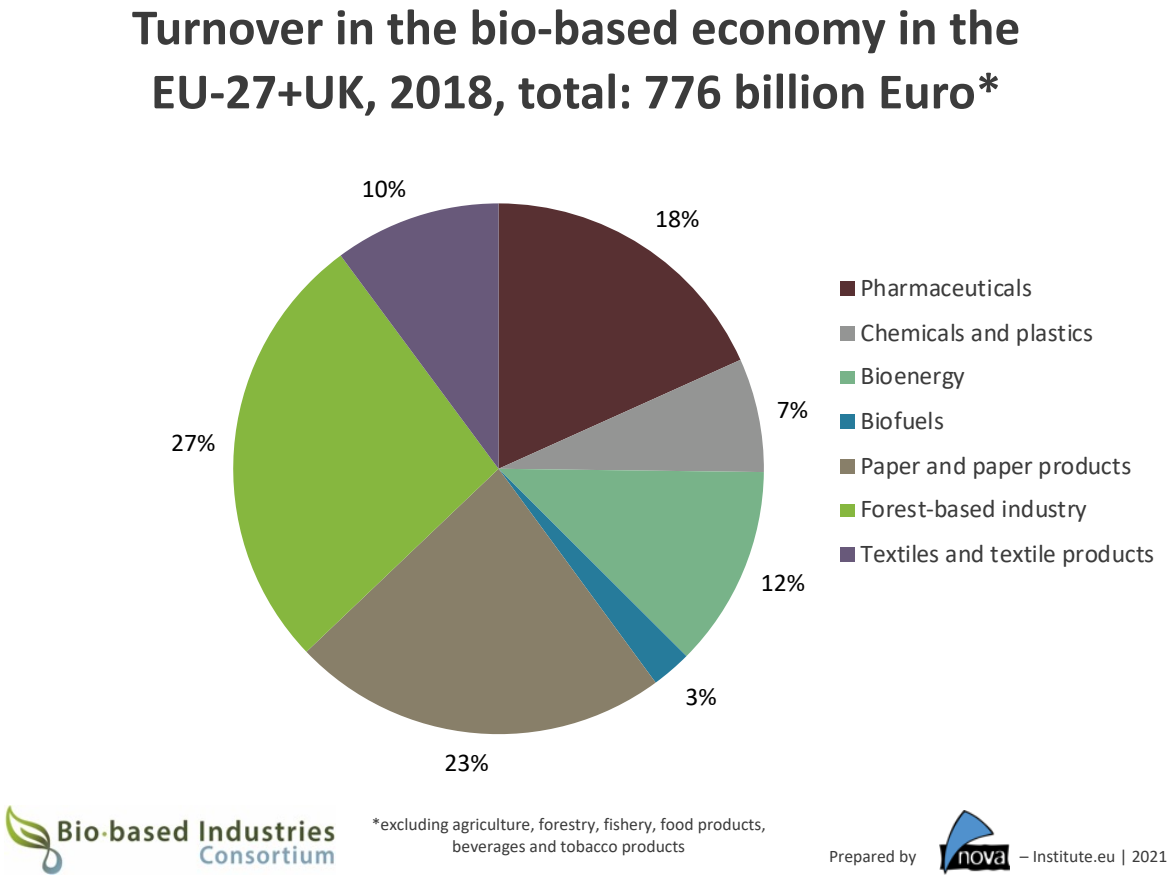

Figure 5 Turnover in the bio-based economy in the EU-27 (+UK), 2018

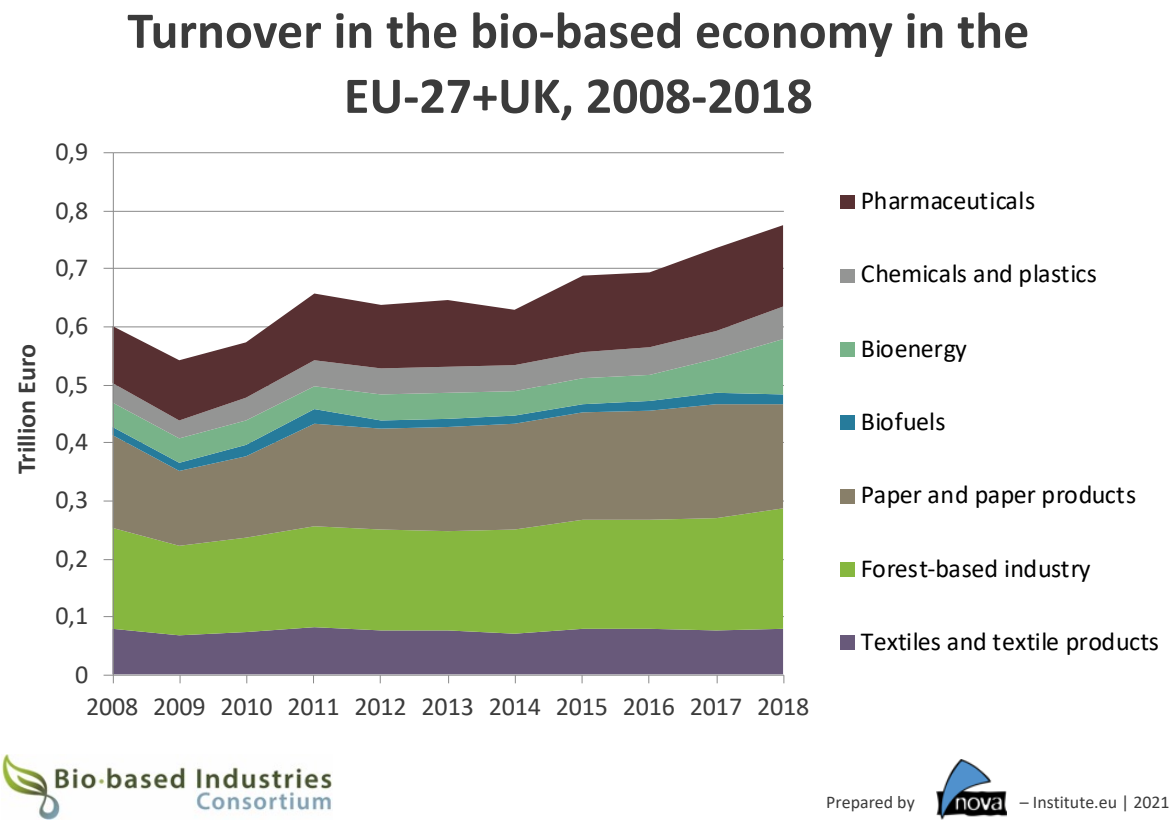

Figure 6 Turnover in the bio-based economy in the EU-27 (+UK), 2008–2018

Figure 6 shows the development of the turnover in the bio-based industries from 2008 to 2018. During this period, the chemicals and plastics sector has increased its turnover by 68 % from 32 billion Euro to around 54 billion Euro. A similar development applies to the pharmaceutical industry. Here, turnover increased by 42 % from 100 billion to 142 billion Euro. Other sectors, such as the paper industry, either recorded only a small increase in turnover (161 billion Euro in 2018 to 178 billion Euro in 2018; increase of 10.5 %), or a stable development, such as for the textile sector (78 billion Euro in 2018 to 79 billion Euro in 2018; increase of around 1 %).

4.2 Employment

Employment in the EU bioeconomy (EU-27 (+UK), 2008-2018)

Similar to the presentation of the turnover, Figure 7 first shows the development of employment for the entire bioeconomy in the period 2008–2018, measured in terms of the total number of employees. The comparison of Figure Figure 7 with Figure Figure 3 clearly shows that, in contrast to total turnover, total employment of the EU bioeconomy is declining. However, as Figure 7 shows, this decline of employment of the total bioeconomy is mainly due to the decline of the agricultural sector, which is caused by the increasing optimisation, automation and digitalisation of this sector. Other sectors have been stable or even increased their employment like the pharmaceutical sector. In 2018, the total number of employed persons in the EU bioeconomy amounted to 18.4 million (Figure 7 & Figure 8).

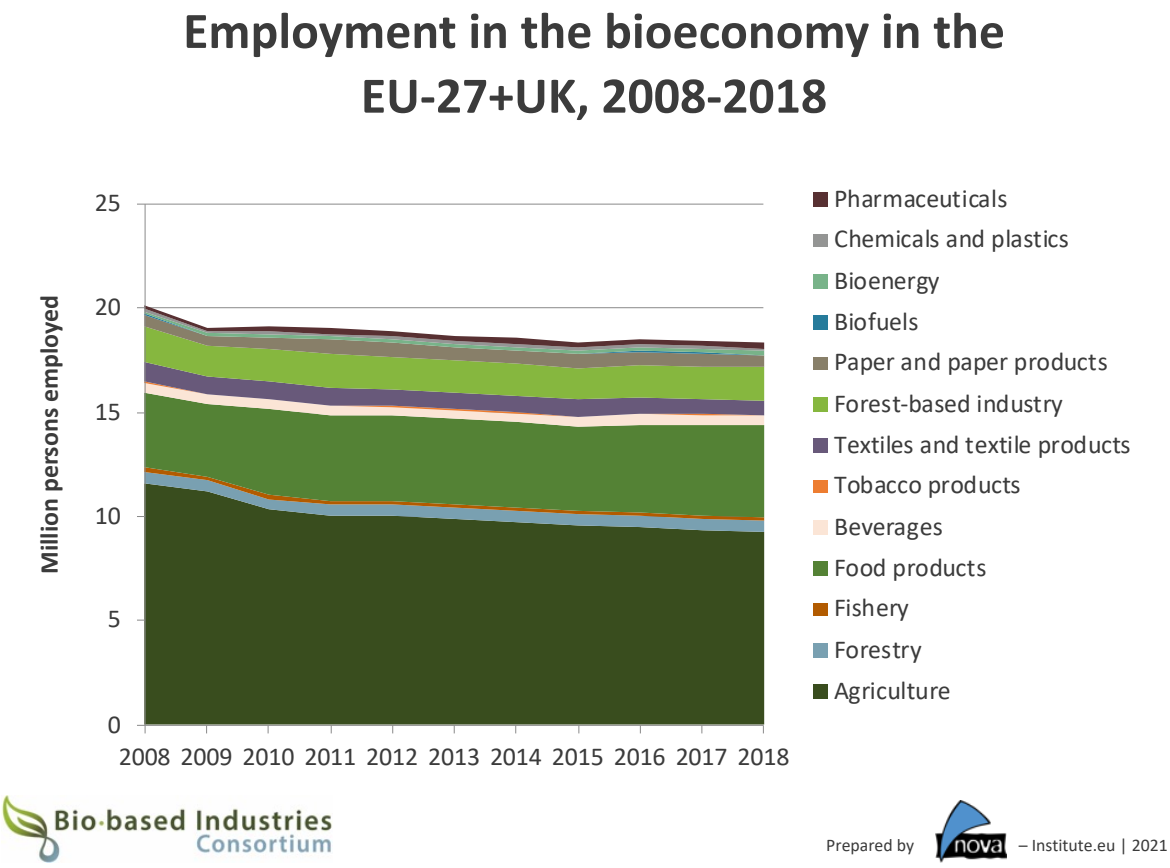

Figure 7 Employment in the bioeconomy in the EU-27 (+UK), 2008–2018

Looking at the employment figures for the bioeconomy in 2018 (Figure 8), it can be seen that the so-called primary sectors (agriculture, forestry and fishing) generate the most jobs with over 50 % (10 million employees). This is followed by the food and beverage industry with 4.9 million employees (26 %). The tobacco industry, on the other hand, employs about 350,000 people. The rest of the employment is attributed to the bio-based sectors with almost 20 % (3.5 million employees). A more detailed breakdown of the distribution can be found in Figure 9.

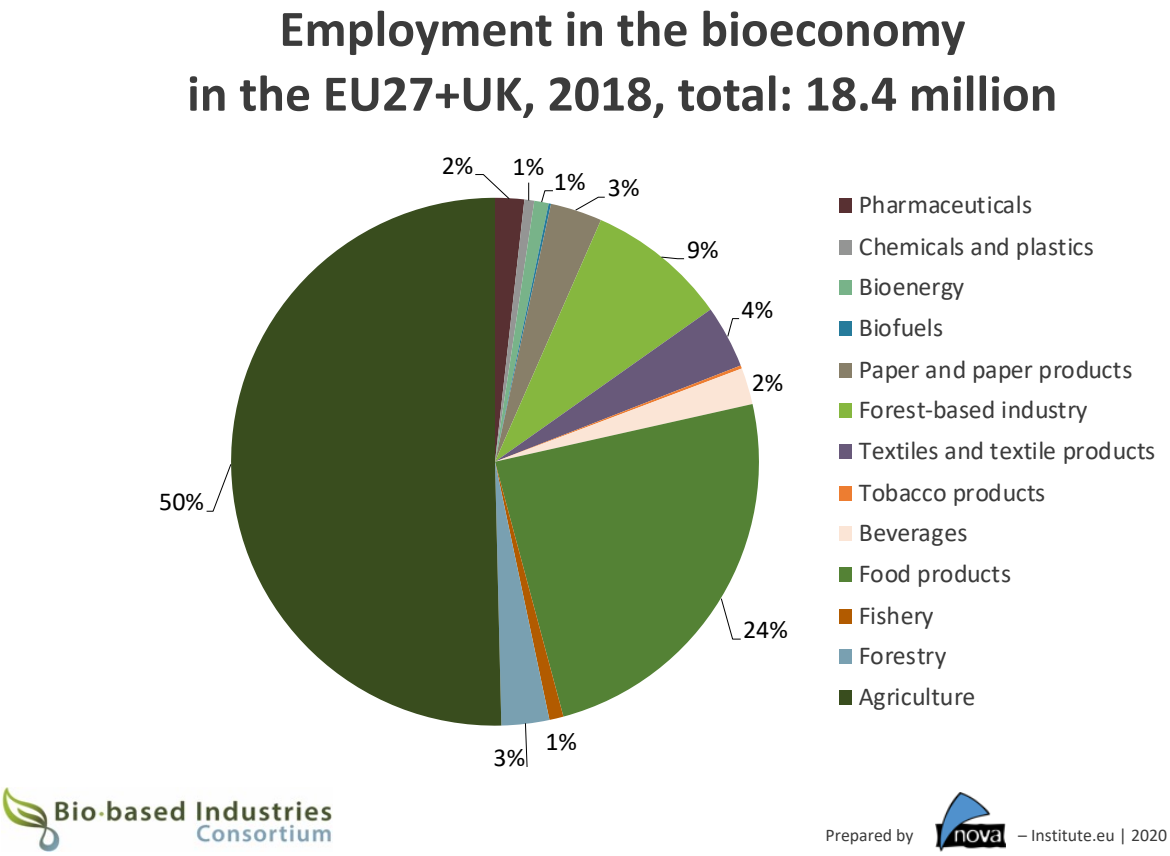

Figure 8 Employment in the bioeconomy in the EU-27 (+UK), 2018

Employment in the EU bio-based sector (EU-27 (+UK), 2008–2018)

Looking only at employment in bio-based industries, total employment amounts to 3.5 million jobs in 2018. The most significant sectors are forest-based industries supplying 45 % of the jobs, the textiles sector supplying 20 % of the jobs and the paper and paper products sector with 17 % of the jobs (Figure 9 and Figure 10).

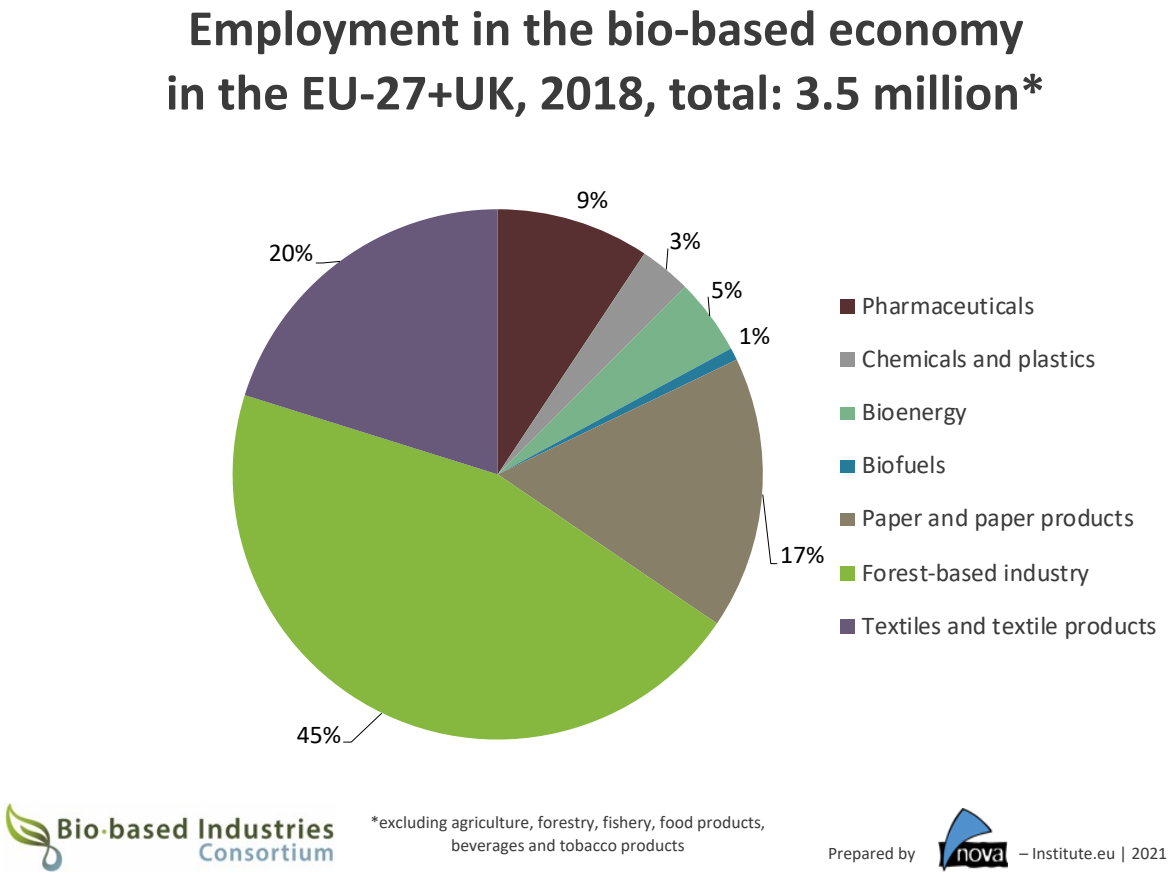

Figure 9 Employment in the bio-based economy in the EU-27 (+UK), 2018

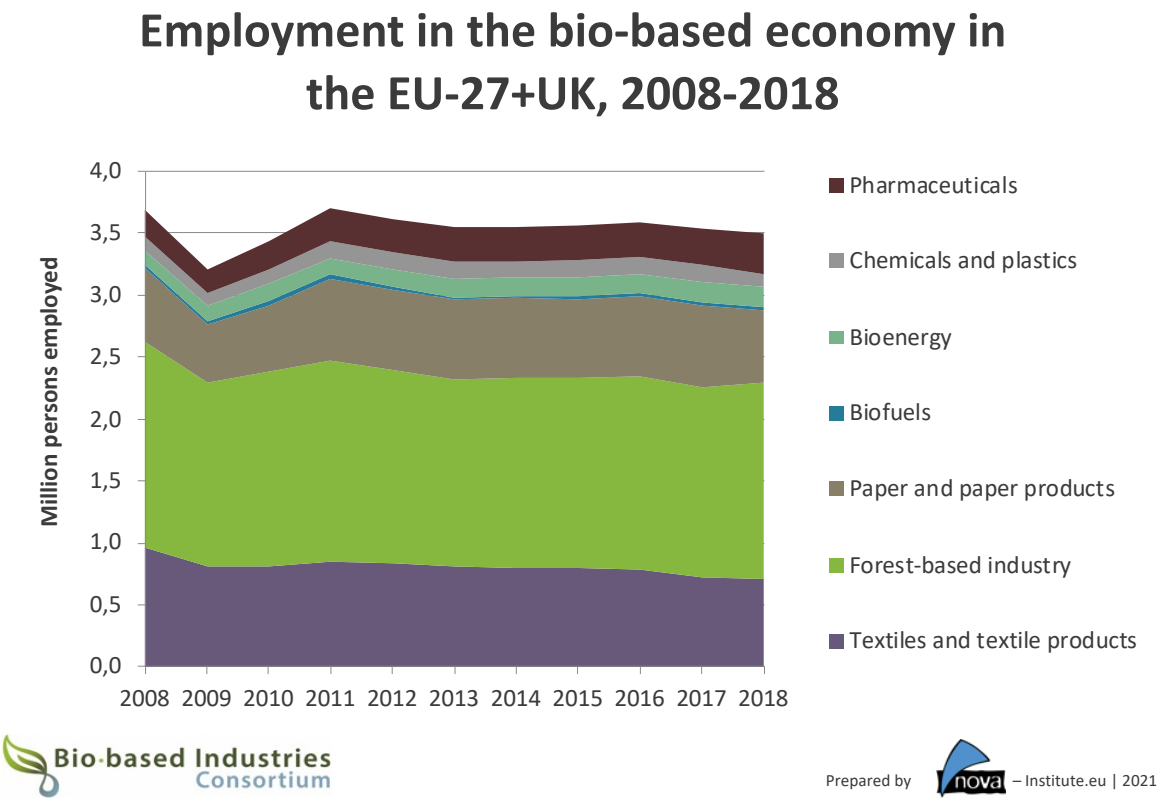

Figure 10 Employment in the bio-based economy in the EU-27 (+UK), 2008–2018

The development of employment in the bio-based industries during the period from 2008 to 2018 shows a minimal downward trend (Figure 10). Employment fell from 3.7 million in 2008 to approximately 3.5 million in 2018, with the textile industry in particular losing approximately 250,000 jobs during this period (2008: 956,000 employees; 2018: 706,000 employees). In other sectors, such as the pharmaceutical industry, employment has increased. While 214,000 people have been employed in 2008, the figure has now risen to around 327,000.

Turnover and employment ratios in the EU bio-based economy by Member State

Figure 11 below sets the total turnover in the bio-based economy (excluding agriculture, forestry, fisheries, food, beverages and tobacco) in relation to the respective employment numbers for each EU-27 Member State and the United Kingdom in 2018. This metric shows how much turnover is generated by one unit of employment in full-time equivalents (FTEs) and can hint at the structure of the industries in the Member States. A higher value of turnover per employment implies a larger share of refining and value-adding industries in a country whereas a lower share usually implies a larger share of production of primary biomass. The figure shows clear differences between groups of Member States, e.g. the Western and Northern European countries generate much higher turnover compared to employment generated in 2018. Countries such as Belgium, Finland, France and Germany, among others, show a large difference between turnover and employment. By comparison, Eastern European countries such as Lithuania, Romania and Bulgaria are stronger in less value-adding sectors of the bio-based economy, which require more employment per turnover.

Figure 11 Turnover in thousand € per employment unit (FTE) in the EU-27 (+UK) bio-based economy per Member State, 2018

Employment per turnover in sectors of the bio-based economy

Figure 12 compares the number of employed persons per one 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 2008–2018.

This figure shows that sectors such as biofuels generate a lot of turnover with comparatively little employment. Conversely, the forest-based and textile processing industries generate less turnover with high employment. Note that employment and turnover here always refer to the end product manufacturing stage only, meaning that neither the employment and turnover in primary biomass production nor indirect effects in other sectors due to machinery purchases etc. are accounted for in any of the industrial sectors.

The pulp and paper sector, meanwhile, can be found in an intermediate position. Here, production requires more labour but also generates higher turnover than textiles and textile products as well as the forest-based industry. In general, a decline in the employment-turnover ratio can be seen in almost all industries, which point to improved productivity, indicating a continued competitiveness of Europe. Strongest is the decrease of this ratio in the forest-based industry and the textile industry, which can be explained by the overall economic crisis following the year 2008, and partly by increases in productivity.

The chemicals and plastics as well as bioenergy sectors also show a clear downward trend, in particular from 2016 on. However, for the chemicals and plastics sector, this could be due to data gaps in the SBS database on employment figures, as already described in the correction chapter of this report. The same applies to the bioenergy sector. Here, the rather significant decrease in the turnover to employment ratio for bioenergy is attributed to the incomplete and partly very changeable availability of data sets in the SBS database and is therefore not representative. It is worth noting that the analysis of the bioenergy sector is based, among other, on the turnover figures of the SBS database in the fields of “Manufacture of gas”, “Production of electricity” and “Steam and air conditioning supply”. For 2018, all these turnover values for the EU-27 & UK have been available for the first time since 2011. In between these years, data gaps strongly influenced results for the bioenergy sector. This results in a higher turnover value for bioenergy than in previous years, which in turn, with employment figures remaining the same, leads to a decline in the employment-turnover ratio.

Pharmaceuticals is the only industry to show an increase in the ratio. Here, increasing turnover leads to more employment and investment in the area of research.

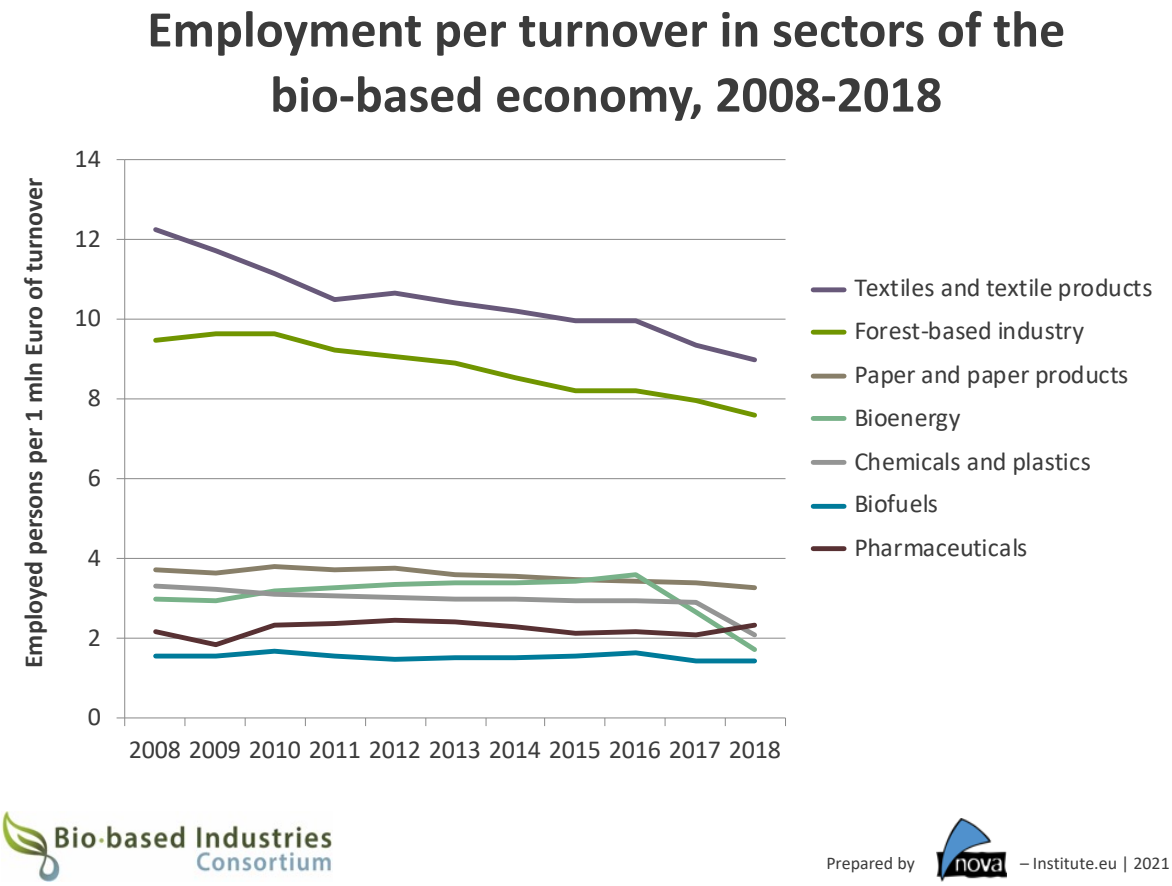

Figure 12 Employment per turnover in sectors of the bio-based economy, 2008–2018

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

The following Figure 13 compares the estimated overall bio-based shares in the NACE division 20 (Chemicals and chemical products, excluding biodiesel and bioethanol) between 2010 and 2018 for the EU-27 & UK as well as for each single state. The data show an overall increase in the bio-based share in the EU-27 & UK from about 5 % in 2008 to 7.5 % in 2018. That said, some countries show much larger shifts in their national bio-based share.

According to Figure 13, Denmark stands out as the Member State with the highest bio-based share over the entire 2010-2018 period. This figure has risen from 36.1 % in 2010 to 50.1 % in 2018. This is mainly due to the highly relevant enzyme industry in Denmark. This is followed by Latvia, which, in contrast, is mainly characterized by large production volumes of charcoal, which belongs to NACE class 20. This artefact in the data underlines the importance of looking at the results accurately and critically. However, the data for Latvia show significant irregularities and even a decrease in the bio-based share from 29.9 % in 2010 to 19.0 % in 2018. These large fluctuations are mainly due to discontinuous source data from Eurostat. For example, in 2017 and 2018, the values for class 20.15, which contains fertiliser products, are missing. In particular, the lack of data on the fully bio-based product group of animal and vegetable fertilisers has affected Latvia's total bio-based share.

Also of particular note is the steady increase in Bulgaria's bio-based share, which reached the third highest share in the EU-27 (+ UK) in 2018. This is particularly due to high production volumes of essential oils.

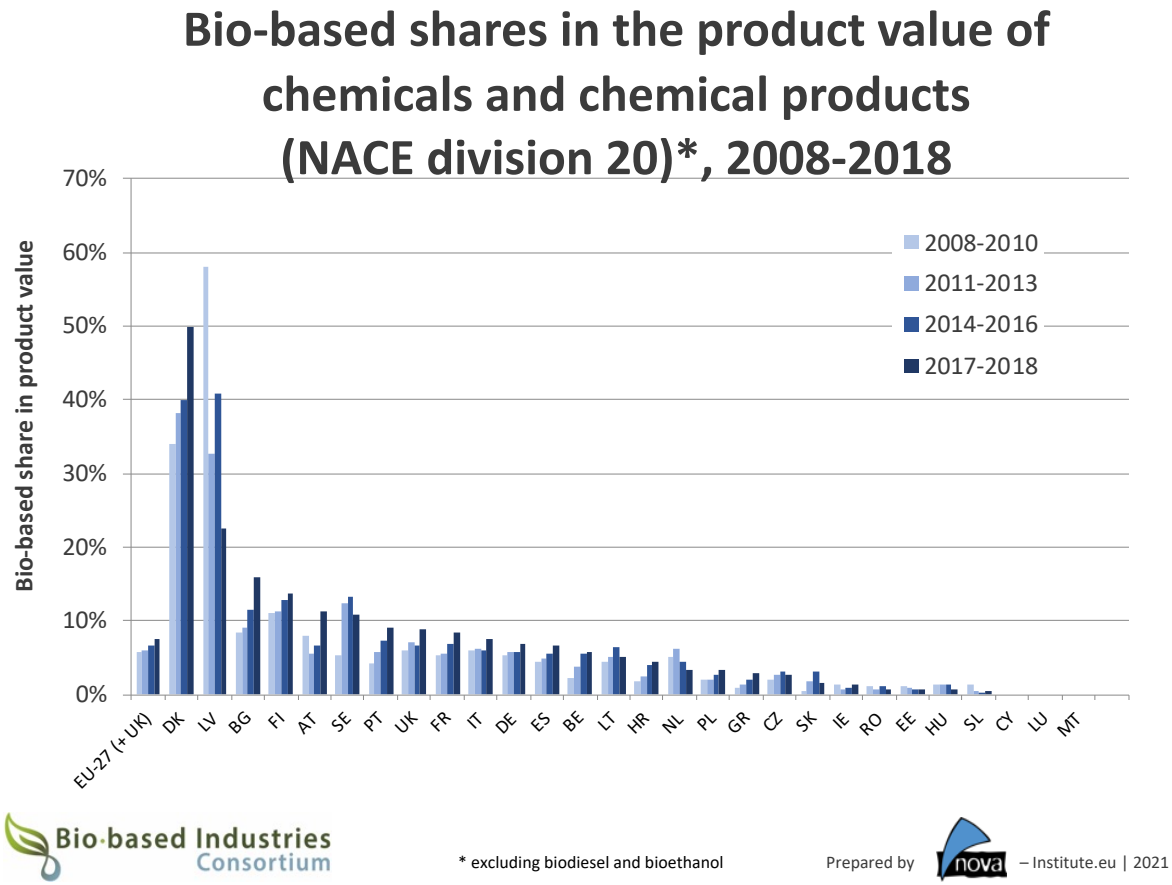

Figure 13 Bio-based shares in the product value of chemicals and chemical products, 2008 - 2018

The raw material composition for the chemical industry is about 50 % organic (fossil and bio-based) and 50 % inorganic (minerals, metals). If only the organic share is taken into account, because only this can be substituted by biomass, the total bio-based share rose from 11 % in 2008 to 15 % in 2018 (Table 1). Additionally, Figure 14 shows these results in graphical form. Note that there may be small differences compared to the reports published earlier due to the updates and differences in the Eurostat data and the revisions of the product-level bio-based shares.

Year	Overall bio-based share in the product value of chemical products	Bio-based share in the organic part of chemical products (approx.)
2008	5.3%	10.7%
2009	5.8%	11.5%
2010	5.9%	11.8%
2011	5.9%	11.8%
2012	5.9%	11.8%
2013	6.2%	12.4%
2014	6.2%	12.4%
2015	6.3%	12.6%
2016	7.2%	14.4%
2017	7.5%	14.9%
2018	7,5%	14,9%

Table 1 Bio-based shares in the product value of chemicals and chemical products in the EU-27 (+UK), 2008 - 2018

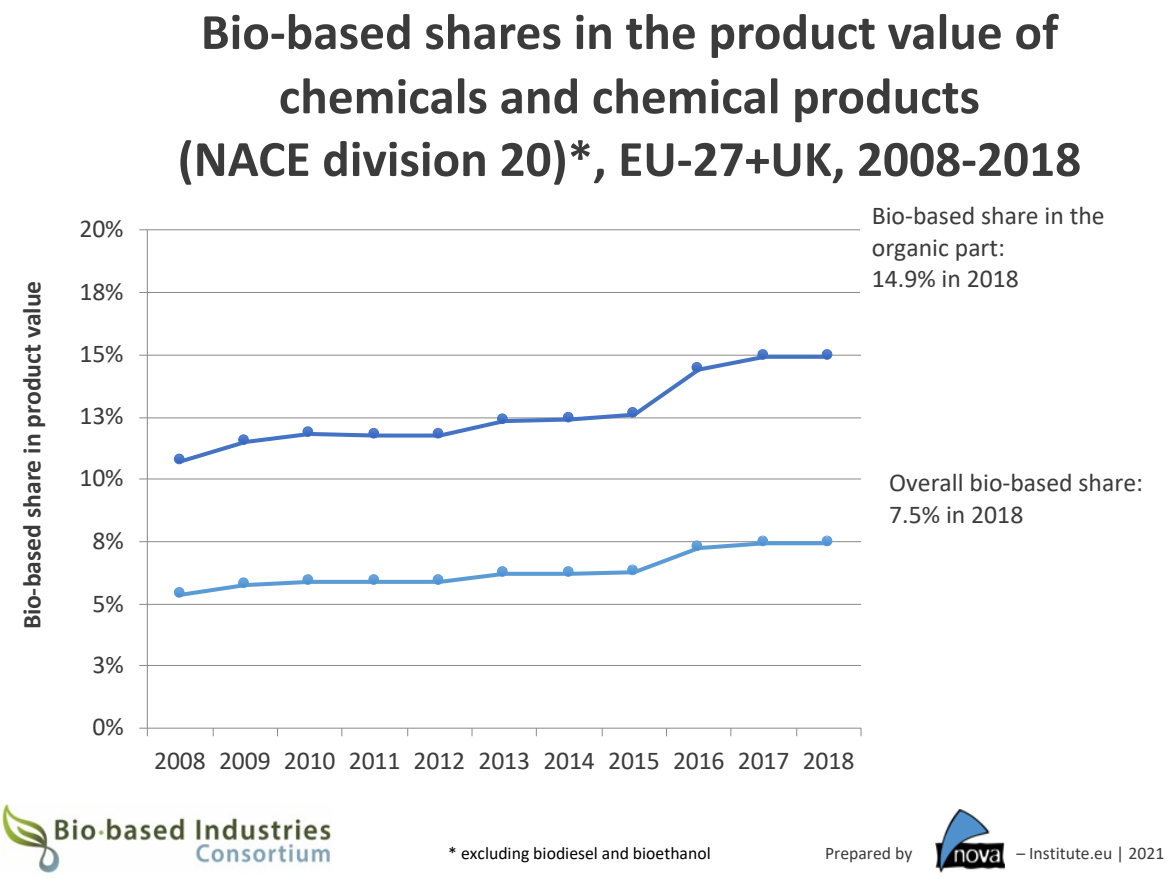

Figure 14 Bio-based shares in the product value of chemicals and chemical products in the EU-27 (+UK), 2008 - 2018

Figure 15 shows in more detail which NACE classes have contributed to the overall increase of the bio-based share of the chemical industry, by illustrating the development of the bio-based products values in each NACE class of division 20. The resulting total product value of bio-based chemicals of 28.1 billion Euro in 2018 is 7.5 % of the overall product value of chemicals and chemical products (both petro- and bio-based), therefore corresponding to the overall 7.5 % share of bio-based chemicals shown in Figure 14.

Figure 15 also clearly shows that the remarkable increase of the bio-based share between 2015 and 2018 was mainly due to an increase of the production value of class 20.53 (essential oils), while other organic basic chemicals (20.14) have also shown a moderate, but continued increase.

This increase of production value in the product group 20.14 (other organic basic chemicals) and the general growth of the bio-based chemicals sector over the last couple of years is undoubtedly a success. It can be attributed to the continuous efforts of stakeholders, such as the Bio-based Industries Consortium and nova Institute that promote the use of bio-based feedstocks in material uses regularly.

On the other hand, class 20.60 (man-made fibres) shows a clear drop. This can again be attributed to missing data in the Eurostat databases. For example, in 2017 and 2018, data are missing for the product group "Artificial filament tow and staple fibres (not carded, combed or otherwise processed for spinning), of viscose rayon" (PRODCOM code: 20.60.21.20), which is a product group that is described as fully bio-based. The absence of these data leads to strong changes in the overall assessment.

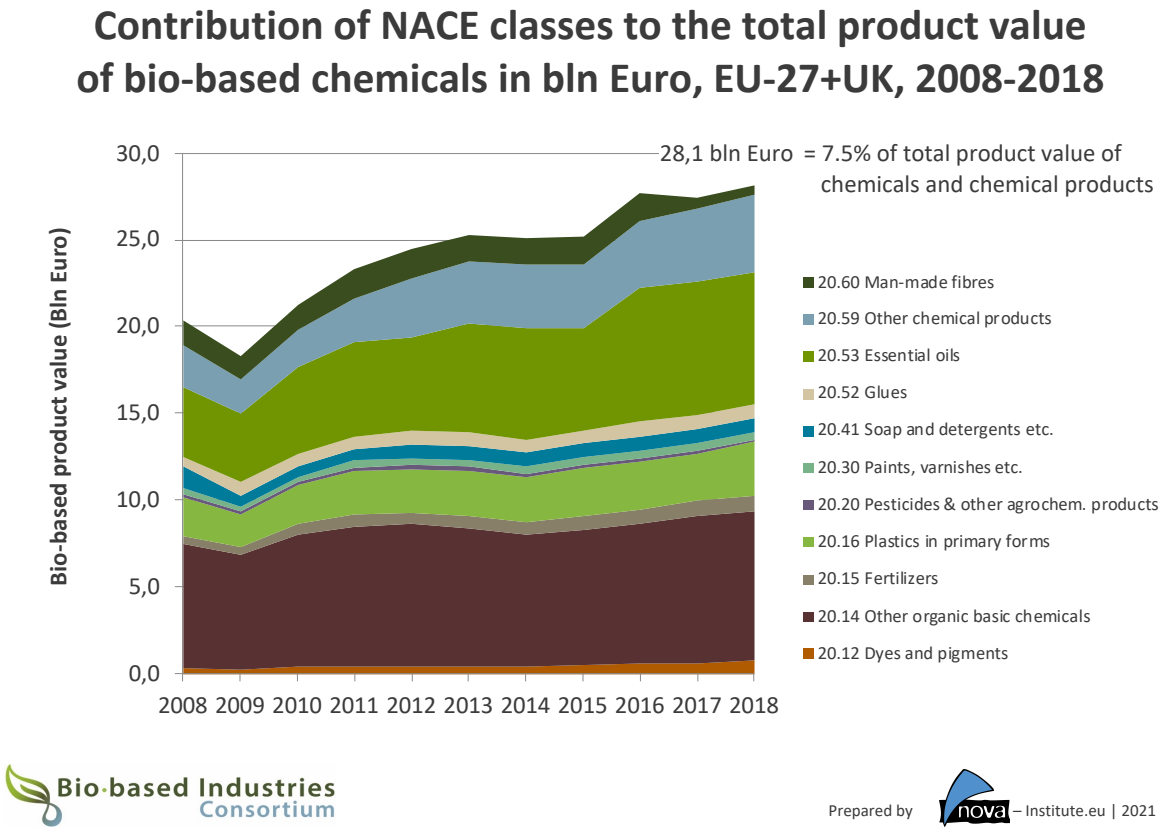

Figure 15 Contribution of NACE classes to the total product value of bio-based chemicals, EU-27 (+UK), 2008 - 2018

While Figure 15 indicates the bio-based production value contributed by each whole NACE class within division 20 to the overall bio-based production value in the chemical industry, a deeper look is necessary to understand which products make up the lion's share in this total value.

Therefore, Table 2 shows the 20 partly or fully bio-based chemical products with the highest bio-based production value in 2018. Some values have changed compared to last year's data.

It shows, for example, that odoriferous substances for food or drink industries (part of class 20.53, essential oils) alone contributed 4.24 billion Euro (15.1 % of the total value of 28.1 billion Euro) to the bio-based production value of division 20 in 2018 and remain the largest part of the bio-based C20 sector. In last year's paper reporting on the 2017 data, it was followed by odiferous substances for **non**-food and drink related purposes but this year switched its position with enzymes (part of class 20.14, other organic basic chemicals). Class 20.14 (other organic basic chemicals) is represented with the highest number (six) of different products out of the 20 high-value chemicals and generally increased its overall production volume visibly.

PRODCOM-code	Name	Bio-based production value (billion Euro)
20.53.10.75	Mixtures of odoriferous substances of a kind used in the food or drink industries	4.24
20.14.64.70	Enzymes; prepared enzymes (not elsewhere specified or included) (excluding rennet and concentrates)	2.22
20.53.10.79	Mixtures of odoriferous substances (excluding those of a kind used in the food or drink industries)	2.16
20.16.59.40	Cellulose and its chemical derivatives, n.e.c., in primary forms	1.19
20.16.59.60	Natural and modified natural polymers, in primary forms (including alginic acid, hardened proteins, chemical derivatives of natural rubber)	1.19
20.53.10.20	Essential oils	1.08
20.59.60.80	Gelatin and its derivatives (excluding casein glues, bone glues and isinglass)	0.97
20.14.32.80	Lauric acid and others; salts and esters	0.92
20.15.80.00	Animal or vegetable fertilisers	0.89
20.59.59.94	Other chemical products, n.e.c.	0.85
20.59.60.20	Caseinates and other casein derivatives (excluding casein glues)	0.61
20.12.22.50	Tanning extracts of vegetable origin; tannins and their salts, ethers, esters and other derivatives	0.60
20.14.35.73	Citric acid and its salts and esters	0.57
20.52.10.80	Prepared glues and other prepared adhesives, n.e.c.	0.55
20.14.31.95	Industrial monocarboxylic fatty acids distilled (excluding stearic, oleic tall oil)	0.53
20.14.22.65	Lauryl alcohol; cetyl alcohol; stearyl alcohol and other saturated monohydric alcohols (excluding methyl, propyl and isopropyl, n-butyl, other butanols, octyl)	0.53
20.59.20.00	Animal or vegetable fats and oils chemically modified	0.48
20.59.51.00	Peptones and their derivatives; other protein substances and their derivatives; hide powder including glutelins and prolamins, globulins, glycinin, keratins, nucleoproteids, protein isolates	0.46
20.30.11.70	Other paints, varnishes dispersed or dissolved in an aqueous medium	0.46
20.14.71.50	Rosin and resin acids; and derivatives; rosin spirit and oils; run gums	0.42

Table 2 The 20 partly or fully bio-based chemical products with the highest bio-based production value in the EU-27 (+UK), 2018

Finally, Figure 16 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 needs to make use of conversion factors for some product groups for which Eurostat does not report production in metric tonnes but in other units, i.e. for example pieces (e.g. of furniture, clothing etc.), square metres (e.g. textiles and fabrics) or cubic metres (e.g. forestry products). Conversion factors to metric tonnes are available from Eurostat, so that a reporting of all production in metric tonnes is possible.

In the case of chemicals, such a conversion is only necessary for a few groups of products such as industrial gases, which are reported in cubic metres. Figure 16 shows that class 20.14 (other organic chemicals) is also a major contributor in terms of production volume. As Table 3 shows, however, other products dominate in terms of bio-based production quantity. According to Table 3, animal and vegetable fertilisers alone contribute 7.5 million t (33.5 % of the total of 22.4 million t) to the bio-based production volume of division 20 in 2018.

However, the decline in production volume compared to the previous year is striking, especially for classes 20.14 (Other organic chemicals) and 20.15 (Fertilisers). This is mainly due to the product volume figures given by the Eurostat database for the respective largest bio-based production groups D-glucitol (sorbitol) (part of 20.14) and animal or vegetable fertilisers (part of 20.15). Comparing the production volume figures for these products from 2018 with last year's 2017 production volume figures, significant differences become apparent. For example, for D-glucitol (sorbitol), the reported product volume in 2017 has been 2.7 million tonnes, compared to 1.8 million tonnes in 2018. For animal or plant fertilisers, a production volume of 8.8 million tonnes has been reported in 2017. One year later, this figure dropped to 7.5 million tonnes (Table 3). These distinct differences in the production volumes reported by Eurostat for the two largest product groups of bio-based chemistry have likely led to the obvious changes in the overall estimate. However, if the production volume of these two products actually decreased as currently reported or if the data currently provided by Eurostat is not complete yet remains to be seen. It will be re-evaluated in next year's report when the 2018 data has likely seen changes and additions.

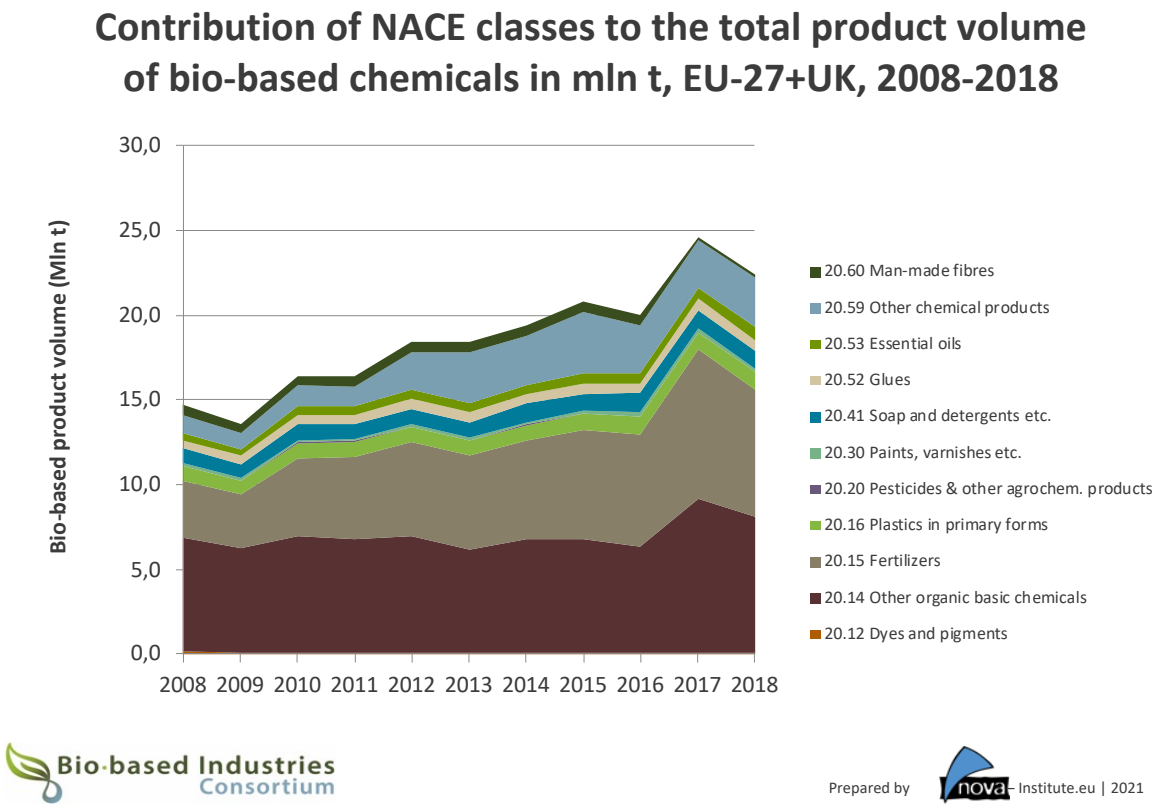

Figure 16 Contribution of NACE classes to the total product volume of bio-based chemicals, EU-27 (+UK), 2008–2018

PRODCOM-code	Name	Bio-based production volume (million tons)
20.15.80.00	Animal or vegetable fertilisers	7.50
20.14.23.33	D-glucitol (sorbitol)	1.80
20.59.59.94	Other chemical products, n.e.c.	1.25
20.59.20.00	Animal or vegetable fats and oils chemically modified	0.72
20.14.71.20	Activated natural mineral products; animal black	0.59
20.53.10.75	Mixtures of odoriferous substances of a kind used in the food or drink industries	0.56
20.41.10.00	Glycerol (glycerine), crude; glycerol waters and glycerol lyes	0.56
20.14.31.95	Industrial monocarboxylic fatty acids distilled (excluding stearic, oleic tall oil)	0.55
20.14.23.60	Glycerol (including synthetic; excluding crude, waters and lyes)	0.55
20.14.71.30	Tall oil; whether or not refined	0.48
20.14.34.73	Citric acid and its salts and esters	0.43
20.16.59.40	Cellulose and its chemical derivatives, n.e.c., in primary forms	0.42
20.52.10.80	Prepared glues and other prepared adhesives, n.e.c.	0.40
20.14.32.80	Lauric acid and others; salts and esters	0.40
20.14.22.65	Lauryl alcohol; cetyl alcohol; stearyl alcohol and other saturated monohydric alcohols (excluding methyl, propyl and isopropyl, n-butyl, other butanols, octyl)	0.38
20.14.71.50	Rosin and resin acids; and derivatives; rosin spirit and oils; run gums	0.37
20.14.64.70	Enzymes; prepared enzymes (not elsewhere specified or included) (excluding rennet and concentrates)	0.31
20.16.59.60	Natural and modified natural polymers, in primary forms (including alginic acid, hardened proteins, chemical derivatives of natural rubber)	0.30
20.14.31.20	Industrial stearic acid	0.26
20.14.31.97	Industrial monocarboxylic fatty acids (excluding stearic, oleic, tall oil, distilled)	0.25

Table 3 The 20 partly or fully bio-based chemical products with the highest bio-based production volume in the EU-27 (+UK), 2018

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6 ANNEX I

Calculation errors

During the data analysis of this year's report, a previous calculation error has been identified in the calculation of turnover and employment of NACE class 22 “plastics & plastic products”, which unfortunately has been carried over throughout the versions of the report. Table 4 & Table 5 below show the old and incorrect versus the new corrected values. It can be seen that the turnover and employment are smaller than previously assumed.

Turnover in plastics & plastic products (NACE Class 22) (in billion Euro)	Incorrect value	Corrected value
2008	~~14.02~~	8.60
2009	~~13.45~~	8.43
2010	~~15.55~~	9.65
2011	~~18.88~~	11.66
2012	~~18.28~~	11.33
2013	~~17.85~~	11.13
2014	~~17.44~~	10.81
2015	~~17.42~~	10.63
2016	~~17.61~~	10.72
2017	~~19.12~~	11.08
2018		11.73

Table 4 Corrected turnover values for plastics & plastic product

Employment in plastics & plastic products (NACE Class 22) (in million)	Incorrect value	Corrected value
2008	~~0.088~~	0.054
2009	~~0.080~~	0.050
2010	~~0.084~~	0.052
2011	~~0.105~~	0.065
2012	~~0.102~~	0.063
2013	~~0.100~~	0.062
2014	~~0.095~~	0.059
2015	~~0.095~~	0.058
2016	~~0.096~~	0.058
2017	~~0.105~~	0.061
2018		0.049

Table 5 Corrected turnover values for plastics & plastic products

Furthermore, due to a calculation error, the turnover for biofuels for 2017 from last year's report has to be adjusted. Instead of the previously calculated 22.0 billion Euro, this amounts to 18.2 billion Euro after the correction.

It should be noted that all graphs have now been updated based on these corrections. However, this may affect the comparability of the graphs with those from last year's reports.

Data gaps

In addition, it should be noted that at the time of writing this year's report, employment figures from the SBS database for several chemical sub-classes in 2018 (manufacture of industrial gases (20.11), fertilisers (20.15), paints (20.30), explosives (20.51), glues (20.52), essential oils (20.53) and other chemical products (20.59)) have been declared confidential for the EU-27 & UK, in contrast to previous years, and are therefore currently not available. This is why, they have not been included in the calculations for 2018. This may lead to invalid statements in this year's report. However, it is expected that these data gaps can be filled in subsequent reports and thus, if possible and necessary, statements on the chemical class can be subsequently supplemented and corrected.