# European Bioeconomy in Figures 2008–2019

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# 1 Executive summary

Even though there have been significant changes in this year's assessment, the bio-based industries continue their ascent and mark a total contribution of over 814 billion EUR. This constitutes an increase of 34 billion EUR (+4 %) compared to 2018 despite removing the UK from the scope. Considering their development from 2008, which is the earliest data taken into account in this series of reports by nova-Institute, until today the bio-based industries have increased their contribution by over 36 %. The initial 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 48 billion EUR (excluding UK) which depicts a decrease from last year's 54 billion EUR (including UK). The respective bio-based share has also been adjusted resulting in a higher share compared to the 13.4 % in 2018 at around 13.8 % for 2019.

The analysis of the 2019 Eurostat data shows that the turnover of the entire bioeconomy[1] including food and beverages and the primary sectors of agriculture and forestry, amounts to just over 2.4 trillion EUR in the EU-27. Even though the new numbers do not consider the UK anymore the turnover remained stable which results in 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 17.6 million people in 2019, 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 (50 %) but a comparative low turnover (17 %). While the employment in the primary biomass production sees a continued and steady decline the processing and value-adding bio-based industries see an increase in employment.

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-adding sectors. In comparison, Western and Northern European countries generate much higher turnover relative to employment, indicating a larger share of refining and value-adding industries. The countries with the highest turnover-to-employment ratios are Finland, Belgium and Sweden. Even though the UK is generally a Northern European country with typically more value-adding bio-based industries the bio-based share of the chemical sector did not see a decrease following the UK's removal from the scope. This hints towards a chemical sector in the UK that does not reach a bio-based share higher than the European mean.

Besides the bio-based share for production value in the chemical sector and for the first time ever, this year's report also includes the chemical sector's bio-based share for production volume. According to our analysis, the bio-based share of the production

[1] *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.*

volume of the organic part of the chemical sector amounts to 9 % in 2019, increasing from 6.8 % in 2008. These numbers show, that the often communicated 10 % share of organic carbon in the chemical sector is a reasonable estimation. Also, the bio-based carbon share in the chemical sector is higher than usually reported by the petrochemical industry.
The new production volume share aims to give insights into how much bio-based volume is being produced in the chemical sector. It adds perspective to the information on bio-based turnover generated in the chemical sector, which is expressed by the well-established production value share. The differences in the volume and value shares are to a large degree caused by higher bio-based shares in the fine chemical sector, which consists of higher value-adding products and respectively lower volumes.

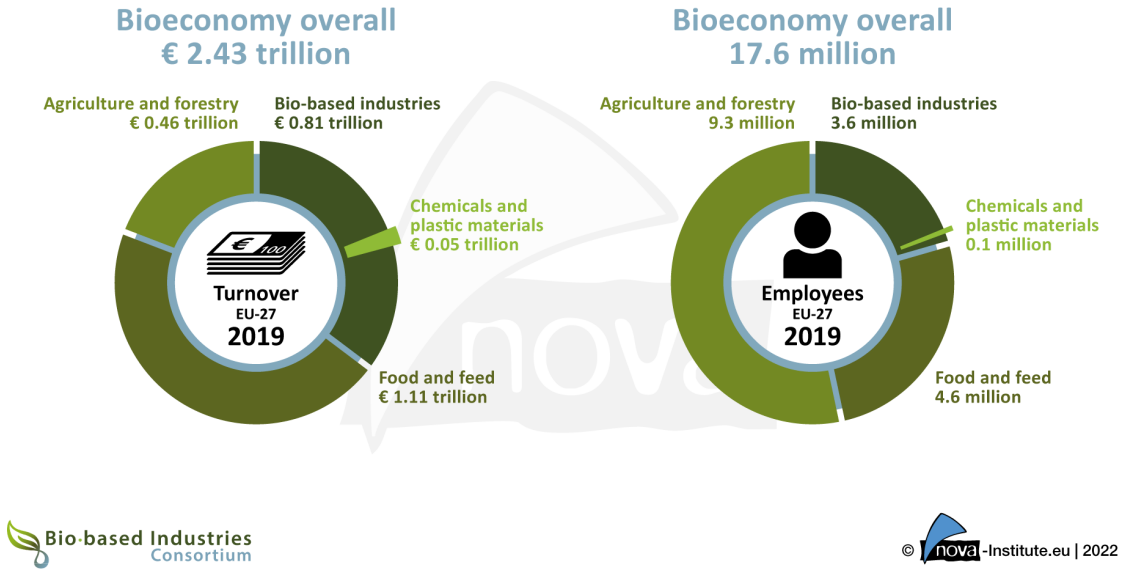


*Figure 1 Overall turnover and employment of the bioeconomy and its bio-based industries in the EU-27 in 2019*

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 clocked in at 13.8 % in 2019, based on the production value, a steady increase compared to the previous bio-based share of 10.6 % 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. Legislation pieces such as the Sustainable Carbon Cycles Communication, the EU Taxonomy and the Policy Framework for bio-based, bio-degradable and compostable plastics are being developed and introduced right now. 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 2019.

**Disclaimer:**

Due to increasing occurrences of 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. The overall quality of data used in our report and provided by Eurostat has been declining over the years and several measures in our assessment had to be taken to produce reasonable and scientifically sound results. Also, the methodologies applied to the data have seen improvements over time resulting in differences compared to the previous reports.

# 2 Introduction

This year's report consists of an assessment of turnover and employment data of the European bioeconomy for the timespan from 2008 to 2019. The assessment is based on publicly available Eurostat databases as the primary data sources.

This updated version of the previous editions of this study, including figures for 2019, 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 by double checking the data of the previous year in every annual update. Due to this fact, small differences with the previous studies are unavoidable. Also, for various products, 2018 and 2019 data are not completely available yet in the Eurostat database and some data has been marked confidential. 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.

**Disclaimer:**

> For the first time the annual numbers have not been continuously updated for the EU 28 and its member states. Following the United Kingdom's exit of the European Union (Brexit) and the three-year delay of the reporting of the data in PRODCOM, the UK has not reported any data on manufacturing and other socio-economic indicators for the year 2019. This is most likely going to continue from now on with at most very scattered and incompletely reported data sets for some sectors.
> In order to prevent bias in our figures we have decided to stop accounting for the UK in our analysis from this year's edition and onwards. All figures in this report either only account for the EU-27 or only include the UK until 2018 with continued time series excluding the UK from 2019 on.

# 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 2022) and the Structural Business Statistics (SBS, Eurostat 2022a). PRODCOM contains data for all Member States on 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 2019 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.

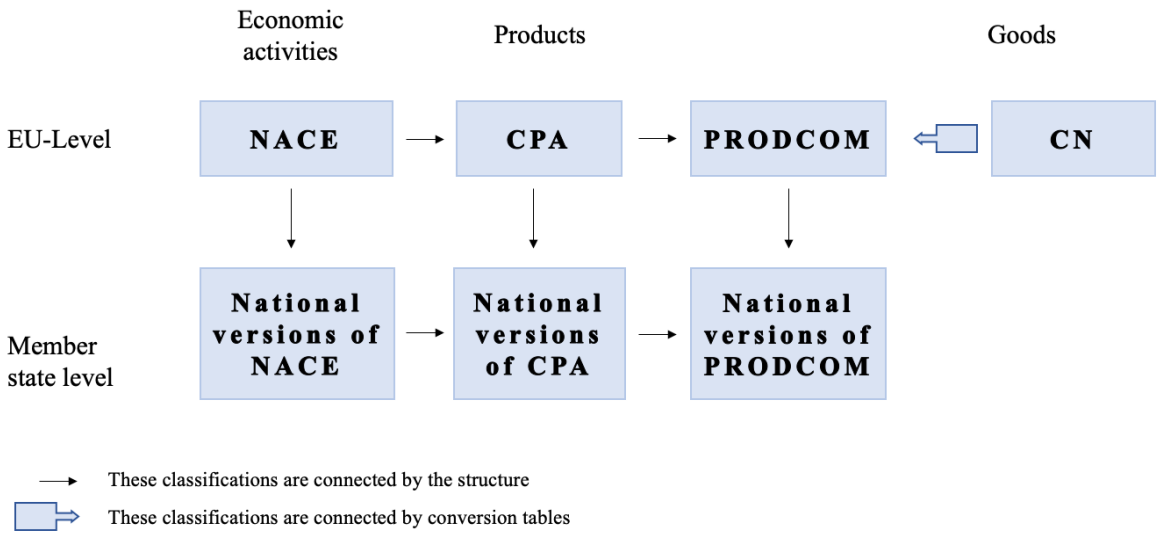


*Figure 2 Relation of NACE and CPA classification*

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 (2019, 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), 2008–2019)*

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 2008–2019. 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 2019, with the food sector being the largest contributor. The removal of UK data for 2019 shows no significant negative impact on turnover over time. However, it may have prevented a further increase in turnover for 2019.

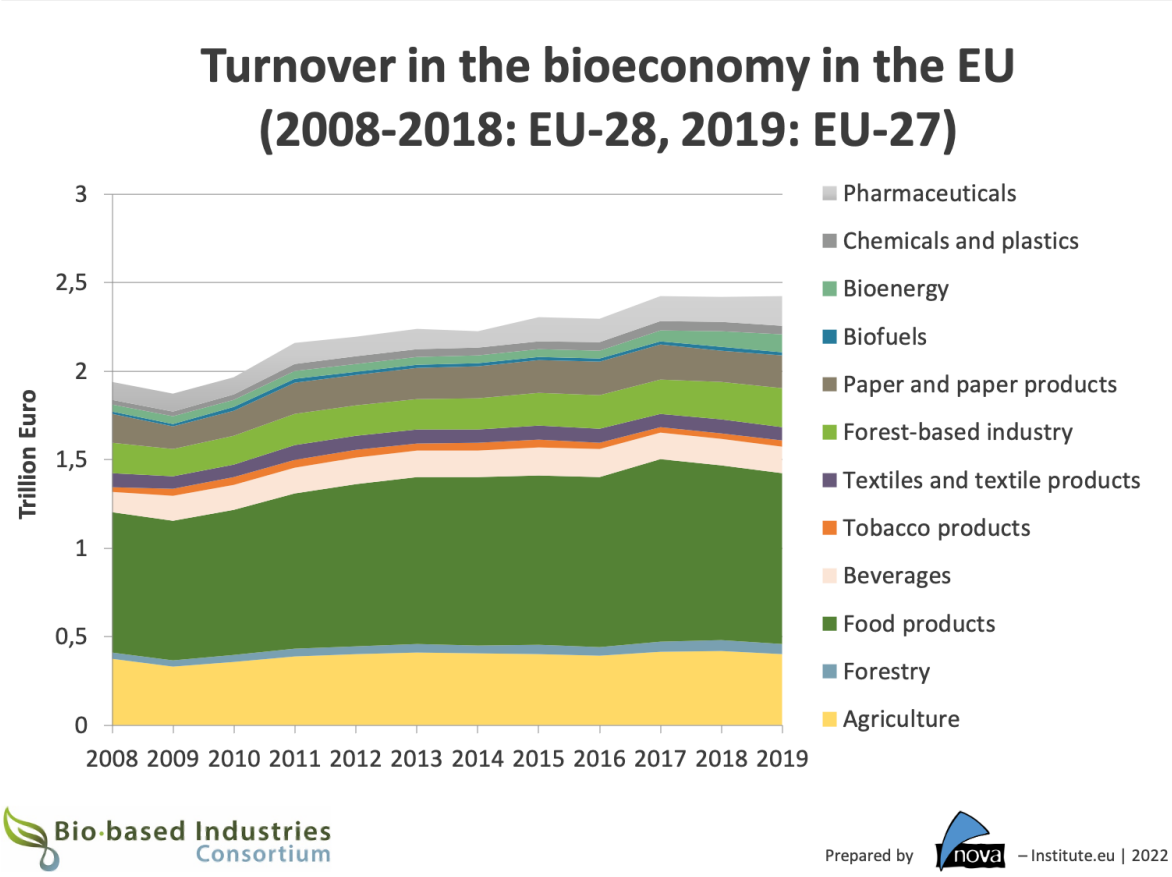


*Figure 3 Turnover in the bioeconomy (2008-2018: EU-28, 2019: EU-27)*

About half of the 2.4 trillion Euro in 2019 (see Figure 4) comes from the food and beverage sector (46 %), 1% from tobacco products and 19 % 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).

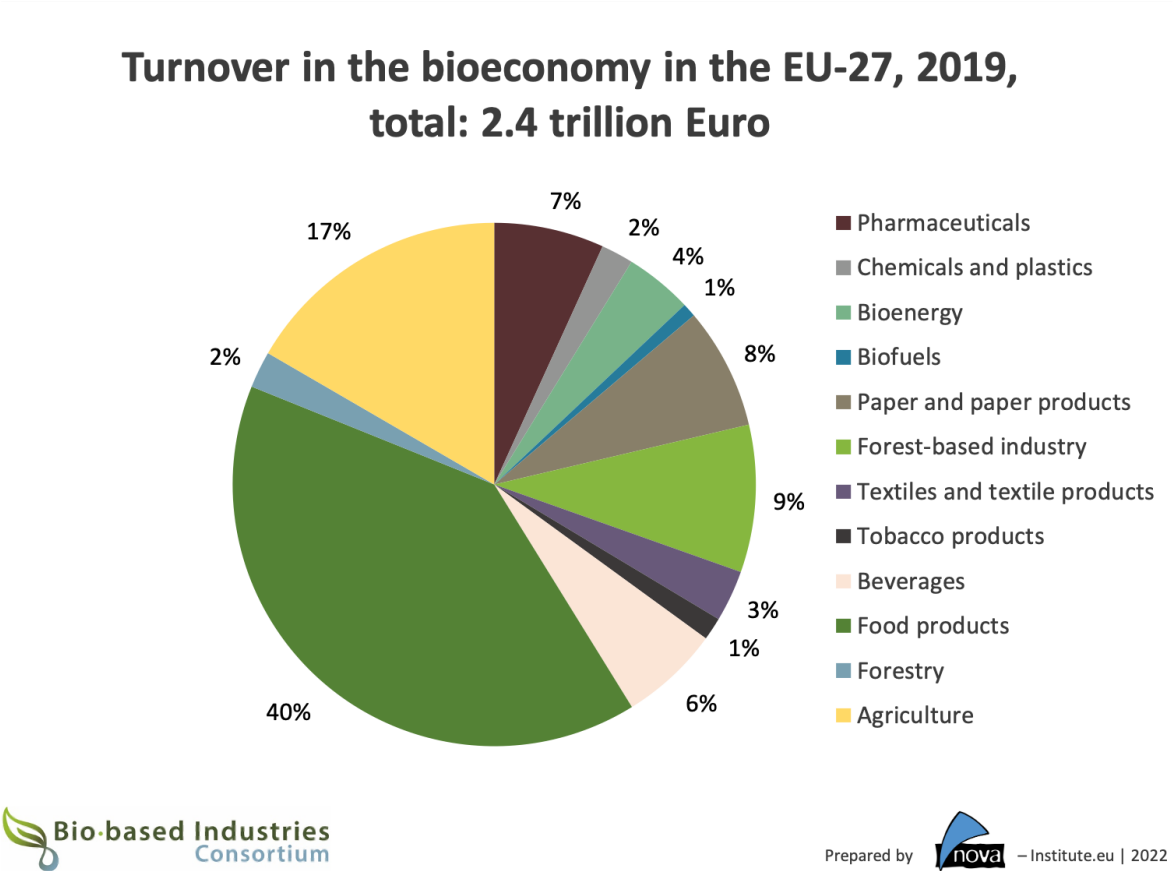


*Figure 4 Turnover in the bioeconomy in the EU-27, 2019*

*Turnover in the EU bio-based sector (EU-27), 2008–2019)*

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 122 billion Euro.

The paper and paper products sector (22 %) and the forest-based industry (wood products and furniture) (27 %) account for the largest shares of turnover. Together they amount to about 402 billion Euro. Bio-based chemicals and plastics account for 51 billion Euro (6 %). The total turnover of the bio-based industries reached around 814 billion Euro in 2019, up from around 600 billion in 2008 (Figure 6).

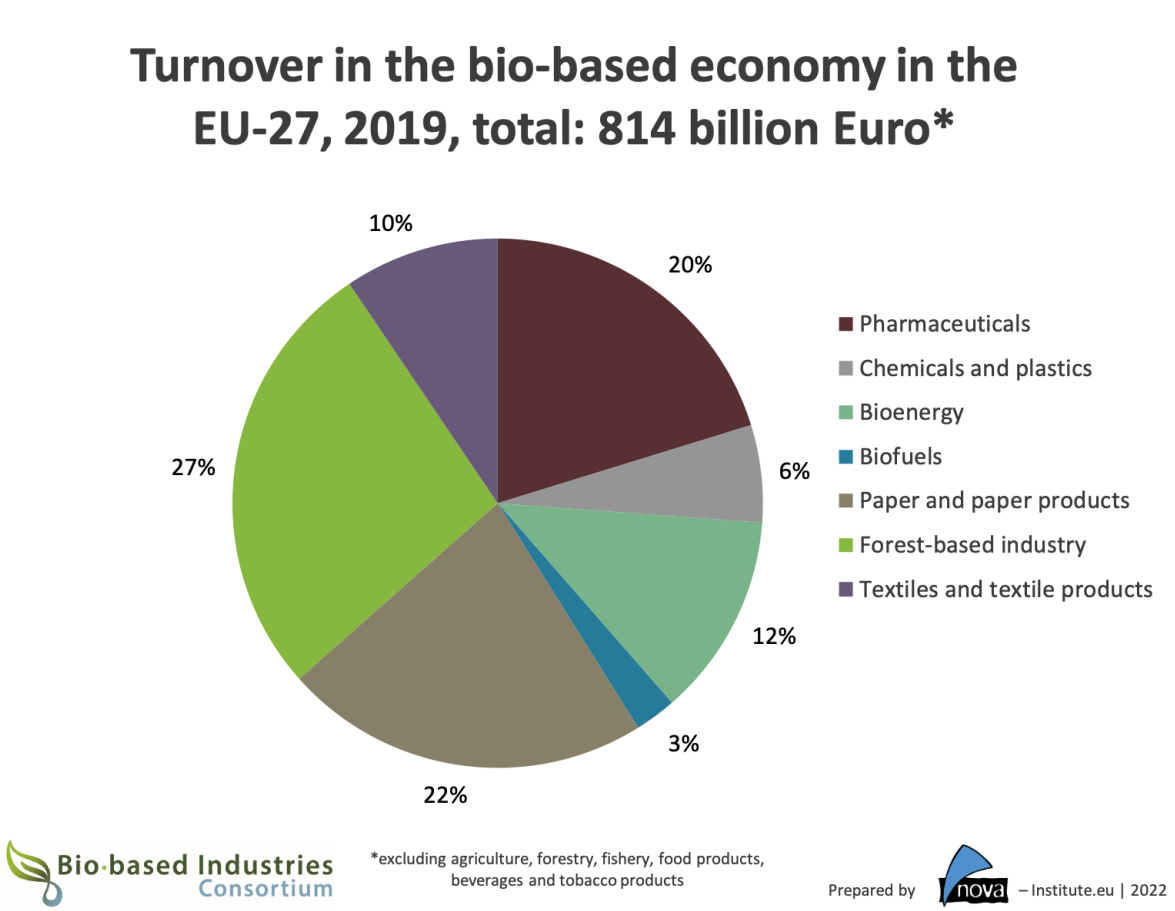


*Figure 5 Turnover in the bio-based economy in the EU-27, 2019*

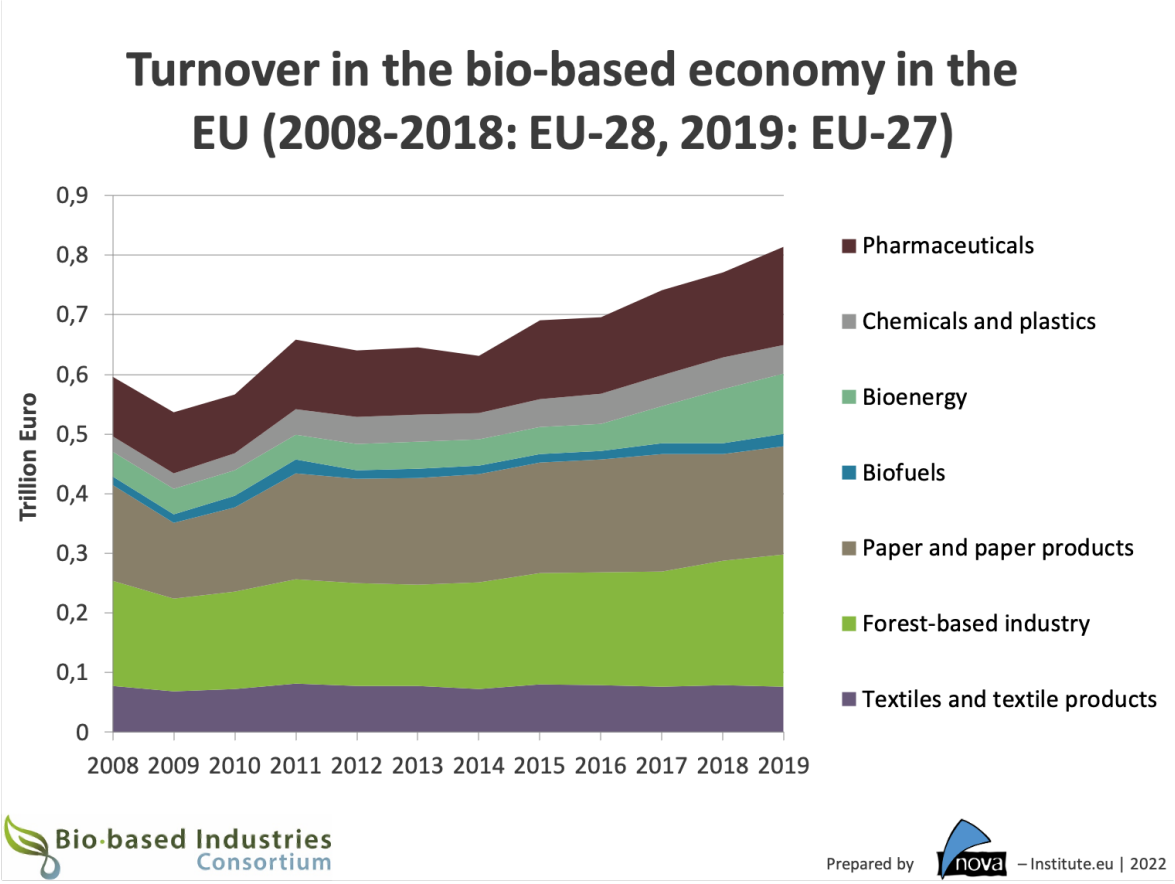


*Figure 6 Turnover in the bio-based economy (2008-2018: EU-28, 2019: EU-27)*

Figure 6 shows the development of the turnover in the bio-based industries from 2008 to 2019. During this period, the chemicals and plastics sector in the EU-28 has increased its turnover by 68 % from 32 billion Euro to around 54 billion Euro between 2008 and 2018. Excluding the UK data, turnover has declined slightly to 48 billion Euro in 2019. Unaffected by the UK's exit is the bio-based pharmaceuticals industry. While turnover has already increased by 42% between 2008 and 2018, from 100 billion Euro to 142 billion Euro, last year even saw a growth of more than 20 billion Euro to 165 billion Euro turnover overall. This translates into a growth of 65 % in the timespan of 2008 – 2019. Other sectors, such as the bioenergy industry in particular, are also seeing a similar rise in turnover from 41 billion Euro in 2008 to over 100 billion Euro in 2019 (143% increase). More stable developments can be observed for industries such as the textiles sector, which recorded a turnover of 78 billion Euro in 2008, 79 billion Euro in 2018 and in turn a slight decline to 77 billion Euro in 2019, which can be explained by the exclusion of the UK from the analysis.

## 4.2 Employment

*Employment in the EU bioeconomy (EU-27 (+UK), 2008-2019)*

Similar to the presentation of the turnover, Figure 7 first shows the development of employment for the entire bioeconomy in the period 2008–2019, measured in terms of the total number of employees. The comparison of 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. In the EU-27, the agricultural sector recorded a decrease of around 280,000 employees in 2019. In addition to these factors, the exclusion of the United Kingdom also affects the assessment. Thus, the employment in the EU agriculture decreased by around 300,000 employees in 2019. This circumstance also affects the food sector in a similar manner. In 2018, around 4.5 million people were employed in this sector in the EU-28, of which just over 390,000 were from the UK. In 2019 and looking at the EU-27, there are about 4.2 million people employed. This decline can be explained by the exclusion of UK numbers. In total, the number of employed persons in the EU bioeconomy amounted to 17.6 million in 2019 (Figure 7 & Figure 8).

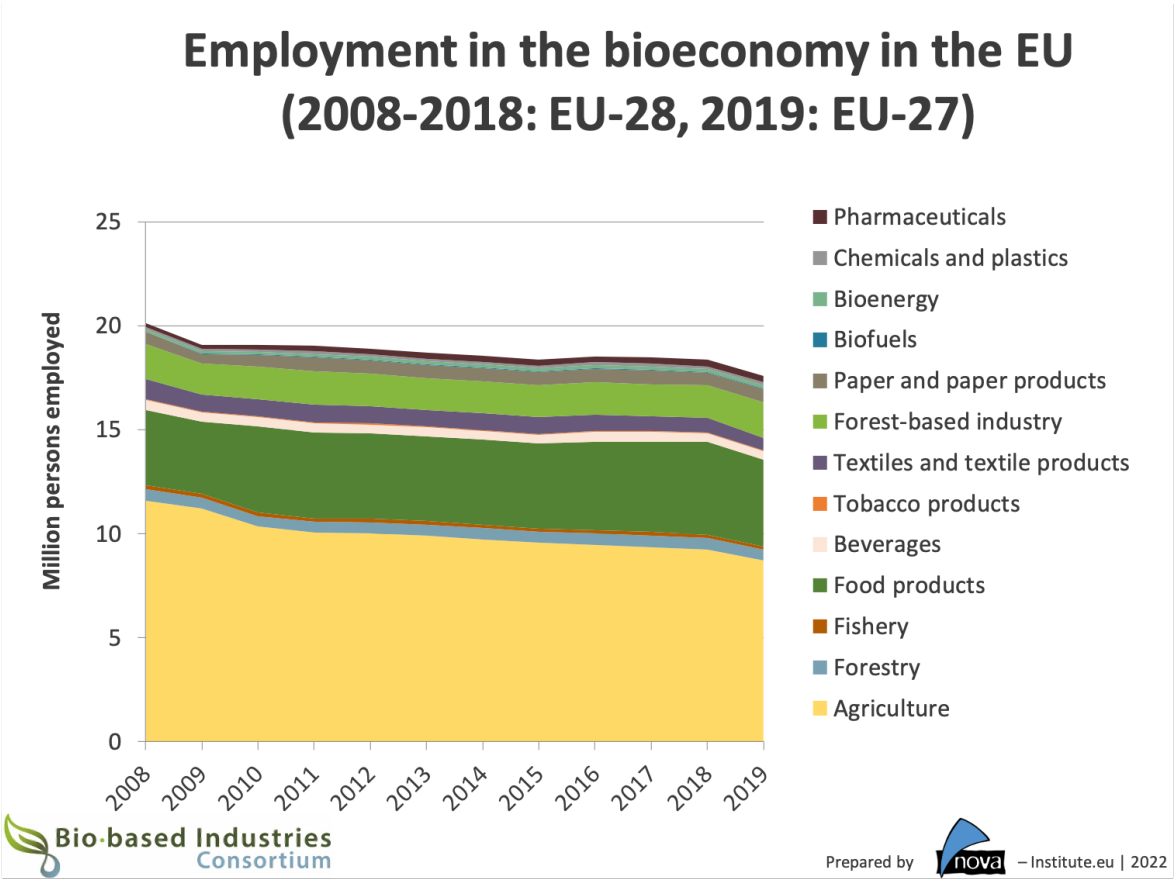


*Figure 7 Employment in the bioeconomy (2008-2018: EU-28, 2019: EU-27)*

Looking at the employment figures for the bioeconomy in 2019 (Figure 8), it becomes obvious that the so-called primary sectors (agriculture, forestry and fishing) generate the most jobs in the bioeconomy with a share of over 50 % (about 9.5 million employees). They are followed by the food and beverage industry with 4.6 million employees (26 %). The tobacco industry, on the other hand, accounts for much less employment and only employs about 370,000 people. The rest of the employment is attributed to the bio-based sectors with over 20 % (3.6 million employees). A more detailed breakdown of the distribution can be found in Figure 9.

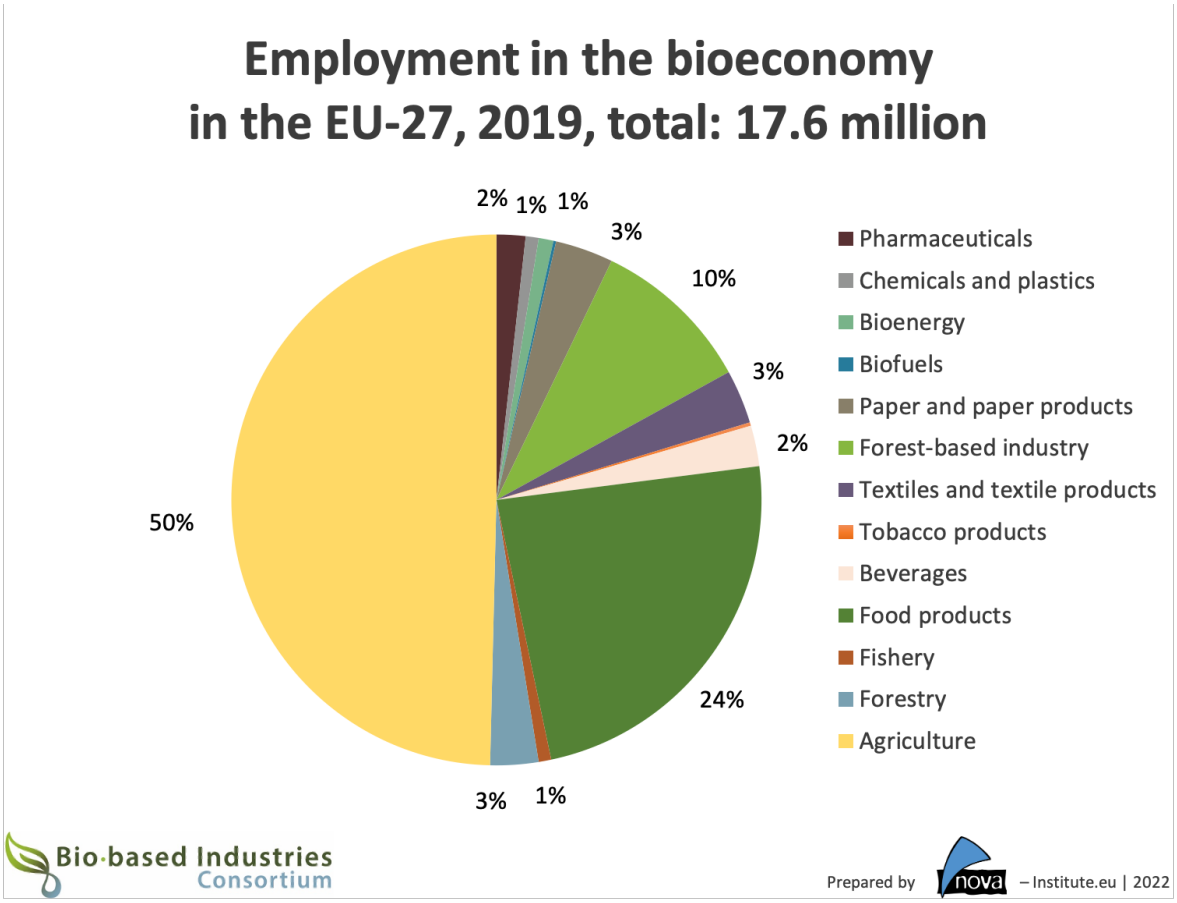


*Figure 8 Employment in the bioeconomy in the EU-27, 2019*

*Employment in the EU bio-based sector (EU-27, 2008–2019)*

Looking only at employment in bio-based industries, total employment amounts to 3.6 million jobs in 2019. The most significant sectors are forest-based industries accounting for 49 % of the jobs, the paper and paper products sector with 17 % and the textiles sector with 16 % of the jobs (Figure 9 and Figure 10).

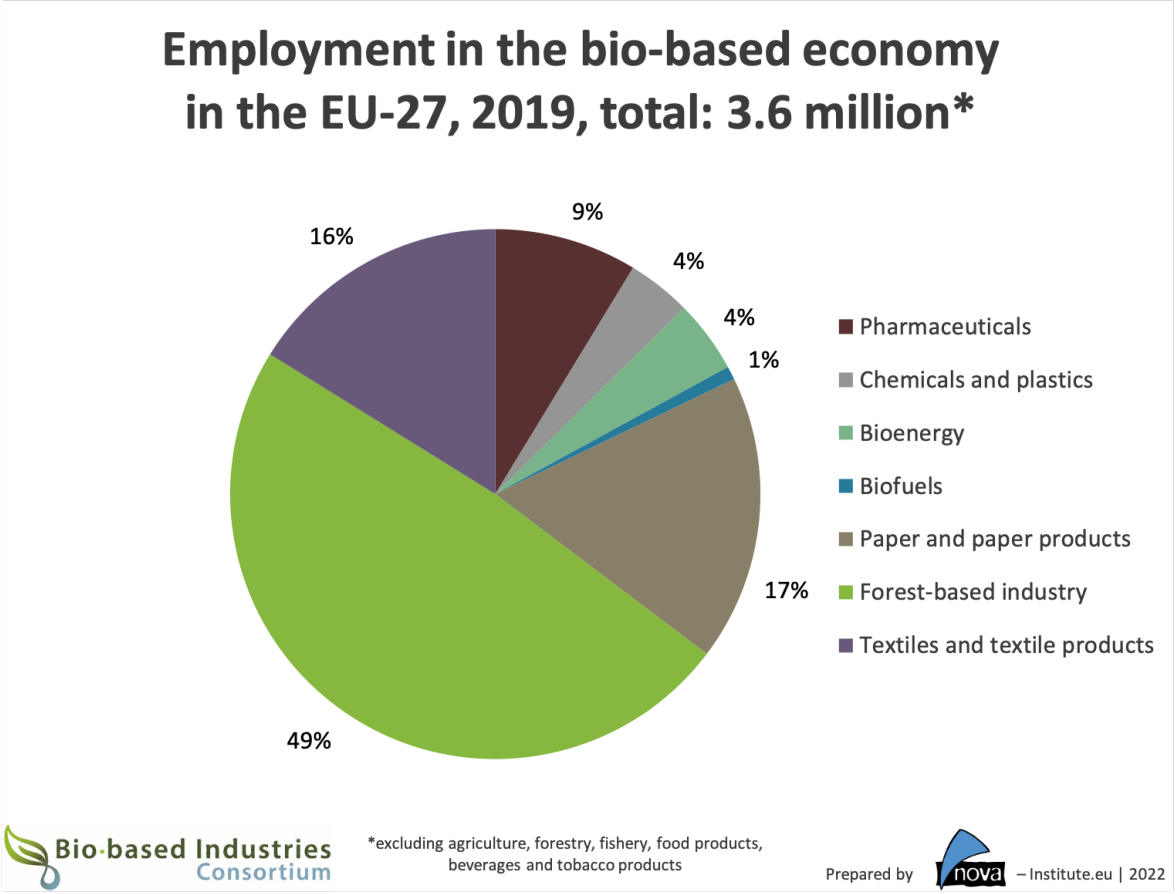


*Figure 9 Employment in the bio-based economy in the EU-27, 2019*

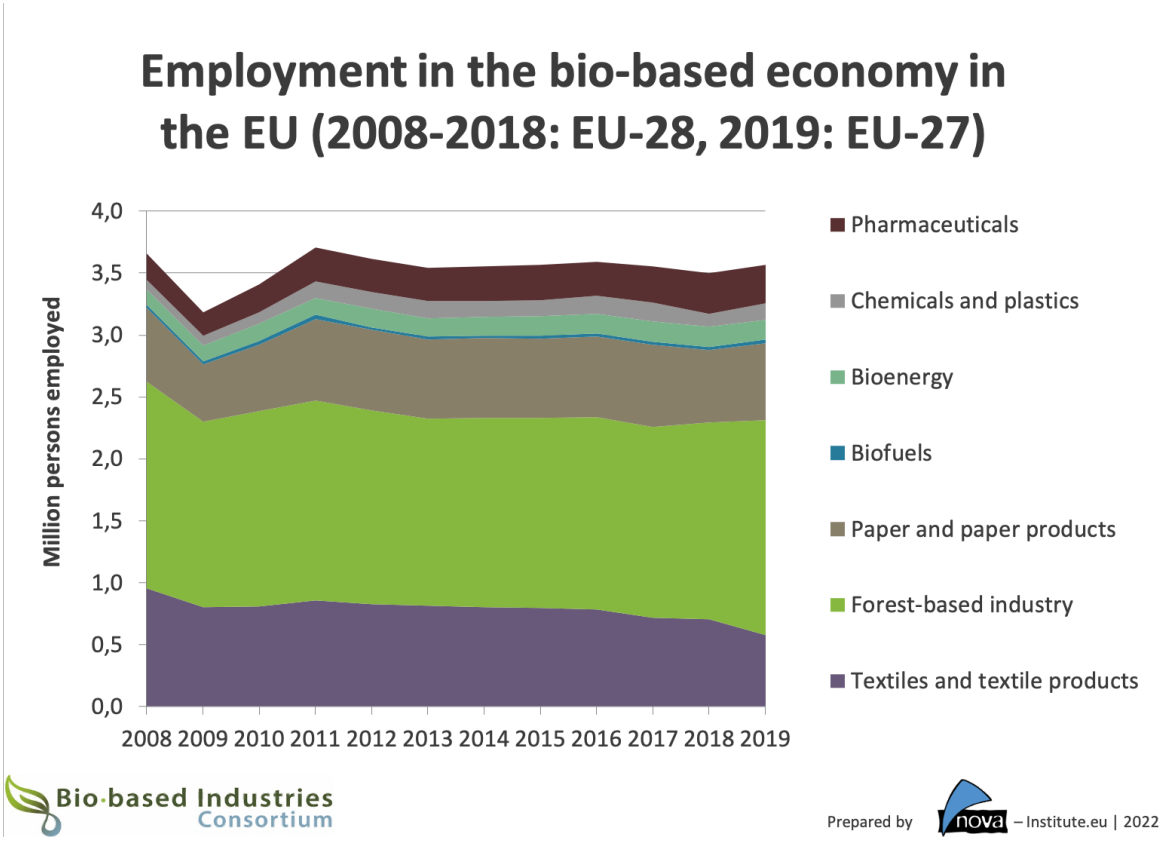


*Figure 10 Employment in the bio-based economy (2008-2018: EU-28, 2019: EU-27)*

The development of employment in the bio-based industries during the period from 2008 to 2019 shows a minimal downward trend (Figure 10). Employment fell from 3.7 million in 2008 to approximately 3.6 million in 2019, with the textile industry in particular losing approximately 380,000 jobs during this period (2008: 956,000 employees; 2019: 577,000 employees). This may be linked to the industry's shift of textile production from Europe to Asia and has, among other factors, already prompted the European Commission to address the EU textile sector in policy with the EU strategy for sustainable textiles. 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 over 310,000. The same is true for the bio-based chemicals and plastics sector, in which employment grew from 106,000 persons in 2008 to about 144,000 in 2019.

### *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 in 2019. 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 2019. Countries such as Finland, Belgium, Sweden, 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. This is an observation, that holds true for 2019 as well.

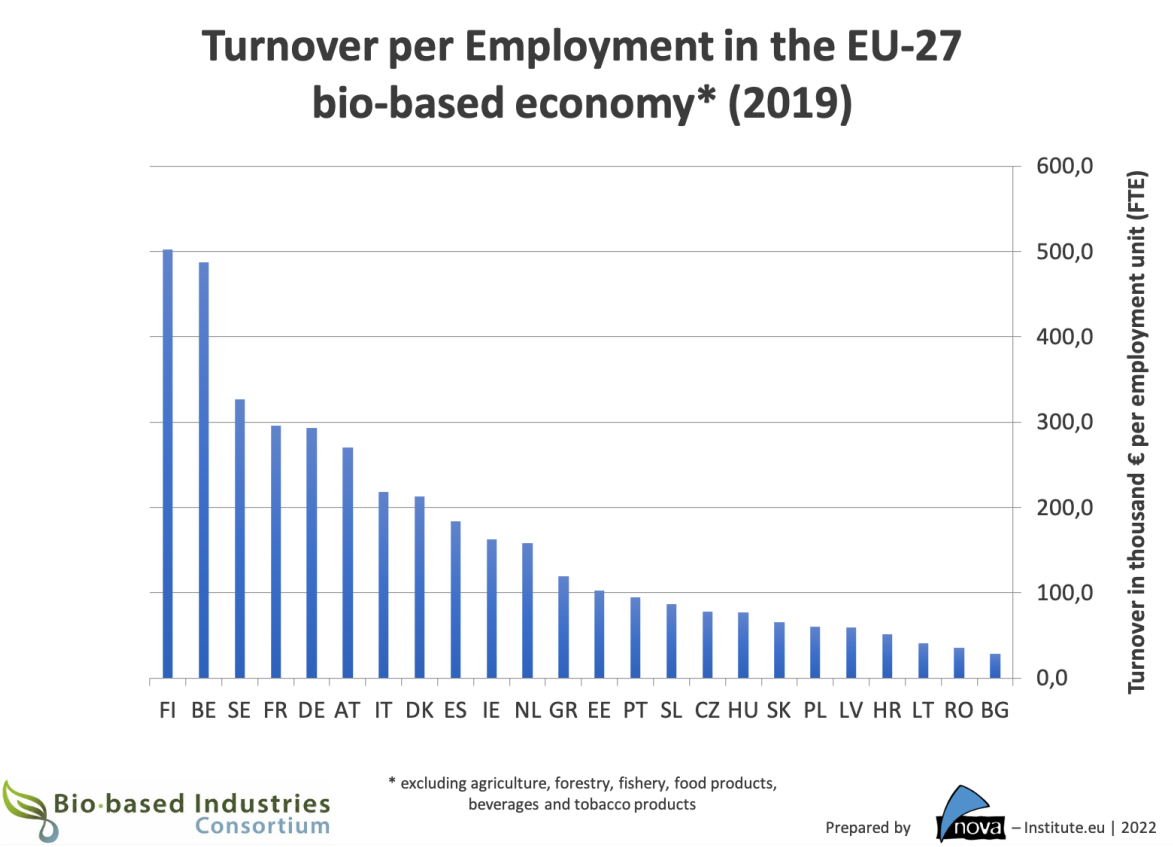


*Figure 11 Turnover in thousand € per employment unit (FTE) in the EU-27 bio-based economy per Member State, 2019*

### *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 2008–2019.

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 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 sector shows a fairly stable development in this area, despite the dip in 2018, which could be due to data gaps in the SBS database on employment figures, as already described in last year's report. A somewhat similar situation applies to the bioenergy sector, which shows a clear downward trend from 2016. However, in 2019 we observe a steep increase to former levels, which underlines the assumption of data gaps as the contributing factor in 2018. 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". Only since 2018, all these turnover values for the EU-27 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.

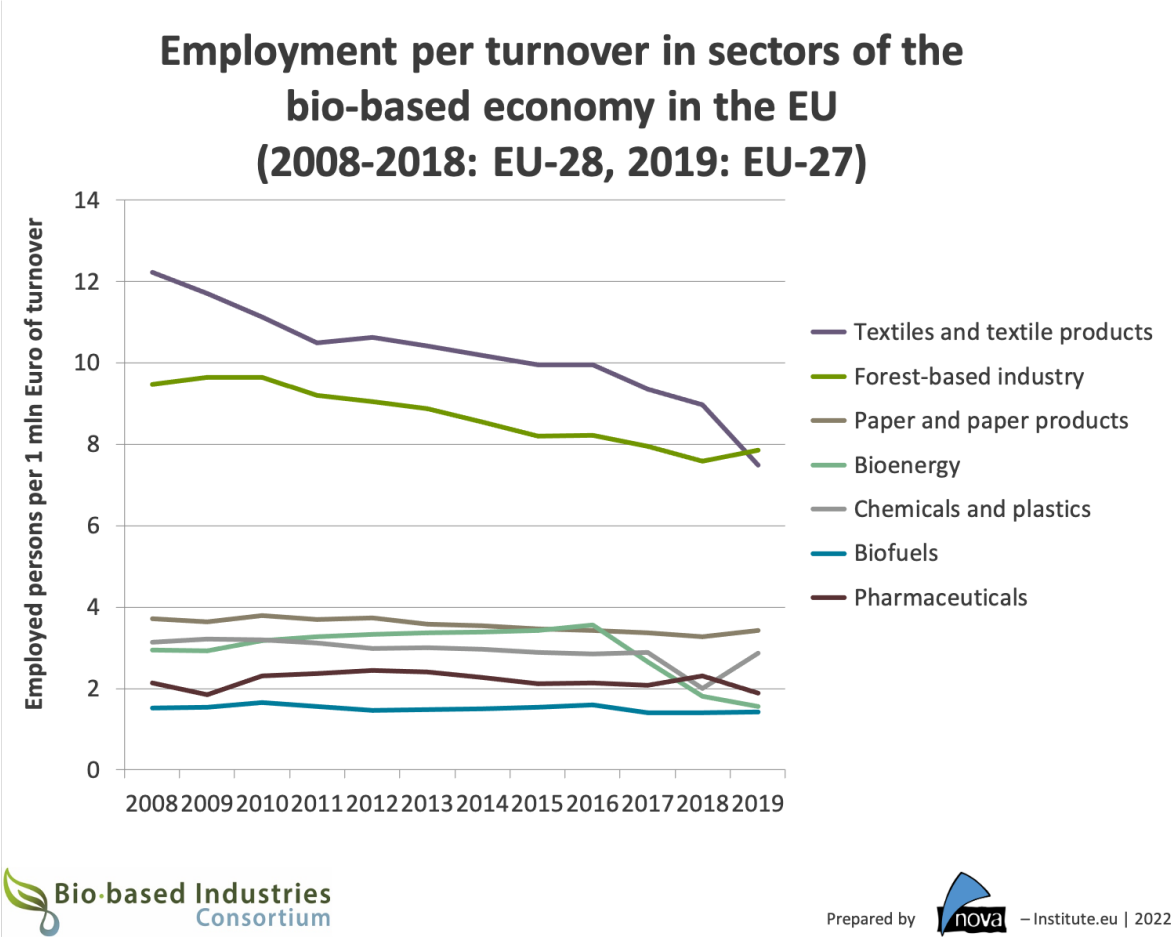


*Figure 12 Employment per turnover in sectors of the bio-based economy (2008-2018: EU-28, 2019: EU-27)*

## 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 2019 for the EU-27 as well as for each single member state. The data show an overall increase in the bio-based share in the EU-27 from about 5 % in 2008 to 6.9 % in 2019. 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 2010-2019 period. This figure has risen from 33.6 % in 2010 to 41.6 % in 2019. This is mainly due to the fairly large and 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 14.0 % in 2019. 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 2019 Latvia reported more products to Eurostat again, which results in its bio-based share decreasing due to higher reported numbers for high-volume low-bio-based products affecting the assessment.

Finland remains relatively stable in its bio-based production with a share of 11.7 % in 2019 compared to the share of 11.6 % in 2008. The bio-based industry in Finland is clearly defined by enzyme production and also tall oil.

Also of particular note is the steady increase in Bulgaria's bio-based share, which reached the fourth highest share in the EU-27 in 2019. This is particularly due to high production volumes of essential oils.

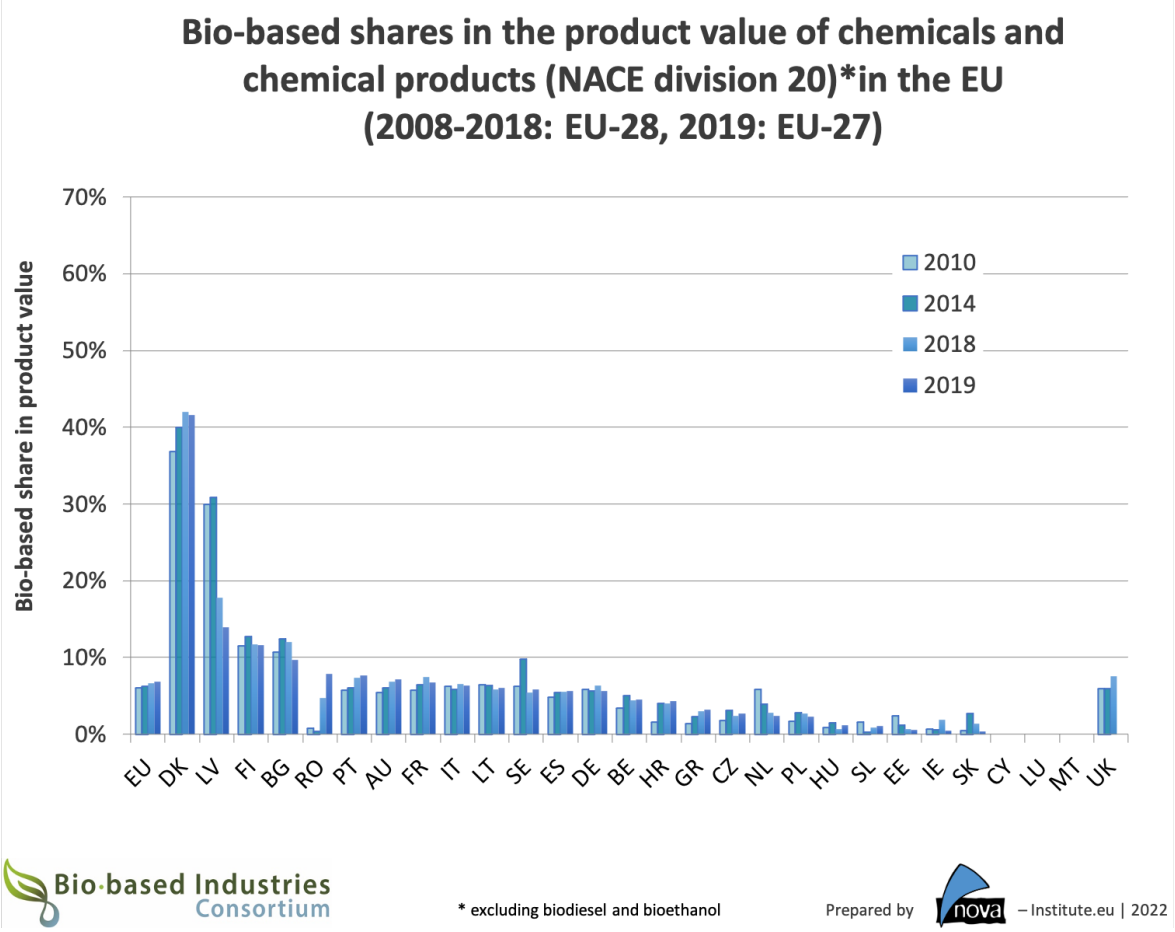


*Figure 13 Bio-based shares in the product value of chemicals and chemical products, 2008 - 2019*

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 in production value rose from 11 % in 2008 to almost 14 % in 2019 (Table 1) with a notable peak in 2016. This peak is based on a gap in Eurostat data, which sees discontinued reporting for high value bio-based products in the man-made fibre category starting in 2017.

The bio-based shares in production volume developed from 6.7 % in 2008 to 9 % in 2019 (Table 2) with a significant peak in 2017 at a little over 10 %. This peak in 2017 originates from an anomaly in Eurostat data concerning other organic basic chemicals, more specifically the product group “D-glucitol (sorbitol)”, whose reporting has been very inconsistent over the years. Additionally, Figure 14 & Figure 15 show 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% | 10.6% |
| **2009** | 5.9% | 11.8% |
| **2010** | 6.0% | 12.0% |
| **2011** | 6.0% | 12.0% |
| **2012** | 6.0% | 12.0% |
| **2013** | 6.3% | 12.6% |
| **2014** | 6.3% | 12.6% |
| **2015** | 6.4% | 12.8% |
| **2016** | 7.3% | 14.6% |
| **2017** | 6.7% | 13.4% |
| **2018** | 6.7% | 13.4% |
| **2019** | 6.9% | 13.8% |

*Table 1 Bio-based shares in the product value of chemicals and chemical products (EU-28: 2008 – 2018; EU-27: 2019)*

| Year | Overall bio-based share in the product volume of chemical products | Bio-based share in the organic part of chemical products (approx.) |
|---|---|---|
| **2008** | 3.4% | 6.8% |
| **2009** | 3.6% | 7.2% |
| **2010** | 3.9% | 7.8% |
| **2011** | 4.0% | 8.0% |
| **2012** | 4.3% | 8.6% |
| **2013** | 4.1% | 8.2% |
| **2014** | 4.4% | 8.8% |
| **2015** | 4.6% | 9.2% |
| **2016** | 4.5% | 9.0% |
| **2017** | 5.1% | 10.2% |
| **2018** | 4.9% | 9.8% |
| **2019** | 4.5% | 9.0% |

*Table 2 Bio-based shares in the product value of chemicals and chemical products (EU-28: 2008 – 2018; EU-27: 2019)*

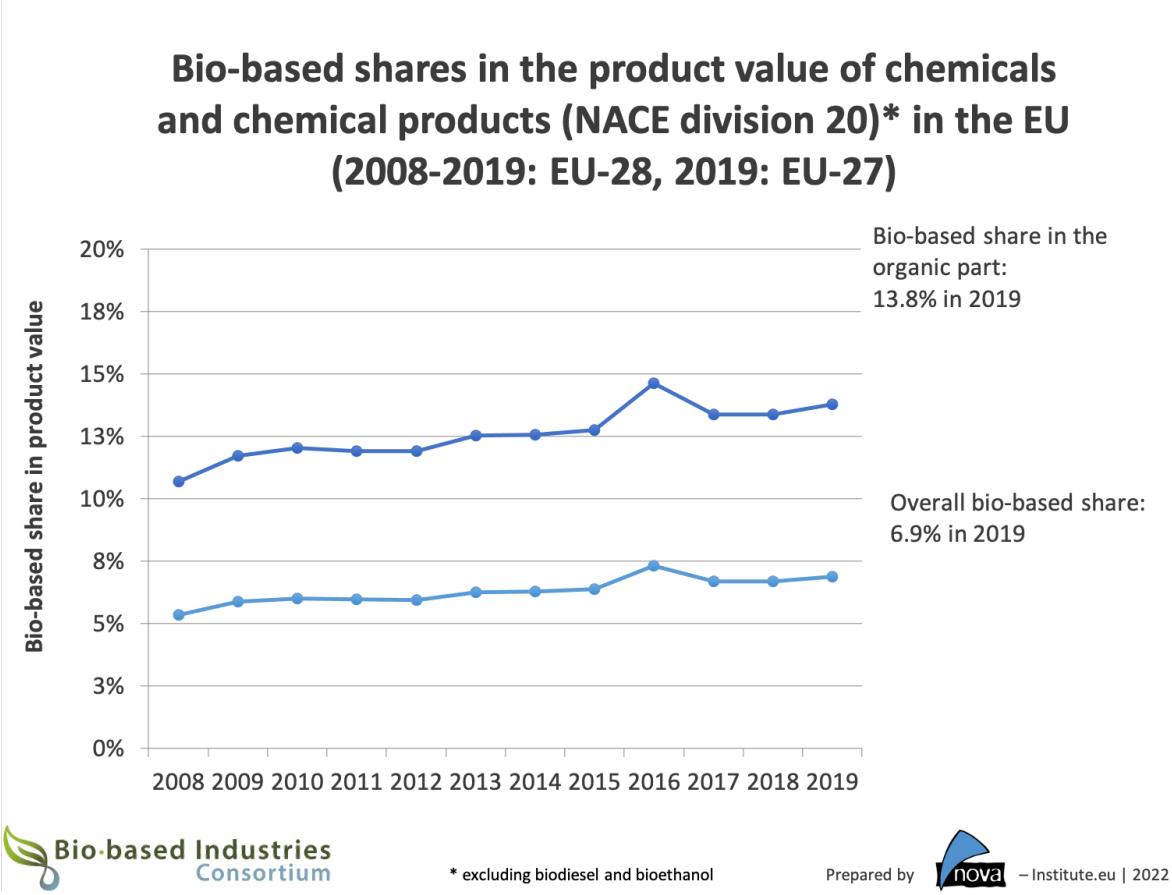


*Figure 14 Bio-based shares in the product value of chemicals and chemical products (EU-28: 2008 – 2018; EU-27: 2019)*

Figure 14 and 15 show the developments of the respective bio-based share of chemicals and chemical products for:

Figure 14: Product **value** based on production value data taken from Prodcom
Figure 15: Product **volume** based on production volume data taken from Prodcom

For the first time ever, this report includes separate assessments of the bio-based shares for value and volume data to point out the significant differences in their interpretation. These differences of the two bio-based shares are in the details. When assessing the product value, the respective bio-based share factors in the generated monetary value of the product in which bio-based feedstocks are being used. This analysis can hint towards applications, that are able to use bio-based feedstocks in their value chain while creating more added value from these feedstocks than other applications.
On the other hand, the bio-based shares of the production volume hint at the actual bio-based feedstock used in the sector and the amount of biogenic carbon bound in the actual products.

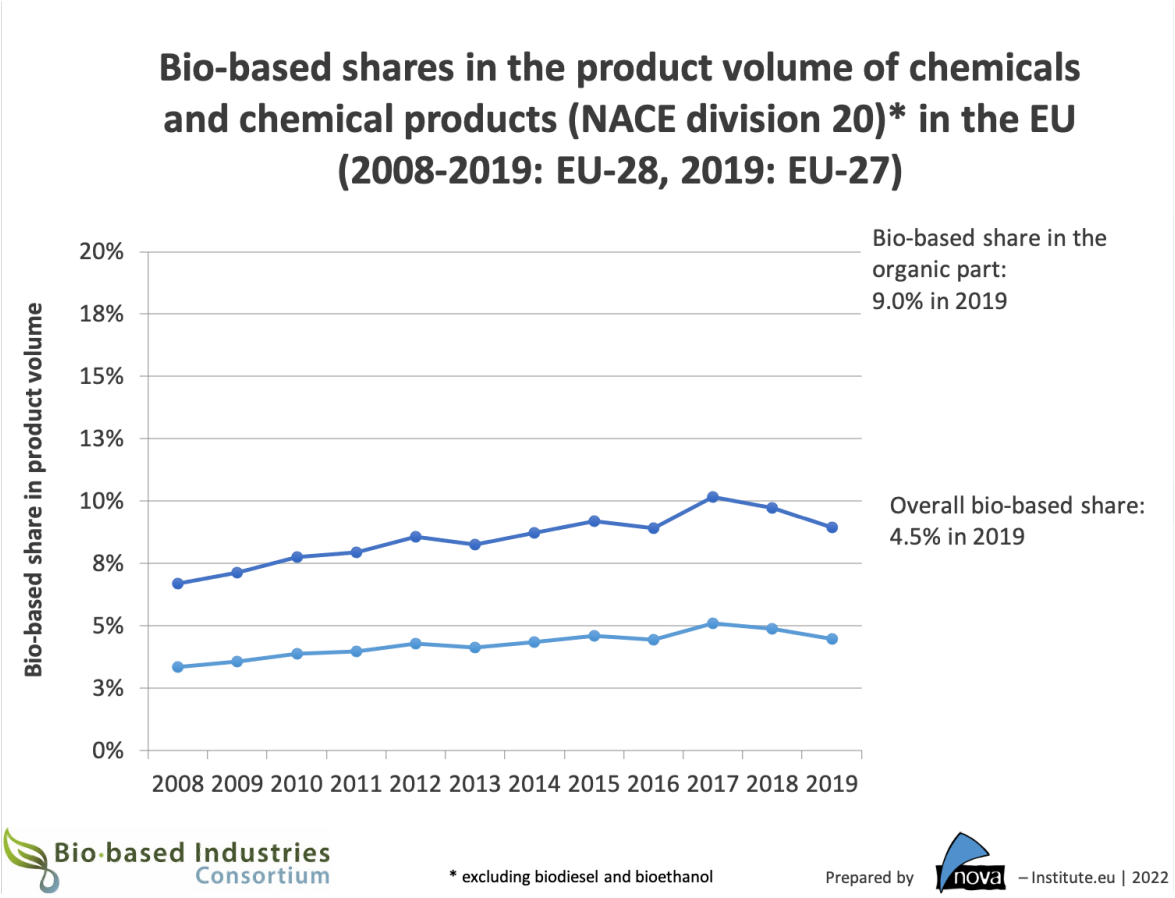


*Figure 15 Bio-based shares in the product volume of chemicals and chemical products (EU-28: 2008 – 2018; EU-27: 2019)*

Figure 16 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 27.1 billion Euro in 2019 is 6.9 % of the overall product value of chemicals and chemical products (both petro- and bio-based), therefore corresponding to the overall 6.9 % share of bio-based chemicals shown in Figure 14.

Figure 16 also shows that despite the removal of the UK from the evaluation the bio-based share seems to have settled at a stable level at around 7 % in 2019, even seeing a slight increase compared to 2018 levels. This suggests a rather smaller role of the UK in the European bio-based chemistry. However, in class 20.53 (Essential oils) a clear impact of the absence is visible. In fact, the UK has contributed between 8 to 10% of the total production value in this class of essential oils in recent years, which now results in a gap of over 790 million Euro for the EU-27 in 2019.

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, as stated before, be attributed to missing data in the Eurostat databases. For example, since 2017 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 and contributed prominently to the man-made fibres category before. The absence of these data leads to strong changes in the overall assessment.

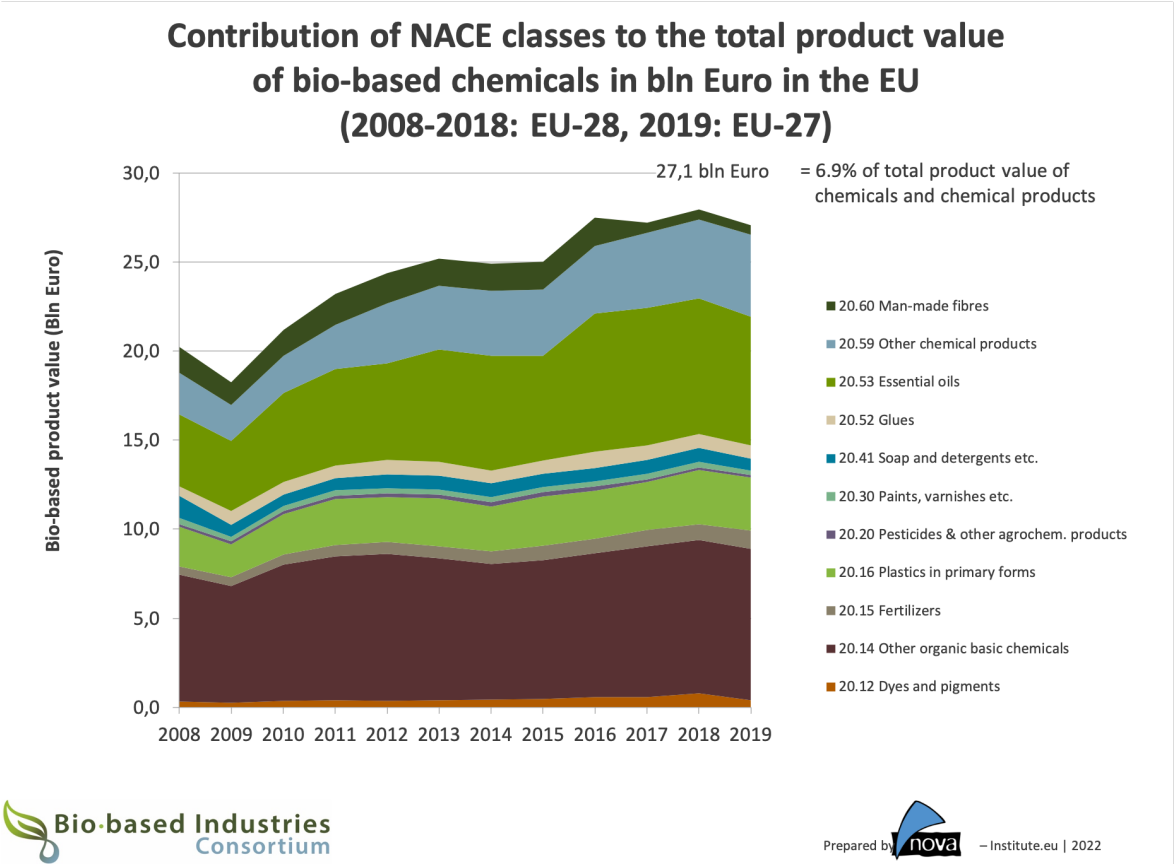


*Figure 16 Contribution of NACE classes to the total product value of bio-based chemicals (EU-28: 2008 – 2018; EU-27: 2019)*

While Figure 16 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 3 shows the 20 partly or fully bio-based chemical products with the highest bio-based production value in 2019. 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 4.06 billion Euro (14.9 % of the total value of 27.1 billion Euro) to the bio-based production value of division 20 in 2019 and remain the largest part of the bio-based C20 sector. In last year's paper reporting on the 2018 data as well as this year, it is followed by odoriferous substances for **non**-food and drink related purposes and enzymes (part of class 20.14, other organic basic chemicals). Class 20.14 (other organic

basic chemicals) is represented with the highest number (seven) 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 | 4.06 |
| **20.53.10.79** | Mixtures of odoriferous substances (excluding those of a kind used in the food or drink industries) | 2.18 |
| **20.14.64.70** | Enzymes; prepared enzymes (not elsewhere specified or included) (excluding rennet and concentrates) | 2.17 |
| **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 |
| **20.59.60.80** | Gelatin and its derivatives (excluding casein glues, bone glues and isinglass) | 1.06 |
| **20.15.80.00** | Animal or vegetable fertilisers | 0.95 |
| **20.53.10.20** | Essential oils | 0.91 |
| **20.59.59.94** | Other chemical products, n.e.c. | 0.87 |
| **20.14.32.80** | Lauric acid and others; salts and esters | 0.83 |
| **20.14.23.33** | D-glucitol (sorbitol) | 0.60 |
| **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 | 0.60 |
| **20.14.35.73** | Citric acid and its salts and esters | 0.58 |
| **20.59.20.00** | Animal or vegetable fats and oils chemically modified | 0.57 |
| **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) | 0.56 |
| **20.59.60.20** | Caseinates and other casein derivatives (excluding casein glues) | 0.52 |
| **20.52.10.80** | Prepared glues and other prepared adhesives, n.e.c. | 0.52 |
| **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 | 0.45 |
| **20.14.71.50** | Rosin and resin acids; and derivatives; rosin spirits and oils; run gums | 0.39 |

*Table 3 The 20 partly or fully bio-based chemical products with the highest bio-based production value in the EU-27, 2019*

Finally, Figure 17 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 4 shows, however, other products dominate in terms of bio-based production quantity. According to Table 3, animal and vegetable fertilisers alone contribute 7.96 million t (38.6 % of the total of 20.6 million t) to the bio-based production volume of division 20 in 2019.

However, the decline in production volume compared to the previous year is striking, especially for classes 20.14 (Other organic chemicals). This is mainly due to the product volume figures given by the Eurostat database for the respective largest bio-based production group D-glucitol (sorbitol) (part of 20.14). Comparing the production volume figures for these products from this year, 2018 and 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 and merely 0.4 million tonnes in 2019. These reported numbers are especially noteworthy and difficult to comprehend as this spike in 2017 and still high numbers in 2018 do not translate to the respective production value data for D-glucitol (sorbitol) in the same years. This shows very blatantly how unreliable the data sets in Eurostat can be. D-glucitol (sorbitol), once the second largest contributor in bio-based production volume for the chemical sector has dropped to the middle of the table in 2019.

For animal or plant fertilisers, a production volume of 8.8 million tonnes has been reported in 2017 and 7.5 million tonnes in 2018 respectively. Animal or vegetable fertilisers remain one of the largest contributors to bio-based production volume in the chemical sector clocking in at 7.96 million tonnes in 2019 (Table 4). 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.

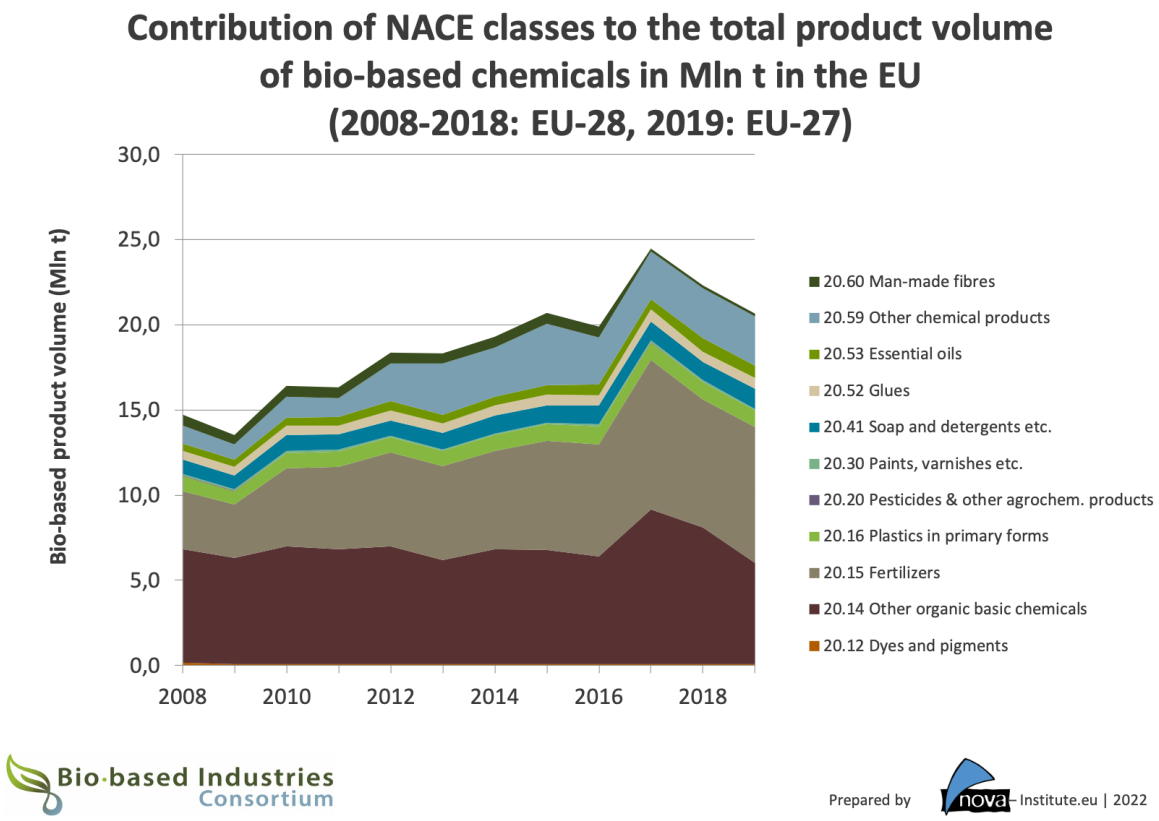


*Figure 17 Contribution of NACE classes to the total product volume of bio-based chemicals (EU-28: 2008 – 2018; EU-27: 2019)*

| PRODCOM-code | Name | Bio-based production volume (million tons) |
|---|---|---|
| **20.15.80.00** | Animal or vegetable fertilisers | 7.96 |
| **20.59.59.94** | Other chemical products, n.e.c. | 1.18 |
| **20.59.20.00** | Animal or vegetable fats and oils chemically modified | 0.79 |
| **20.41.10.00** | Glycerol (glycerine), crude; glycerol waters and glycerol lyes | 0.69 |
| **20.53.10.75** | Mixtures of odoriferous substances of a kind used in the food or drink industries | 0.55 |
| **20.14.71.20** | Activated natural mineral products; animal black | 0.52 |
| **20.14.23.60** | Glycerol (including synthetic; excluding crude, waters and lyes) | 0.51 |
| **20.14.71.30** | Tall oil; whether or not refined | 0.47 |
| **20.52.10.80** | Prepared glues and other prepared adhesives, n.e.c. | 0.43 |
| **20.14.34.73** | Citric acid and its salts and esters | 0.42 |
| **20.16.59.40** | Cellulose and its chemical derivatives, n.e.c., in primary forms | 0.42 |
| **20.14.23.33** | D-glucitol (sorbitol) | 0.40 |
| **20.14.31.95** | Industrial monocarboxylic fatty acids distilled (excluding stearic, oleic tall oil) | 0.40 |
| **20.14.32.80** | Lauric acid and others; salts and esters | 0.39 |
| **20.14.71.50** | Rosin and resin acids; and derivatives; rosin spirit and oils; run gums | 0.35 |
| **20.16.59.60** | Natural and modified natural polymers, in primary forms (including alginic acid, hardened proteins, chemical derivatives of natural rubber) | 0.30 |
| **20.14.64.70** | Enzymes; prepared enzymes (not elsewhere specified or included) (excluding rennet and concentrates) | 0.30 |
| **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) | 0.25 |
| **20.14.72.00** | Wood charcoal whether or not agglomerated (including shell or nut charcoal) | 0.24 |
| **20.14.31.20** | Industrial stearic acid | 0.23 |

*Table 4 The 20 partly or fully bio-based chemical products with the highest bio-based production volume in the EU-27, 2019*

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# 6 ANNEX I

*Calculation corrections*

During the data analysis of this year's report, a previous evaluation error has been identified in the analysis of bio-based shares in product value of chemicals & chemical products in the EU, which unfortunately has been carried over throughout the versions of the report. Table 5 below show the old and incorrect versus the new corrected values. It can be seen that the bio-based share still shows an upward trend in the timespan of 2008 to 2018 but for the last couple of years not as steep as formerly reported by us. Not taking into account the anomaly in 2016 we still see a steady increase from 2015 to 2019. The spike in 2016 is caused by the inconsistently reported figures for man-made fibres as mentioned in the report above.

**Bio-based shares in product value of chemicals & chemical products (NACE division 20; excluding biodiesel and bioethanol) in the EU**

*(EU-28: 2008 – 2018; EU-27: 2019)*

| | | Corrected value |
|---|---|---|
| **2008** | ~~**5.3%**~~ | **5.3%** |
| **2009** | ~~**5.8%**~~ | **5.9%** |
| **2010** | ~~**5.9%**~~ | **6.0%** |
| **2011** | ~~**5.9%**~~ | **6.0%** |
| **2012** | ~~**5.9%**~~ | **6.0%** |
| **2013** | ~~**6.2%**~~ | **6.3%** |
| **2014** | ~~**6.2%**~~ | **6.3%** |
| **2015** | ~~**6.3%**~~ | **6.4%** |
| **2016** | ~~**7.2%**~~ | **7.3%** |
| **2017** | ~~**7.5%**~~ | **6.7%** |
| **2018** | ~~**7,5%**~~ | **6.7%** |

*Table 5 Corrected bio-based shares in product value of chemicals & chemical products*

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.