



The European Commission's Knowledge Centre for Bioeconomy



Brief on jobs and growth of the EU bioeconomy 2008-2017¹

Key messages

1. In 2017, the bioeconomy generated 4.7% of the gross domestic product (GDP) of the EU-27² and employed 8.9% of the labour force (see section 1).
2. Concomitant growth in value added and reduction in number of people employed resulted in apparent labour productivity gains over the period 2009–2017. In 2017, the EU bioeconomy showed a steep rise in value added compared to the previous year. For the first time, during the 10 years monitored, an increase in the number of people employed has also been observed (see section 2).
3. The employment in the primary production sectors decreased by around 4.2% in the second quarter of 2020, in comparison to the second quarter of 2019, while the total hours worked decreased by 5.6%. On the other hand, the gross value added of the primary production sectors increased by 0.1%. Yet, the impact of the COVID-19 crisis on the bioeconomy cannot be comprehensively quantified at this stage due to lack of complete official statistics.
4. Bioeconomy sectors with a high proportion of inputs have a greater impact on the turnover of the EU bioeconomy than on the value added. There are also significant differences in the average labour productivity, both by sector and by Member State (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, except in Greece, the productivity gap between distinct groups of Member States is widening. The specialisation of national labour markets towards the bioeconomy did not substantially change (see section 4).

¹ This brief is based on Ronzon et al. (2020a), [Data portal of agro-economics Modelling – DataM](#): Bioeconomics dataset (Ronzon et al., 2020b) and Jobs and wealth in the EU bioeconomy dashboard (version 11/03/2020). It is accompanied by the dedicated infographic "[Bioeconomy employment and value added: 2017 data](#)" (KCB, 2020).

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 bioeconomy created up to EUR 614 billion of value added in the EU-27 in 2017, which represents 4.7% of the GDP. Around 35% came from the food, beverages and tobacco industry, and 31% from agriculture (Figure 1).

Using turnover as an indicator³, the bioeconomy created EUR 2.2 trillion in the EU-27 in 2017. Half of this was generated by the food, beverages and tobacco industry, 19% by agriculture (Figure 1).

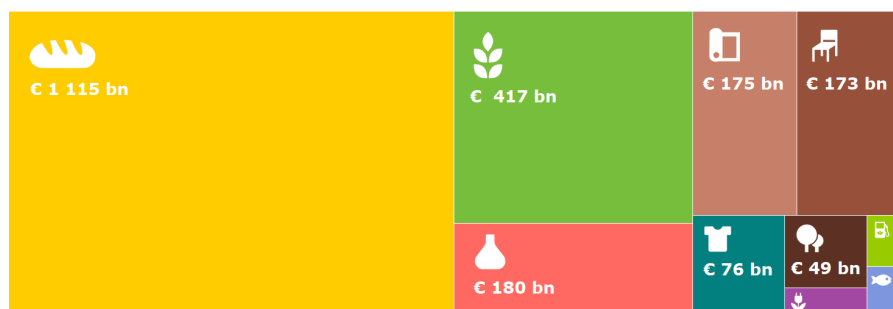
In 2017, the bioeconomy employed 17.5 million people in the EU-27, which represents 8.9% of the total labour force. More than half worked in agriculture (53%) and a quarter in the food, beverages and tobacco industry (25%).

Value added - EUR 614 billion

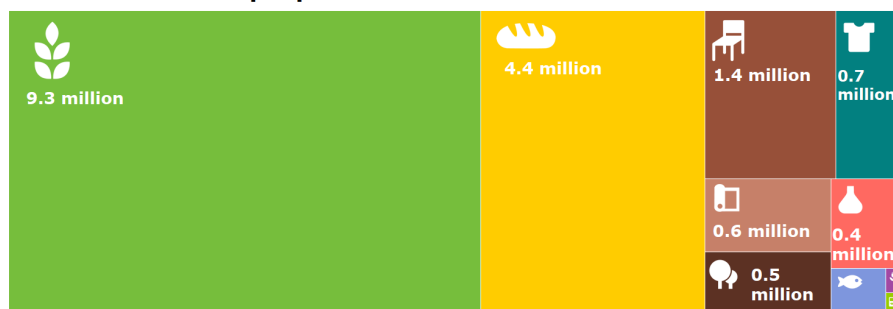


Figure 1. Value added (billion EUR), turnover (billion EUR) and employment (million people) in the bio-based sectors of the EU-27 in 2017⁴.

Turnover - EUR 2.2 trillion



Jobs - 17.5 million people



- Agriculture
- Forestry
- Fishing and aquaculture
- Manufacture of food and beverages and other agro-manufacturing
- Manufacture of bio-based textiles
- Manufacture of wood products and furniture
- Manufacture of paper
- Manufacture of bio-based chemicals, pharmaceuticals, plastics and rubber (excluding biofuels)
- Manufacture of liquid biofuels
- Production of bioelectricity

³ 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.

⁴ Some specific bio-based sectors are not covered in this brief, e.g. the production of bio-heat, construction and the management of organic waste (see "Knowledge gaps"). Some missing sectors are covered in published literature such as Kuosmanen et al. (2020) for bio-based service (tertiary) sectors and Robert, et al. (2020) for specific wood-based sectors. The latter, for instance, estimates the employment in the "printing and reproduction of recorded media" and "wood-based construction" sectors at around 0.7 and 0.5 million people employed in 2017 in EU-27, respectively.

2. How did value added and employment in the bioeconomy evolve over the period 2008-2017?

The European bioeconomy contracted in 2009 due to the economic downturn, but it recovered quickly and has since continued its trend of steady growth until 2017. Value added increased by approximately EUR 142 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 tobacco sector. Within this timeframe, the bio-based electricity⁵ sector showed the greatest percentage growth⁶, followed by the forestry sector (see Figure 2, right).

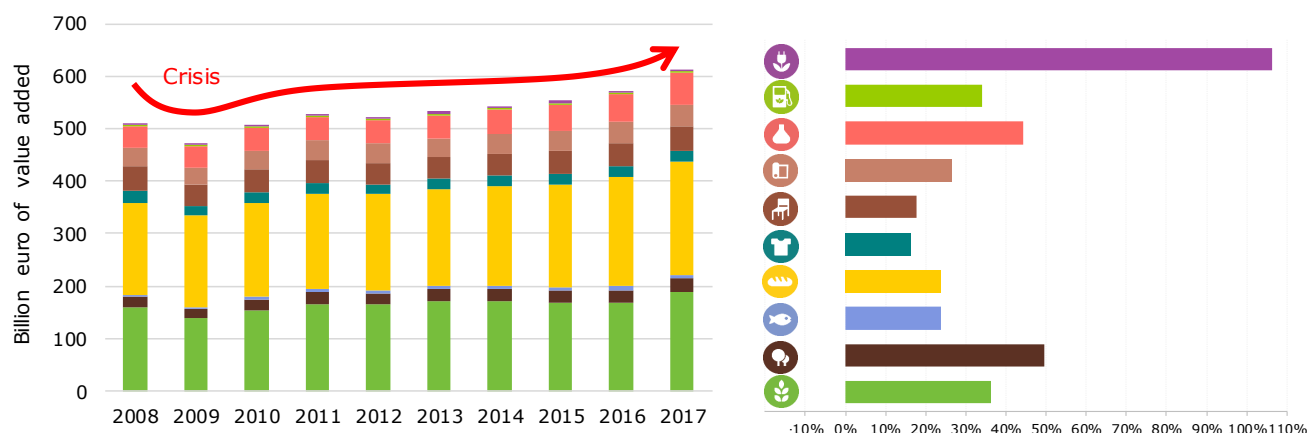


Figure 2. Value added in the EU-27 bio-based sectors: evolution since 2008 (billion EUR, left) and sectoral variation (% , right) during the period 2009-2017.

The latest data on value added also show a steep rise in economic growth in 2017 (7.2% annual growth of value added compared to 2016). A growth from 2016 to 2017 was observed in all the sectors of the bioeconomy, with the sector that comprises bio-based chemicals, pharmaceuticals, plastics and rubber and the agriculture sector being the leading ones (annual growth rate of 14% and 12%, respectively). Within the former, the bio-based pharmaceutical sector was particularly prominent in terms of sectoral annual growth (18%).

As regards jobs, an ongoing restructuring of the agriculture sector⁷ led to a reduction in the number of people employed in this sector by 1.8 million (-16%) between 2009 and 2017 (Figure 3). This is the main driver of the decrease in overall employment in the EU bioeconomy.

The labour force during this period also declined significantly in other "traditional" sectors (see Figure 3), such as the manufacture of bio-based textiles (-184 000 people, -21.0%) and the manufacture of wood products and wooden furniture (-132 000 people, -8.5%). On the other hand, employment increased significantly in the following sectors: manufacture of food, beverage and tobacco (+257 000 people, +6.2%), bio-based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels) (+37 000 people, +10.2%)⁸, forestry (+35 000 people, +7.3%) and bio-based electricity⁵ (+15 000 people, +184.8%).

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 2017, 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 six EU-27 Member States (Eurostat, 2018).

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).

⁸ The breakdown of this sector shows an increase in the employment in all subsectors, i.e. bio-based pharmaceuticals (25 000 people, +10.6%), chemicals (10 000 people, 13.7%), plastics and rubber (1 825 people, 3.5%).

The bioeconomy can act as a buffer against unemployment in times of economic crisis as shown in the 2008 economic crisis, when 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.

The impact of the COVID-19 crisis on the bioeconomy is difficult to quantify at this stage due to the lack of updated official statistics for all bioeconomy sectors. Recent estimates show that the risk to be on temporary layoff or have reduced working hours during the second quarter of 2020 in the primary production sectors (agriculture, forestry and fishing) was the lowest of all the sectors of the economy⁹. Yet, the available data show that the number of people employed in the primary production sectors decreased in the second quarter of 2020 by around 4.2% (399 000 people) in comparison to the second quarter of 2019¹⁰. In terms of the labour input to the economy, the total hours worked¹¹ in the primary sectors decreased by 5.6%. In a context of a slowdown of the overall economy, by which the gross value added of all economic sectors decreased by 10.5% (EUR 359 000 trillion) in the second quarter of 2020 in comparison to the second quarter of 2019, the gross value added of the primary production sectors actually increased by 0.1% (EUR 63 million)¹².

⁹ Risk of temporary layoff / reduced hours in the second quarter 2020 by economic sector in EU ([Eurostat, 2020a](#)). EU-27 without Germany.

¹⁰ Employment industry breakdowns ([Eurostat, 2020b](#)). Data for some countries, like BG, DE, EL, ES, NL, PL and RO are provisional and some others (PT) are estimated.

¹¹ Total hours worked is the most appropriate measure of labour inputs for the national accounts ([Eurostat, 2013](#)).

¹² Gross value added and income industry breakdowns ([Eurostat, 2020c](#)). Data for some countries (BE, BG, DE, EL, ES, HR, NL, RO) are provisional and some others (PT) are estimated.

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 tobacco contributes far more to the EU bioeconomy's turnover (50%) than to its added value (35%), in contrast to agriculture (19% turnover vs. 31% value added). Figure 5 shows the value added (first bar) and turnover (second bar) per sector.

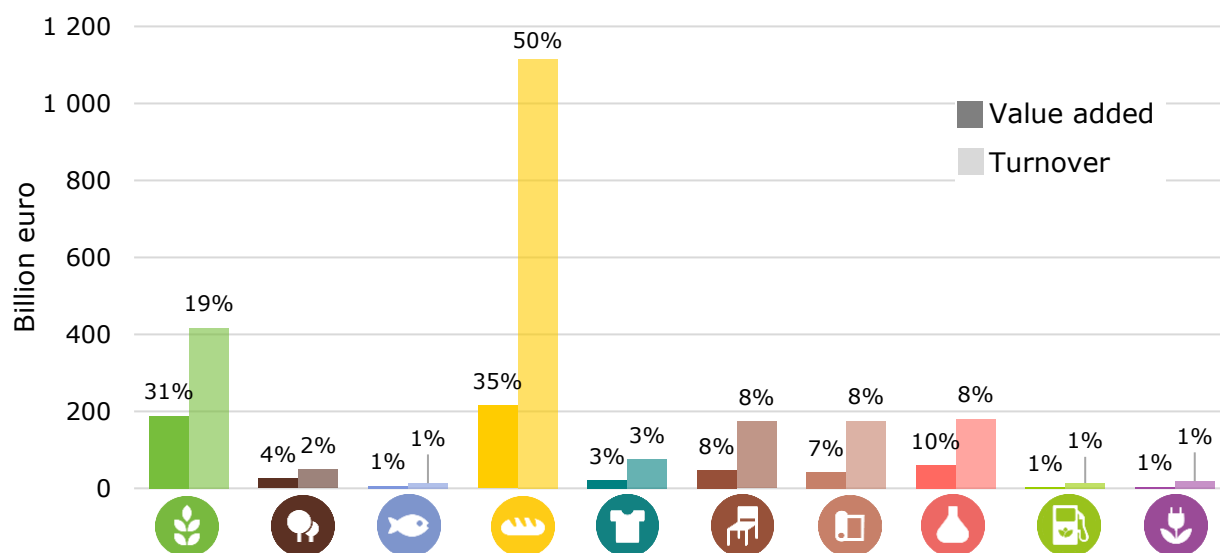


Figure 5. Value added and turnover per sector in the EU-27 in 2017 (% of total Bioeconomy in the EU-27).

There are significant differences in the average labour productivity during the period 2015-2017, both by sector and by Member State (Figure 6).

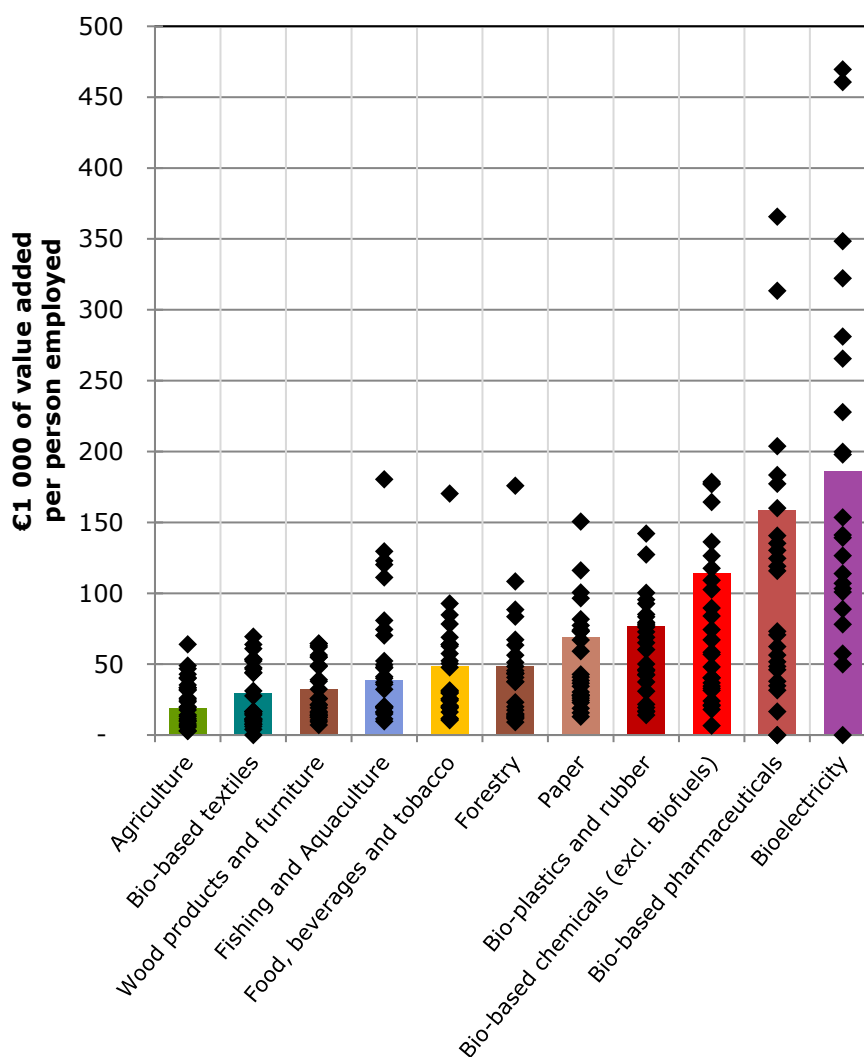


Figure 6. Apparent labour productivity¹³ in the EU-27 bioeconomy in 2015-2017 (3-years average) by sector. Bars show the EU-27 apparent labour productivity; points show the Member States' apparent labour productivity.

By analysing the concentration of national labour markets in the bioeconomy (using location quotient¹⁴ as a proxy for the employment situation), and the apparent labour productivity of the bioeconomy, 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 the bioeconomy sectors (location quotient > 1.5), 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 tobacco 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 specialisation or biomass endowment.

¹³ 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.

¹⁴ In this context, location quotient (LQ) is the share of those employed in a Member State that are working in the bioeconomy (or one of its sectors), divided by the equivalent employment share in the EU as a whole. LQ helps quantify how "concentrated" the bioeconomy is in a Member State compared to the EU as a whole.

- **Group 1.2** (Cyprus, Czech Republic, Estonia, Hungary, Malta, Slovakia and Slovenia): MS with a medium specialisation of national labour markets in the bioeconomy sectors (location quotient ≤ 1.3) and a medium-low level of apparent labour productivity (slightly below the EU average). In this group, the agriculture and the food, beverages and tobacco 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 specialisation of national labour markets in the bioeconomy (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 specialisation 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).

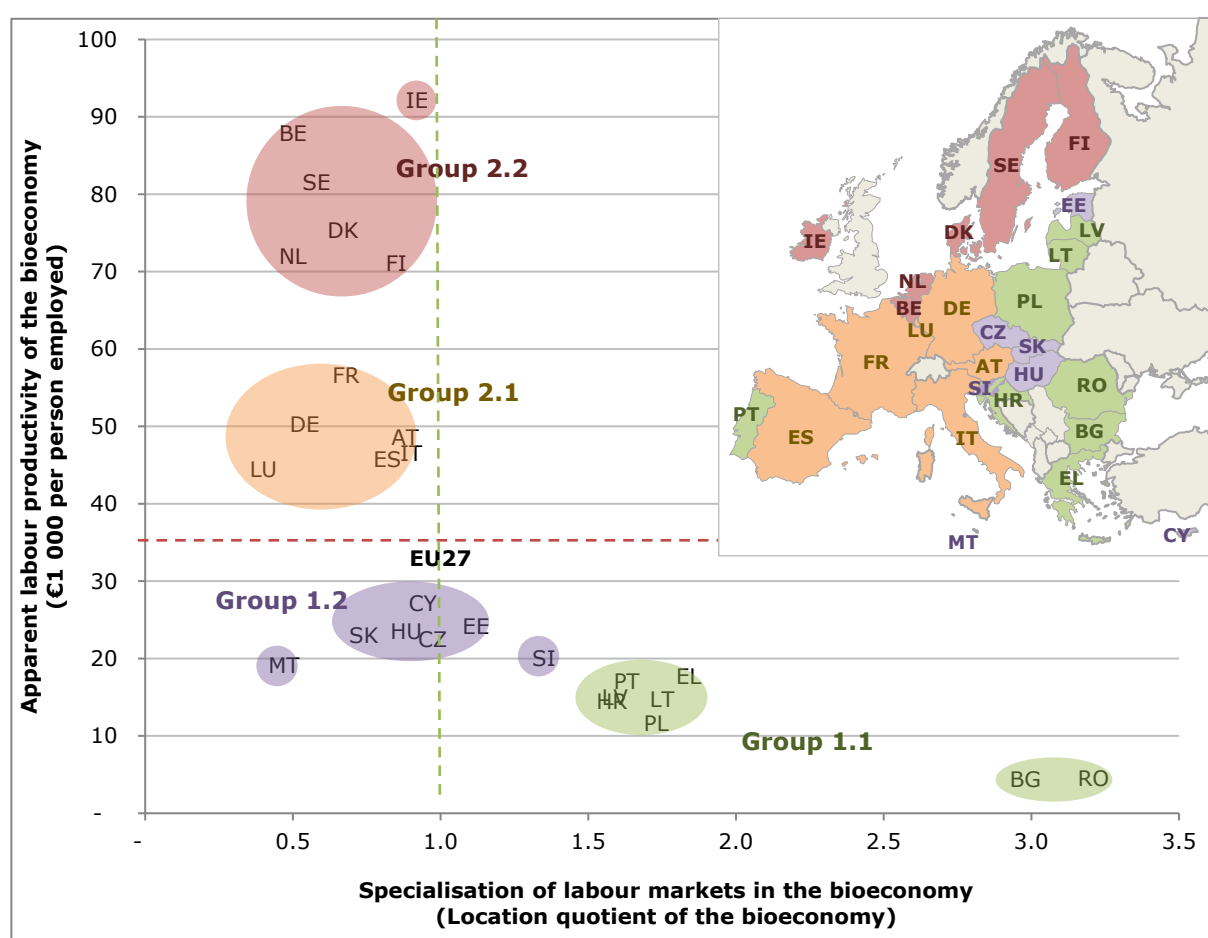


Figure 7. Clustering of EU-27 Member States based on the apparent labour productivity and employment concentration (3-year averages: 2015-2017) in the different sectors. Average EU-27 values are shown as dashed lines.

4. How did the bioeconomies of Member States evolve over the period 2008-2017 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, Ireland and Finland had the largest increase in labour productivity (between EUR 17 000 to EUR 21 000 per person employed based on three-year averages in the period 2015-2017 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 specialisation (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 reduced from 20% to 14% and from 36% to 29%, respectively (and thus, with a decrease in the location quotient). On the contrary, the labour market specialisation towards the bioeconomy increased in Greece, mainly in the biomass production sectors.

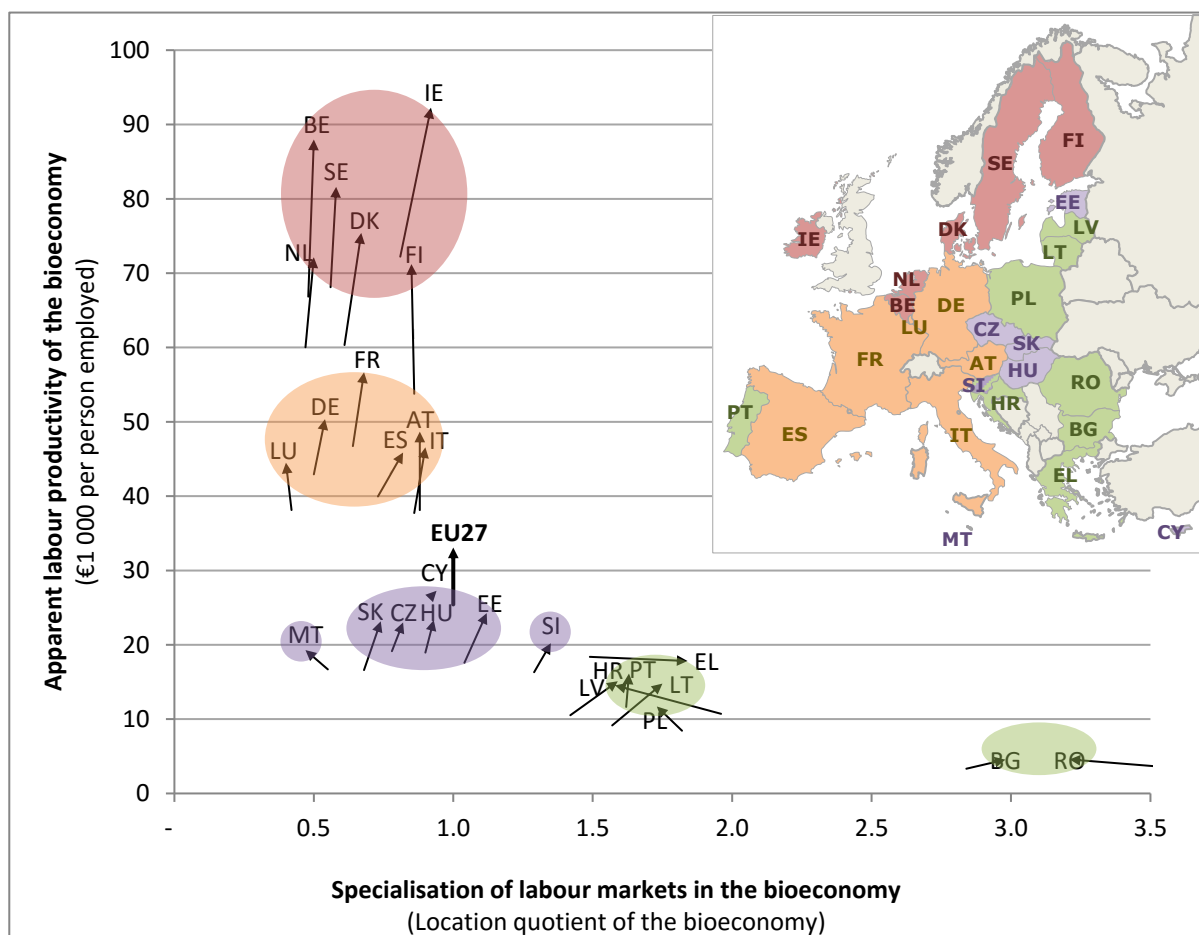


Figure 8. Evolution of the location quotient and apparent labour productivity in the bioeconomy in EU-27 (average in 2015–2017 vs. average in 2008–2010).

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. (2020a). 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. Data for 2017 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. New research (e.g. the BioMonitor project funded under the EU's Horizon 2020 programme) aims to fill some of these gaps.
4. The updated EU Bioeconomy Strategy added new sectors to the definition of the bioeconomy such as services, e.g., restaurants, waste treatment, food retail trade, repair of bio-based products and recreational activities. These sectors were not included in this analysis due to the difficulty of assessing the bio-based shares of such sectors.
5. The estimates presented in this brief may be subject to correction in the future as more data become available.

References

- Knowledge Centre for Bioeconomy (KCB). 2020. Bioeconomy employment and value added: 2017 data – Infographic. Available at: https://ec.europa.eu/knowledge4policy/publication/bioeconomy-employment-value-added-2017-data-infographic_en. Accessed: 27 Oct, 2020.
- Kuosmanen, T., Kuosmanen, N., El-Meligli, A., Ronzon, T., Gurria, P., Iost, S., M'Barek, R. 2020. How Big is the Bioeconomy? Reflections from an economic perspective. EUR 30167 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-17858-3, doi:10.2760/144526, JRC120324
- Robert, N., Jonsson, R., Chudy, R., Camia, A. 2020. The EU Bioeconomy: Supporting an Employment Shift Downstream in the Wood-Based Value Chains?. *Sustainability* 2020, 12, 758. <https://doi.org/10.3390/su12030758>.
- Ronzon, T., M'Barek, R. 2018. Socioeconomic Indicators to Monitor the EU's Bioeconomy in Transition. *Sustainability* 2018, 10, 1745. <https://doi.org/10.3390/su10061745>.
- Ronzon, T., Piotrowski, S., Tamosiunas, S., Dammer, L., Carus, M., M'Barek, R. 2020a. Developments of Economic Growth and Employment in Bioeconomy Sectors across the EU. *Sustainability* 2020, 12, 4507. <https://doi.org/10.3390/su12114507>.
- Ronzon, T., Piotrowski, S., M'Barek, R., Carus, Mi., Tamošiūnas, S. 2020b: Jobs and wealth in the EU bioeconomy / JRC - Bioeconomics. European Commission, Joint Research Centre (JRC) [Dataset] PID: <https://data.europa.eu/89h/7d7d5481-2d02-4b36-8e79-697b04fa4278>.

Web-based references

- Biomonitor Project. European Union's Horizon 2020 Research and Innovation Programme. Grant agreement N°773297. Available at: <https://biomonitor.eu/>. Accessed: 17 Nov, 2020.
- Data portal of agro-economics Modelling – DataM. Jobs and wealth in the EU bioeconomy dashboard. <https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html>. Accessed: 10 Oct, 2020.
- Eurostat. NACE Rev. 2 Statistical Classification of Economic Activities in the European Community; Office for Official Publications of the European Communities: Luxembourg, 2008; p. 367.
- Eurostat. 2013. European System of Accounts: ESA 2010. Collection: Manuals and Guidelines. Luxembourg: Publications Office of the European Union. ISBN 978-92-79-31242-7. doi:10.2785/16644. Cat. No: KS-02-13-269-EN-C. Available at: <https://ec.europa.eu/eurostat/documents/3859598/5925693/KS-02-13-269-EN.PDF/44cd9d01-bc64-40e5-bd40-d17df0c69334>. Accessed: 13 Nov, 2020.
- Eurostat. 2018. The evolution of farms and farmland from 2005 to 2016. In *Farms and farmland in the European Union - statistics. Statistics explained*. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics. Accessed: 26 Oct, 2020.
- Eurostat. 2019. Agricultural labour productivity. In *Performance of the agricultural sector. Statistics explained*. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Performance_of_the_agricultural_sector. Accessed: 26 Oct, 2020.
- Eurostat. 2020a. Risk of temporary layoff reduced hours by economic sector in EU (measured as probability from 0 to 1). In "*COVID-19 labour effects across the income distribution*". Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=COVID-19_labour_effects_across_the_income_distribution#A_EU_level_overview. Accessed: 13 Nov, 2020.
- Eurostat. 2020b. Employment A*10 industry breakdowns - Quarterly national accounts. 2020. Available at: https://ec.europa.eu/eurostat/databrowser/view/NAMQ_10_A10_E_custom_119216/default/table?lang=en Accessed: 10 Oct, 2020.
- Eurostat. 2020c. Gross value added and income A*10 industry breakdowns - Quarterly national accounts. Available at: https://ec.europa.eu/eurostat/databrowser/view/NAMQ_10_A10_custom_119256/default/table?lang=en. Accessed: 10 Oct, 2020.

This brief has been prepared by the Joint Research Centre (JRC) for the European Commission's Knowledge Centre for Bioeconomy, which brings together knowledge and scientific evidence from within and outside of the European Commission in a transparent, tailored and concise manner, to inform policymaking on the bioeconomy. The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use that might be made of this publication.



European Commission's Knowledge Centre for Bioeconomy
<https://ec.europa.eu/knowledge4policy/bioeconomy>

Contact: EC-Bioeconomy-KC@ec.europa.eu

JRC122314

Printed in Italy

© European Union, 2020

Reproduction is authorised provided that the source is acknowledged, save where otherwise stated.