European Commission

The European Commission's Knowledge Centre for Bioeconomy

Brief on jobs and growth in the EU bioeconomy 2012-2021

Key messages

1. In 2021 the biomass-producing and converting sectors of the EU economy created up to EUR 728 billion of value added and employed 17.2 million people. These values represent 5.0 % of the EU's gross domestic product (GDP) and 8.2 % of its labour force.

2. Between 2012 and 2021, the value added in the bioeconomy sectors in real terms grew by 39 %, mainly driven by the bio-based manufacturing sectors.

3. However, there was a decrease of 1.3 million jobs in the same period, primarily due to the reduction in agricultural employment; by contrast, some bio-based industries increased their employment levels during the period analysed.

4. With respect to the COVID-19 crisis, the bioeconomy showed more resilience than the overall economy. Traditional biomass-processing sectors declined in 2020 but strongly recovered in 2021, while more technological sectors show more stable trends during this period. This highlights the key role of the EU bioeconomy, not only for environmental sustainability, but also for strengthening socioeconomic resilience and the contribution to the EU's strategic autonomy.

5. The structure of the EU bioeconomy varies across Member States. Generally, Eastern and Southern European countries have higher shares of bio-based sectors over GDP and total employment, due to their specialisation in primary sectors. However, these countries also accounted for most of the agricultural workforce decline, resulting in a subsequent increase of the apparent labour productivity.

Policy context and scope of this brief[1]

The bioeconomy in the EU is seen as a key enabler and outcome of the transition to a sustainable and equitable economy. The EU's Bioeconomy Strategy is aligned with the overarching European Green Deal and can act as a catalyser for systemic change.

The EU's Bioeconomy Strategy outlines five objectives:

1) Ensuring food and nutrition security

2) Managing natural resources sustainably

3) Reducing dependence on non-renewable resources

4) Mitigating and adapting to climate change

5) Strengthening European competitiveness and creating jobs

In order to monitor progress in achieving these objectives, the JRC has developed the EU Bioeconomy Monitoring System to track economic, environmental, and social advancements towards a sustainable bioeconomy (Mubareka et al., 2023).

This brief is based on the update of the 'Jobs and Wealth in the European Union Bioeconomy' dataset for the year 2021. This data source provides estimates of the number of persons employed and value added in the biomass producing and converting sectors[2] (i.e., the primary sectors, and the manufactures of food, beverages and other agro-manufacturing; bio-based textiles, wood products and furniture, paper, bio-based chemicals, pharmaceuticals, plastics and rubber, liquid biofuels and bio-based electricity).

These indicators also feed the EU-Bioeconomy Monitoring System (EU-BMS), thereby supporting the assessment of progress of the fifth objective of the EU's Bioeconomy Strategy.

[1] This brief is based on EU-BMS-Jobs&Growth dataset (Jobs and wealth in the EU bioeconomy) dashboard. It is accompanied by the dedicated infographic "Bioeconomy employment and value added: 2021 data". The underlying socio-economic indicators are part of the EU Bioeconomy Monitoring System, hosted in the EC Knowledge Centre for Bioeconomy.

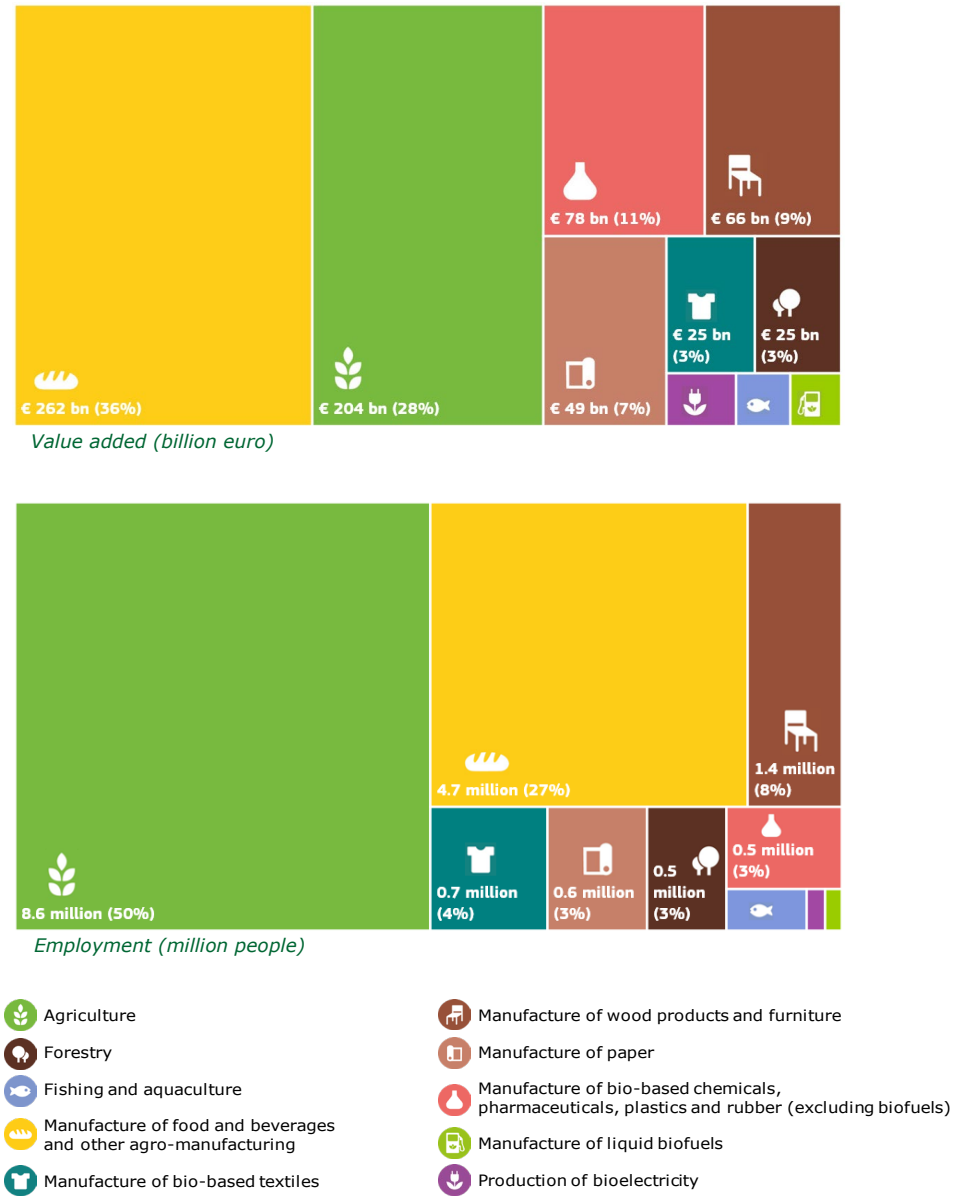
[2] Some specific bio-based sectors are not covered in this brief (see "Knowledge gaps" section). Additionally, other important dimensions (such as the environmental aspects) are also not analysed in this document.

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

Based on the most recent estimates, the bioeconomy contributed in 2021 up to EUR 728 billion in value added to the EU-27[3], accounting for 5.0 % of the GDP. Of this, almost two thirds were generated in the agri-food sector (agriculture and manufacture of food, beverages and other agro-manufacturing). The bio-based chemicals, pharmaceuticals, plastics, and rubber sectors are the third largest contributors with 11 % of the total bio-based value added (see Figure 1).

In terms of employment, the bioeconomy provided 17.2 million jobs in 2021, which represented 8.2 % of total EU employment. More than half worked in agriculture (51 %), 27 % in the food, beverages and other agro-manufacturing, and around 8 % in the wood and wooden furniture manufacturing sectors.

Figure 1. *Value added (billion euro, on top) and employment (million people, on bottom) the biomass producing and converting sectors of the EU-27 in 2021.*



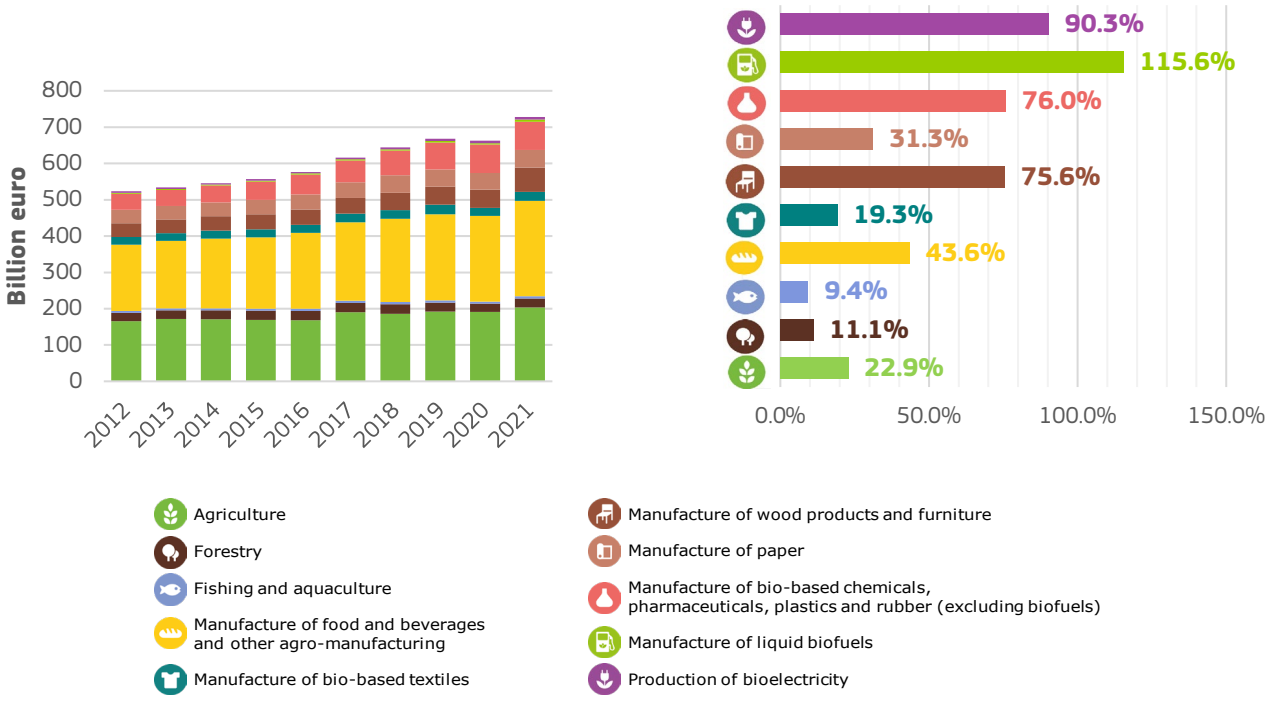
Source: *Own elaboration*

[3] 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), Czechia (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).

2. How did value added and employment in the bioeconomy evolve over the period 2012-2021?

Since the financial and sovereign debt crisis, the EU bioeconomy has registered steady growth. Between 2012 and 2021, the **value added** at market prices in the analysed bioeconomy sectors grew by 39 % (from 523 billion euros to 728 billion, see Figure 2). Within this trend, the most significant growth was observed in energy-related sectors (see Figure 2). Specifically, the liquid biofuels sector grew by 116 % in the analysed period, while the generation of bio-based electricity[4,5] increased by 90 %. Sectors with growth above 70 % include bio-based chemicals, pharmaceuticals, plastics, and rubber (76 %), as well as the wood and wooden furniture sectors (76 %). The manufacturing sector of food, beverages, and other agro-manufacturing also saw an increase of 44 %, while the paper industry grew by 31 %. Conversely, sectors like primary industries and bio-based textiles experienced growth below 25 %.

Figure 2. *Value added in the EU-27 bio-based sectors: evolution since 2012 (billion euro, left) and sectoral variation (%, right) during the period 2012-2021.*



Source: *Own elaboration*

The value added in the bioeconomy sectors grew at an average annual rate of 2.8 %, surpassing the EU-27 GDP at market prices, which grew by 2.2 % on average during the same period. Additionally, from 2016 onwards, the bioeconomy sectors recorded higher growth than the GDP in virtually all years.

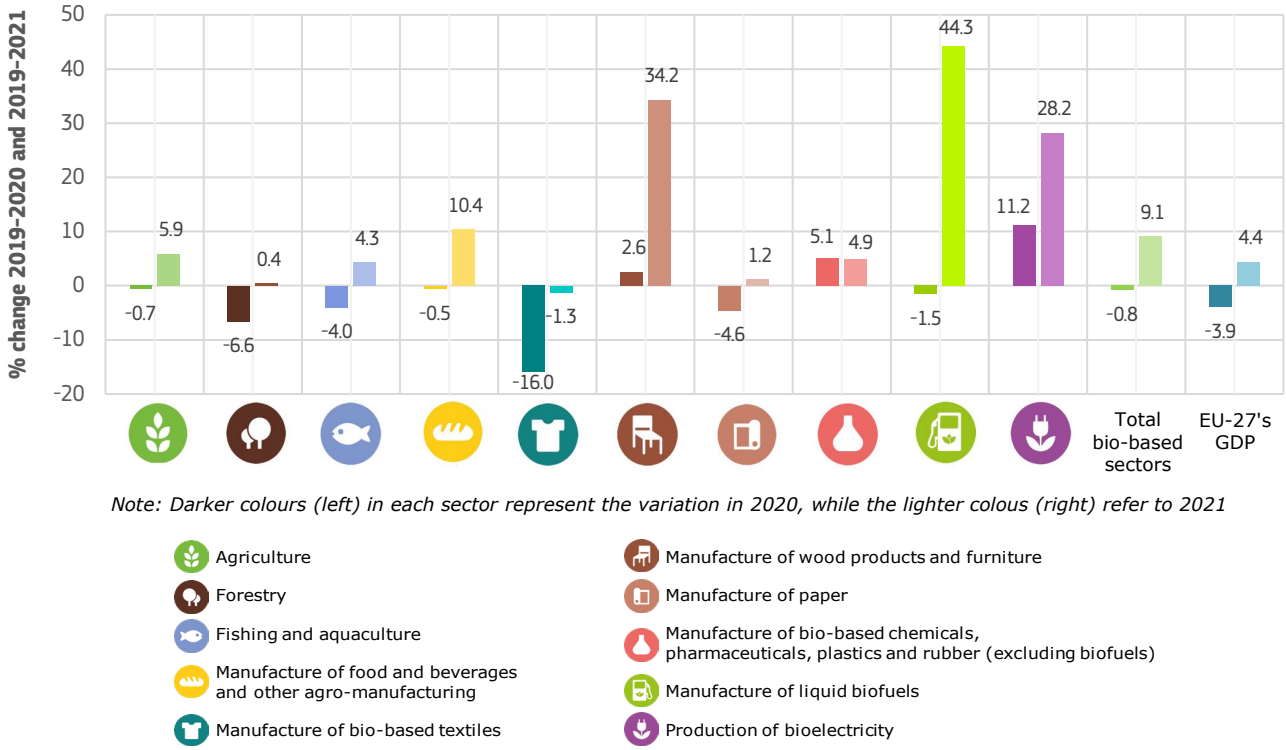
The analysis of the last two years (2020 and 2021) provides some insights on the economic impact of the **COVID-19 pandemic** on the bioeconomy. In general, the biomass-producing and converting sectors of the EU bioeconomy showed greater resilience to the pandemic shock than the overall economy, not only due to a smaller decline in 2020 (-0.8 % vs. -3.9 %, respectively), but also to a stronger recovery in 2021 (9.9 % vs. 8.7 %). The value added of the analysed bio-based sectors in 2021 was 9.1 % above the 2019 level, compared to a 4.4 % change of the EU's GDP (see Figure 3). These facts point to the key role of the EU bioeconomy not

[4] 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.

[5] 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).

only for advancing the green transition, but also for strengthening the socio-economic resilience and contributing to the strategic autonomy of the EU.
At the sector level, the value added in several activities (i.e. the bio-based chemicals, pharmaceuticals, plastics and rubber, the wood products and furniture manufacturing sectors and the production of bio-based electricity) outperformed both the bioeconomy average and the EU's GDP. Sectors such as food, beverages and other agro-manufacturing, and agriculture presented negative growth, albeit still above the EU's GDP[6].

Figure 3. *Percentage variation of the value added by sector in both 2020 and 2021 compared to the 2019 level (EU-27).*



Note: Darker colours (left) in each sector represent the variation in 2020, while the lighter colous (right) refer to 2021

Source: *Own elaboration*

In 2021, the bioeconomy sectors showed a widespread recovery. The value added of the agriculture and the manufacture of food, beverages, and other agro-manufacturing sectors were respectively 5.9 % and 10.4 % above the 2019 levels. Due to their greater relative importance within the bioeconomy, these sectors acted as the main drivers of the economic recovery. The manufacture of wood and wooden furniture also supported the bioeconomy recovery, growing by 34 % over the two years analysed. The sectors of liquid biofuels and production of bio-based electricity also registered strong growth. All the remaining sectors exceeded the 2019 level, with the exception being the bio-based textiles, which still lagged 1.3 % behind. The sector of bio-based chemicals, pharmaceuticals, plastics, and rubbers is the only one that showed a decrease compared to the previous year, after an increase in 2020. However, its value added in 2021 was still 4.9 % above the 2019 level, which evinces the stabilising role of this sector during the two years analysed.

Regarding **employment**, the number of people employed in the biomass producing and converting sectors of the bioeconomy showed a decreasing trend (see Figure 4, left). The total number of jobs decreased from 18.5 million in 2012 to 17.2 million in 2021 (-7 %). However, this overall reduction trend hides significant sectoral divergences among the different bio-based sectors.

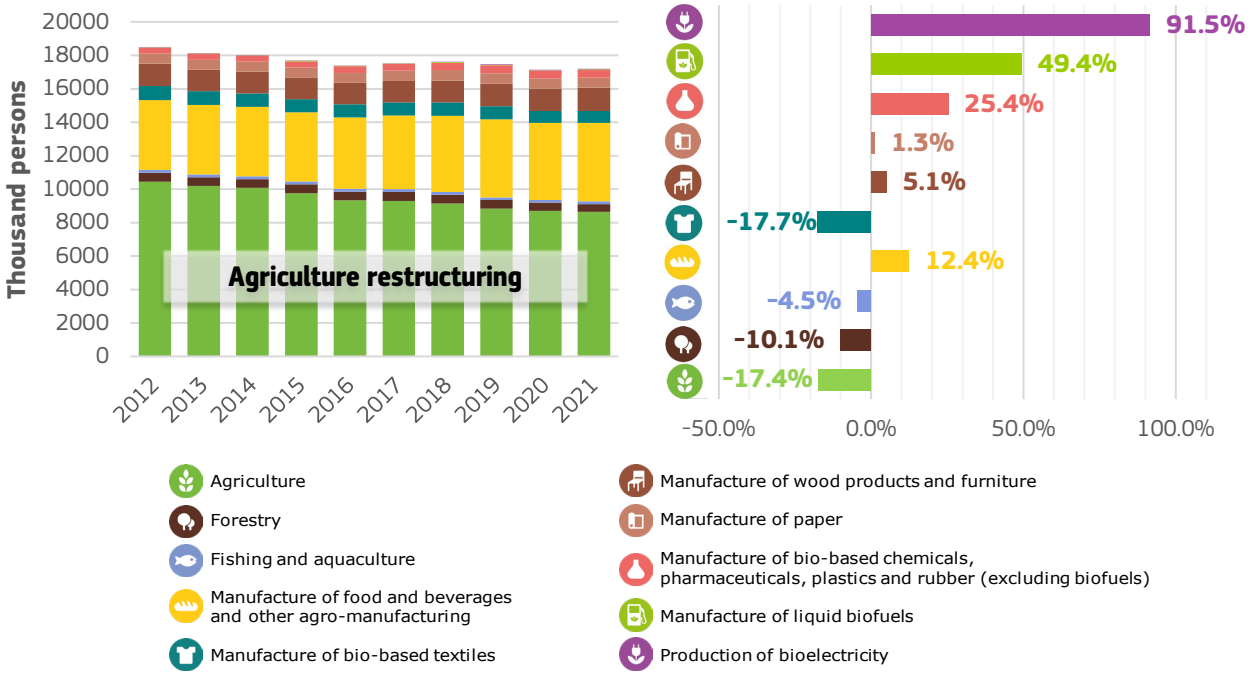
The main factor explaining the decreasing trend in employment is the ongoing restructuring of the agriculture sector[7], which led to a reduction in the number of persons employed by 1.8 million (-17.4 % of total agricultural workforce) between 2012 and 2021 (see Figure 4, right). The number of persons employed also declined significantly in other "traditional" sectors, such as the manufacture of bio-based textiles (-149 900 jobs, -17.7

[6] See Lasarte-López et al. (2023) for further details on the impact of the pandemic on the bioeconomy in 2020.

[7] The restructuring refers to changes in the pattern of land holdings and size distribution of farms (Eurostat, 2018) driven by changes in mechanization and efficiency, resulting in the reduction of the agricultural workforce and a subsequent increase in the apparent labour productivity (Eurostat, 2019).

%) and the other primary sectors (-53 000 jobs in the forestry sector, -10.1 %; and -7 700 jobs in the fishing and aquaculture sectors, -4.5 %).

Figure 4. *Employment in the EU-27 bio-based sectors: evolution since 2012 (million people employed, left) and sectoral variation (%, right) during the period 2012-2021.*

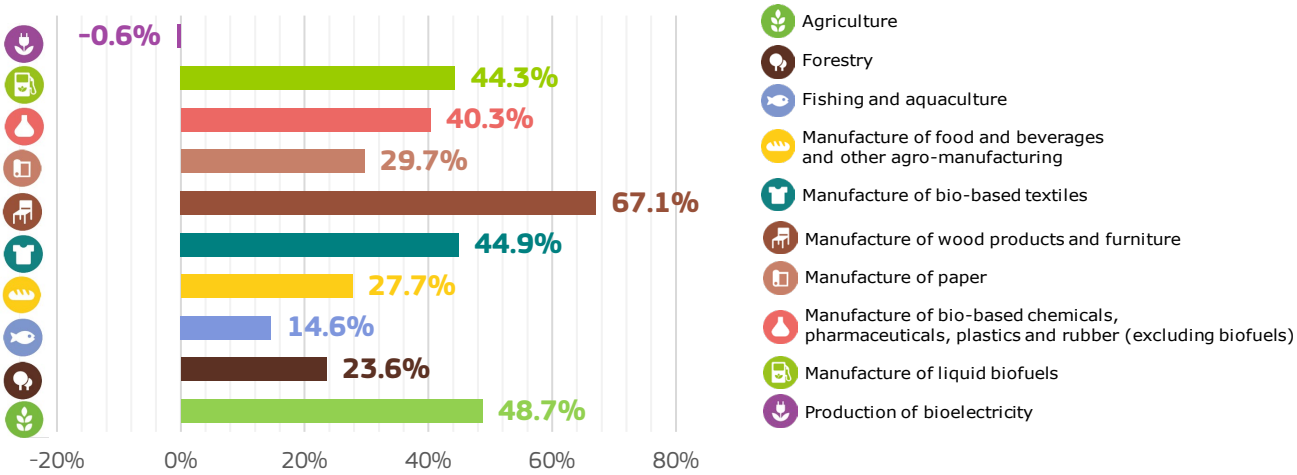


Source: *Own elaboration*

On the other hand, employment increased significantly in the following sectors: manufacture of food, beverage and other agro-manufacturing (+519 600 people, +12.4 %), bio-based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels) (+92 700 people, +25.4 %), wood products and furniture (+68 100 people, +5.1 %), bio-based electricity (+17 400 people, +91.5 %), liquid biofuels (+28 860 people, 4.8 %) and paper (+7 400 people, +1.3 %).

Most bioeconomy sectors registered gains in **labour productivity** from 2012 to 2021 (see Figure 5). The wood products and furniture manufacturing sectors showed the highest increase (+67.1 %)[8]. In the agriculture and the bio-based textiles sectors, the labour productivity grew 48.7 % and 44.9 %, respectively, due to the aforementioned opposed trends in value added (increasing) and the number of persons employed (decreasing). Increases above 40 % are also observed in the bio-based chemicals, pharmaceuticals, plastics and rubber sectors, including the liquid biofuels manufacturing. On the other hand, we find the bio-based electricity production sector, where labour productivity appears to have been more stable (-0.6 %).

Figure 5*. Labour productivity growth in the bio-based sectors between 2009 and 2019 in the EU-27.*



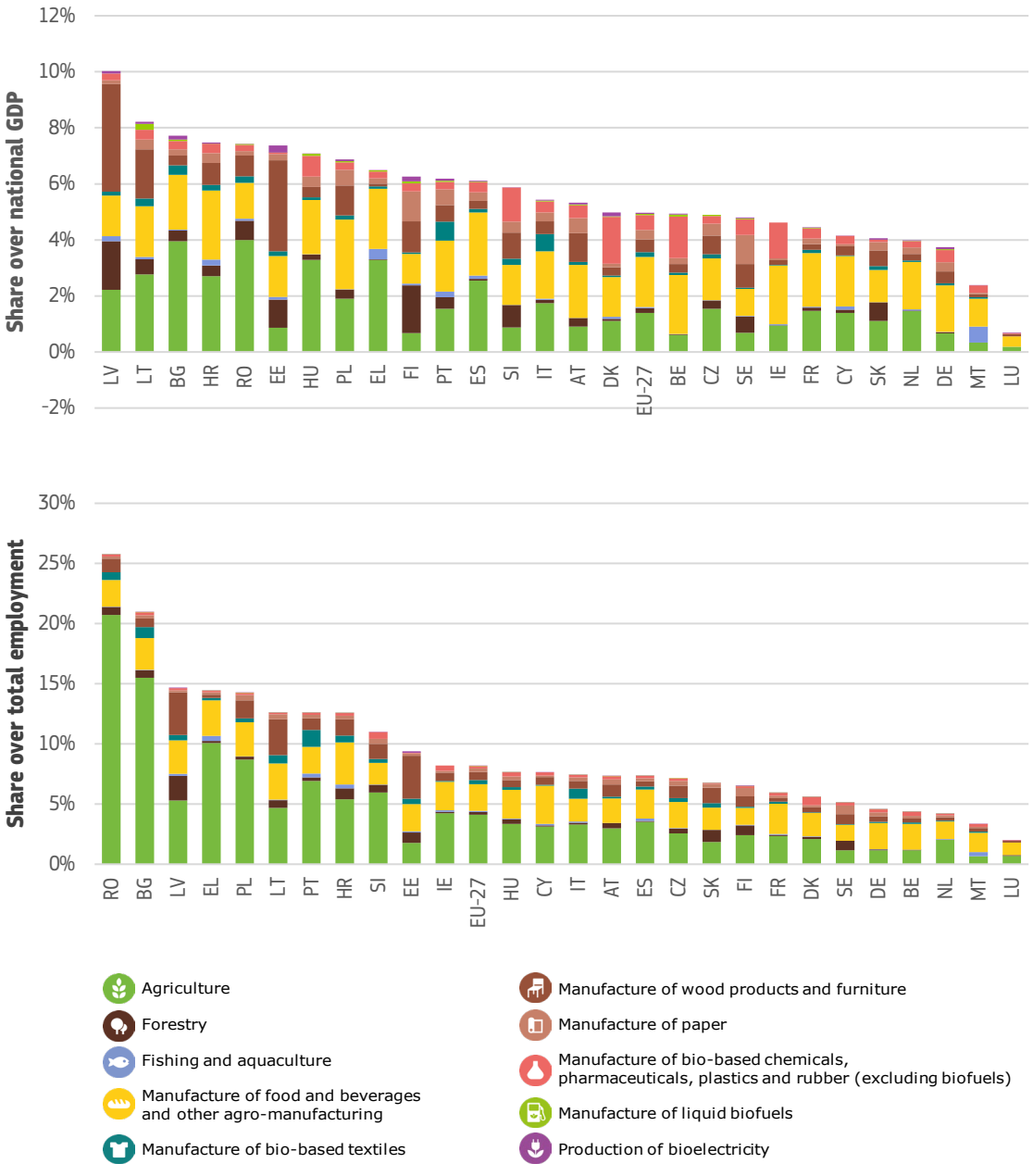
Source: *Own elaboration*

[8] The increase of wood prices in the last years had a significant effect in the evolution of this variable, especially from 2020 onwards.

3. What are the main trends of socio-economic indicators of the bioeconomy among EU Member States?

The bioeconomy varies in structure and dynamics across EU Member States (Figure 6). In general, the biomass-producing and converting sectors range from less than 1 % (Luxembourg) to around 10 % (Latvia), with most Member States falling within the 4 %-8 % range. Employment in these sectors varies more widely, with some countries exceeding 20 %. However, the majority of countries have 5 % to 15 % of jobs in biomass-producing and converting sectors. Moreover, Eastern European countries tend to have higher shares of bioeconomy sectors, and are more specialised in agriculture and food manufacturing (e.g. Romania, Bulgaria or Hungary), as well as forestry and wood converting (e.g. Baltic countries).

Figure 6. *Share of value added (on top) and employment (bottom) in the biomass producing and converting sectors over total EU-27 employment in 2021.*

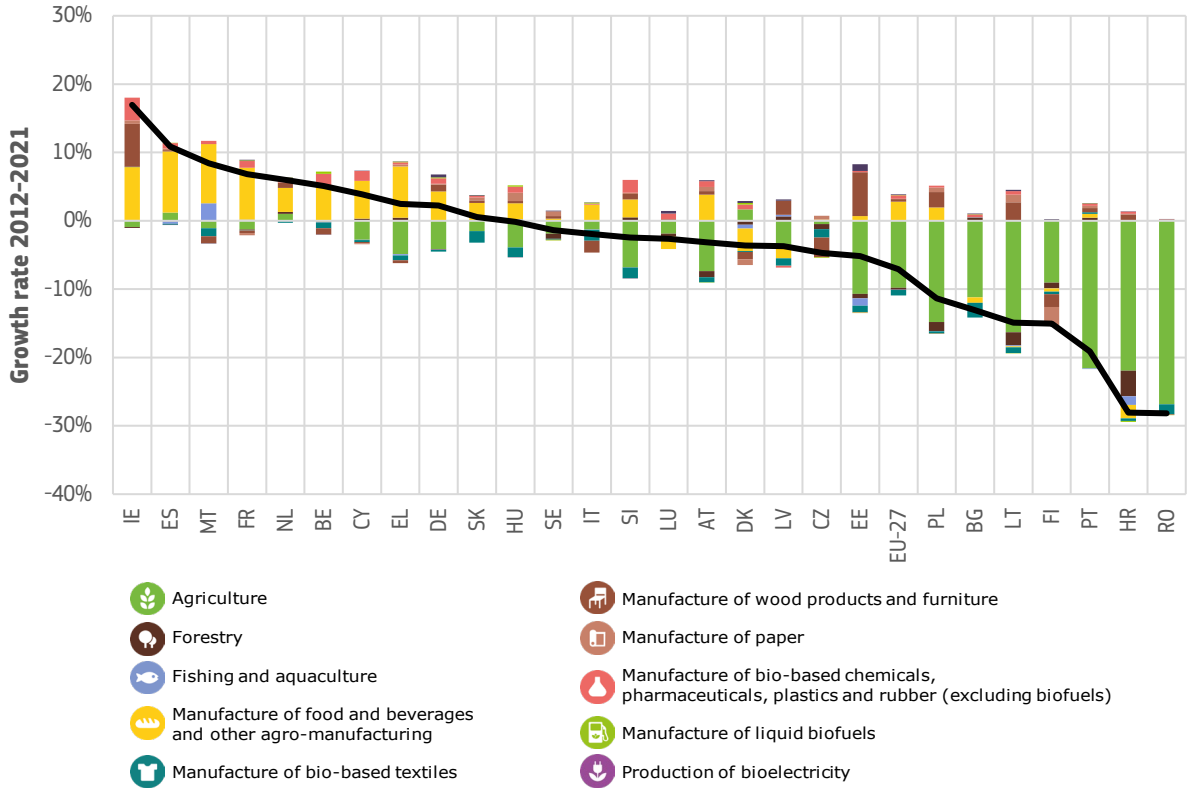


Source: *Own elaboration*

While value added from all bioeconomy sectors registered steep rises across Member States between 2012 and 2021, we can observe significant divergences in the case of employment (see Figure 7). The trend of restructuring in agriculture identified in section 2 is mainly occurring in the countries more oriented towards agriculture in Eastern Europe (Romania, Croatia, Lithuania, Bulgaria, Poland and Estonia, among others), probably as a consequence of the modernisation of biomass-producing and converting sectors. This effect is also observed in other European countries (e.g. Portugal or Finland). These facts, alongside the increasing trends in value added, evidenced substantial increases of agricultural productivity.

On the other hand, the manufacturing of food and beverages and other agro-manufacturing sectors were the main drivers in those countries with the highest increases in the number of employed persons in the bioeconomy. Additionally, the bio-based chemicals, pharmaceuticals, plastics, and rubber industries made positive contributions across all Member States.

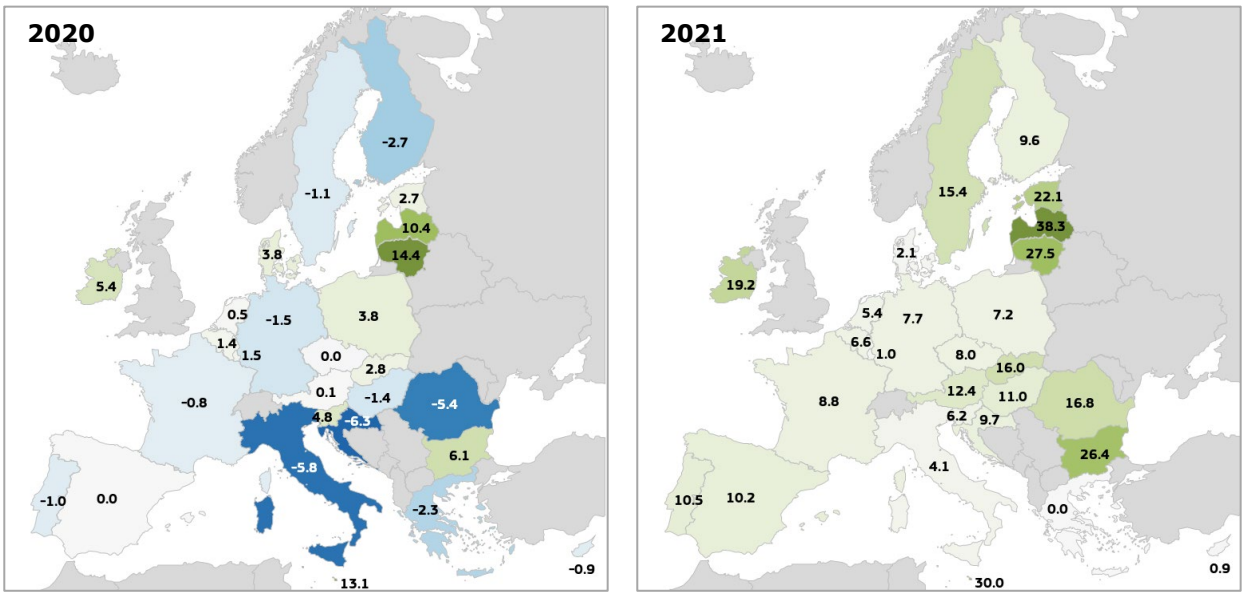
Figure 7. *Contribution by sector to overall growth rate of biomass-producing and converting activities in the EU-27*



Source: *Own elaboration*

The evolution of the bioeconomy in the EU Member States during the last two years is characterised by a high degree of heterogeneity in the **impact of the COVID-19 pandemic** in 2020 and the recovery in 2021. While there is not a clear geographical pattern in the value added variation of the bioeconomy sectors in 2020, Eastern European countries generally had better performance, as their bioeconomies mostly recorded positive growth ratios (see Figure 8, left). However, there are substantial divergences; while bioeconomy sectors in Latvia and Lithuania registered steep rises above 10 %, Hungary, Romania, and Croatia experienced decreases.

Figure 8. *Value added growth in biomass-producing and converting sectors in 2020 (left) and 2021 (right) compared to 2019.*



Source: *Own elaboration*

As of the rest of the EU, the bioeconomy sectors in Ireland, Denmark, Luxembourg, Belgium, and the Netherlands registered positive growth rates. With the exception of Sweden and Finland, these countries correspond to those with higher value added in the bioeconomy sectors, with a prevalence of bio-based manufacturing sectors (see Ronzon et al., 2022). Positive growth is also registered for Malta and Austria, while in Spain and Czechia the rate was near to zero.

In 2021, the biomass-producing and converting sectors already surpassed the 2019 level in all countries (Figure 8, right). Again, Eastern countries outperformed the EU average, with the Baltic countries standing out with growth rates above 20 %, probably influenced by the rise in wood prices. This effect is also significant for Sweden and Finland.

Two-digit growth rates are also identified in other 9 Member States (Malta, Bulgaria, Ireland, Romania, Hungary, Austria, Slovakia, Portugal and Spain). For these Member States, the sectors acting as main drivers of the positive evolution are the primary sectors and/or the manufacture of food, beverages and other agro-manufacturing sectors.

Overall, we can conclude that the evolution of the EU bioeconomy is also reflected in the divergences among Member States. On the one hand, those countries whose bioeconomy is more specialised in highly productive bio-based manufacturing (bio-based chemicals, pharmaceuticals, plastics, rubber, and liquid biofuels) also tended to register more stable growth rates during the pandemic (countries in Central Europe). Meanwhile, those countries more specialised in traditional sectors recorded greater volatility, although with a stronger recovery, driven by the food system and the wood supply chain sectors.

Knowledge gaps

1. In the absence of official statistics for all sectors of the bioeconomy, this document is partly based on estimates following the nova-Institute's methodology for bio-based shares. 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 are not available for certain sectors in most recent years (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. In addition to the sectors analysed in this report, there are other sectors that, according to the EU definition, also fall within the scope of the bioeconomy, but are not covered in this report due to the difficulties in measuring their socioeconomic contribution to the bioeconomy. This includes bio-heat generation, construction, management of organic waste, or production of algae through aquaculture. Furthermore, bioeconomy services, such as restaurants, waste treatment, food retail trade, repair of bio-based products, and recreational activities, were not included in this analysis due to the challenge of assessing the bio-based shares of such sectors.
4. Work to close those gaps is published in Ronzon et al. (2022a), Robert, et al. (2020) for specific wood-based sectors, Ronzon et al. (2022b) for bio-based services and by Kuosmanen et al. (2020) and Cingiz et al. (2021) for all sectors represented in the National Accounts.
5. The estimates presented in this brief may be subject to correction in the future as more data become available.
6. The scope of this brief is to provide an overview of the current socioeconomic situation of key bioeconomy sectors. The authors are aware that the discussion around the bioeconomy is broader, and a holistic assessment of the bioeconomy should also consider the environmental aspects. The report "Trends in the EU Bioeconomy" (Mubareka et al., 2023) provides a complete analysis of all indicators considered within the EU-Bioeconomy Monitoring System.

References

Cingiz, K., Gonzalez-Hermoso, H., Heijman, W., & Wesseler, J. H. H., 2021, A Cross-Country Measurement of the EU Bioeconomy: An Input–Output Approach. Sustainability, 13(6), 3033. https://doi.org/10.3390/su13063033

Eurostat, 2008, NACE Rev. 2 Statistical Classification of Economic Activities in the European Community; Office for Official Publications of the European Communities: Luxembourg, p. 367. Available at: https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF

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, 2021, Annual detailed enterprise statistics for industry. Available at: https://ec.europa.eu/eurostat/databrowser/bookmark/9d8c6439-d25e-4499-9397-1f78d0b3edad?lang=en. Accessed: 18 May, 2022.

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, ISBN 978-92-76-17858-3, doi:10.2760/144526, JRC120324

Lasarte-López, J., Grassano, N., M'barek, R., & Ronzon, T., 2023, Bioeconomy and resilience to economic shocks: insights from the COVID-19 pandemic in 2020. *Bio-based and Applied Economics*. https://doi.org/10.36253/bae-14827

Mubareka, S., Giuntoli, J., Sanchez Lopez, J., Lasarte Lopez, J., M`barek, R., Ronzon, T., Renner, A. and Avraamides, M., 2023, Trends in the EU bioeconomy, Publications Office of the European Union, Luxembourg, https://doi.org/10.2760/835046, JRC132639

Robert, N., Jonsson, R., Chudy, R., Camia, A., 2020. The EU Bioeconomy: Supporting an Employment Shift Downstream in the Wood-Based Value Chains?, *Sustainability*, 12, 758. https://doi.org/10.3390/su12030758.

Ronzon, T., Piotrowski, S., Tamosiunas, S., Dammer, L., Carus, M., M'Barek, R, 2020, Developments of Economic Growth and Employment in Bioeconomy Sectors across the EU. *Sustainability*, 12, 4507. https://doi.org/10.3390/su12114507.

Ronzon, T., Iost, S. & Philippidis, G., 2022a. Has the European Union entered a bioeconomy transition? Combining an output-based approach with a shift-share analysis. *Environ Dev Sustain* 24, 8195–8217. https://doi.org/10.1007/s10668-021-01780-8.

Ronzon, T., Iost, S., Philippidis, G. 2022b. An output-based measurement of EU bioeconomy services: Marrying statistics with policy insight. *Structural Change and Economic Dynamics*, Pages 290-301, Vol.10. https://doi.org/10.1016/j.strueco.2021.10.005.

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