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SCIENCE FOR POLICY BRIEF

The Life Sciences sectors in the EU: drivers of economic growth and innovation

HIGHLIGHTS

→ The Life Sciences (LS) sectors cover the economic activities relying on LS knowledge and know-how, such as healthcare, pharmaceuticals, biotechnology, medical devices, and agrifood technologies. This policy brief analyses three main areas within the LS sectors: (1) primary production, food and bio-based manufacturing, (2) human healthcare technologies and services, and (3) horizontal knowledge-based activities.

→ The Life Sciences (LS) sectors are significant contributors to the EU economy. In 2022, they employed 29 million people (13.6 % of total EU employment), generated EUR 1.5 trillion in value added (9.4 % of EU's GDP).

→ The LS sectors are very diverse in terms of their structure and recent trends. In 2022, the primary production, food and bio-based manufacturing activities created 18 million jobs and EUR 785 billion in value, while human health technologies and services generated 9.5 million jobs and EUR 622 billion.

→ Despite stable employment levels in the LS sectors between 2012 and 2022, there was a shift towards high-skill sectors (e.g. bio-based chemicals, pharmaceuticals, medical equipment, scientific research, etc.).

→ The value added generated in LS sectors outperformed the overall GDP growth between 2012 and 2022. The main drivers were medical products, pharmaceuticals, and bio-based manufacturing activities like bio-based chemicals or food manufacturing.

→ Business expenditure on R&D from the LS sectors was 19.4 % of total EU expenditure. This share is significantly higher than that of employment or value added. The manufacture of pharmaceuticals and scientific research activities are the main contributors.

→ The LS sectors boosted EU growth in recent years (increasing contribution to GDP, creating jobs in knowledge-based activities) and are innovation-intensive sectors with potential to enhance competitiveness.

Access to data: https://datam.jrc.ec.europa.eu/datam/mashup/LIFE_SCIENCES_SECTORS

INTRODUCTION

Life sciences play a vital role in addressing EU challenges and promoting prosperity. By driving innovation in key areas such as healthcare, biotechnology, biomanufacturing, food or agriculture, life sciences have the potential to tackle major societal issues, including enhancing competitiveness, promoting sustainability, ensuring food security, improving health outcomes, strengthening open strategic autonomy and, ultimately, improving the quality of life for EU citizens. The new EU Life Sciences Strategy aims to boost competitiveness, accelerate green and digital transitions, create jobs, and reduce external dependencies by rapidly developing and commercialising innovative ideas and solutions.

Joint Research Centre

Socioeconomic relevance

The Life Sciences (LS) sectors comprise the activities relying on life sciences knowledge and innovation, including healthcare, pharmaceuticals, biotechnology, medical devices, and agrifood technologies[1]. This brief provides an overview of the socioeconomic context, sectoral structure and trends of LS sectors in the EU. For this, three key areas have been identified where life sciences have significant importance and potential:

1. **Primary production, food and bio-based manufacturing**, which encompasses a range of activities, including agriculture, forestry, and fishing, the manufacture of food and beverages and other products, as well as bio-based textiles wood products and furniture, paper and printing products, bio-based chemicals (including biofuels), plastics and rubber, generation of bio-based electricity, and bio-based construction.
2. The **human healthcare technologies and services** are another key area, which includes the manufacture of pharmaceutical products (both bio-based and non-bio-based), irradiation equipment, electromedical and electrotherapeutic equipment, medical and dental instruments and supplies, and human health activities (healthcare services provided by health professionals and healthcare providers).
3. The third area covers **horizontal and knowledge-based activities**, which comprises activities driven by life sciences knowledge and know-how, such as scientific R&D in biotechnology and other natural sciences; technical activities such as architecture, veterinary, and botany, and education in fields relevant to life sciences and human health.

As reflected in their contribution to the main socio-economic indicators (Table 1), the LS sectors play a vital role in shaping the economic and social landscape in the EU.

The LS sectors employed approximately **29 million people in 2022**, accounting for **13.6 % of the EU's total employment (see Figure 1)**. Of this size, approximately 18 million people worked in activities related to primary production, food, and bio-based manufacturing, of which around 13.5 million people were employed in agrifood activities. Human health technologies and services employed 9.5 million people, while horizontal knowledge-based activities created around 1.7 million jobs.

Table 1. Socioeconomic indicators of the Life Sciences sectors

Economic sector	Number of persons employed (thousand persons)	Value added (million Euro)	Business expenditure on R&D (million euro)
Primary production, food and bio-based manufacturing (*)	**17 931**	**785 317**	**7 568**
Agriculture, forestry and fishing	9 161	270 448	1 133
Food, beverages and other agro-manufacturing	4 759	274 033	3 240
Bio-based textiles	685	27 490	526
Wood products and furniture; Paper and printing activities	2 291	143 791	1 281
Bio-based chemicals, plastics and rubber	203	23 414	1 259
Generation of bio-based electricity	38	8 375	36
Bio-based construction	685	33 332	93
Other bio-based manufacturing	110	4 435	n.a.
Human health technologies and services	**9 489**	**621 939**	**24 730**
Pharmaceuticals	650	146 761	18 686
Manufacture of irradiation, electromedical, and electrotherapeutic equipment	75	8 953	2 385
Manufacture of medical and dental instruments	570	44 227	2 919
Human health activities	8 193	421 999	739
Horizontal knowledge-based activities	**1 735**	**102 987**	**14 255**
Scientific R&D	291	31 963	13 475
Veterinary and other technical professions	773	36 578	775
Education	671	34 446	5
TOTAL LIFE SCIENCES SECTORS	**29 155**	**1 510 243**	**46 553**

(*) Excluding bio-based pharmaceuticals, which are included in human health technologies and services.

Source. Own elaboration

[1] Given the absence of a clear definition of LS sectors, the sector scope from the Call for evidence on the EU Life Sciences Strategy is considered: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14592-EU-life-sciences-strategy_en

The **LS sectors value added was 1.5 trillion in 2022 (9.4 % of the EU's GDP, see Figure 2).** The primary production, food and bio-based manufacturing activities contributed EUR 785 billion; the human health technologies and services activities generated EUR 622 billion, while horizontal knowledge-based activities accounted for EUR 103 billion.

Regarding business expenditure on R&D, **the LS sectors invested EUR 46.6 billion in R&D in 2022**, which represents **19.4 % of the EU's total R&D expenditure (see Figure 3)**. The sectoral distribution of this indicator reveals a different pattern than that of the previous indicators. The human health technologies and services activities are the largest contributor, accounting for EUR 24.7 billion, of which the pharmaceutical industry contributed EUR 18.7 billion. The horizontal knowledge-based activities invested EUR 14.3 billion, while the primary production, food and bio-based activities expended EUR 7.5 billion.

TRENDS IN THE EU LIFE SCIENCES SECTORS

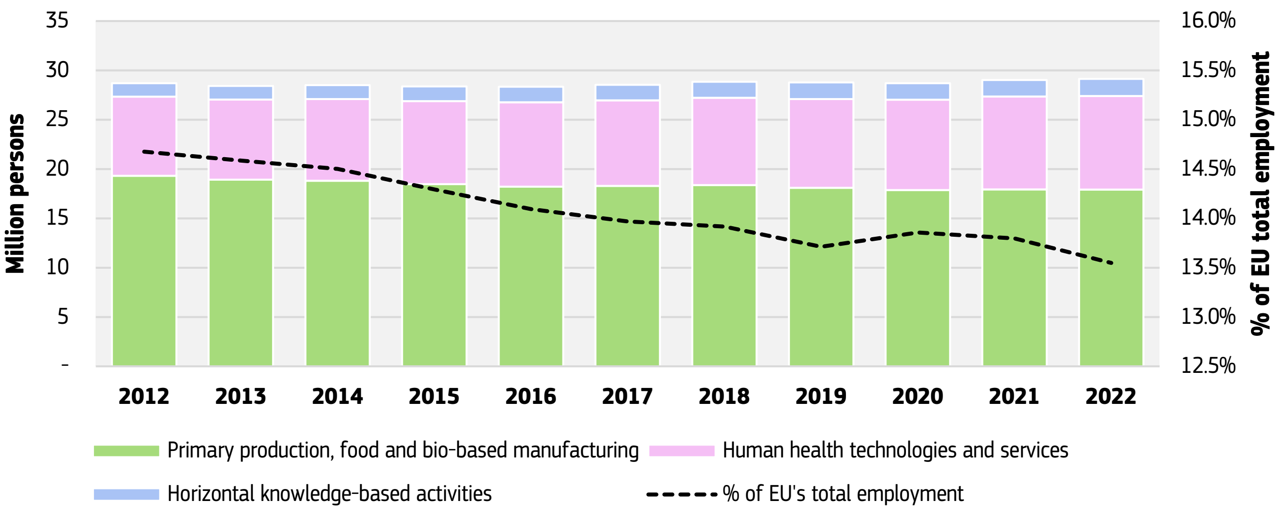
Employment

Figure 1 shows trends in employment in absolute numbers as well as percentage of total employment, differentiating among the three areas defined. In general, the number of persons employed in LS sectors was stable in the last decade, growing only +1.5 % (+430 000 workers) between 2012 and 2022. The **share of LS employment** over the total experienced a **decrease along this period** (from 14.7 % to 13.6 %).

Despite the stable trend in the overall employment level, some **changes** in its sectoral composition **towards high-skill and knowledge-intensive sectors** are observed along the analysed period:

- The number of persons employed in primary production, food and bio-based manufacturing activities declined by 7.2 % (from 19.3 million jobs in 2012 to 17.9 million in 2022). This trend is primarily driven by the reduction in the primary production workforce, which decreased by 2 million persons (approximately -18 %) between 2012 and 2022 (from 11.2 million jobs to 9.2 million). This decrease is explained by structural changes in the primary sector, that became more capital-intensive especially in Eastern Member States [1]. However, this decline was partially offset by an increasing trend in the number of jobs created by the bio-based manufacturing activities during the same period (+610 000 workers, +7.5 %).
- The number of persons employed in human health technologies and services activities grew by 18.4 %, (+1.5 million persons, of which 1.2 million jobs were created by human health activities). Despite their smaller contribution, the manufacture of medical products and pharmaceuticals activities experienced the highest accumulated growth between 2012 and 2022, (+30 %, +300 000 jobs).
- The horizontal knowledge-based activities also registered substantial growth in the analysed period (+26.0 %, from 1.37 million jobs in 2012 to 1.73 million in 2022). Within this sector, the scientific research and development activities grew by 44 % along the period, going from 202 000 jobs in 2012 to 291 000 in 2022.

Figure 1. Employment in the life sciences sectors (number of persons employed and percentage of total employment)



Source: Own elaboration

Value added

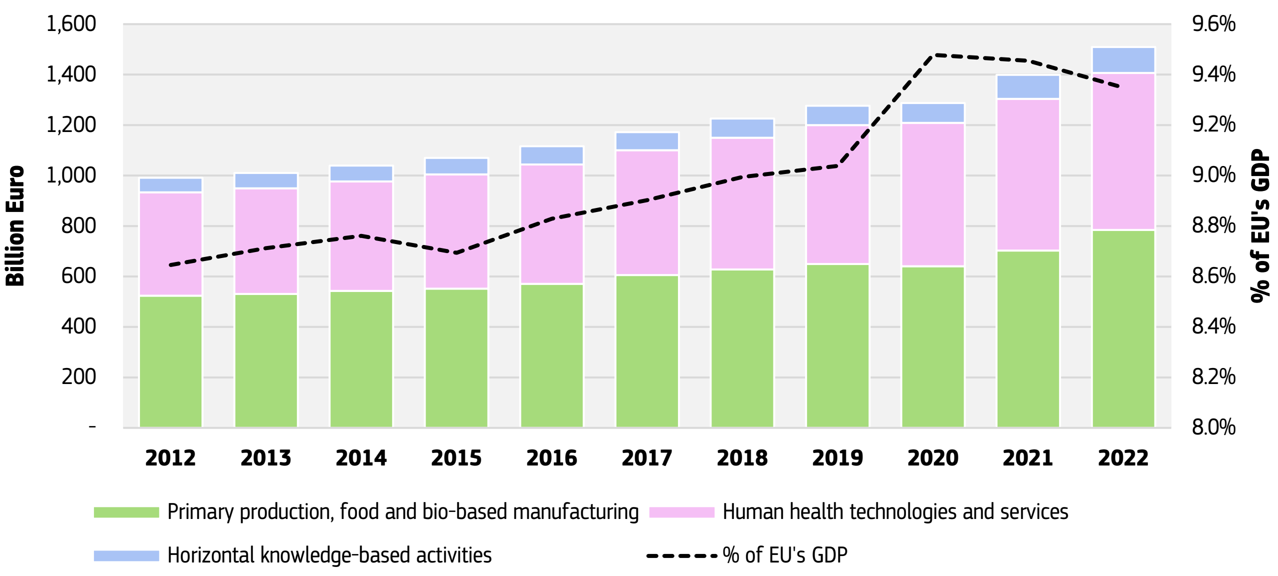
Figure 2 illustrates the value added generated by the three main areas of the LS sectors between 2012 and 2022, and as a percentage of GDP. Overall, the value added exhibited a steady increase over the analysed period. Notably, **the contribution of LS sectors to GDP grew from 8.6 % in 2012 to 9.4 % in 2022, suggesting a higher average growth than that of the overall EU economy** in this period. Indeed, the Compound Annual Growth Rate[2] (CAGR) of value added in the LS sectors was 4.3 %, compared to a CAGR of 3.5 % for the EU's GDP.

In 2020, the share of GDP peaked at 9.5 %, driven primarily by healthcare activities (pharmaceuticals and human health services), given its importance in the face of the disruption caused by the COVID-19 pandemic. Following this peak, a slight decline was observed, although the share of LS sectors in GDP remained visibly above pre-pandemic levels.

From a sectoral perspective, the three sectors showed higher growth than that of the overall economy:

- The primary production, food and bio-based manufacturing sectors grew from 524 billion euro in 2012 to 785 billion in 2022. This represents a significant increase of over 50 % over the 10-year period (CAGR of 4.1 %). Within this category, the activities with higher growth were the generation of bio-based electricity (CAGR of 7.6 %) and the manufacture of bio-based chemicals and plastics and rubber (CAGR of 6.6 %). The primary production activities (CAGR of 3.5 %) and the manufacturing of food, beverages and other agro-manufacturing (CAGR of 4.1 %) are also significant contributors, given its relevance in absolute terms.
- The human health technologies and services increased from EUR 410 billion in 2012 to EUR 622 billion in 2022. This represents an accumulated growth rate of around 52 % over the analysed period (CAGR of 4.3 %). The three covered manufacturing activities show a respective CAGR above the EU average (7.1 % for both pharmaceuticals, and irradiation, electromedical, and electrotherapeutic equipment, and 6.0 % for medical and dental instruments), while human health activities show a more modest, yet still positive, CAGR of 3.2 %.
- The horizontal knowledge-based activities also experienced significant growth, increasing from EUR 58 billion in 2012 to EUR 103 billion in 2022 (+77 % along the analysed period, CAGR of 5.9 %). Within the activities considered under this category, the scientific research in biotechnology and other natural sciences stands out, as it virtually tripled its value added between 2012 and 2022, going from EUR 10.7 billion to EUR 32 billion (CAGR of 11.6 %).

Figure 2. Value added generated in the Life Sciences sectors (million euro and percentage of EU's GDP)



Source: Own elaboration

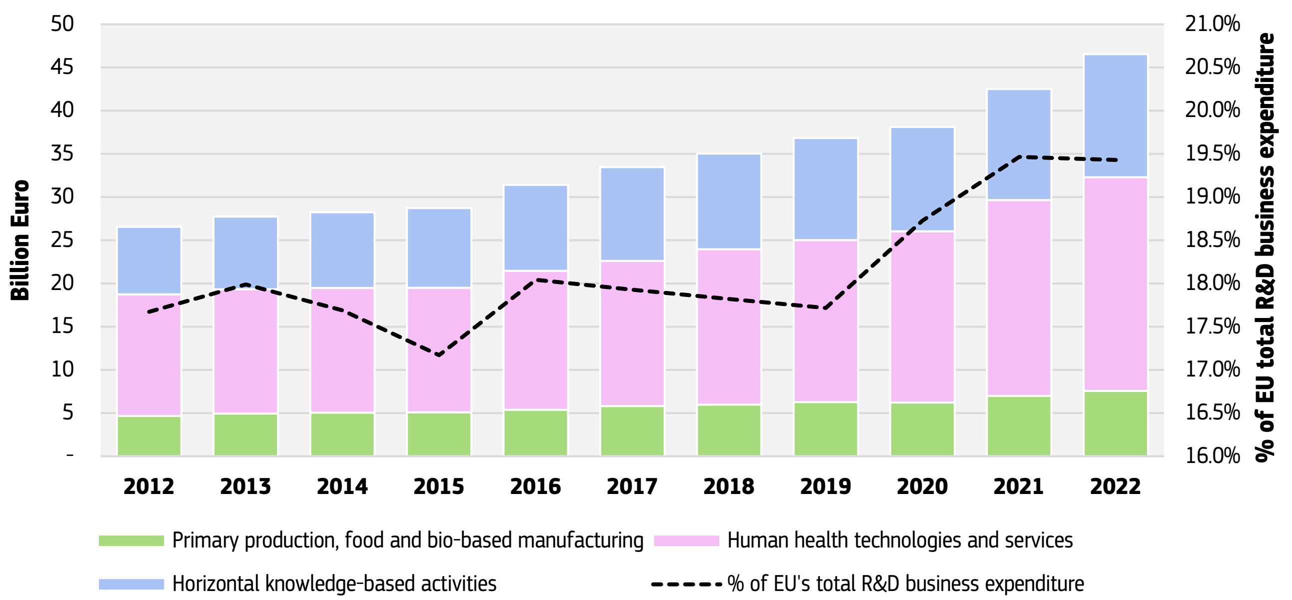
[2] The CAGR is a metric that measures the average growth of an economic variable as if it had grown at a constant rate each year. The formula is $CAGR = \left(\frac{Final\ value}{Initial\ value}\right)^{1/n} - 1$, where *n* is the number of years.

Business expenditure on R&D

Figure 4 illustrates the evolution of business expenditure on R&D in LS sectors between 2012 and 2022, both in billion Euro and as a share of total business expenditure in the EU. In general, **business expenditure on R&D in the LS sectors** has followed an **upward trend between 2012 and 2022**, increasing from EUR 26.6 billion to EUR 46.6 billion (CAGR of 5.8 %). This represents a growth above the total EU business expenditure on R&D (CAGR of 4.7 %). As a result, **the contribution from LS sectors to total business expenditure on R&D increased from 17.7 % in 2012 to 19.4 % in 2022**. This share is notably higher than the relative contributions of LS sectors to employment (13.6 %) and GDP (9.4 %). This fact evidences that the **LS sectors present, on average, a high intensity of innovation** efforts in comparison to the rest of economic activities, which positions them as strategic drivers with the potential to boost competitiveness and sustainability in the next years and decades.

- The primary production, food and bio-based manufacturing activities experienced a significant increase in business expenditure on R&D over this period, rising from EUR 4.7 billion in 2012 to EUR 7.6 billion in 2022 (i.e. accumulated growth of around 62 %, and CAGR of 4.9 %). In general, most activities covered in this sector showed a CAGR between 4 % and 7 %. The primary and food activities were key drivers of this trend, with agriculture, forestry and fishing exhibiting a CAGR of 6.5 % (from EUR 0.6 billion to EUR 1.1 billion) and the manufacture of food, beverages and tobacco showing a CAGR of 4.9 % (from EUR 2 billion to EUR 3.2 billion).
- The human health technologies and services activities saw a substantial rise in business expenditure on R&D, increasing from EUR 14 billion in 2012 to EUR 24.7 billion in 2022 (accumulated growth of 76 %; CAGR of 5.8 %). This growth was driven by strong performance across all the encompassed activities. The manufacture of pharmaceutical products was the main contributor in absolute terms going up from EUR 11 billion in 2012 to EUR 18.7 billion in 2022 (CAGR of 5.4 %). The human health activities and the manufacture of medical and dental sectors also showed significant growth in relative terms (CAGR of 10.3 % and 9.4 %, respectively).
- The horizontal knowledge-based activities also exhibited a notable increase in business expenditure on R&D, with an accumulated growth of 82 % and a CAGR of 6.2 %, growing from EUR 7.8 billion in 2012 to EUR 14.3 billion in 2022.

Figure 3. Business expenditure on R&D in the Life Sciences sectors (million euro and percentage of EU's total BERD)



Source: Own elaboration

LIFE SCIENCES SECTORS AS ENABLERS OF ECONOMIC GROWTH

The LS sectors play a vital role in the EU economy. As shown in the previous section, these sectors employed approximately 29 million people in 2022, representing 13.6 % of EU total employment, with the primary production, food and bio-based manufacturing activities being the largest employer. They also generated a value added of EUR 1.5 trillion, accounting for 9.4 % of the EU's GDP. Last, business expenditure on R&D amounted to EUR 46.6 billion, which corresponds to 19.4 % of total business expenditure.

The LS sectors were a key driver of the economic trends in the EU in the last decade. While overall employment levels in these sectors remained stable between 2012 and 2022, a change occurred in the sectoral composition of employment, reflecting a shift towards jobs in highly productive sectors, such as the manufacture of chemicals, pharmaceuticals, and medical equipment, as well as scientific research in R&D and knowledge-based activities.

The growth in value added of the LS sectors between 2012 and 2022 was higher than that of the overall economy, thereby increasing their contribution to GDP from 8.6 % in 2012 to the said 9.4 % in 2022. Some activities driving this trend were the manufacture of medical products and pharmaceuticals, which have been the fastest-growing sectors, with CAGRs above 6.0 % in value added. High growth rates were also observed in other sectors, such as the generation of bio-based electricity, the manufacture of bio-based chemicals, and the scientific research in biotechnology and other natural sciences activities.

Last, business expenditure on R&D also experienced notable growth, increasing from EUR 26.6 billion in 2012 to EUR 46.6 billion in 2022 (CAGR of 5.8 %). The high contribution of these sectors to total business expenditure on R&D (19.4 %), especially in comparison with other indicators (i.e. employment or value added), positions the LS sectors as strategic drivers of innovation and competitiveness in the EU, with the potential to address major challenges such as sustainability, food security, health, energy independence, and open strategic autonomy.

BOX 1. METHODOLOGY

1. Sector delimitation

Table 2 shows the details on the selected activities considered under the three main areas that fall under the scope of this study, including the codes from the Statistical Classification of Economic Activities in the European Community (NACE hereinafter). The primary activities, food and bio-based manufacturing activities were selected following the methodological approach described in [2], [3] and [4] to delimit bioeconomy-related activities. For this, an output-based criterion is applied, meaning that only economic activities whose output is made (fully or partially) of bio-based content are considered. This includes sectors that only produce or process biomass (e.g. agriculture or food manufacturing), as well as those sectors whose production is only partially bio-based (e.g. chemicals or furniture manufacturing).

Regarding human health technologies and services, the activities related to the manufacturing of pharmaceuticals (both bio and non-bio), medical tools and equipment, as well as healthcare activities are taken into account. Last, the horizontal knowledge-based activities refer to supporting services and expertise, such as scientific R&D, technical professions, veterinary, and education, which are based on the development and application of scientific knowledge and technologies related to Life Sciences. These activities play a critical role in driving innovation and improving competitiveness across the Life Sciences sectors.

2. Data **sources** and pre-processing

Three economic indicators have been estimated for the selected sectors in this document: Number of persons employed, Value Added (million Euro) and Business Expenditure on R&D (million Euro).

The data on value added, and employment is primarily retrieved from Structural Business Statistics (SBS) in Eurostat. Data up to 2020 is extracted from the following databases: sbs_na_ind_r2 for Industry, sbs_na_con_r2 for Construction, and sbs_na_1a_se_r2 for Services. For data from 2021 onwards, the sbs_ovw_dataset is used. Additionally, National Accounts databases from Eurostat (nama_10_a64 and nama_10_a64_e) are utilized for sectors not covered by SBS, such as primary production activities. Regarding R&D investment, data is retrieved from the Business Expenditure on Research and Development by NACE Rev. 2 activity (rd_e_berdindr2) database. To address missing data, the procedure outlined in [5] is applied.

Table 2. Sectoral delimitation of Life Sciences sectors

Description	Area	NACE code	Observations
Agriculture, forestry and fishing	Primary production, food and bio-based manufacturing	A	Fully bio-based NACE code.
Food, beverages and tobacco	Primary production, food and bio-based manufacturing	C10, C11, C12	Fully bio-based NACE code.
Bio-based textiles	Primary production, food and bio-based manufacturing	C13, C14, C15	Only bio-based activities within the selected NACE codes are considered.
Wood products and furniture; Paper and printing	Primary production, food and bio-based manufacturing	C16, C17, C18, C31	Only bio-based activities within the selected NACE codes are considered.
Bio-based chemicals and plastics and rubbers	Primary production, food and bio-based manufacturing	C20, C22	Only bio-based activities within the selected NACE codes are considered.
Pharmaceuticals	Human health technologies and services	C21	Healthcare-related (Both bio-based and non-bio-based activities are considered).
Other bio-based manufacturing	Primary production, food and bio-based manufacturing	C2365, C32 (other than C325)	Only bio-based activities within the selected NACE codes are considered.
Manufacture of irradiation, electromedical and electrotherapeutic equipment	Human health technologies and services	C266	Healthcare-related.
Manufacture of medical and dental instruments and supplies	Human health technologies and services	C325	Healthcare-related.
Generation of bio-based electricity	Primary production, food and bio-based manufacturing	D3511	Only bio-based activities within the selected NACE codes are considered.
Bio-based construction	Primary production, food and bio-based manufacturing	F	Only bio-based activities within the selected NACE codes are considered.
Scientific research in biotechnology and other natural sciences.	Horizontal knowledge-based activities.	M72	Only indicators on both bioeconomy- and healthcare-related sub-fields are considered.
Veterinary activities and other technical professions	Horizontal knowledge-based activities.	M71, M73, M74, M75	Only indicators on both bioeconomy- and healthcare-related sub-fields are considered.
Education	Horizontal knowledge-based activities.	P85	Only indicators on both bioeconomy- and healthcare-related sub-fields are considered.
Human health activities	Human health technologies and services.	Q86	Healthcare-related

Source: Own elaboration

3. Estimation of socioeconomic indicators

3.1. Primary production, food and bio-based manufacturing

The figures for primary production, food and bio-based manufacturing activities were prepared using the methodology proposed by [2], [3] and [4], as well as [6] for R&D indicators. These approaches involve reporting values from sectors with fully bio-based output as provided by Eurostat (after estimating missing data), while for partially bio-based sectors, the data must be combined with bio-based shares to derive the contribution from bio-based activities in terms of employment, value added and R&D investment.

The applied bio-based shares inform on the proportion of production by sector which is made of biomass. These shares are initially prepared at the product level through a survey of sector experts, who determine the bio-based content of each item from the PRODCOM product classification. These shares are then applied to the value of sold production by product category as a proxy to estimate the value of the bio-based production. This value is then aggregated by both NACE activities and Member States and compared to the total production value by sector to derive sector-level bio-based shares. The shares are applied to the value of the selected socioeconomic indicators by sector as a proxy to estimate the contribution of bio-based activities to said indicators. Further details on these shares can be found in [2] and [3].

3.2. Human health technologies and services

For the human health technologies and services, no specific share is applied, as they are considered fully relevant to the life sciences.

3.3. Scientific and knowledge-based activities

For scientific and knowledge-based activities, proxies based on its relation to Life Sciences to estimate its socioeconomic contribution. In general, the computation of shares by bioeconomy-relevant services is applied as proposed by [4], with specific adjustments to some sectors to take into account healthcare-relevant activities.

- For Education (NACE P85), a share informing on expenditure and employment in bioeconomy- and healthcare-relevant fields within tertiary education is applied.
- For technical professions (NACE M71, M73, M74) and Scientific research and development (NACE M72), the share is applied as proposed in [4].
- No adjustments are needed for Veterinary (M75), as it is considered entirely relevant to life sciences.

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