European Commission

The European Commission's Knowledge Centre for Bioeconomy

Brief on jobs and growth in the EU bioeconomy 2008-2019[1]

Key messages

1. The biomass producing and converting sectors of the EU bioeconomy created up to EUR 657 billion of value added and employed 17.4 million people in the EU-27[2] in 2019. These values represent 4.7% of the EU's gross domestic product (GDP) and 8.3% of its labour force (see section 1).
2. Concomitant growth in value added and reduction in number of people employed resulted in apparent labour productivity gains in all bioeconomy sectors over the 2009-2019 period, especially in the agriculture sector. After a steep rise in value added generated in 2017, compared to the previous year, the EU bioeconomy showed a slower but continued growth (see section 2).
3. The analysis of the COVID-19 crisis impact, based on preliminary data, shows that the employment and the gross value added in the primary production sectors decreased between 2019 and 2020 by around 2% and 0.4%, respectively (see section 2).
4. Significant differences in the average labour productivity exist amongst sectors, ranging from EUR 21 000 per person in agriculture to EUR 177 000 per person in bio-based pharmaceuticals, but also amongst Member States, ranging from EUR 5 000 per person in Bulgaria to EUR 97 000 per person in Belgium (average in 2017-2019). The concentration of the national labour markets in the bioeconomy also differs across Member States (see section 3).
5. Since 2008, the bioeconomies in the EU Member States have been following different trajectories in terms of jobs and growth. While the apparent labour productivity has increased in all Member States, except Greece, the productivity gap between distinct groups of Member States is widening. The concentration of national labour markets towards the bioeconomy reduced remarkably in Croatia and Romania and increased the most in Greece. It did not substantially change in the other Member States (see section 4).

[1] This brief is based on Data portal of agro-economics Modelling – DataM: Bioeconomics dataset (Ronzon et al., 2022a), Ronzon et al. (2020) and Jobs and wealth in the EU bioeconomy dashboard (Ronzon et al., 2022b, version 08/03/2022). It is accompanied by the dedicated infographic "Bioeconomy employment and value added: 2019 data" (KCB, 2022). The underlying socio-economic indicators are part of the EU Bioeconomy Monitoring System, hosted in the Knowledge Centre for Bioeconomy.

[2] EU-27 refers to the 27 Member States comprising the EU since the departure of the UK on 31 January 2020: Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Cyprus (CY), Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (EL), Hungary (HU), Ireland (IE), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Malta (MT), Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Slovenia (SI), Spain (ES) and Sweden (SE).

1. How much value added, turnover and employment does the EU bioeconomy generate?

According to the most recent estimates, the biomass producing and converting sectors of the EU bioeconomy[3] created up to EUR 657 billion of value added in the EU-27 in 2019, which represents 4.7% of the GDP. Around 36% came from the food, beverages and other agro-manufacturing sector, and 29% from agriculture (Figure 1).

Using turnover as an indicator[4], the bioeconomy sectors considered created EUR 2.3 trillion in the EU-27 in 2019. Almost half of this was generated by the food, beverages and other agro-manufacturing sector, 19% by agriculture (Figure 1).

In 2019, the same sectors employed 17.4 million people in the EU-27, which represents 8.3% of the total labour force. More than half worked in agriculture (51%) and 27% in the food, beverages and other agro-manufacturing sector.

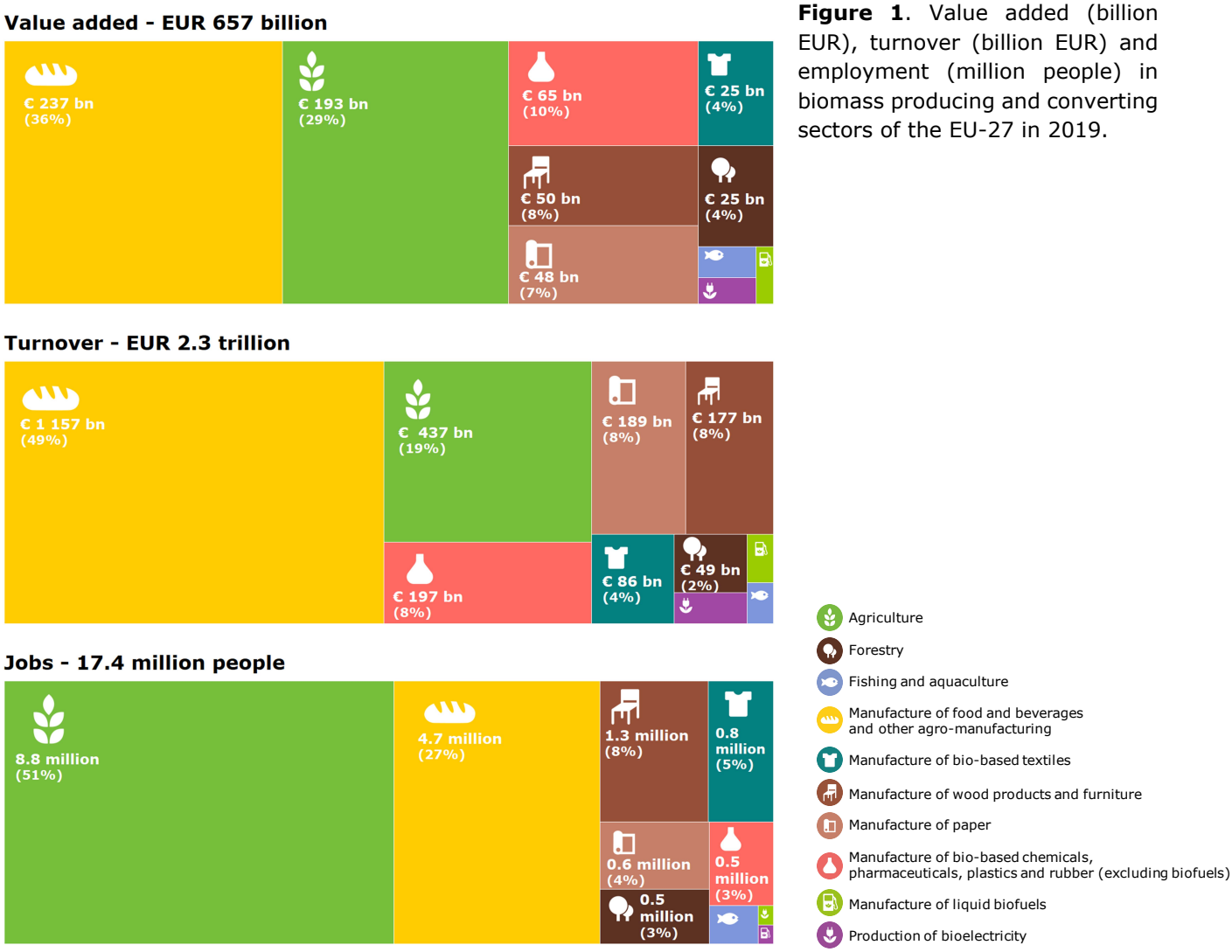

Figure 1. Value added (billion EUR), turnover (billion EUR) and employment (million people) in biomass producing and converting sectors of the EU-27 in 2019.

[3] Covering the following sectors: agriculture, forestry, fishing and aquaculture, the manufacturing of food, beverages, and other agro-manufacturing products, bio-based textiles, bio-based wearing apparels, leather, paper and wooden products, and bio-based chemicals, pharmaceuticals, plastics and rubber, liquid biofuels and the production of bioelectricity. Some other sectors of the EU bioeconomy are not covered in this brief (see "Knowledge gaps").

[4] Turnover is defined, in the context of structural business statistics, as the totals invoiced by the observation unit during the reference period, which corresponds to the total value of market sales of goods and services to third parties (Eurostat), including production costs. The sum of turnover across bioeconomy's sectors results in counting at least twice, firstly as the output of the primary bio-based production and secondly as the input of secondary bio-based production. On the other hand, the added value accounts the additional value created by a sector and avoids the double counting issue. Hence, value added is usually preferred to turnover as an indicator of economic performance of the overall bioeconomy.

2. How did value added and employment in the bioeconomy evolve over the period 2008-2019?

The European biomass producing and converting sectors contracted in 2009 due to the economic downturn, but it recovered quickly and has since continued its trend of steady growth until 2019. Value added increased by approximately EUR 181 billion during this period (Figure 2, left), with more than 64% of the increased value added generated by two sectors: agriculture and the food, beverages and other agro-manufacturing sector. Within the 2009-2019 timeframe, the sector of liquid biofuels showed the greatest percentage growth (despite a significant reduction from 2018 to 2019) followed by the bio-based electricity sector[5,6] (see Figure 2, right).

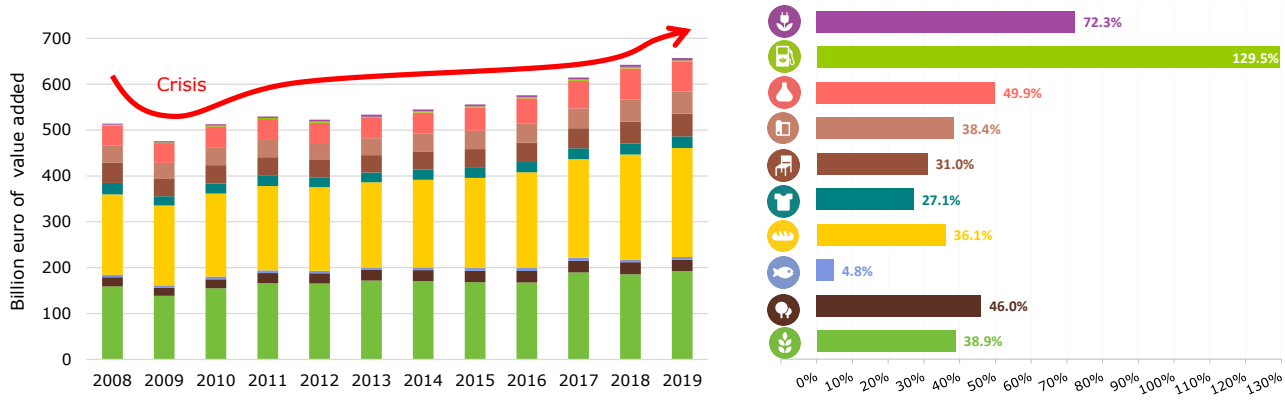

Figure 2. Value added in the EU-27 bio-based sectors: evolution since 2008 (billion EUR, left) and sectoral variation (%, right) during the period 2009-2019.

The latest data on value added (2018 and 2019) show a deceleration of the steep rise in economic growth observed in 2017 (annual growth of value added decreased from 6.7% in 2017 to 4.5% and 2.3% in 2018 and 2019, respectively, compared to the previous year). While the value added generated in most of the individual sectors of the bioeconomy was higher in 2019 than in 2018 (especially the bio-based electricity and bio-based textiles with 8.1% and 5.4% sectoral growth, respectively), some sectors experienced a reduction, namely the liquid biofuels (-8.1%), forestry (-6.0%), fishing and aquaculture (-4.6%) and bio-based chemicals and materials (-4.3%) sectors.

As regards jobs, an ongoing restructuring of the agriculture sector[7] led to a reduction in the number of people employed in this sector by 2.2 million (-20.1%) between 2009 and 2019 (Figure 3). This is the main driver of the decrease in overall employment in the sectors considered, observed throughout this period, with the exception of 2017 and 2018, when the overall employment increased by 142 720 and 96 110 jobs respectively. Most of those employment gains were lost in the following year (2019) when the bioeconomy lost 202 770 jobs, mainly due to the further decline in the employment in agriculture (-318 000 people employed, -3.5% compared to the previous year).

The labour force during the period 2009-2019 declined significantly also in other "traditional" sectors (see Figure 3), such as the manufacture of bio-based textiles (-159 343 people, -16.8%), the manufacture of wood products and wooden furniture (-117 388 people, -8.2%) and fishing and aquaculture (-17 680 people, -9.9%). On the other hand, employment increased significantly in the following sectors: manufacture of food, beverage and other agro-manufacturing (+514 700 people, +12.4%), bio-based chemicals,

[5] Bio-based electricity includes the operation of generation facilities that produce electric energy from biomass, and excludes the production of electricity through incineration of organic waste (Eurostat, 2008). Following official reporting statistics, only the enterprises with Combined Heat and Power (CHP) plants where the share of the value added in the production of electricity is higher than in the production of heat are included in this brief.

[6] Data for the production of bio-based electricity have to be treated with caution due to scarce reporting by EU Member States. In 2019, the number of people employed and the value added generated in the production of electricity was not reported, or was classified as confidential or with low reliability, for five EU-27 Member States (Eurostat, 2021).

[7] The restructuring refers to certain qualitative changes in the pattern of land holdings and size distribution of farms (Eurostat, 2018) driven by, inter alia, great strides in mechanisation and efficiency (Eurostat, 2019).

pharmaceuticals, plastics and rubber (excl. biofuels) (+81 289 people, +21.3%)[8], paper (+28 860 people, 4.8%), forestry (+10 430 people, +2.1%), bio-based electricity[6] (+10 379 people, +70.8%) and liquid biofuels (+9 950 people, 63%).

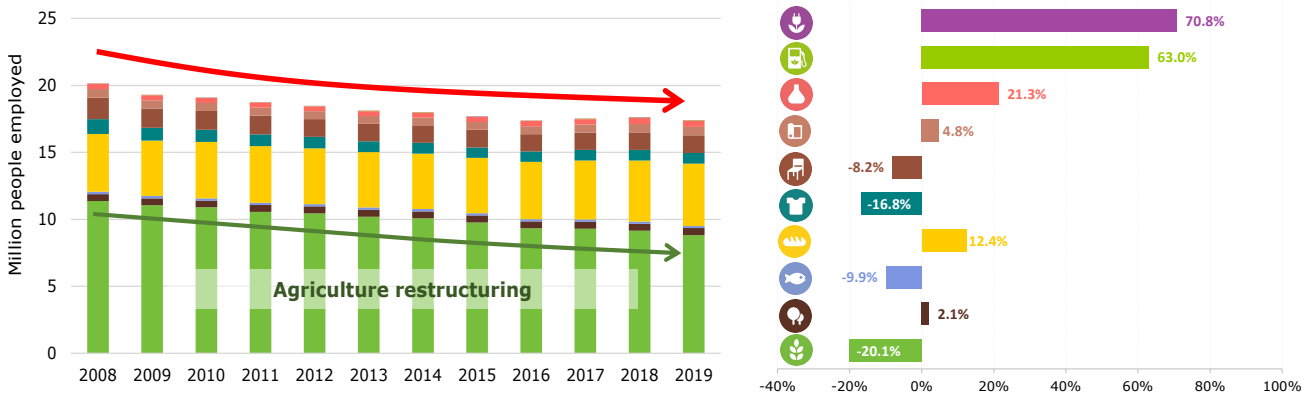

Figure 3. Employment in the EU-27 bio-based sectors: evolution since 2008 (million people employed, left) and sectoral variation (%, right) during the period 2009-2019.

Labour productivity gains were achieved in all biomass producing and converting sectors over the 2009-2019 period, especially in the agriculture sector (+73.9%) (Figure 4), in which the value added generated grew while the employment decreased.

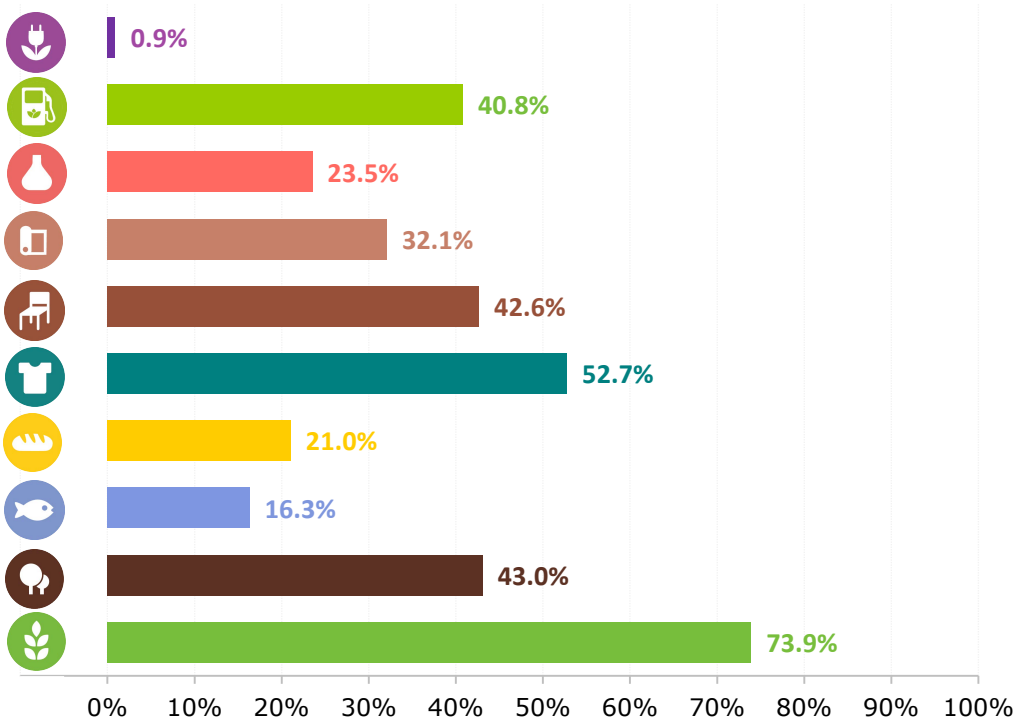

Figure 4. Labour productivity growth in the bio-based sectors between 2009 and 2019 in the EU-27.

[8] The breakdown of this sector shows an increase in the employment only in two subsectors, i.e. bio-based pharmaceuticals (+73 845 people, +31.4%) and plastics and rubber (+9 421 people, 17.8%), since in the chemicals sector there was actually a decrease in the people employed (-2 000 people, -2.1%).

During the 2008 economic crisis, the unemployment trends of the bioeconomy sectors were lower than the rest of the economy in EU countries such as Bulgaria, Greece, Croatia, Lithuania and Latvia and, to a lesser extent, in Ireland. This indicates that, in times of economic crisis, the bioeconomy can act as a buffer against unemployment. At this stage, the impact of the COVID-19 crisis on the bioeconomy remains difficult to quantify, due to the lack of updated official statistics for many of the bioeconomy sectors and for the whole pandemic period. Preliminary data available indicate a reduction in the employment in the primary production sectors and in the total economy in 2020 compared to 2019. However, in relative terms, the contraction has been smoother in the primary production sectors (-2%) than in the total economy (-6.7%)[9]. In the same period, the gross value added in the primary producing sectors decreased only by -0.4% compared to a decrease of -4.1% in the total economy[10].

3. How do the socio-economic indicators of the EU bioeconomy vary between sectors and Member States?

The EU bioeconomy is made up of sectors that vary greatly in terms of their capacity to employ people and generate economic growth, but also in their production costs. Sectors with a high proportion of inputs (or high costs of bought-in goods and services) have a greater impact on the turnover of the EU bioeconomy than on the value added. As an example, the manufacture of food, beverages and other agro-manufacturing contributes far more to the EU bioeconomy's turnover (49%) than to its added value (36%), in contrast to agriculture (19% turnover vs. 29% value added). Figure 5 shows the value added (first bar) and turnover (second bar) per sector.

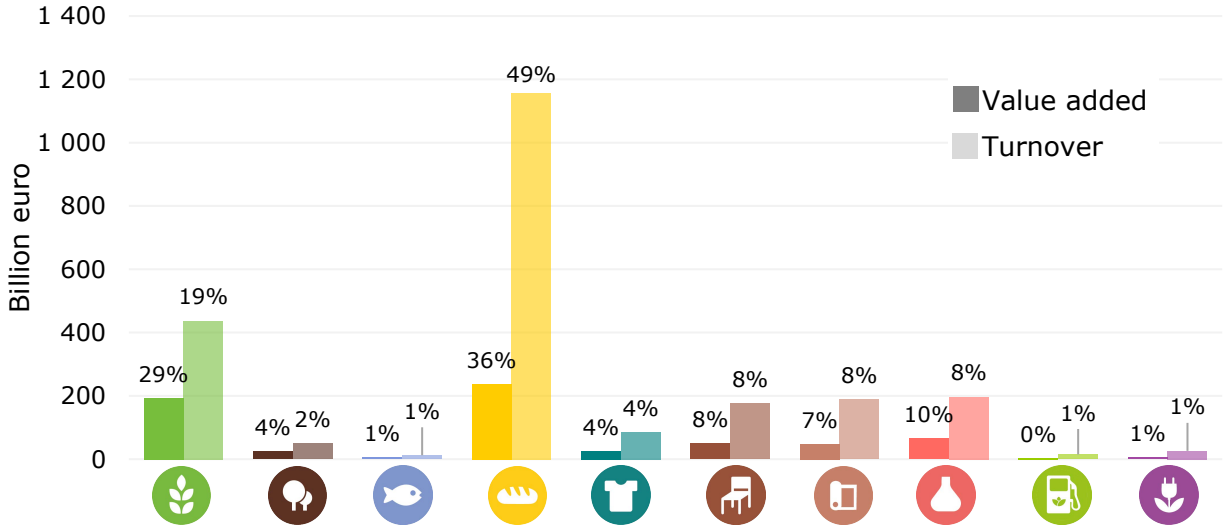

Figure 5. Value added and turnover per sector in the EU-27 in 2019 (% of total biomass producing and converting sectors considered in the EU-27).

There are significant differences in the average labour productivity during the 3-year average 2017-2019, both between sectors (ranging from EUR 21 000 per person in agriculture to EUR 177 000 per person in bio-based pharmaceuticals for EU-27) (Figure 6) and between Member States (ranging from EUR 5 000 per person in Bulgaria to EUR 97 000 per person in Belgium for the sectors considered) (Figure 6 and Figure 7).

[9] Considering average hours worked for Q1-Q4 in 2019 and 2020. Employment industry breakdowns (Eurostat, 2022a). Data for some countries (BG, DE, EL, ES, NL, LU, PT, RO) are provisional while for some other countries (BE, MT) are missing.
[10] Considering average gross value added for Q1-Q4 in 2019 and 2020. Gross value added and income industry breakdowns (Eurostat, 2022b). Data for some countries (BE, BG, DE, EL, ES, HR, NL, PT, RO) are provisional.

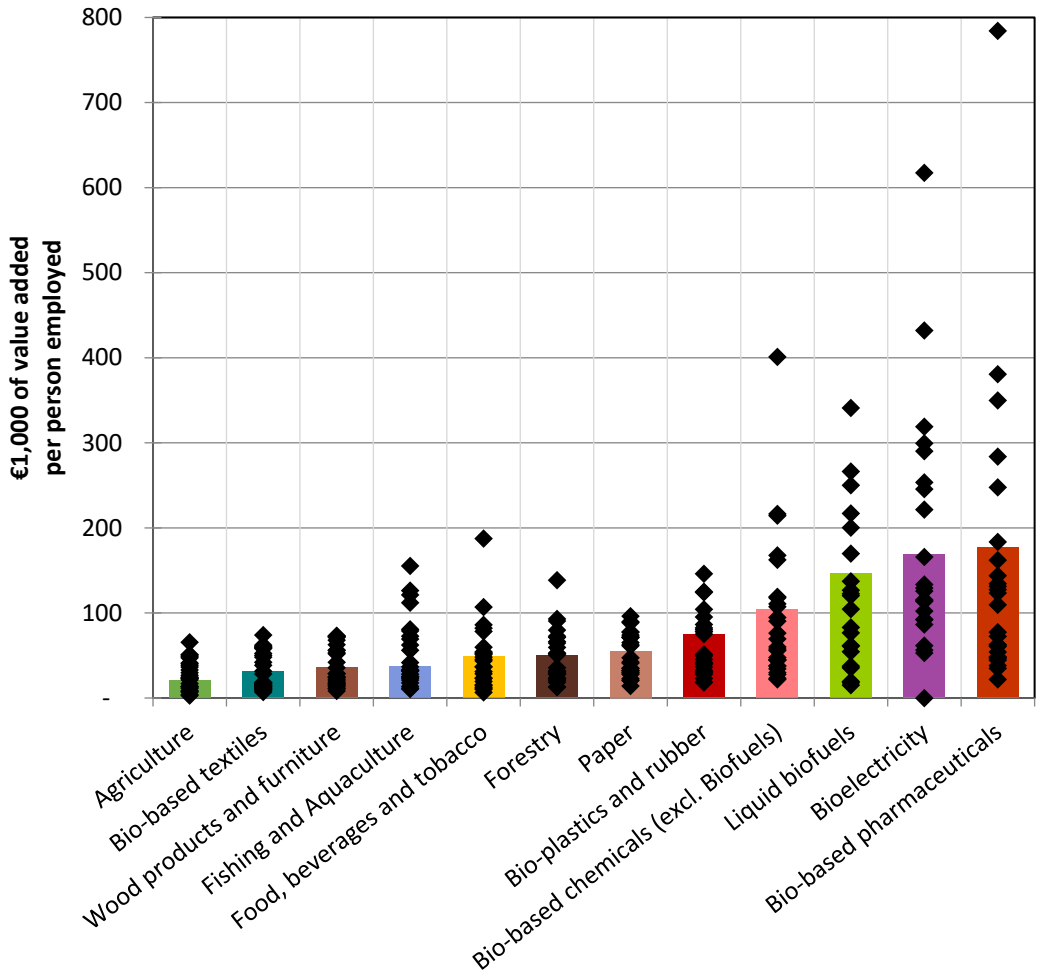

Figure 6. Apparent labour productivity[11] in EU-27 biomass producing and converting sectors in 2017-2019 (3-year average). Bars show the EU-27 apparent labour productivity; points show the Member States' apparent labour productivity.

By analysing the concentration of national labour markets in the biomass producing and converting sectors of the bioeconomy (using location quotient[12] as a proxy for the employment situation), and the apparent labour productivity of those sectors, four distinct groups of Member States (MS) can be identified as follows (see Figure 7):

- Group 1.1 (Bulgaria, Croatia, Greece, Latvia, Lithuania, Romania, Poland and Portugal): MS whose national labour markets are strongly specialised in bioeconomy sectors (location quotient > 1.4), but have a low level of apparent labour productivity (less than half of EU average). In this group, the bioeconomy is geared towards biomass producing sectors and the food, beverages and other agro-manufacturing sector, while other manufacturing sectors with low levels of apparent labour productivity (i.e. labour-intensive production sectors), such as the manufacturing of textiles and/or wood products, can play a significant role, depending on their historical sectoral concentration or biomass endowment.
- Group 1.2 (Cyprus, Czech Republic, Estonia, Hungary, Malta, Slovakia and Slovenia): MS with a medium concentration of national labour markets in bioeconomy sectors (location quotient ≤ 1.3) and a medium-low level of apparent labour productivity (slightly below the EU average). In this group, the

[11] Apparent labour productivity is an indicator of the economic growth potential, calculated as the value added at factor costs divided by the number of people employed.
[12] In this context, the location quotient (LQ) is the ratio of people employed in bioeconomy sectors to the total employment in a Member State, divided by the equivalent ratio in EU-27. LQ helps quantify how "concentrated" the bioeconomy is in a Member State compared to the EU as a whole.

agriculture and the food, beverages and other agro-manufacturing sectors are the main sources of bioeconomy jobs and value added, but other biomass producing sectors are also relevant due to resource availability (e.g. fishing in MT and forestry in EE, SK and CZ).

- Group 2.1 (Austria, France, Germany, Italy, Luxembourg and Spain): MS with a low concentration of national labour markets in bioeconomy sectors (location quotient ≤ 0.9) and medium-high level of apparent labour productivity (above the EU average level). Generally, these MS show high sectoral diversification and productivity, suggesting a high level of maturity of the bioeconomy manufacturing sectors.
- Group 2.2 (Belgium, Denmark, Finland, Ireland, the Netherlands and Sweden): MS with a low level of bioeconomy concentration in their national labour markets (location quotient ≤ 0.9) and high level of apparent labour productivity of the bioeconomy sectors (more than double the EU-27 average level).

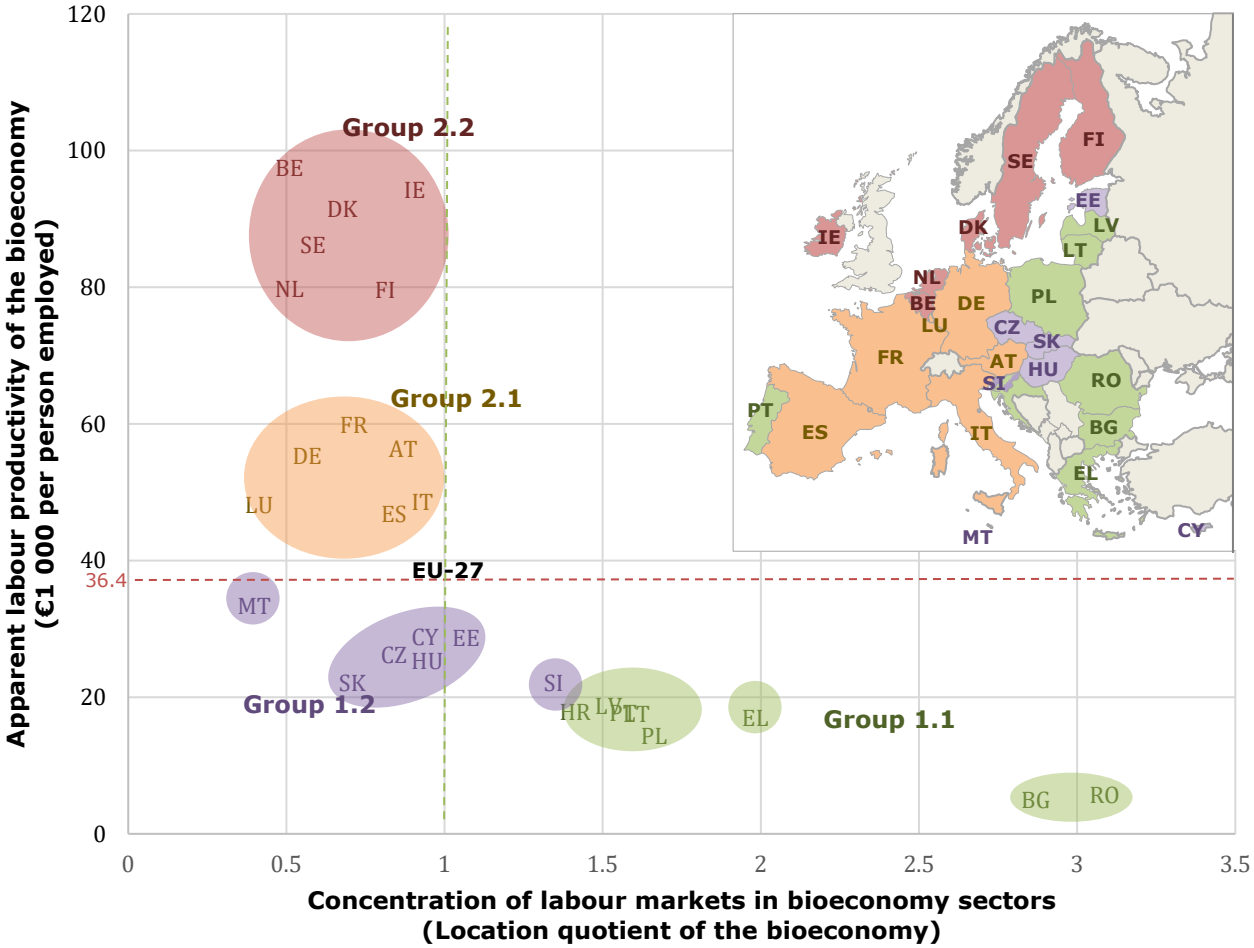

Figure 7. Clustering of EU-27 Member States based on the apparent labour productivity and employment concentration (3-year averages: 2017-2019) in the sectors considered. Average EU-27 values are shown as dashed lines.

4. How did the bioeconomies of Member States evolve over the period 2008-2019 according to the socio-economic indicators?

Since 2008, the bioeconomies in the MS have been following different trajectories, in terms of jobs and growth (see Figure 8).

While the apparent labour productivity has increased in all MS except in Greece (shift in the Y-axes of Figure 8), this increase was highest in MS groups 2.2 and 2.1 respectively, which widened the productivity gap with the MS groups 1.1 and 1.2. During this period, Belgium, Denmark, Finland and Ireland had the largest increase in labour productivity (between EUR 23 000 to EUR 29 000 per person employed based on three-year averages in the period 2017-2019 compared to 2008-2010). As a result for example, Finland moved from group 2.1 to group 2.2, thanks to the productivity leap in certain bioeconomy sectors (e.g. manufacturing of bio-based chemicals, pharmaceuticals and plastics, forestry, and the manufacture of paper), which represents a transition towards a more labour productive bioeconomy.

In terms of labour concentration (shift along the X-axes of Figure 8), most MS did not experience a remarkable transition. Exceptions are Croatia and Romania, where the proportion of persons employed in the bioeconomy sectors considered, reduced considerably from 20% to 13% and from 36% to 27%, respectively (and thus, with a decrease in the location quotient). On the contrary, the labour market concentration towards the bioeconomy increased the most in Greece, mainly in the biomass production sectors.

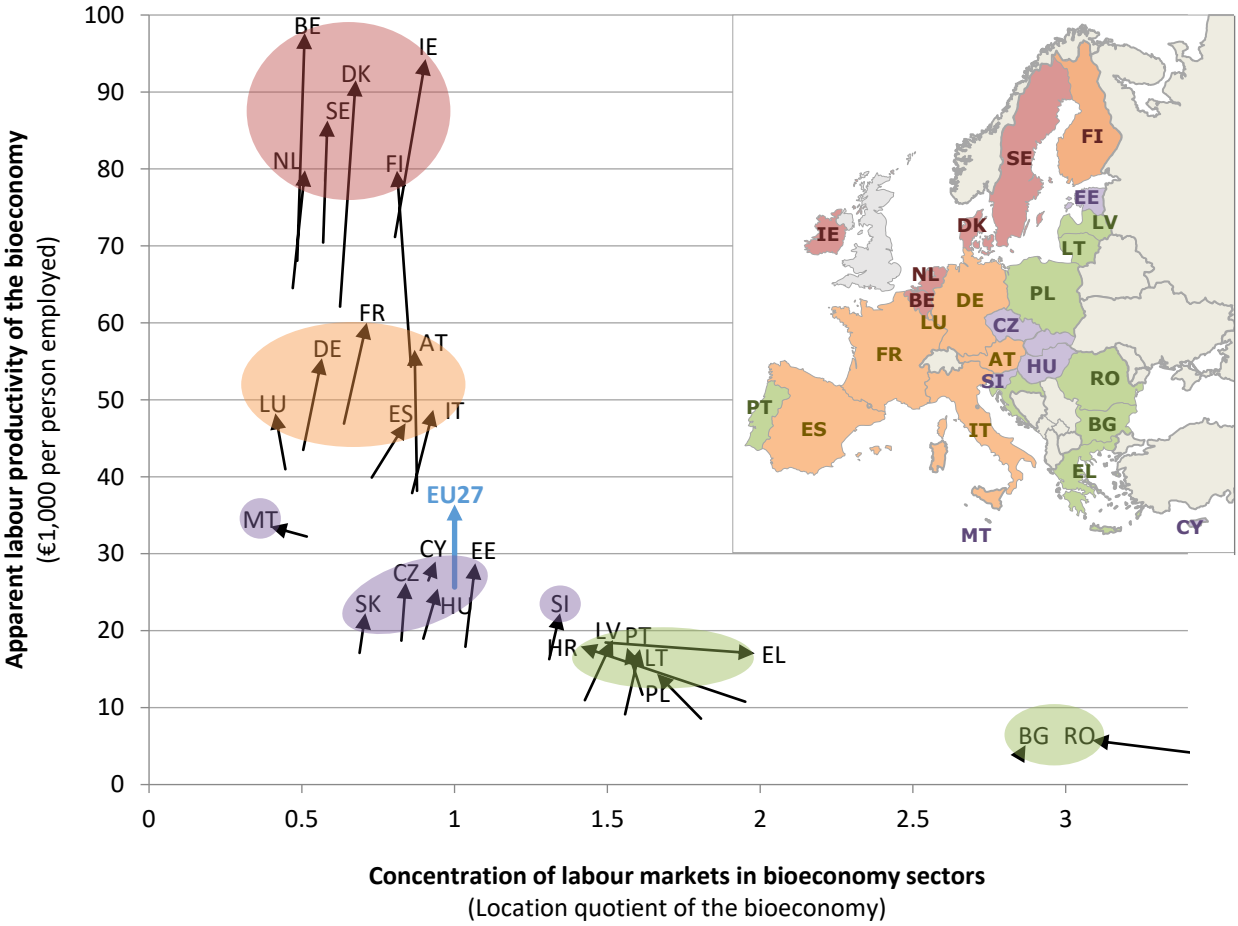

Figure 8. Evolution of the location quotient and apparent labour productivity in bioeconomy sectors in EU-27 (average in 2017–2019 vs. average in 2008-2010).

Knowledge gaps

1. In the absence of official statistics on all sectors of the bioeconomy, this document is partly based on estimates following the nova-Institute's methodology. The methodology is detailed in Ronzon et al. (2020). Although these estimates give valuable information on the relative weight of each bioeconomy sector and on main trends, absolute numbers are subject to uncertainties and should therefore be used with caution.
2. Primary data for 2019 are not available for certain sectors (e.g. liquid biofuels and bio-based electricity) and countries (e.g. Malta, Cyprus and Luxembourg). As a result, their estimates are subject to a higher degree of uncertainty and may be underestimated.
3. Certain 'hybrid' sectors (i.e. activities that make use of biomass and other types of feedstock) are not covered in this brief due to the lack of statistics for the economic indicators assessed and/or estimates of the bio-based shares. This is the case for bio-heat generation (including district heating, domestic heating, and certain Combined Heat and Power plants), construction and the management of organic waste. The jobs and growth generated in the management of their feedstock are, however, included in the primary sectors (e.g. agriculture, forestry). Similarly, statistics on the production of algae through freshwater aquaculture (i.e. bioreactors) are not reported. Furthermore, bioeconomy services e.g., restaurants, waste treatment, food retail trade, repair of bio-based products and recreational activities were not included in this analysis due to the difficulty of assessing the bio-based shares of such sectors.
4. Work to close those gaps is published in Ronzon et al. (2022c), Robert, et al. (2020) for specific wood-based sectors, Ronzon et al. (2022d) for bio-based services and by Kuosmanen et al. (2020) and Cingiz et al. (2021) for all sectors represented in the National Accounts. Other research that aims to fill some of these gaps is ongoing (e.g. the BioMonitor project funded under the EU's Horizon 2020 programme).
5. The estimates presented in this brief may be subject to correction in the future as more data become available.

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other agro-manufacturing sector

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