



Priority Sector Report: Biopharmaceuticals



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Introduction

The Cluster Mapping Approach

Clusters can be understood as regional concentrations of economic activities in related industries connected through local linkages and spill-overs that have long been known to be a competitive feature of the market economy.¹ They have a distinct geographic dimension, reflecting the dynamics of local spill-overs. Clusters are also deeply embedded in a broader geographic context: they serve markets elsewhere and are connected to other clusters with complementary strengths in regional, interregional or global value chains. This mirrors the role of location for firms: while local conditions provide the unique context for building distinct capabilities and strategic positions, national and international linkages are critical to access other markets, suppliers, and collaboration partner. Cluster mapping is of high relevance to better understand the key competences of the cluster actors as well as to review to what extent the respective value chain is properly covered.

This report provides perspectives on the Biopharmaceuticals emerging industry clusters across Europe. The report uses firm-level data to supplement the statistical data from national and EU statistical offices. This firm-based data significantly increases the robustness of the data, especially in countries like Germany that collect regional data through samples rather than reporting by all firms. It also enables performance of individual firms to be tracked over time, gaining more granular insights into patterns of entrepreneurship, SME performance and new business creation. The report is based on an enriched dataset that is compiled specifically for analysing detailed patterns of cluster evolution. The core of the dataset is the firm- and plant-level data sources from the Orbis database supplied by Bureau van Dijk. This dataset provides detailed data on the economic performance of firms. It allows the usage of data of firms' turnover, wage bill, capital, materials and employment, totalling more than 1 billion data points. The coverage is very good in most countries in Europe, and especially for larger limited liability companies. However, for some countries, significant gaps are still present.

Cluster stars per region

In this report, strong clusters are being determined based on the cluster mapping approach of the European Panorama for Clusters and Industrial Change, which measures cluster size, specialisation, employee productivity for the relevant industries in a region (covering three established categories), complemented by two new categories capturing SME (high-growth) performance and the innovation potential of global frontier firms.

¹ Ketels, C. (2017). Cluster Mapping as Tool for Development, Harvard Business School, http://www.hbs.edu/faculty/Publication%20Files/Cluster%20Mapping%20as%20a%20Tool%20for%20Development%20report_ISC%20WP%20version%2010-10-17_c46d2cf1-41ed-43c0-bfd8-932957a4ceda.pdf

The extent to which regional clusters in traded sectoral industries or cross-sectoral (emerging) industries have achieved this specialised critical mass is shown by allocating them up to three so-called cluster stars for each of these following five categories:

- *Size*: total number of employees in full time equivalent units in the industry for a given region. This indicator captures general employment performance.
- *Specialisation*: degree of specialisation measured by a location quotient. The location quotient is calculated as the ratio between the industry's share of total employment in a given region and the industry's share of total employment in all the countries considered in the analysis. Values above unity imply high regional specialisation, with a location quotient of two corresponding to twice as many employees in an industry than would be expected if all employment was distributed evenly.
- *Productivity*: measured by the average wage per employee (in full time equivalent units) in the region as a proxy. Productivity levels vary across Europe and these differences are captured as part of the cluster strength measure.
- *SME performance*: measured by number of high growth firms (i.e. have annual growth rates of 20% for turnover or employment over 3 years while respecting minimum employment and turnover size thresholds). Research suggests that entrepreneurial activity drives economic growth and entrepreneurship policy in highly developed economies should focus on potentially fast-growing new firms.
- *Innovation leaders*: measured by the number of global frontier firms (i.e. top 5% of firms in terms of productivity (value added based, per employee), calculated by adding up factor incomes going to employees (wages) and to capital owners (profits) within any given emerging industry or traded cluster and year) as the relative strength of such firms probably reflects their capacity to innovate, rapidly diffuse and replicate cutting-edge ideas.

For the first three dimensions, a star is assigned to regions that are in the top 20 per cent in Europe. These stars are then summed up for the years 2014, 2015 and 2016 to arrive at the final star rating, with a maximum of three stars for each category. For the latter two dimensions, three stars are assigned to regions that are in the top 20 per cent in Europe in the years 2008 – 2016, two stars for those in the top 20-40 per cent range and one in the top 40-60 per cent range. An industrial regional clusters can therefore be allocated a maximum of 15 cluster stars.

In terms of geographic scope, the analysis covers all the countries participating in the COSME programme, namely all 28 EU Member States, as well as Iceland, North Macedonia, Montenegro, Turkey, Albania, Serbia, Moldova, Armenia, Bosnia & Herzegovina and Ukraine. These regions are used as a pragmatic choice because they are likely to encompass the "economically relevant" regions; there is data available, and in most cases there is some level of government that can take action for this specific region.

For comparative purposes, OECD member states are included, such as Australia, Canada, Chile, Israel, Japan, Korea, Mexico, New Zealand, Norway, Switzerland and United States. Wherever possible, firm-level data are used at the NACE 4-digit and NUTS 3-digit level. In the maps, the data for the administrative boundaries is from EuroGeographics.

Cluster trends and case examples

The report also points to some transformation trends of relevance for the priority sector. This is foremost written though from a cluster perspective and based on the expertise gathered from the cluster mapping work carried out and not from an expert perspective nor extensive research of the priority sector concerned.

The report still offers a cluster case example with the identification of specialised SME intermediaries – so called cluster organisations – that manage the collaboration, networking and learning in a clusters and provide or channel tailored business support service to group of specialised SMEs in the priority area. Such cluster organisations can help firms to better engage with other local actors within their cluster and to organise collective actions to strengthen the local context. Moreover, they can reduce transaction costs for firms, especially SMEs, in building linkages to firms and collaboration partners in other locations.

Overview

The Biopharmaceuticals emerging industry is the result of an evolution of the traditional pharmaceutical industry that emerged in the late 1800s, mainly based on chemical production. The industry has incorporated the more recent emergence of biotechnology developed on living cells and molecules, stemming from key innovations in the 1970s and 1980s. The most specific area of biopharmaceutical product development includes vaccines, blood components, hormones, antibodies, cell-based therapies, stem cells, gene therapy or enzymes.

Europe's employment in the Biopharmaceuticals is at 2.4 million people, which is the lowest figure among the emerging industries.² However, both wages and gross value added are significantly higher than in other industries (by 50%) and also compared to the overall economy (by 90%), suggesting very high levels of productivity. In 2016, the average wage in the Biopharmaceuticals was 50.800 euros, with specialised clusters, (regional concentrations of related traded industries³) showing a 7% wage premium over other locations.⁴ The average

² European Observatory for Clusters and Industrial Change (2019). Panorama Report.

³ A specialised cluster has a specialisation rate of over 1.5 – measured by the location quotient – and has more than 500 employees in the given industries. Values above unity imply high regional specialisation, with a location quotient of 1.5 corresponding to 1.5 times as many employees in an industry than would be expected if all employment was distributed evenly.

⁴ This calculation takes into account the average wage level in the country. For example, it can be that most of the specialised clusters locate in lower wage countries. In this case, the difference in wage levels follows from the differences between nations, not from the differences between specialized clusters versus other locations. For the "modified" wage premium, a wage level in a region is first compared to the region's average wage level and the possible premium is calculated. These premiums for specialised clusters and other locations in a country are then summed up. Finally, the "modified" wage premium is the average of these national premiums.

employment in specialised clusters was almost three times higher than that of other locations and in total about 42% of the employment in the biopharmaceuticals industry is based in specialised clusters. From 2011 to 2016, the employment in this emerging industry has grown 0.6% and the wages 0.9% per year, on average.

Table 1. Basic facts of the Biopharmaceuticals emerging industry.

	Specialised clusters	Other locations
Number of NUTS 2 regions	71	282
Average employment 2016	14 000	4 900
Annual change in employment 2014-2016	0.1 %	-0.6 %
Average wage 2016	49 200 €	51 700 €
Annual change in wages 2014-2016	4.7 %	3.8 %

Wage premium considering the local average wage level: 6.8 %

At the global level, the overall turnover of Biopharmaceuticals in 2017 was estimated between 164 billion⁵ and 192 billion⁶ euros, with an estimated average growth rate for the period 2018–2023 ranging from 8% to 13%. The biopharmaceuticals market is geographically segmented into North America, Europe, Asia-Pacific, the Middle East and Africa and South America. North America owns the highest share of market revenues, due to rapid technological advancements and large investments carried out in last years. The USA is responsible for 70% of the global research and innovation in biotechnology and has a strong business network with nearly 2,500 companies. These numbers, which are three-times higher than the volume of the European industry, place the USA far ahead of its competitors. In the near future, the Asia-Pacific area is expected to undergo a significant increase, thanks to factors such as increasing access to healthcare facilities in the region and economic growth. The European biopharmaceutical industry occupies an important position with respect to market share, innovation capability and R&D expenditure. Between 2011 and 2016, the European top five producing countries (Germany, France, Italy, Spain and UK) launched 17.5% of all medicines and active ingredients newly marketed, compared to 64.7% from the USA and 7.3% from Japan.⁷

Industry composition

Today, the global biopharmaceutical industry is a momentous driver of scientific advancement, and the source of innovative medicines addressing a wide range of human health-related needs around the world. Still, as Figure 1 illustrates, the biggest share of employment (over 40 %) takes place in the sector “Manufacture of pharmaceutical preparations”.

⁵ Allied Market Research (2018). Biopharmaceuticals Market by Type and Application: Global Opportunity Analysis and Industry Forecast, 2018-2025.

⁶ Mordor Intelligence (2018). Global Biopharmaceutical Market Report.

⁷ EFPIA (2018). The Pharmaceutical Industry in Figures. Key data.

With regard to the economic dimension, biosimilars⁸ have recently gained increased attention in the EU, particularly by public healthcare systems. Biosimilars are approved according to the same standards of pharmaceutical quality, safety and efficacy that apply to all biological medicines⁹. Biosimilars can be available at considerably lower prices and the biosimilar industry may change the commercial landscape as profoundly as the generic industry has done for chemical pharmaceuticals¹⁰. The commercialization of biosimilars began in Europe, where broad reimbursement coverage, high treatment rates and dedicated regulatory pathways created a thriving market. By May 2019, the European Union has approved 59 biosimilars, and many have been commercialized successfully in Australia, Canada, Japan and South Korea. Projections suggest that global sales could more than double to \$15 billion by the early 2020s, with an estimated \$5 billion to \$8 billion coming from emerging markets¹¹.

Figure 1. Biopharmaceuticals emerging industry composition based on employments on NACE industry classifications 2008.

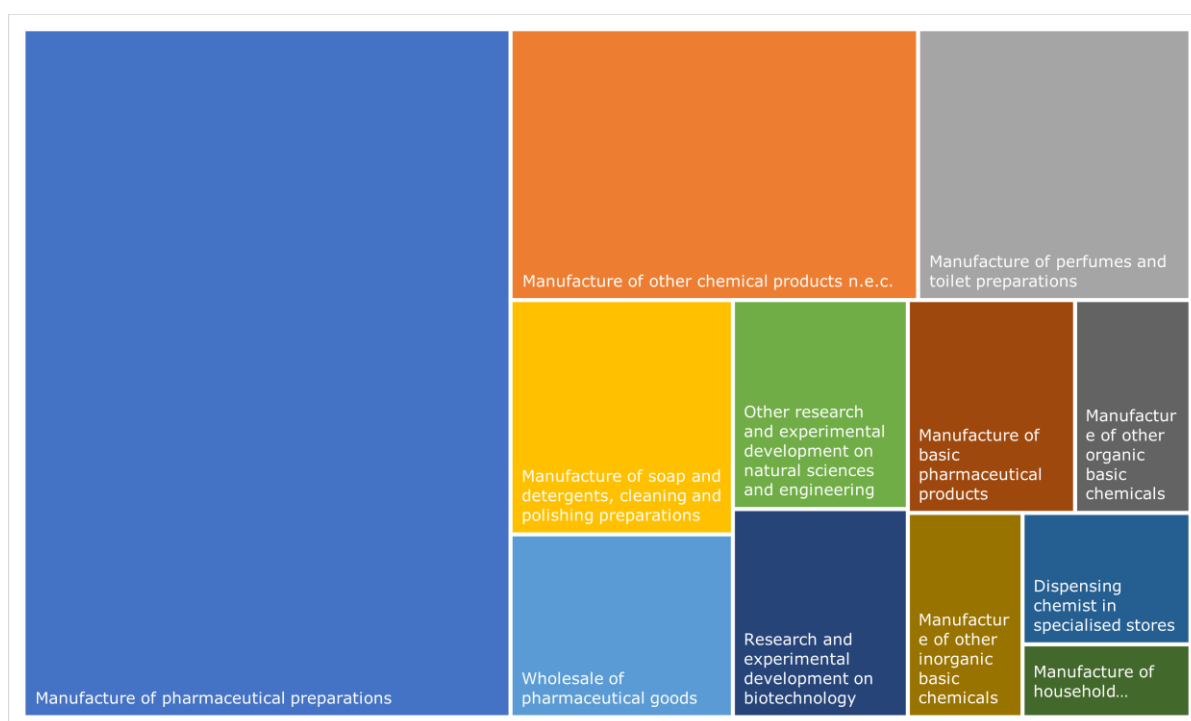


Figure 2 profiles all European regions according to the Cluster Stars in Biopharmaceuticals. Most of the regions with strong clusters in the industry are located in Belgium, Sweden, Germany, Norway, the United Kingdom, as well as in France, Italy and Spain. Also, there are some above-average regions in Denmark and Ireland. The strongest ones, holding the maximum of 15 Stars, are located in Belgium, Norway, Sweden and the United Kingdom.

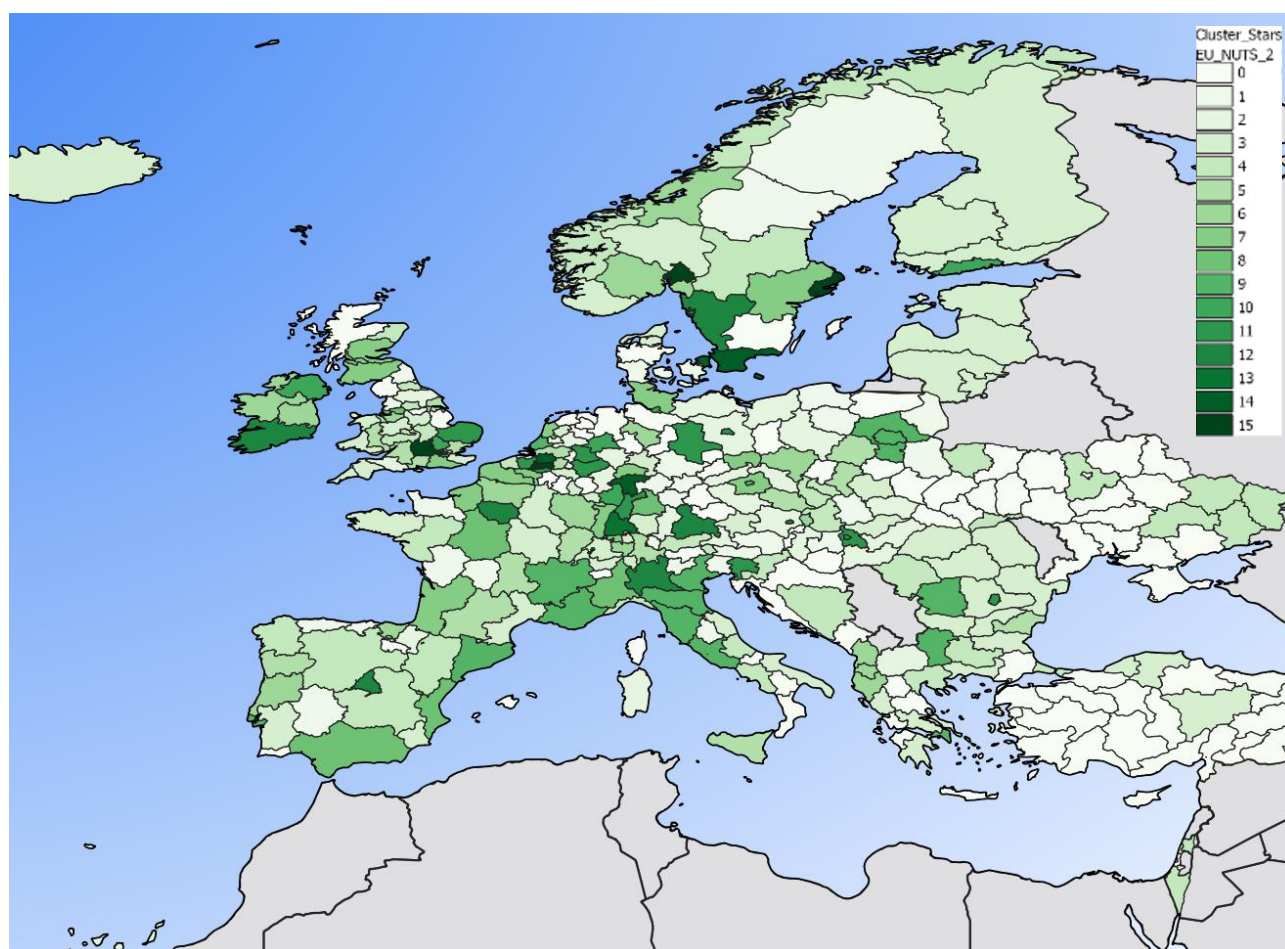
⁸ Biosimilars are biopharmaceuticals highly similar to another already approved biological medicine (the 'reference medicine') and they can enter the market only after patent expiry of the reference medicine.

⁹ <https://www.ema.europa.eu/en/human-regulatory/overview/biosimilar-medicines-overview>

¹⁰ McKinsey (2014). Rapid growth in biopharma: Challenges and opportunities.

¹¹ McKinsey (2019). What's next for biosimilars in emerging markets?

Figure 2. Cluster Stars in Biopharmaceuticals (2016).



Note: The depth of the green colour indicates the region's star rating on a scale from 0 to 15.

According to Figure 2 and Table 2, especially Belgium can be determined as a major player in terms of Biopharmaceuticals. Big Belgian pharmaceutical companies include Janssen Pharmaceutica, Solvay, UCB (Union Chimique Belge) and GMED Healthcare, and also subsidiaries such as BASF Antwerpen and GlaxoSmithKline Biologicals. The following Table 2 gives an overview of the top 20 regional clusters across Europe.

Table 2. European top 20 regions in Biopharmaceuticals (Cluster Stars, 2016).

Cluster stars							
	Region	Size (0-3)	Specialisation (0-3)	Productivity (0-3)	SME performance (0-3)	Innovation (0-3)	Total stars (0-15)
1	BE24 - Flemish Brabant	3	3	3	3	3	15
1	NO01 - Oslo og Akershus	3	3	3	3	3	15
1	SE11 - Stockholm	3	3	3	3	3	15
1	UKI7 - Outer London - West and North West	3	3	3	3	3	15
1	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	3	3	3	3	3	15
6	BE10 - Brussels-Capital Region	3	3	3	2	3	14
6	BE21 - Antwerp	3	3	3	2	3	14
6	DE71 - Darmstadt	3	3	3	2	3	14
6	DK01 - Hovedstaden	3	3	3	2	3	14
6	SE22 - South Sweden	3	3	3	3	2	14
11	DE13 - Freiburg	3	3	3	1	3	13
12	AT13 - Wien	3	3	0	3	3	12
12	DE21 - Oberbayern	3	3	0	3	3	12
12	ES30 - Madrid	3	0	3	3	3	12
12	FR10 - Ile-De-France	3	0	3	3	3	12
12	IE02 - Southern and Eastern	3	3	0	3	3	12
12	ITC4 - Lombardia	3	3	0	3	3	12
12	SE23 - West Sweden	3	0	3	3	3	12
19	BE23 - East-Flanders	0	3	3	2	3	11
19	BE31 - Walloon Brabant	0	3	3	2	3	11

Other 11 Cluster Star regions include DE12 - Karlsruhe, DE30 - Berlin, DEA1 - Duesseldorf, DEA2 - Koeln, DEE0 - Sachsen-Anhalt, HU10 - Central Hungary, RO32 - Bucharest-Ilfov, SI04 - Western Slovenia and UKH1 - East Anglia

Employment

Figure 3 illustrates the employment pattern in Biopharmaceuticals in Europe, showing several regions employing more than 20 000 workforces. The core of Biopharmaceuticals employment lies in Southern and Western Germany, Belgium, Ireland and Israel (see Table 3 and Figure 3). In particular, the Israeli Central district has the highest number of employees (110 000) and the highest specialisation rate.¹²

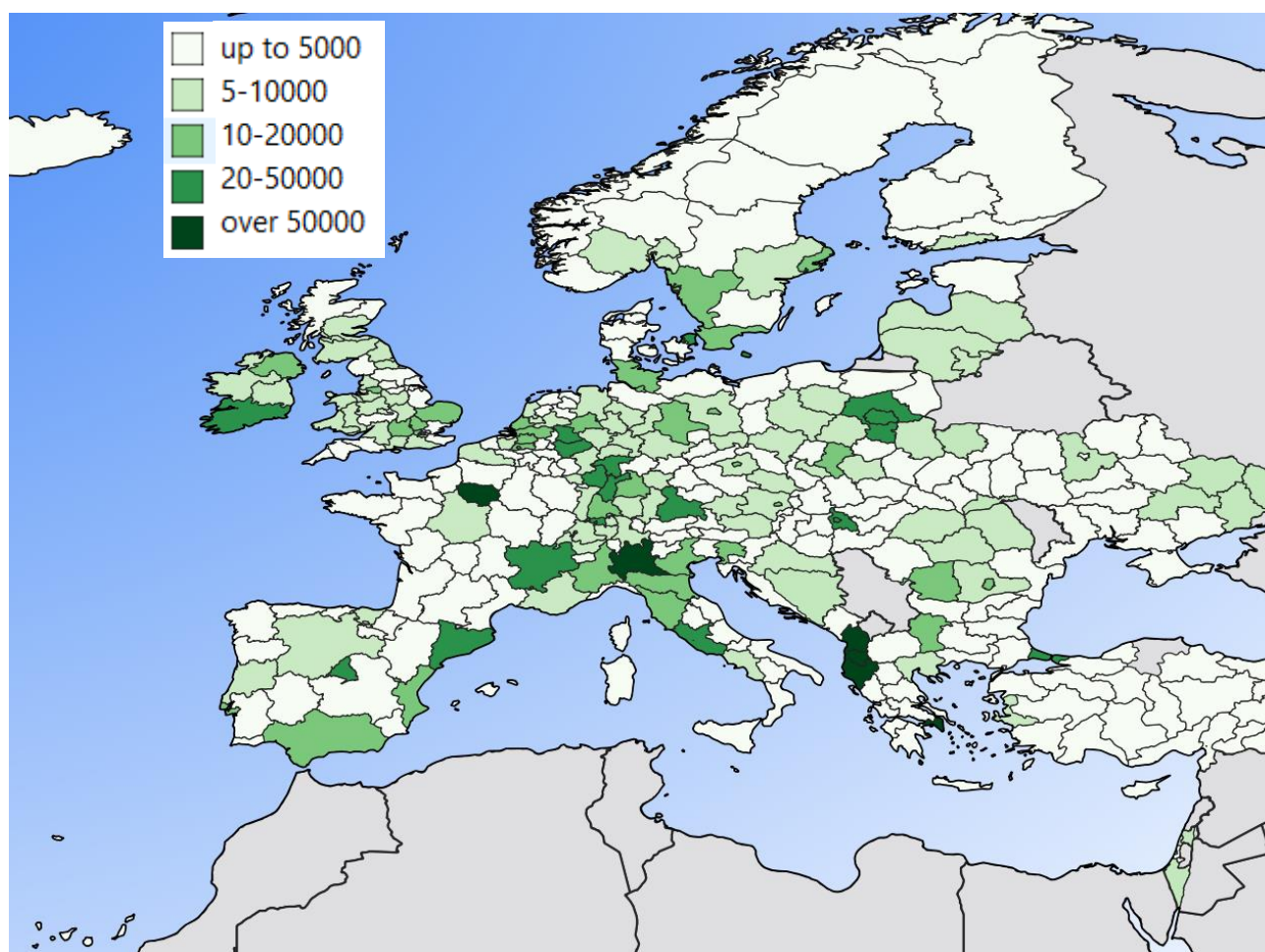
As the mere employment figures by default favour regions with a larger population, the following table not only provides the figures for the top employment regions but also indicates the extent of the regional specialisations, expressed by the location quotient. A value above 1 indicates that a region is more specialised than the average region of similar size. A value of 1.5, together with a threshold of 5 000 employees is used to identify a specialised clusters.

Table 3. Top 20 European regions with the highest number of employment in Biopharmaceuticals (Full Time Equivalents, 2016).

Region	Employees	Specialisation	Region	Employees	Specialisation
IL04 - Central district	109 500	10.8	ES51 - Cataluna	33 500	1
ITC4 - Lombardia	64 400	1.7	PL12 - Mazowieckie	30 700	1.2
EL30 - Attica	55 900	3.3	DEB3 - Rheinhessen-Pfalz	30 400	3.6
FR10 - Ile-De-France	52 800	0.9	HU10 - Central Hungary	30 400	1.4
AL00 - Albania	51 400	2.2	DE12 - Karlsruhe	27 900	1.8
DE71 - Darmstadt	47 900	2.4	ES30 - Madrid	27 800	0.9
TR10 - Istanbul Subregion	46 700	0.9	FR71 - Rhone-Alpes	26 100	1.1
DE21 - Oberbayern	41 700	2	DK01 - Hovedstaden	24 000	2.7
IE02 - Southern and Eastern	38 600	1.9	DEA2 - Koeln	23 300	1.3
DEA1 - Duesseldorf	33 500	1.6	IT14 - Lazio	20 500	1

¹² Whenever possible, the analysis covers all the countries participating in the COSME programme, namely all 28 EU Member States, as well as Iceland, North Macedonia, Montenegro, Turkey, Albania, Serbia, Moldova, Armenia, Bosnia & Herzegovina and Ukraine. In addition, OECD member states are included, such as Australia, Canada, Chile, Israel, Japan, Korea, Mexico, New Zealand, Norway, Switzerland and United States. However, the availability of (regional) data varies a lot between countries.

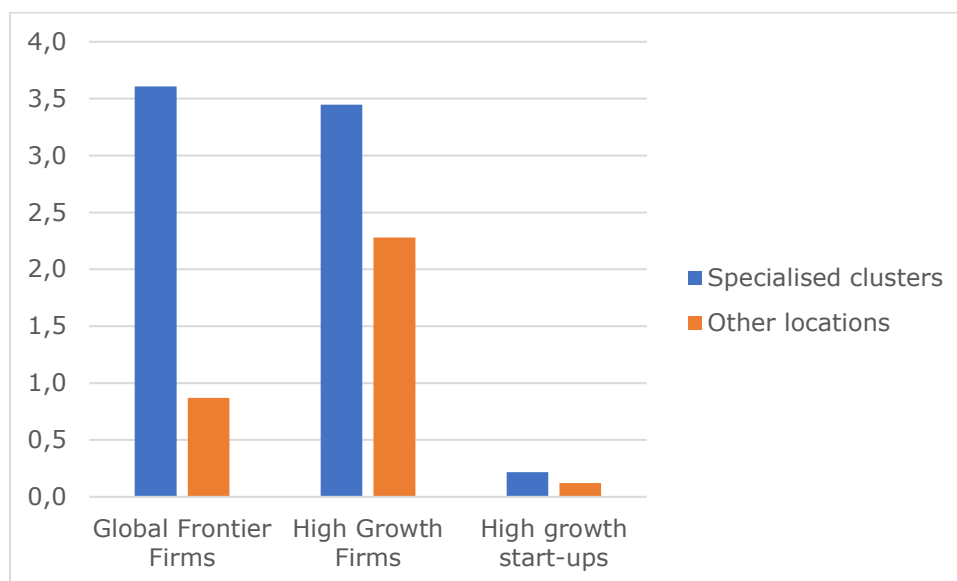
Figure 3. Leading European regions in Biopharmaceuticals (Full Time Equivalents, 2016).



Note: The depth of the green colour indicates the full time equivalent employment in Biopharmaceuticals on a scale from “up to 5 000” to “over 50 000”.

The regions specialised in Biopharmaceuticals perform well in a number of economic indicators. As one can imagine, labour productivity is on a high level. These regions have numerous products and processes, and marketing and organisational innovators, and score high on high-technology employment. Labour-force participation rate, as well as digital engagement, are on a high level. On the other hand, compared to other emerging industries, both start-up and scale-up rates are relatively low among these regions with specialised clusters. However, the regions with specialised clusters locate a much higher rate of global frontier and high growth firms and rapidly growing start-ups than other locations (see Figure 4 below).

Figure 4. Average number of global frontier firms, high growth firms and rapidly growing start-ups in the specialised clusters and other locations (Biopharmaceuticals, 2016).¹³



Enterprises

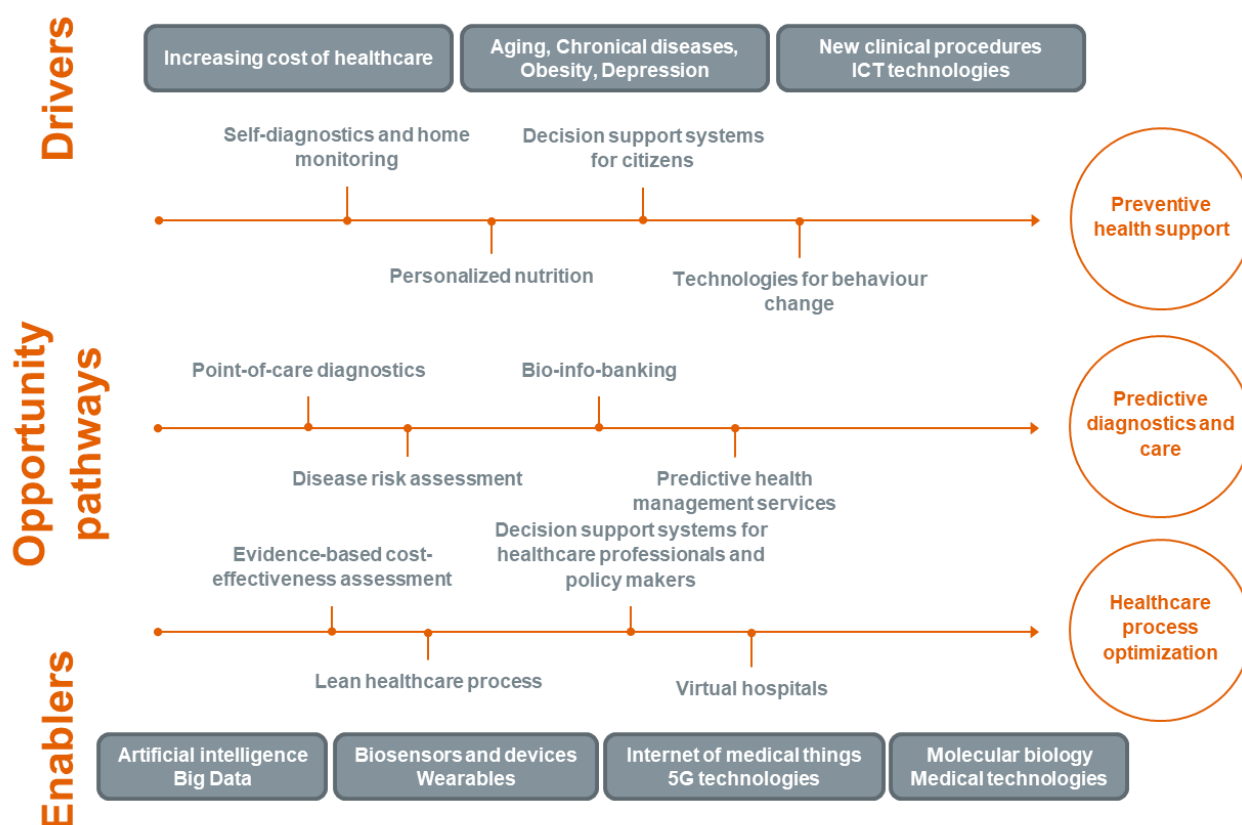
An important drop in the number of cross-sectoral patents between biopharmaceuticals and the basic-materials chemistry sector suggests that this emerging industry is increasingly less focused on developing traditional drugs, and more oriented toward new trends.¹⁴ Biopharmaceuticals industries have already started undergoing significant changes because of the demographic shifts. Population ageing, in particular, creates opportunities of new products and service development and applications in the biopharma field. Constantly rising healthcare and elderly care costs force nations to rethink the healthcare model and invest more in health-supportive activities to prevent lifestyle-related diseases. The future health business is focusing on the predictive and preventive care, based on personalized approaches. Consumers and patients will have a more participatory role. New technologies and business models with human-empowered approaches will revolutionize the health care and its mode of operation. Technologies that enhance capabilities will become cheaper and thus more accessible. Self-testing at home will dramatically increase in importance. Big data based health analytics can

¹³ *Global frontier firms* are the top 5% of firms in terms of productivity (value added based, per employee), calculated by adding up factor incomes going to employees (wages) and to capital owners (profits) within any year. *High growth firms* have annual growth rates of 20% for turnover or employment over 3 years while having at least 20 employees at the end. A *rapidly growing start-up*, on the other hand, is a firm that possesses from 3 to 20 employees and that experiences such a high average turnover, employment or asset growth over a one-, two- or three-year period that it belongs to the top 10% of firms within any given industry.

¹⁴ EOCIC (2019). European Cluster and Industrial Transformation Trends Report.

help us in taking better care of ourselves, enable early diagnosis, follow up treatment, and provide more cost-efficient development of new effective treatments.

Figure 5. Growing healthcare costs together with aging population demand for a paradigm shift for prevention of non-communicable diseases and a new kind of participatory healthcare.

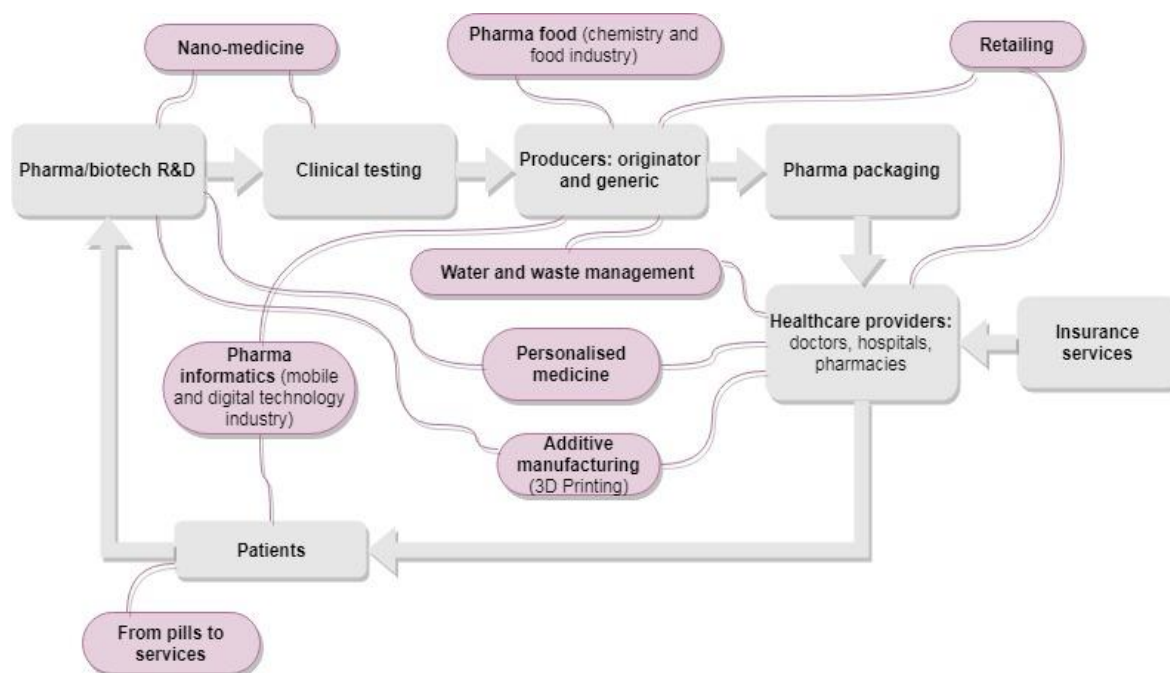


Source: Technical Research Centre of Finland VTT

For example, the Food and Beverage sector is increasingly linked with Biopharmaceuticals, which reflects the strong growth of the pharma food market segment. An in-depth analysis of the sectors increasingly involved in patents, mergers and acquisitions, and joint ventures and alliances with Biopharmaceuticals reveals that the following emerging technologies and industries are transforming the biopharmaceuticals value chain.¹⁵

¹⁵ EOCIC (2019). European Cluster and Industrial Transformation Trends Report.

Figure 6. Cross-sectoral value chain of Biopharmaceuticals.



Source: CSIL (Centre for Industrial Studies)

Table 4 illustrates the top European regions in terms of the corresponding number of enterprises in Biopharmaceuticals. Firm-level data has been used to also identify high growth firms and rapidly growing start-ups, industry leaders¹⁶ and global frontier firms. Due to the availability of the data and differences in accounting rules across countries, the results have to be interpreted however with some caution. Still, it brings a more dynamic view to the cluster mapping and analysis.

¹⁶ Industry leader is a company that belongs to the top 1% of companies having the highest turnover or the highest profits in any particular year in the industry.

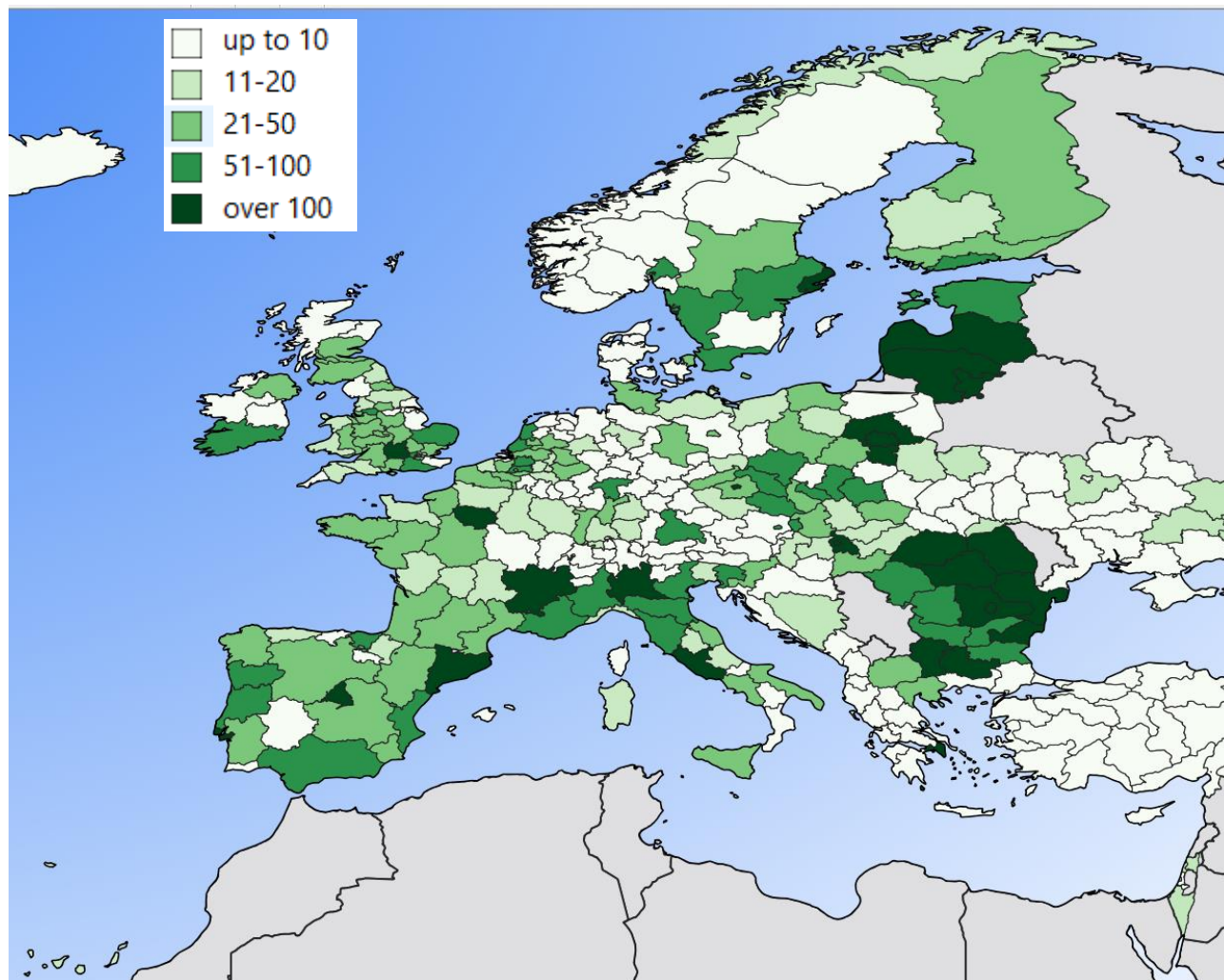
Table 4. Top 20 European regional clusters according to number of high growth firms and start-ups, industry leaders and global frontier firms in Biopharmaceuticals (global share of enterprises, per million people, 2016).

Cluster performance in detail: SME performance driven by high growth firms						Innovation potential driven by industry leaders (top 1%) and global frontier firms (top 5%)				
Region	Turno ver	Emplo yees	Assets	Start- ups	Avg	Region	Turno ver	Profit	Value Add	Avg
BG41 - Yugozapaden	1.6	1.8	1.4	0.4	1.3	BE31 - Walloon Brabant	1.9	1.3	2.2	1.8
BG33 - Severoiztochen	1.8	1.9	1.3	0.0	1.2	BE10 - Brussels-Capital Region	1.6	1.5	1.8	1.6
RO32 - Bucharest-Ilfov	1.2	1.3	1.3	0.7	1.1	BE21 - Antwerp	0.9	0.7	1.5	1.0
SE11 - Stockholm	0.6	0.5	0.6	1.3	0.8	UKI3 - Inner London - West	1.0	0.8	1.2	1.0
ITC4 - Lombardia	0.3	0.4	0.3	1.9	0.7	BE24 - Flemish Brabant	0.4	0.1	2.1	0.9
CZ01 - Prague	0.8	0.9	0.6	0.2	0.6	DK01 - Hovedstaden	0.5	1.3	0.7	0.8
UKI3 - Inner London - West	0.6	0.7	0.7	0.4	0.6	NL32 - Noord-Holland	1.2	1.0	0.1	0.7
PT17 - Area Metropolitana de Lisboa	0.4	0.4	0.5	0.8	0.5	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	0.4	0.9	0.7	0.7
SK01 - Bratislava Region	0.5	0.7	0.6	0.2	0.5	CH03 - Nordwestschweiz	0.7	1.3	0.0	0.6
BG31 - Severozapaden	0.6	0.7	0.6	0.1	0.5	UKI7 - Outer London - West and North West	0.7	0.7	0.4	0.6
HU10 - Central Hungary	0.5	0.5	0.5	0.4	0.5	SE11 - Stockholm	0.0	0.5	1.2	0.6
FR10 - Ile-De-France	0.2	0.2	0.2	1.1	0.4	CH05 - Ostschweiz	0.7	0.9	0.1	0.6
BG42 - Yuzhen Tsentralen	0.6	0.7	0.4	0.1	0.4	FR10 - Ile-De-France	0.5	0.4	0.7	0.5
PL12 - Mazowieckie	0.3	0.1	0.3	1.0	0.4	AT13 - Wien	0.0	0.4	1.1	0.5
BG34 - Yugoiztochen	0.5	0.6	0.5	0.0	0.4	BE23 - East-Flanders	0.0	0.0	1.5	0.5
NO01 - Oslo og Akershus	0.4	0.0	0.5	0.6	0.4	CH01 - Region Lemanique	0.8	0.7	0.0	0.5
LV00 - Latvia	0.5	0.5	0.4	0.2	0.4	IE02 - Southern and Eastern	0.2	0.5	0.6	0.5
FI1B - Helsinki-Uusimaa	0.3	0.4	0.3	0.5	0.4	NL21 - Overijssel	1.1	0.3	0.0	0.5
EL30 - Attica	0.3	0.7	0.2	0.3	0.4	DE73 - Kassel	0.7	0.7	0.0	0.4
ES51 - Cataluna	0.2	0.3	0.2	0.7	0.3	NL33 - Zuid-Holland	0.6	0.5	0.0	0.4

Note: The measures above are relative, that is, the number of high growth firms – with respect to turnover, employment or asset growth – rapidly growing start-ups, industry leaders – with respect to turnover or profit – and global frontier firms is divided by the region’s population (million people).

The pattern, depicted in Figure 7, shows that the SME performance in Biopharmaceuticals is especially high in countries like Bulgaria, Romania, Latvia, Lithuania, with strong hot spots in a number of European capital regions.

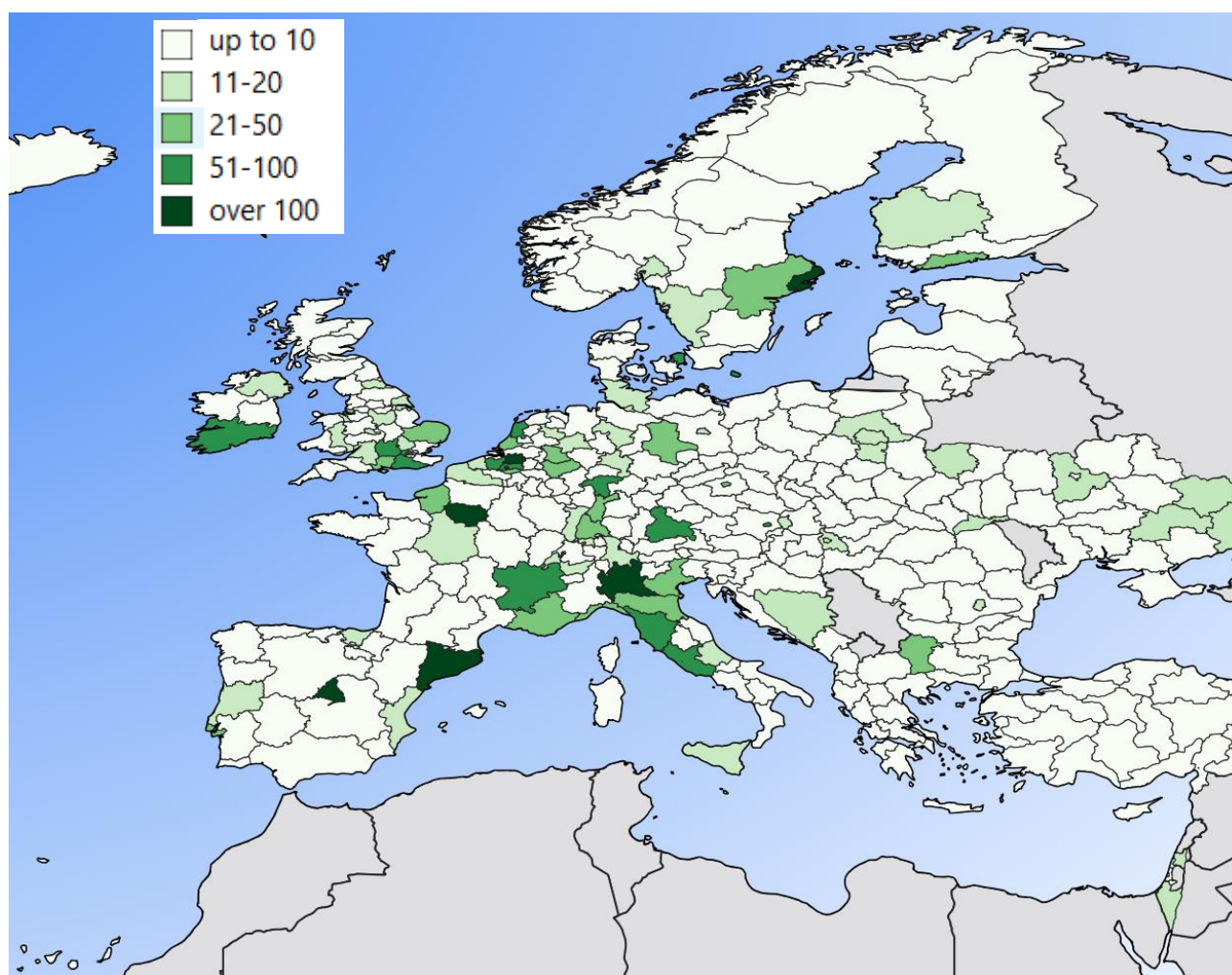
Figure 7. Leading European regions in Biopharmaceuticals (high growth firms, 2008-2016).



Note: The depth of the green colour indicates the occurrences of high growth firms in the region during the period from 2008 to 2016 on a scale from "up to 10" to "over 100".

On the other hand, global-frontier firms are much more concentrated on a small number of areas. Those can be found in Belgium, Northern Italy, the United Kingdom and in capital regions such as Stockholm, Wien and Copenhagen.

Figure 8. Leading European regions in Biopharmaceuticals (global frontier firms, 2008-2016).



Note: The depth of the green colour indicates the occurrences of global frontier firms in the region during the period from 2008 to 2016 on a scale from "up to 10" to "over 100".

In general, being a member of the Biopharmaceuticals cluster correlates with high values for high tech exports, firm investments and digitalisation.

European Strategic Cluster Partnerships for smart specialisation investments (ESCP-S3)

The ESCP-S3 action of the COSME Framework Programme of the European Commission contribute to boost industrial competitiveness and investment within the EU. The ESCP-S3 are facilitating **cluster cooperation** in thematic areas related to **regional smart specialisation** strategies and to increase the involvement of the industry in the context of the Smart Specialisation Platform for Industrial Modernisation¹⁷.

An EU Cluster Partnership, S3martMed gathers 5 European Clusters dedicated to Healthcare and Medical technologies. These are Lyonbiopole (Auvergne-Rhône-Alpes), BioWin (Wallonia), BioRegioStern (Baden-Württemberg), bioPmed (Piedmont) and MedSilesia (Upper Silesia). It aims to foster interregional and cross-sectoral cooperation between European clusters and

¹⁷ <https://s3platform.jrc.ec.europa.eu/industrial-modernisation>

their SME members in the field of medical technologies through the establishment of a unique cluster partnership. Through its action, the partnership will participate to the implementation of the Smart Specialisation policies with their Regions and encourage future investments in medical technologies.¹⁸

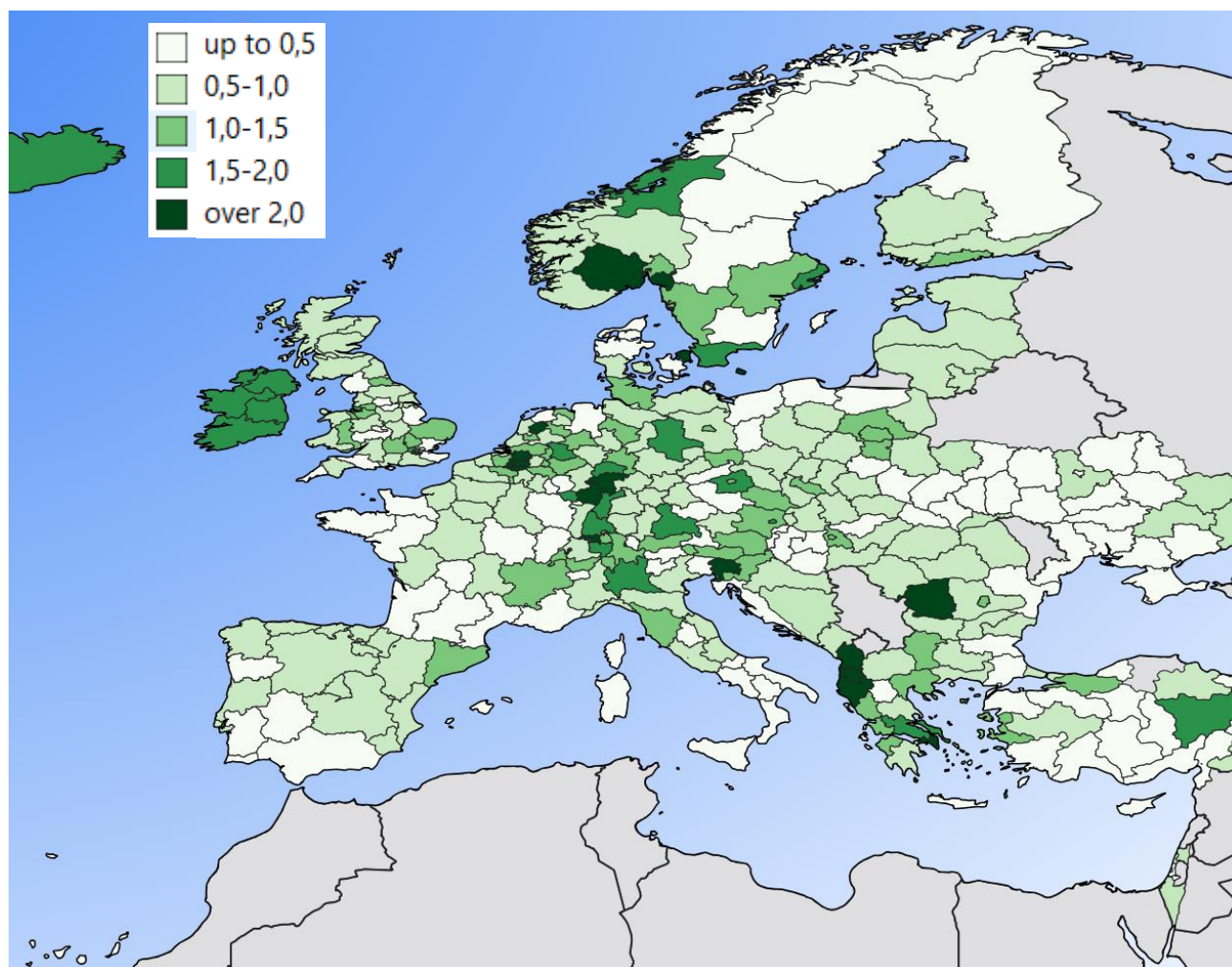
Regional specialisation

Measuring regional specialisation¹⁹ of Biopharmaceuticals can provide interesting insights as to what extent a region is stronger than expected in this sector, given its overall size, compared to the average employment size in the industry across all regions. Because science-based innovation requires continuous exchange of explicit and tacit knowledge, the industry has typically developed into regional clusters of industrialized countries.). Figure 9 shows to what extent European regions are specialised in Biopharmaceuticals.

¹⁸ <https://www.clustercollaboration.eu/node/6482>

¹⁹ Regional specialisation can be measured by the Location Quotient (LQ). A value higher than 1.0 means a given region is more specialised than the European average. As of a value of 1.5, one speaks of specialised regional clusters.

Figure 9. Leading European regions in Biopharmaceuticals (Specialisation, 2016).



Note: The depth of the green colour indicates the region's Location Quotient (LQ) in Biopharmaceuticals on a scale from "up to 0.5" to "over 2.0".

The Israeli Central district has the highest number of employees, 110 000, and the highest specialisation rate. Other regions specialised in Biopharmaceuticals include Northwest Switzerland, several regions in Belgium, Copenhagen, Rheinhessen-Pfalz, Düsseldorf, Albania and the Attica region in Greece. There are a number of regions with specialised clusters in Ukraine, but those do not employ such a large workforce.

Table 5. Top 20 European regions with the highest location quotients (specialisation) in the Biopharmaceuticals (Full Time Equivalents, 2016).

Region	Employees	Specialisation	Region	Employees	Specialisation
IL04 - Central district	109 500	10.8	EL30 - Attica	55 900	3.3
UA08 - Kharkivska	5 200	4.7	UA14 - Luhanska	2 500	3.3
UA12 - Kyiv	5 400	4.4	UA21 - Sumska	1 300	3
IL06 - Southern district	13 700	4.2	UA26 - Zaporizka	1 900	2.9
CH03 - Nordwestschweiz	20 000	4.2	UA02 - Cherkaska	1 300	2.8
UA05 - Dnipropetrovska	5 100	4	UA23 - Vinnytska	1 700	2.8
UA07 - Ivano-Frankivska	1 900	3.8	BE24 - Flemish Brabant	10 200	2.8
UA13 - Kyivska	2 500	3.7	BE31 - Walloon Brabant	3 400	2.7
DEB3 - Rheinhessen-Pfalz	30 400	3.6	DK01 - Hovedstaden	24 000	2.7
IL02 - Northern district	13 800	3.5	BE10 - Brussels-Capital Region	15 300	2.6

Focusing on cross-sectoral linkages along the value chain of Biopharmaceuticals, the most dynamic hotspots are spread throughout Europe. The social-network analysis identifies eleven communities of regions that were the most closely connected through cross-sectoral linkages during 2011–2016. These communities centre around specific node regions (hotspots):²⁰

Community 1: Małopolskie (Poland)	Community 7: Lombardia (Italy)
Community 2: Cataluña (Spain)	Community 8: Ile-de-France (France)
Community 3: București - Ilfov (Romania)	Community 9: Zuid-Holland (Netherlands)
Community 4: Hovedstaden (Denmark)	Community 10: Berlin (Germany)
Community 5: Praha (Czech Republic)	Community 11: Inner London - West (UK)
Community 6: Attiki (Greece)	

By comparing the cross-sectoral communities over the three periods, several observations emerge:²¹

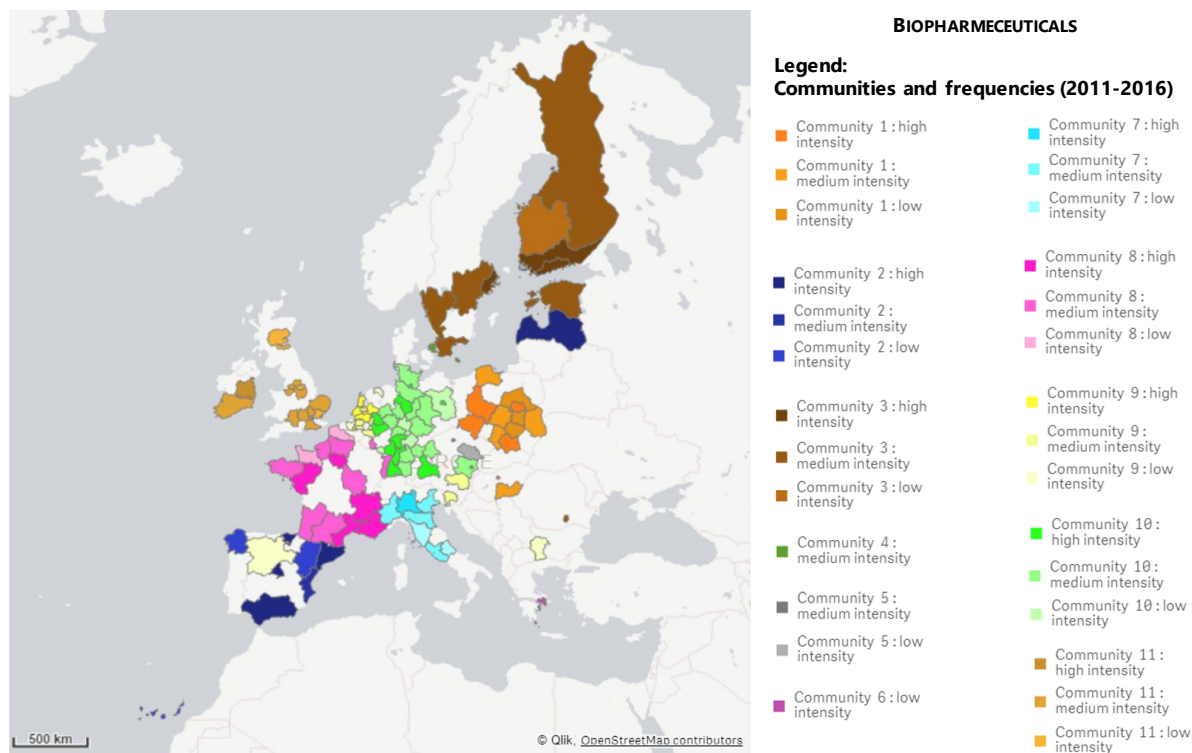
- The Spanish community (community 2) has enlarged. While the community comprised only two Spanish regions in the 2000–2004 period, the number of Spanish regions with a significant number of cross-sectoral and cross-regional interlinkages has increased.
- While southern Italian regions had a high number of cross-sectoral interlinkages with other regions in the periods 2000–2004 and 2005–2010, their cross-regional connections have significantly decreased.
- A new community has emerged (community 1) covering most of the Polish regions.

²⁰ EOCIC (2019). European Cluster and Industrial Transformation Trends Report.

²¹ Ibid.

- While the Italian, French and Spanish regions were grouped in one community in the period 2005–2010, they belong to three different national communities in the most recent period.

Figure 10. Cross-sectoral communities and hotspots of Biopharmaceuticals in Europe (2011–2016).



Source: CSIL (Centre for Industrial Studies) and Deloitte

Case: Centre-Val de Loire²²

Centre-Val de Loire is distinguished from other French territories in terms of specialisation and employment by pharmaceuticals and cosmetics.²³ Examples of large stakeholders located in the region include LVMH (cosmetics) and Servier (pharmaceuticals). Foreign-owned companies are also influential in the regional ecosystem, especially in the areas close to Paris (e.g. Novo Nordisk for pharmaceuticals at Chartres).²⁴ However, in spite of the presence of these larger multinational companies, the decision centres remain outside the region, as groups tend to be headquartered in Paris or abroad.²⁵

²² EOCIC (2018). Regional assessment report – Hauts-de-France.

²³ INSEE, *Nombre d'établissements et de Postes Salariés Par Secteur d'activité Détaillé et Tranche d'effectifs Salariés Détaillés Au 31 Décembre 2015*.

²⁴ CCI Centre-Val de Loire, *Les 50 Premiers Établissements Industriels En Région Centre-Val de Loire*; CCI Centre-Val de Loire and DEV'UP Centre-Val de Loire, *Les Entreprises à Capitaux Internationaux En Région Centre-Val de Loire*.

²⁵ Interviews with regional stakeholders, 2018

The region benefits from a favourable enabling environment in terms of Research and Development (R&D), with 1.65% of regional GDP dedicated to this area in 2014²⁶. A relatively important share of the resources dedicated to R&D is provided by the private sector (3rd rank among French regions). However, private research is highly concentrated on specific sectors, notably pharmaceuticals, which accounted for 16% of private R&D expenditure in 2014.²⁷ The pharmaceuticals cluster is highly concentrated in the north of the region (Chartres – Orléans) as well as near Tours. The strong regional pharmaceuticals sector is currently transitioning towards biopharmaceuticals.²⁸

Cosmetic Valley is by far the biggest structure with more than 400 adherents, followed by 2 pôles (S2E2 and Elastopole, between 100 and 200 adherents) and 2 clusters (AREA and Polepharma, around 150 adherents each). The other cluster organisations are of smaller size.

Cosmetic Valley covers a very important share of regional employment, mainly in Loiret and Eure-et-Loire, but from Paris and Normandy regions also. It has very limited collaboration with other regional clusters, but partnerships with other cosmetics clusters.

A few clusters prove to be potentially effective in structuring the regional industrial fabric in as much as their members cover an entire “filière” or value chain. Polepharma is a representative of this group. It is regrouping stakeholders of the dynamic pharmaceuticals ecosystem. As such, it is heavily research and export-oriented, with a significant number of large enterprises and laboratories. It is strongly rooted in the region, especially the Cher département, with members in Normandy and Ile-de-France (i.e. Paris) as well, and has strong collaborations with research institutions.

Summary

The Biopharmaceuticals emerging industry is the result of an evolution of the traditional pharmaceutical industry that emerged in the late 1800s, mainly based on chemical production. The industry has incorporated the more recent emergence of biotechnology developed on living cells and molecules, stemming from key innovations in the 1970s and 1980s. Today, the global biopharmaceutical industry is a momentous driver of scientific advancement, and the source of innovative medicines addressing a wide range of human health-related needs around the world.

Europe’s employment in Biopharmaceuticals is at 2.4 million people, which is the lowest figure among the emerging industries. However, both wages and gross value added are significantly

²⁶ This is lower than the national average, but the latter is highly skewed by Occitanie and Ile-de-France. See Centréco, *Innovation, Recherche et Développement En Région Centre-Val de Loire*.

²⁷ Ibid.

²⁸ CSIL, *Meeting with Regional Stakeholders*.

higher than in other industries (by 50%) and then in the overall economy (by 90%), suggesting very high levels of productivity. In 2016, the average wage in Biopharmaceuticals was 50 800 euros with specialised clusters showing a 7% wage premium over other locations. From 2011 to 2016, the employment has grown 0.6% and the wages 0.9% per year on average – the growth rates having been higher in specialised clusters than in other locations.

Biopharmaceuticals have already started undergoing significant changes because of the demographic shifts. Population ageing, in particular, creates opportunities of new products and service development and applications in the biopharma field. Constantly-rising healthcare and elderly care costs force nations to rethink the healthcare model and invest more in health-supportive activities to prevent lifestyle-related diseases. Consumers and patients will have a more participatory role in healthcare. New tools are needed to support a healthy lifestyle and to add more personalized, preventive and predictive actions in the healthcare system. There is also a need to optimize the healthcare process at all levels.

The core of Biopharmaceuticals employment lies in Southern and Western Germany, Belgium, Ireland and Israel. Most of the strong regions in the industry are located in these countries as well as in Denmark, France, Italy, Norway, Spain, Sweden and the United Kingdom. The strongest ones, holding the maximum of 15 Cluster Stars, are located in Belgium, Norway, Sweden and the United Kingdom.

The regions specialised in Biopharmaceuticals perform well in a number of economic indicators. As one can imagine, labour productivity is on a high level. These regions have numerous products and processes, and marketing and organisational innovators, and score high on high-technology employment. Labour force participation rate as well as digital engagement are on a high level. On the other hand, compared to other emerging industries, both start-up and scale-up rates are relatively low among these regions with specialised clusters. However, the regions with specialised clusters locate a much higher rate of global frontier and high growth firms and rapidly growing start-ups than other locations.

The SME performance in Biopharmaceuticals is especially high in countries like the Bulgaria, Romania, Latvia, Lithuania with strong hot spots in a number of European capital regions. The most innovative, global frontier, firms are much more concentrated on a small number of areas. Those can be found in Belgium, Northern Italy, the United Kingdom and in capital regions such as Stockholm, Wien and Copenhagen.

Appendix

European top regions in the Biopharmaceuticals emerging industry (at least 8 Cluster Stars, 2016)

NUTS	Region	Cluster Stars	Employment 2016	Average annual change in employment 2014-2016	Average wage 2016	Average annual change in wage 2014-2016
BE24	BE24 - Flemish Brabant	15	10 200	2,3 %	102 800 €	2,5 %
NO01	NO01 - Oslo og Akershus	15	9 900	-1,7 %	89 200 €	5,9 %
SE11	SE11 - Stockholm	15	19 200	-0,1 %	70 400 €	1,6 %
UKI7	UKI7 - Outer London - West and North West	15	14 500	-3,7 %	116 400 €	11,6 %
UKJ1	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	15	19 500	-6,5 %	82 200 €	8,5 %
BE10	BE10 - Brussels-Capital Region	14	15 300	0,7 %	87 300 €	0,2 %
BE21	BE21 - Antwerp	14	15 400	0,1 %	112 200 €	6,7 %
DE71	DE71 - Darmstadt	14	47 900	5,0 %	88 000 €	5,3 %
DK01	DK01 - Hovedstaden	14	24 000	1,9 %	72 700 €	3,4 %
SE22	SE22 - South Sweden	14	10 400	-0,8 %	147 000 €	3,4 %
DE13	DE13 - Freiburg	13	16 100	-0,2 %	85 900 €	2,6 %
AT13	AT13 - Wien	12	13 700	0,0 %	65 800 €	4,1 %
DE21	DE21 - Oberbayern	12	41 700	1,2 %	64 000 €	4,9 %
ES30	ES30 - Madrid	12	27 800	-1,5 %	89 300 €	5,9 %
FR10	FR10 - Ile-De-France	12	52 800	-0,2 %	78 700 €	3,9 %
IE02	IE02 - Southern and Eastern	12	38 600	4,6 %	57 400 €	0,4 %
ITC4	ITC4 - Lombardia	12	64 400	-1,8 %	59 800 €	2,9 %
SE23	SE23 - West Sweden	12	11 000	-1,1 %	81 800 €	8,5 %
BE23	BE23 - East-Flanders	11	6 300	-2,9 %	78 200 €	4,0 %
BE31	BE31 - Walloon Brabant	11	3 400	-2,2 %	114 800 €	2,3 %
DE12	DE12 - Karlsruhe	11	27 900	4,8 %	62 600 €	2,1 %
DE30	DE30 - Berlin	11	17 500	1,2 %	77 900 €	5,3 %
DEA1	DEA1 - Duesseldorf	11	33 500	2,6 %	51 900 €	2,5 %
DEA2	DEA2 - Koeln	11	23 300	0,7 %	80 500 €	3,8 %
DDE0	DDE0 - Sachsen-Anhalt	11	16 400	-1,5 %	47 300 €	4,8 %
HU10	HU10 - Central Hungary	11	30 400	3,7 %	31 400 €	-3,6 %
RO32	RO32 - Bucharest-Ilfov	11	19 200	1,9 %	36 600 €	4,9 %
SI04	SI04 - Western Slovenia	11	10 800	-2,1 %	43 200 €	3,6 %
UKH1	UKH1 - East Anglia	11	16 400	1,3 %	71 000 €	10,1 %
DE60	DE60 - Hamburg	10	10 800	0,8 %	71 900 €	2,3 %
DEA3	DEA3 - Muenster	10	11 900	-3,9 %	73 000 €	3,8 %
DEB3	DEB3 - Rheinhessen-Pfalz	10	30 400	2,3 %	83 600 €	3,0 %

NUTS	Region	Cluster Stars	Employment 2016	Average annual change in employment 2014-2016	Average wage 2016	Average annual change in wage 2014-2016
FI1B	FI1B - Helsinki-Uusimaa	10	8 900	-2,7 %	59 400 €	5,1 %
UKH2	UKH2 - Bedfordshire and Hertfordshire	10	10 400	-6,6 %	73 400 €	18,3 %
UKI6	UKI6 - Outer London - South	10	12 700	-2,3 %	54 800 €	0,5 %
UKN0	UKN0 - Northern Ireland	10	11 900	-3,0 %	44 300 €	8,8 %
BG41	BG41 - Yugoapaden	9	16 200	0,6 %	32 800 €	8,0 %
CZ01	CZ01 - Prague	9	11 000	1,4 %	52 500 €	4,6 %
EL30	EL30 - Attica	9	55 900	3,3 %	18 300 €	-1,6 %
ES51	ES51 - Cataluna	9	33 500	-0,1 %	59 000 €	3,2 %
FR71	FR71 - Rhone-Alpes	9	26 100	3,4 %	66 300 €	3,0 %
FR82	FR82 - Provence-Alpes-Cote D'Azur	9	7 900	-1,5 %	69 100 €	4,3 %
ITH3	ITH3 - Veneto	9	16 100	0,4 %	51 700 €	1,6 %
ITH5	ITH5 - Emilia-Romagna	9	13 800	-0,9 %	54 800 €	8,4 %
ITI1	ITI1 - Toscana	9	14 400	-2,3 %	60 000 €	7,1 %
ITI4	ITI4 - Lazio	9	20 500	-5,3 %	64 600 €	6,0 %
NL33	NL33 - Zuid-Holland	9	11 500	-4,3 %	71 800 €	3,7 %
PL12	PL12 - Mazowieckie	9	30 700	1,8 %	41 000 €	8,6 %
PT17	PT17 - Area Metropolitana de Lisboa	9	15 100	-1,2 %	58 200 €	-0,6 %
RO41	RO41 - South-West Oltenia	9	10 100	-1,4 %	18 700 €	8,0 %
DE11	DE11 - Stuttgart	8	15 300	-2,5 %	73 700 €	5,8 %
ES52	ES52 - Comunidad Valenciana	8	11 000	1,8 %	40 100 €	1,9 %
ES61	ES61 - Andalucia	8	10 500	1,3 %	41 200 €	5,3 %
FR24	FR24 - Centre	8	7 300	2,6 %	73 900 €	2,3 %
ITC1	ITC1 - Piemonte	8	11 400	1,1 %	45 200 €	0,8 %
UKD3	UKD3 - Greater Manchester	8	13 600	-6,1 %	46 800 €	6,3 %
UKD7	UKD7 - Merseyside	8	6 000	-2,3 %	51 800 €	2,2 %

European Observatory for Clusters and Industrial Change

The European Observatory for Clusters and Industrial Change (#EOCIC) is an initiative of the European Commission's Internal Market, Industry, Entrepreneurship and SMEs Directorate-General. The Observatory provides a single access point for statistical information, analysis and mapping of clusters and cluster policy in Europe, aimed at European, national, regional and local policy-makers, as well as cluster managers and representatives of SME intermediaries.



The aim of the Observatory is to help Europe's regions and countries design better and more evidence-based cluster policies and initiatives that help countries participating in the COSME programme to:

- develop world-class clusters with competitive industrial value chains that cut across sectors;
- support Industrial modernisation;
- foster Entrepreneurship in emerging industries with growth potential;
- improve SMEs' access to clusters and internationalisation activities; and
- enable more strategic inter-regional collaboration and investments in the implementation of smart specialisation strategies.

In order to address these goals, the Observatory provides an Europe-wide comparative cluster mapping with sectoral and cross-sectoral statistical analysis of the geographical concentration of economic activities and performance, made available on the website of the European Cluster Collaboration

Platform (ECCP)²⁹. The Observatory provides the following services:

- **Bi-annual "European Panorama of Clusters and Industrial Change"** that analyses cluster strengths and development trends across 51 cluster sectors and 10 emerging industries, and investigates the linkages between clusters and industrial change, entrepreneurship, growth, innovation, internationalisation and economic development;
- **"Cluster and Industrial Transformation Trends Report"** which investigates the transformation of clusters, new specialisation patterns and emerging industries;
- **Cluster policy mapping** in European countries and regions as well as in selected non-European countries;
- **"Regional Eco-system Scoreboard for Clusters and Industrial Change"** that identifies and captures favourable framework conditions for industrial change, innovation, entrepreneurship and cluster development;

²⁹ <https://www.clustercollaboration.eu/>

- **Updated European Service Innovation Scoreboard**³⁰, that provides scorecards on service innovation for European regions;
- **"European Stress Test for Cluster Policy"**, including a self-assessment tool targeted at cross-sectoral collaboration, innovation and entrepreneurs with a view to boosting industrial change;
- **Customised advisory support services** to twelve selected model demonstrator regions, including expert analysis, regional survey and benchmarking report, peer-review meeting, and policy briefings in support of industrial modernisation;
- **Advisory support service to European Strategic Cluster Partnerships**, in order to support networking between the partnerships and to support exchanges of successful practices for cross-regional collaborations and joint innovation investments;
- **Smart Guides** for cluster policy monitoring and evaluation, and for entrepreneurship support through clusters that provide guidance for policy-makers; and
- **Brings together Europe's cluster policy-makers and stakeholders** at four European Cluster Policy Forum events in 2018 and 2019, European Cluster Days and at the European Cluster Conference in May 2019 in Bucharest (Romania) in order to facilitate high-level cluster policy dialogues, exchanges with experts and mutual cluster policy learning.
- Online presentations and publications, discussion papers, newsletters, videos and further promotional material accompany and support information exchanges and policy learning on cluster development, cluster policies and industrial change.

More information about the European Observatory for Clusters and Industrial Change is available at: <https://www.clustercollaboration.eu/eu-initiatives/european-cluster-observatory>

³⁰ Previous versions for 2014 and 2015 were developed by the European Service Innovation Centre (ESIC), see http://ec.europa.eu/growth/tools-databases/esic/index_en.htm

