European Commission

European Panorama of Clusters and Industrial Change

Performance of strong clusters across 51 sectors and the role of firm size in driving specialisation

2020 edition

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Visit: https://ec.europa.eu/growth/industry/policy/cluster/observatory_en and https://www.clustercollaboration.eu/eu-initiatives/european-cluster-observatory

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Executive Summary

Industrial clusters are responsible for a significant share of European jobs, SME growth and specialisation within regions. Cluster strength for Europe's regions has, for many years, been measured using the cluster star methodology introduced by the European Cluster Observatory measuring strengths in size, specialisation and productivity. The European Observatory for Clusters and Industrial Change has added two new dimensions measuring the presence of high-growth SMEs and the presence of innovation leaders.

Performance across 51 exporting industries

This report analyses cluster strength across 51 exporting industry sectors in Europe and identifies **2,950 regional industrial clusters**, which account for almost every fourth job in Europe (61.8 million jobs or 23.4% of total employment) and about half of employment in exporting industries (50.3%).

The report also introduces a new, further refined distinction for strong clusters according to performance levels. It identifies **198 *high-performing cluster*** *across Europe*, which are regional concentrations of exporting industries[1] where the number of cluster stars across the five cluster star dimensions is at least 13. Moreover, it identifies 898 *medium-performing clusters* where the number of cluster stars is at least 10 (and less than 13) and 1,854 *basic-performing clusters* where the number of cluster stars is at least 7 (and less than 10). Regional areas of exporting industries where the number of cluster stars is 6 or less are said to have no cluster strength.

Clusters matter

2,950 clusters

Account for 61.8 million jobs or 1 out of 4 jobs in Europe

Productivity 25% above average

Productivity growth 0.3%-point above average

Large regional differences

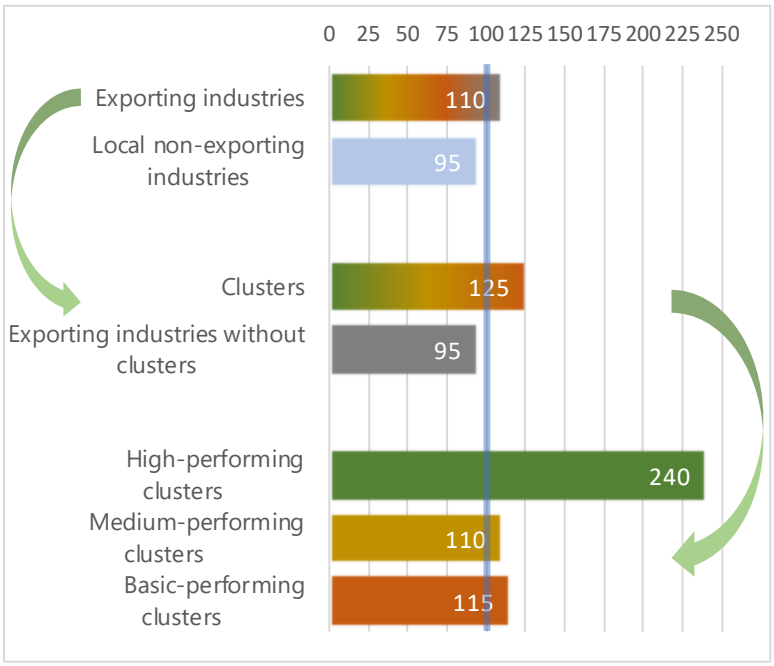
Almost 200 high-performing clusters with productivity 140% above average

[1] The European Cluster Observatory and the 2019 Panorama report refer to traded industries, the concept introduced originally in the US cluster mapping exercise. As firms in traded industries "sell products or services across regions and countries", an intuitively more straightforward name is exporting industries. The term exporting industries is used in the 2020 Panorama report, whereas traded industries are used in the 2019 Panorama report, both referring to the same industries.

Productivity in clusters is much higher than average productivity, corresponding to a 25% above average productivity effect. Moreover, **productivity increases with cluster strength**. In basic-performing clusters productivity and medium-performing clusters productivity is 10-15% above average, while **productivity in high-performing clusters is more than twice as high as the average** (+140%).

The **relevance of cluster differs across sectors.** The highest employment shares of clusters are in Leather and Related Products (85.5% of all employment is based in clusters), Footwear (71.5%) and Video Production and Distribution (70.5%). Employment shares of clusters are the lowest and below 30 percent in Metal Mining and Music and Sound Recording.

Strong clusters are more productive



Note: Index scores relative to average productivity for all industries (traded and non-traded). The blue line shows average productivity.

The **majority of exporting industries have at least 50% of the industry employment located in clusters** (i.e. 27 out of 51 sectors). High-performing clusters can be found in all but three sectors, which are construction, electricity production and environmental that either still host a relatively large number of medium- and basic-performing clusters or that have not (yet) evolved sufficiently to include high-performing clusters.

Overall, employment has grown at 1.5% per year between 2014 and 2017. Employment growth in clusters is close to average. Employment in high--performing clusters has grown faster than average while employment in medium- and basic-performing clusters has grown below average.

Overall, productivity has grown at 3.5% per year between 2014 and 2017. Productivity growth in clusters is higher than average, in particular in high-performing clusters where productivity growth is almost 1%-point higher.

There is a **positive correlation between the size of the region and the number of clusters** in that region. The top-25 regions with the largest number of strong clusters includes many metropolitan areas. There are 10 metropolitan areas with more than 2.5 million inhabitants among the top-25 regions, including among others Barcelona (Spain), Budapest (Hungary), Madrid (Spain), Milano (Italy), Munich (Germany), Paris (France), Rome (Italy), Stuttgart (Germany), Valencia (Spain) and Warsaw (Poland).

Emerging industries

The 10 cross-sectoral so-called **emerging industries have seen a strong increase in employment** between 2014 and 2017, most notably in Creative Industries and Experience Industries. The rate of increase is less than that for the 51 sectoral industries suggesting that the Emerging industries suffered less during the economic crisis offering less room for recovery.

The report also compares results from recent literature that show that clusters contribute positively to employment growth, firm growth and urbanization. Moreover, the report introduces a **new perspective by assessing the role of firm size** in determining the degree of specialisation through a new methodology that looks at the concentration and influence of large firms and SMEs.

Employing the breakdown of the degree of specialisation in an international context shows that, within cross-sectoral emerging industries, the **EU is less specialised overall** compared to other larger international economies. This points to the need to further complete the EU Internal Market and to better connect Europe's regional ecosystems. The EU is also a special case in both large firms and SMEs have an equal share of influence on the degree of specialisation, i.e. present a **specialisation symbiosis in the EU** compared to other countries.

Large firms are more dominant in China, Japan, South Korea and the United States whereas in the EU SMEs are more dominant in determining specialisation. Large firms are the most agglomerated in the US, Japan and China, whereas both the EU and South Korea experience a large concentration of SMEs. Looking only at European regions, the concentration of larger firms is the most dominant across all 10 emerging industries, most notably in Mobility Technologies, Advanced Packaging, and Logistical Services. In half of the emerging industries – Advanced Packaging, Digital Industries, Environmental Industries, Medical Devices and Mobility Technologies respectively – a geographical concentration of size dominant effects is observed in regions which are more centrally located in Europe.

1 Introduction

Cluster analysis has been part of the European Commission's competitiveness strategy for just more than a decade, as evidenced by the first Panorama report in 2008. As clusters are responsible for a significant share of European jobs, SME growth and specialisation within a region, they provide Europe opportunities to strengthen its position on the global market.

This Panorama report is the second report published under the European Observatory for Clusters and Industrial Change. The 2019 Panorama report (European Commission, 2019b) introduced a revised methodology for measuring cluster strength by combining the *three 'traditional' cluster star measures* introduced under the European Cluster Observatory capturing the size, degree of specialisation and employee productivity (where wage levels serve as a proxy) with *two 'new' cluster star measures* capturing the presence of high-growth SMEs and the presence of global frontier firms (where the latter is taken as a proxy for the importance of innovation). For each dimension an industry can earn up to 3 cluster stars, resulting in a maximum number of 15 cluster stars.

This report builds on a further refinement of the new methodology by introducing three distinct performance levels for clusters: *High-performing clusters* are all regional concentrations of exporting industries (also referred to as traded industries[2])where the number of cluster stars across the five cluster star dimensions is at least 13. Accordingly, *Medium-performing clusters* are to be found where the number of cluster stars is at least 10 (and less than 13) while *Basic-performing clusters* are where the number of cluster stars is at least 7 (and less than 10).

Regional areas of exporting industries where the number of clusters is 6 or less may or may not show some clustering effects but are said to have no cluster strength (or at least not yet reached a critical mass of cluster strength).

Where the 2019 Panorama report focuses on the 10 emerging or cross-sectoral industries only, the 2020 Panorama report present results for each of the 51 sectors of exporting industries and explores the relative presence of strong clusters.

The report further discusses the role of SMEs in driving cluster specialisation, and introduces a new, more experimental methodology, for differentiating the degree of specialisation between two different effects. The degree of specialisation is measured by location quotients and these are split into a *'plant' or SME effect* (i.e. the role of many SME), measuring differences in the concentration of firms in the same industry across regions, and a *'size' or large firm effect* (i.e. the role of larger firms), measuring the size of firms in the same industry across regions. This methodology is then

[2] The European Cluster Observatory and the 2019 Panorama report (European Commission, 2019b) refer to traded industries, the concept introduced originally in the US cluster mapping exercise. As firms in traded industries "sell products or services across regions and countries", an intuitively more straightforward name is exporting industries. The term exporting industries is used in the 2020 Panorama report, whereas traded industries are used in the 2019 Panorama report, both referring to the same industries.

applied to each of ten cross-sectoral emerging industries showing that the large firm effect is the most dominant effect in determining the degree of specialisation.

This report is structured as follows. The first part of this report (Chapter 2) presents the methodology and results for these new concepts of clusters for each of the 51 exporting industries. The second part of the report (Chapter 3) discusses the economic performance of 10 emerging industries, their change over time, and presents the results for different firm size for clusters in emerging industries.

Annex A shows geographical maps for the location of clusters across all regions for each of 51 sectors or exporting industries. It also lists the individual names of the high-performing and medium-performing regional clusters for these industries. Annex B compares employment shares and Annex C productivity levels according to the different performance levels of clusters across the 51 sectors. Annex D gives the references for the comparative meta-analysis of cluster effects within US and EU academic literature. Annex E gives all other references used in this report.

2 Cluster strengths and sectoral industries

Clusters matter in exporting industries that are also referred to as groups of related traded industry sectors. They are geographically concentrated, sell their products and services across many regions and face competition from other regions. Cross-sectoral so-called emerging industries build on traded industries and can be understood as either new industrial sectors or existing industrial sectors that are evolving or merging into new industries. The analysis of this report follows the established definition of 10 (cross-sectoral) emerging industries and 51 (sectoral) exporting industries developed under the previous European cluster mapping work (under the label of the European Cluster Observatory).[3]

2.1 Measuring cluster strength

Cluster strength has been calculated using the cluster mapping approach applied by the previous European Cluster Panorama, yet with a revised approach for allocating so-called cluster stars.[4] Cluster strength is based on the traditional measures of cluster size, specialisation, and employee productivity, and is complemented by two new categories of SME (high-growth) performance and innovation leaders (Figure 2). The two newly added cluster star criteria aim to capture the dynamic part of cluster performance[5]. By including the extent of presence of high-growth SMEs and the extent of presence of innovation leaders, including both large firms and SMEs, the new criteria aim to apply the right balance for better capturing the dynamic performance of clusters and the complementary role of firms of different sizes.

The extent to which regional clusters in sectoral industries or cross-sectoral (emerging) industries have achieved this specialised critical mass is shown by allocating them up to three 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 *location quotients*. 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 one imply high regional specialisation, with a location quotient of two corresponding to

[3] Although both – the ten emerging industries and the 51 exporting industries - are made up of a mix of NACE 4-digit industries, the former is labelled as cross-sectoral and the latter as sectoral given that the latter was defined more along traditional sectoral boundaries and the former was defined according to co-location patterns.

[4] Cf. the European Cluster Panorama 2019 report for more details (European Commission, 2019b).

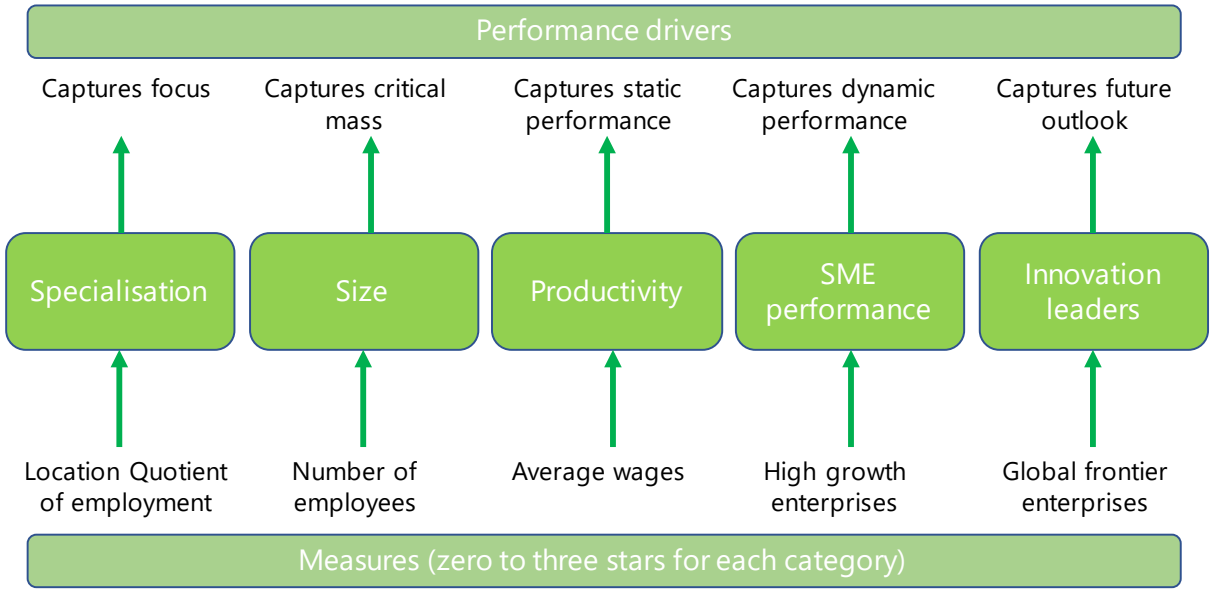
[5] Cf. the Methodology report for the European Panorama of Clusters and Industrial Change and European cluster database (European Commission, 2019d).

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 cross-sectoral (emerging) industry or sectoral (exporting) industry and year as the relative strength of such firms reflects their capacity to innovate, rapidly diffuse and replicate cutting-edge ideas.

For the first three dimensions, size, specialisation and productivity, a cluster star is assigned to regions that are in the top 20 per cent in Europe. These stars are then summed up over a three-year period for the years 2015, 2016 and 2017 to arrive at the final star rating, with a maximum of three stars for each category. For the latter two dimensions, SME performance and innovation leaders, three stars are assigned each to regions that are in the top 20 per cent in Europe over a nine-year period in the years 2009–2017, two stars for those in the top 20-40 per cent range and one in the top 40-60 per cent range. The maximum number of cluster stars across all five dimensions is 15, and the number of cluster stars for a sectoral exporting industry in any region is thus between zero and 15.

Figure 1 Measuring cluster performance



Where the 2019 Panorama report (European Commission, 2019b) showed results for each number of cluster stars, for this report a new methodology will be used introducing four cluster performance groups. The **new methodology** combines the three traditional star components (size, specialisation, productivity) with the two new star components (SME performance, innovation) **to differentiate between clusters performing at different levels**. For size, specialisation and productivity, it is reasonable to assume for clusters to achieve a star in at least 2 of the 3 years captured as it is very likely that if a cluster is among the top 20 per cent in one year it is also in the top 20 per cent in both or one of the other years. For SME performance and innovation, stars are assigned over a longer period and to more regions (60 per cent of the region are assigned at least one star). The threshold here is lower than for the traditional star components, and for clusters it is assumed that at least one star should be achieved, but two is preferred.

The performance amongst clusters is differentiated as follows:

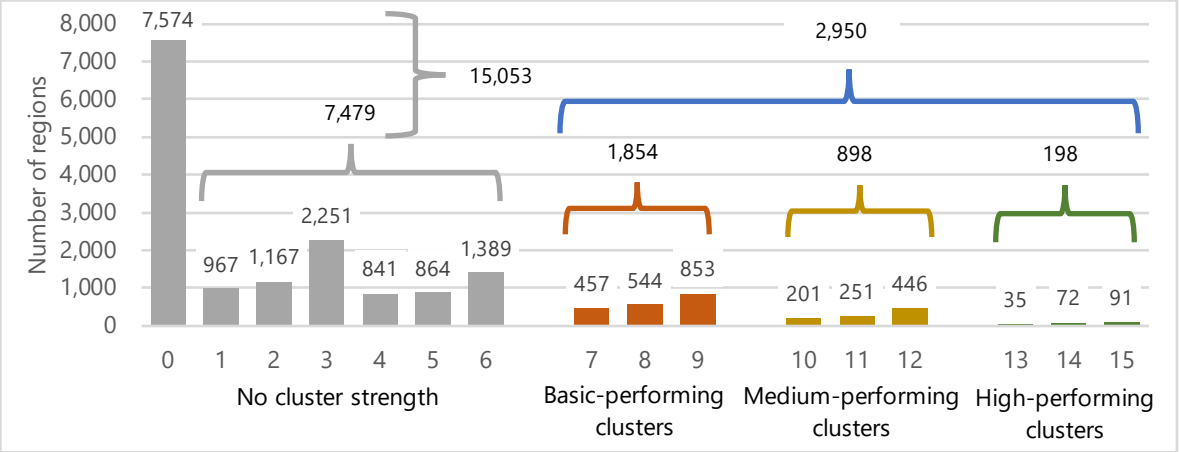
- **High-performing clusters** are those regional concentrations of exporting industries with:
    - High performance on size, specialisation and productivity, i.e. at least 3 stars for two of these and 2 stars for one of these, or at least 8 stars;
    - Medium to high performance on SME performance and innovation leaders, i.e. at least 3 stars for one of these and 2 stars for the other, or at least 5 stars;
    - Combined this gives at least 13 stars, and to make the calculations easier and more transparent, these 13 stars can be earned in any possible combination across the five cluster star dimensions.
- **Medium-performing clusters** are those regional concentrations of exporting industries with:
    - Medium performance on size, specialisation and productivity, i.e. at least 3 stars for one of these and 2 stars for the other two, or at least 7 stars;
    - Medium performance on SME performance and innovation leaders, i.e. at least 3 stars for both combined;
    - Combined this gives at least 10 stars, and to make the calculations easier and more transparent, these 10 stars can be earned in any possible combination across the five cluster star dimensions.
- **Basic-performing clusters** are those regional concentrations of exporting industries with:
    - Low performance on size, specialisation and productivity, i.e. at least 4 stars combined;
    - Low performance on SME performance and innovation leaders, i.e. at least 3 stars for both combined;
    - Combined this gives at least 7 stars, and to make the calculations easier and more transparent, these 7 stars can be earned in any possible combination across the five cluster star dimensions.

Regional areas of exporting industries where the number of cluster stars is 6 or less may or may not show some clustering effects but are considered as areas **without cluster strength** (or at least without yet having reached a critical mass of cluster strength).

2.2 Cluster strength and economic performance in Europe

In total there are 2,950 regional industrial clusters across Europe, of which 198 are high-performing clusters, 898 medium-performing clusters and 1,854 basic-performing clusters (Figure 2). 15,053 regional areas with exporting industries do not show specific cluster strength as their economy is not sufficiently specialised. Annex A includes geographic maps for all exporting industries showing the location of regions across Europe with high-, medium- and basic-performing clusters.

Figure 2 Strong clusters defined



The differentiation between cluster strengths raises the question if exporting industries with cluster strengths show improved economic performance. In this section performance differences in employment, employment growth, productivity and productivity growth will be analysed at an aggregate level, while the following section 2.3 will focus on the performance of clusters across the individual sectors of exporting industries.

The 51 exporting industries account for 46.5 per cent of total employment (Figure 4). Clusters, defined as regional concentrations of exporting industries with high, medium or basic-performing cluster strength, play an important role in the European economy. Industrial clusters account for 61.8 million jobs or about half (46.4%) of employment in exporting industries and for almost 1 out of 4 jobs in total employment (23.4%). Medium- and basic-performing clusters account for almost equal shares of total employment. High-performing clusters account for 2.5% of total employment and 5.3% of employment in all exporting industries.

Figure 3 Share of traded industries and strong clusters in total employment

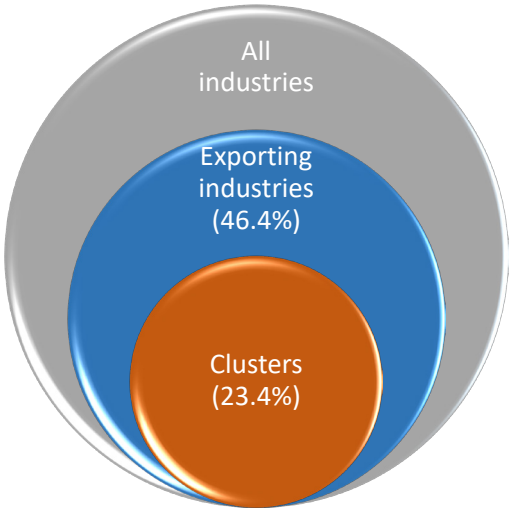
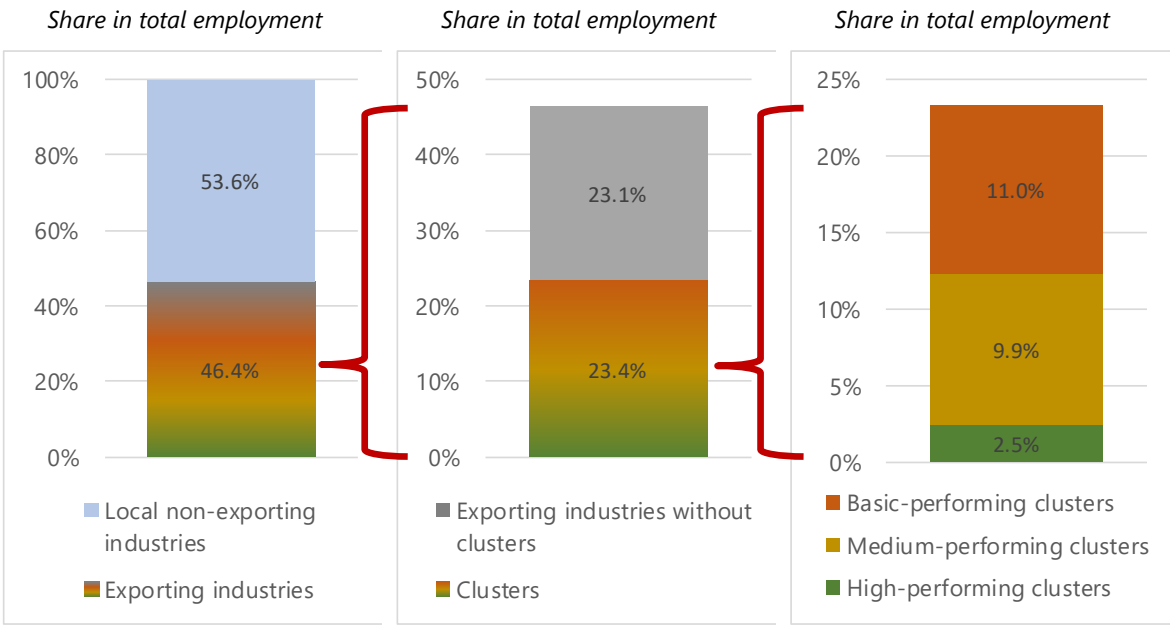


Figure 4 Employment shares (2017): Exporting industries and clusters

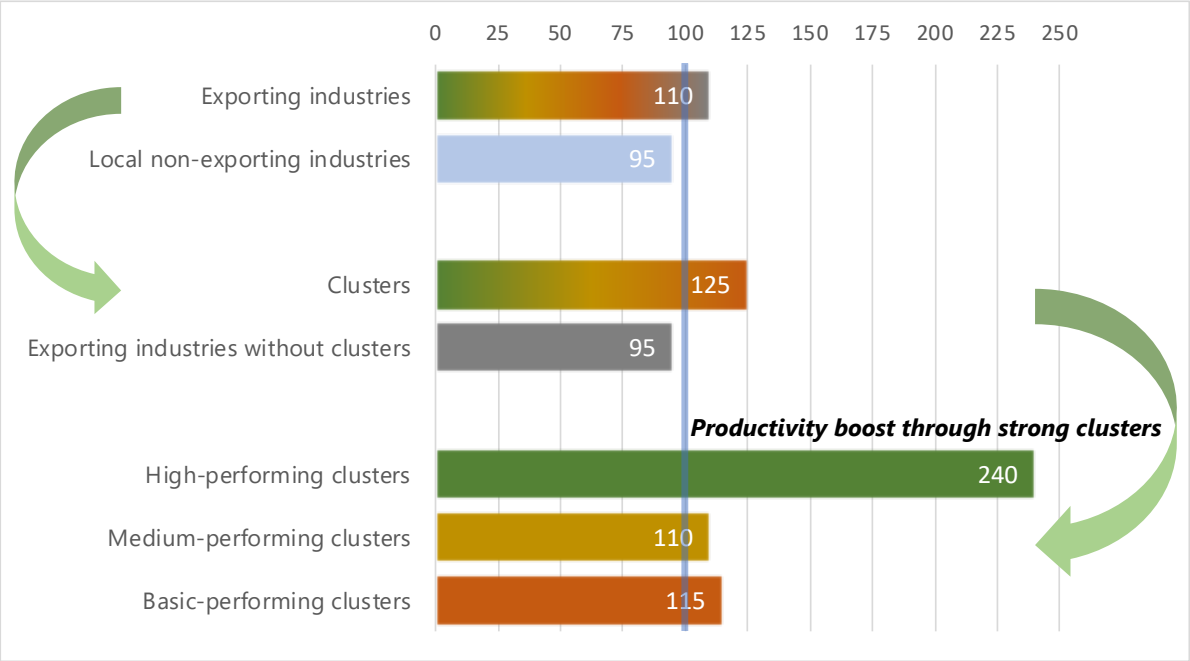


Productivity, which is measured in this study by average wages per employed person, is 25% higher in regional industrial clusters than that for all industries and about 15% higher than productivity in all exporting industries (Figure 5). In high-performing clusters averages wages and productivity are very high, at more than double the rate of that for all industries.

Productivity in exporting industries is about 10% higher than that in all industries, and productivity in local non-exporting industries is about 5% lower than that in all industries (Figure 5). Productivity in regional industrial clusters is much higher than average (+25%) and also much higher than in exporting industries without clusters – corresponding to a 35% above average productivity effect between exporting industries with and without clusters.

Productivity increases with cluster strength. In basic-performing clusters productivity is 15% above average, in medium-performing clusters productivity is 10% above average, and in high-performing clusters productivity is more than twice as high as average productivity (+140%). Productivity in high-performing clusters is much higher than that in medium- and basic-performing clusters. This can be explained by the high demand for and corresponding wages of highly specialised employees in those highly specialised areas.

Figure 5 Cluster strength and productivity (2017)



Note: Index scores relative to average productivity for all industries (traded and non-traded). The blue line shows average industrial productivity (100%).

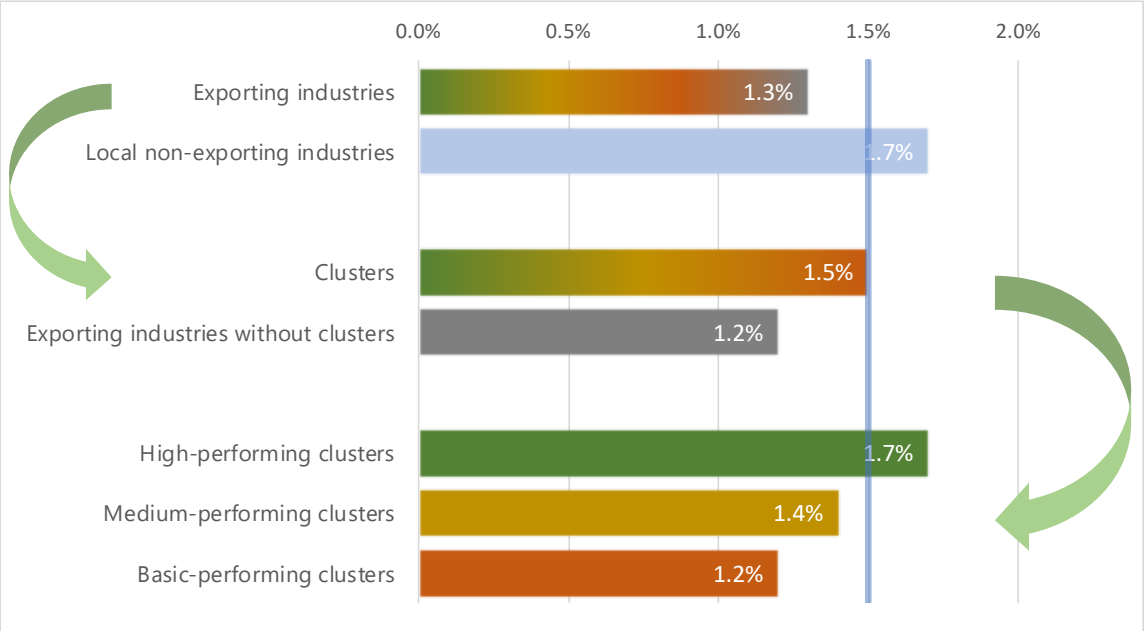
Employment growth in regional industrial clusters is higher than that in exporting industries without clusters (Figure 6). Overall, employment has grown at 1.5% per year between 2014 and 2017[6]. For the exporting industries employment growth (1.3%) is below average. Employment growth in regional industrial clusters is close to average and higher than that of the exporting industries overall. Employment in high--performing clusters has grown faster than average, employment in medium- and basic-performing clusters has grown below average.

Across all regions, productivity has grown at 3.5% per year between 2014 and 2017 (Figure 7). For the exporting industries productivity growth (3.9%) is above average. For clusters productivity growth is above average but just below that of exporting industries without clusters. High-performing clusters show the highest increase in productivity at 4.3% per year between 2014 and 2017, followed by productivity growth in basic-performing (3.8%) and medium-performing clusters (3.6%).

The fact that productivity growth is high and employment growth is low in high-performing clusters, suggests that growth in these clusters is driven by efficiency improvements, among others resulting from process innovations, where labour is replaced by capital, leading to lower employment growth but more rapidly increasing productivity.

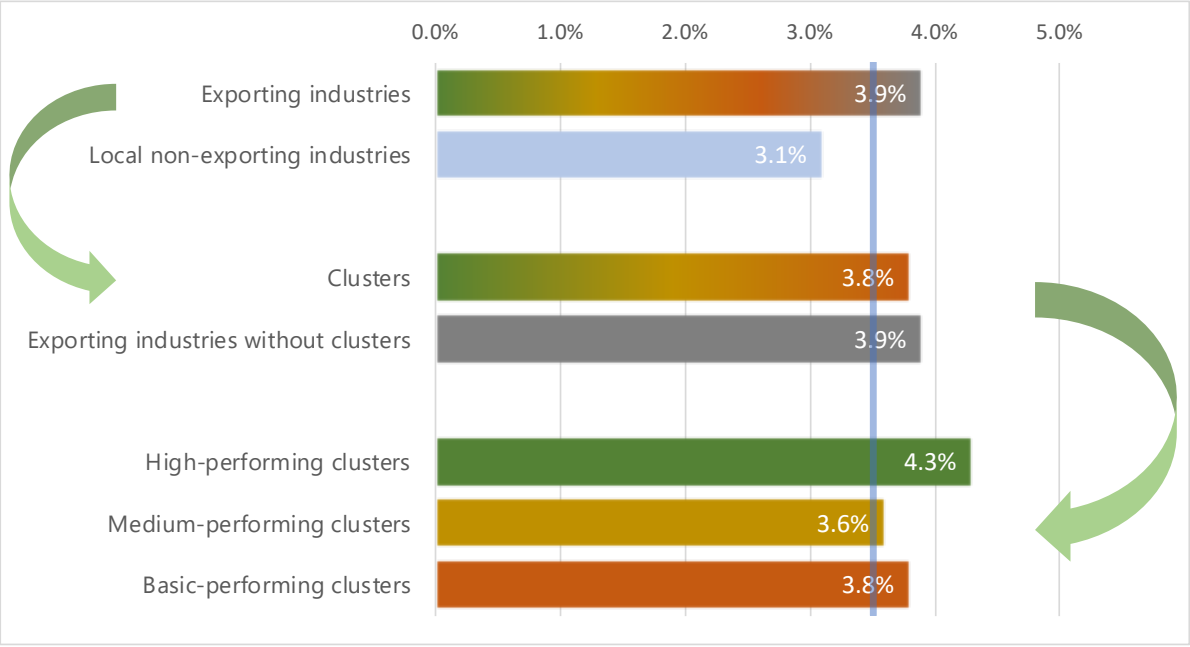
[6] For this analysis the period 2014 to 2017 was selected as this corresponds to the years for which data were updated under the European Observatory for Cluster and Industrial Change.

Figure 6 Average annual employment growth



Note: Average annual growth rates between 2014 and 2017. The blue line shows average annual growth for all industries.

Figure 7 Average annual productivity growth



Note: Average annual growth rates between 2014 and 2017. The blue line shows average annual growth for all industries.

2.3 Cluster performance across sectors

This section gives an overview of the cluster performance across 51 sectors of exporting industries by comparing the employment shares and productivity levels for clusters as well as giving an overview of productivity levels according cluster performance levels for each sector individually.

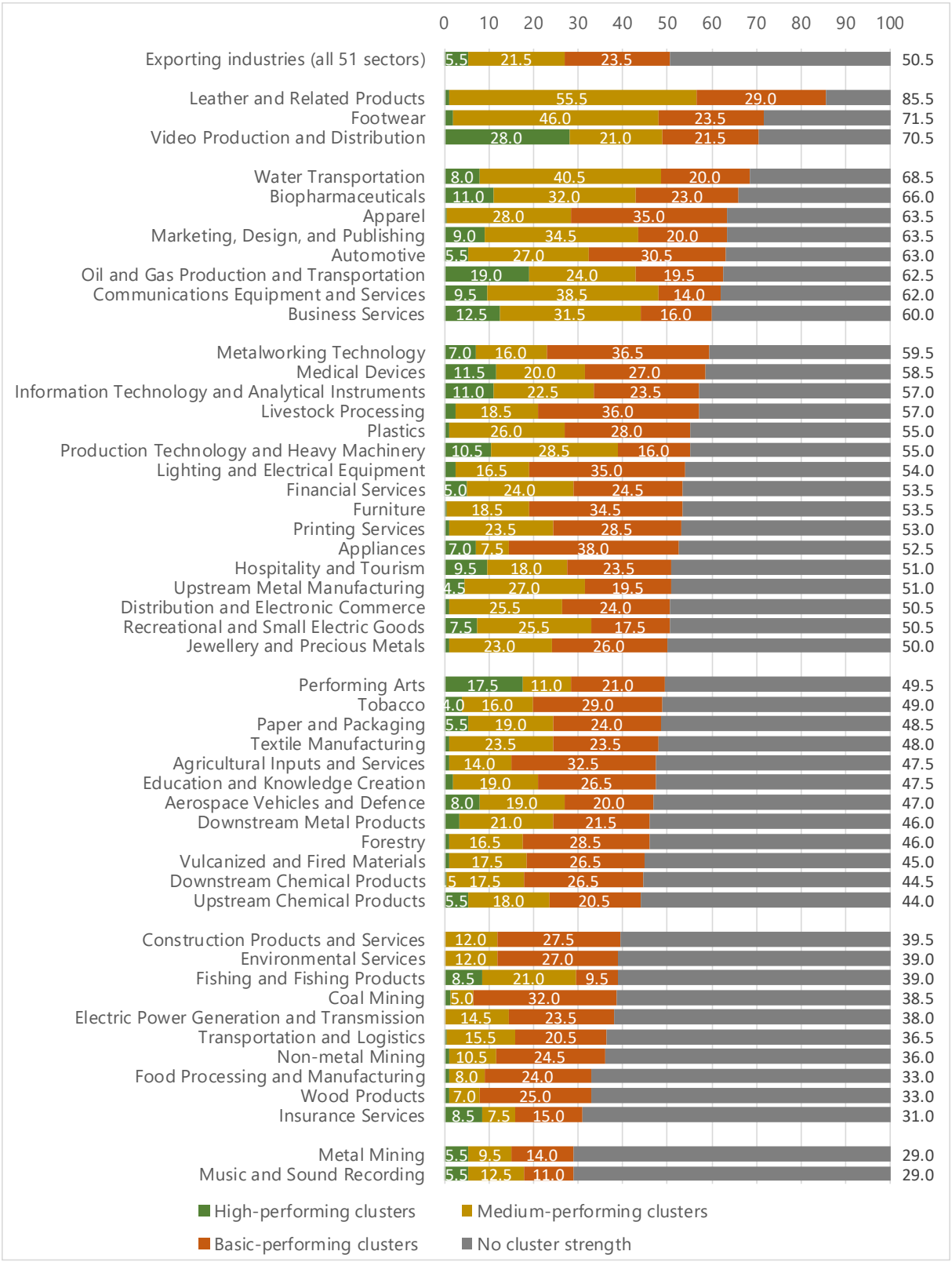
2.3.1 Employment shares of clusters compared across 51 sectors

Figure 8 on the next page shows that the majority (28) of the 51 sectors of traded industries has at least 50% of its industry employment located in clusters. It also illustrates that the **relevance of clusters differs across sectors**, as certain sectors are more ubiquitous, while others necessitate a concentration of activity or a network of highly specialised SMEs to be competitive. It shows how the employment shares of clusters vary across the 51 sectors of exporting industries (ranked top-down), which combine all shares of basic-, medium- and high-performing clusters. (Annex B presents all percentage shares in a table format). The results are as follows:

- The **highest employment shares of clusters** with *more than 70 percent* are in Leather and Related Products (85.5% of all employment is based in clusters), Footwear (71.5%) and Video Production and Distribution (70.5%);
- The employment shares of clusters are *between 60 and 70 percent* in Water Transportation (68.5), Biopharmaceuticals (66.0%), Apparel (63.5%), Marketing, Design, and Publishing (63.5%), Automotive (63.0%), Oil and Gas Production and Transportation (62.5%), Communications Equipment and Services (62.0%) and Business Services (60.0%);
- The employment shares of clusters are *between 50 and 60 percent* in Metalworking Technology (59.5%), Medical Devices (58.5%), Information Technology and Analytical Instruments (57.0%), Livestock Processing (57.0%), Plastics (55/0%), Production Technology and Heavy Machinery (55.0%), Lighting and Electrical Equipment (54.0%), Financial Services (53.5%), Furniture (53.5%), Printing Services (53.0%), Appliances (52.5%), Hospitality and Tourism (51.0%), Upstream Metal Manufacturing (51.0%), Distribution and Electronic Commerce (50.5%), Recreational and Small Electric Goods (50.5%) and Jewellery and Precious Metals (50.0%);
- The employment shares of clusters are *between 40 and 50 percent* in Performing Arts (49.5%), Tobacco (49.0%), Paper and Packaging (48.5%), Textile Manufacturing (48.0%), Agricultural Inputs and Services (47.5%), Education and Knowledge Creation (47.5%), Aerospace Vehicles and Defence (47.0%), Downstream Metal Products (46,0%), Forestry (46,0%), Vulcanized and Fired Materials (45.0%), Downstream Chemical Products (44.5%), and Upstream Chemical Products (44.0%);
- The employment shares of clusters are *between 30 and 40 percent* in Construction Products and Services (39.5%), Environmental Services (39.0%), Fishing and Fishing Products (39.0%), Coal Mining (38.5%), Electric Power Generation and Transmission (38.0%), Transportation and Logistics (36.5%), Non-metal Mining (36.0%), Food Processing and Manufacturing (33.0%), Wood Products (33.0%), Insurance Services (31.0%);

- The **lowest employment shares of clusters** with *below 30 percent* in Metal Mining (29.0%) and Wood products (29.0%).

Figure 8 Concentration of employment in clusters compared across 51 sectors of exporting industries



Note: Percentage scores on the right show the total employment shares for all clusters (i.e. the combined percentages of high-, medium- and basic performing clusters). More details are shown in Annex B.

The highest employment shares for **high-performing clusters** (indicated in green in Figure 8) are in Video Production and Distribution (28.0%), Oil and Gas Production and Transportation (19.0%), Performing Arts (17.5%), and Business Services (12.5%). High-performing clusters can be found in all exporting industries but three sectors, i.e. Construction Products and Services, Electric Power Generation and Transmission, and Environmental Services. They still host medium- and basic-performing clusters.

The highest employment shares for **medium-performing clusters** (indicated in dark yellow in Figure 8) are in Leather and Related Products (55.5%), Footwear (46.0%), Water Transportation (40.5%), Communications Equipment and Services (38.5%), and Marketing, Design, and Publishing (34.5%). The lowest employment shares are in Coal Mining (5.0%), Wood Products 7.0%), Appliances (7.5%), and Insurance Services (7.5%).

The highest employment shares for **basic-performing clusters** (indicated in brown in Figure 8) are in Appliances (38.0%), Metalworking Technology (36.5%), Livestock Processing (36.0%), Apparel (35.0%), and Lighting and Electrical Equipment (35.0%). The lowest employment shares are in Fishing and Fishing Products (9.5%), Music and Sound Recording (11.0%), Communications Equipment and Services (14.0%), and Metal Mining (14.0%).

Overall, one can observe a tendency that the cluster effect is stronger in complex technology-dependent industries while being weaker in those industries, which depend on natural resources or that are related to agriculture.

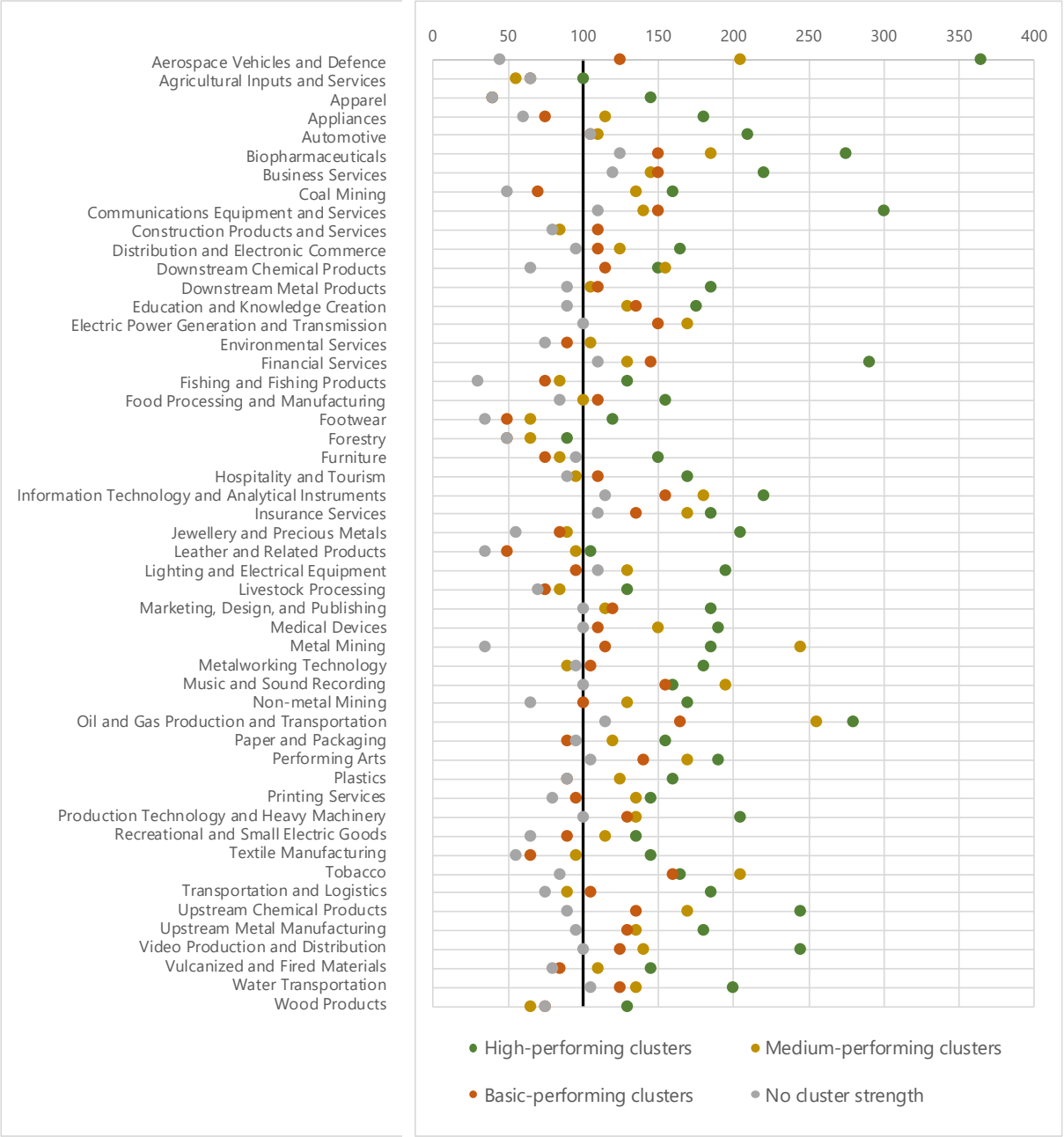
2.3.2 Productivity levels of clusters compared across 51 sectors

With regard to **productivity**, measured by the average wage per employee, high-performing clusters also display the highest productivity levels (Euros 71,700)[7], followed by medium-performing clusters (Euros 43,200) and basic-performing clusters (Euros 39,600). Productivity is lowest in exporting industries with no clusters (Euros 32,700). The declining productivity order is observed for 29 of 51 exporting industries. Differences in order are mostly observed between medium-performing clusters, basic-performing clusters and exporting industries with no clusters.

The following Figure 9 and the individual sector graphs in the next section 2.3.3 show that for 44 out of the 51 sectors of the exporting industries productivity is highest in high-performing clusters. In 3 sectors there are no high-performing sectors, of which Electric Power Generation and Transmission and Environmental Services show the highest productivity in medium-performing clusters while for Construction Products and Services productivity is highest in basic-performing clusters. In 4 sectors (namely Downstream Chemical Products, Metal Mining, Music and Sound Recording, and Tobacco), productivity in medium-performing sectors surpasses that of high-performing clusters.

[7] Annex C shows productivity levels for the different clusters in all 51 exporting industries.

Figure 9 Average wages indicating productivity levels across clusters in 51 exporting industries



Note: The grey line indicates the overall average wage level (as a value of 100) while the coloured dots may point to higher or lower productivity levels for the different cluster performance categories.

Figure 9 shows that productivity in high-performing clusters (green dots) are above average, except for Forestry. Productivity is close to or above three times the average productivity in Aerospace Vehicles and Defence (365), Communications Equipment and Services (300), Financial Services (290), and Oil and Gas Production and Transportation (285). Productivity is about 2.5 times the average productivity in Biopharmaceuticals (275) and Upstream Chemical Products (245).

For 35 out of the 51 sectors or exporting industries, productivity in medium-performing clusters is above average. Productivity is about 2.5 times the average productivity in Oil and Gas Production and Transportation (255) and Metal Mining (245). Productivity is close to twice the average productivity in Aerospace Vehicles and Defence (205), Tobacco (205), and Music and Sound

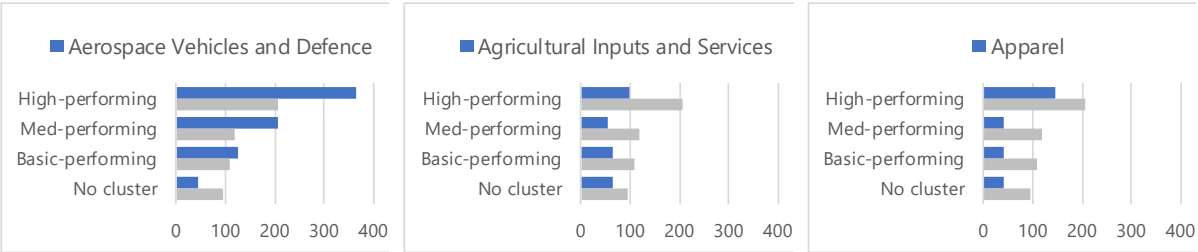
Recording (195). Productivity is lowest in Apparel (40), Agricultural Inputs and Services (55), Footwear (65), Forestry (65), and Wood Products (65).

For 30 out of the 51 sectors or exporting industries, productivity in basic-performing clusters is above average. Productivity is close to or above 1.5 times the average productivity in Oil and Gas Production and Transportation (165), Tobacco (160), Information Technology and Analytical Instruments (155), Music and Sound Recording (155), Biopharmaceuticals (150), Business Services (150), Communications Equipment and Services (150), Electric Power Generation and Transmission (150), and Financial Services (145). Productivity is lowest in Apparel (40), Footwear (50), Forestry (50), and Leather and Related Products (50).

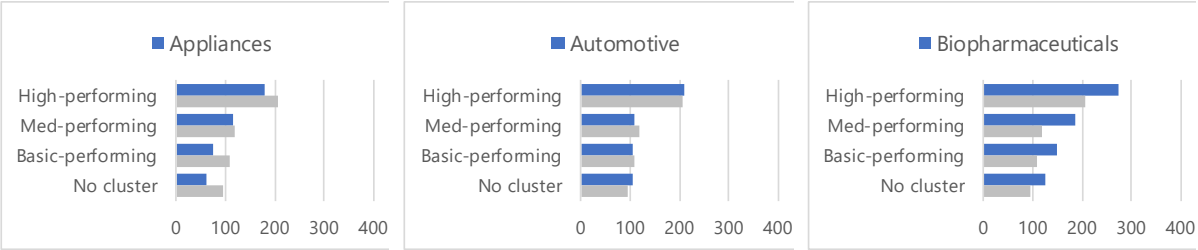
For exporting industries with no clusters, productivity is below average for 40 (or 3 out 4) industries. Productivity is relatively high in Biopharmaceuticals (125), Business Services (120), Information Technology and Analytical Instruments (115), and Oil and Gas Production and Transportation (115).

2.3.3 Productivity levels by cluster performance for 51 sectors

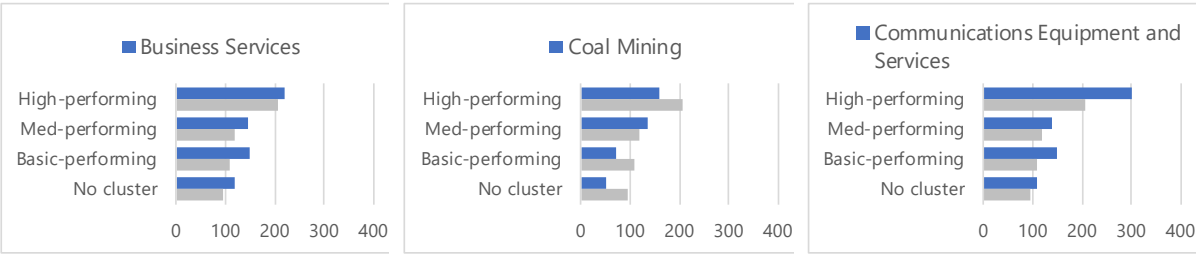
The following set of graphs present **individual results in blue for all 51 sectors** of exporting industries. The bar charts show productivity levels for each of the cluster performance categories for the specific individual sectoral industries (indicated in blue) relative to average productivity for all industries and regions (indicated in grey and at the same level for all 51 sectors), allowing a quick comparison if productivity is above or below average (where the average across all sectors and cluster categories is 100). The **grey coloured bars show average productivity** in each cluster category level across all exporting industries. Although not discussed in the text, these grey-coloured bars easily show if productivity in a cluster performance category in a particular sector is above or below average productivity for that cluster performance category across all 51 sectors of exporting industries.



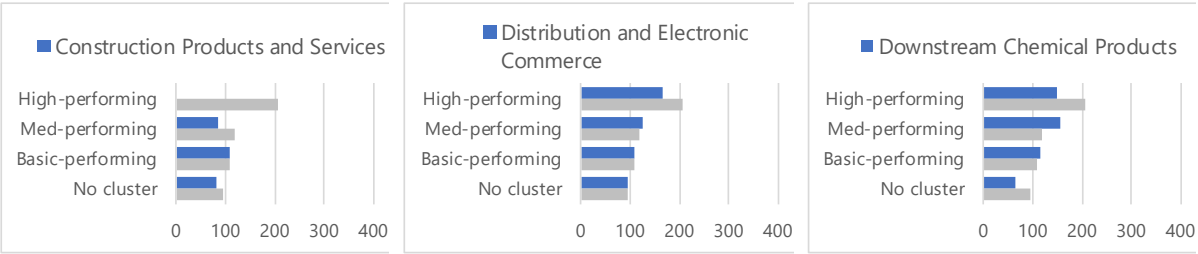
In *Aerospace Vehicles and Defence*, productivity in high-performing clusters is 265 percent above average productivity. In medium-performing clusters productivity is 105 percent above average productivity and in basic-performing clusters productivity is 25 percent above average. In *Agricultural Inputs and Services*, productivity in high-performing clusters is about average. In medium-performing clusters productivity is 45 percent below average productivity and in basic-performing clusters productivity is 35 percent below average. Productivity differences with exporting industries without cluster strength are relatively small. In *Apparel*, productivity in high-performing clusters is 45 percent above average productivity. In both medium-performing and basic-performing clusters productivity is 60 percent below average. Productivity differences with exporting industries without cluster strength are relatively small.



In *Appliances*, productivity in high-performing clusters is 80 percent above average productivity. In medium-performing clusters productivity is 15 percent above average productivity and in basic-performing clusters productivity is 25 percent below average. In *Automotive*, productivity in high-performing clusters is 110 percent above average productivity. In medium-performing clusters productivity is 10 percent above average productivity and in basic-performing clusters productivity is 5 percent above average. In *Biopharmaceuticals*, productivity in high-performing clusters is 175 percent above average productivity. In medium-performing clusters productivity is 85 percent above average productivity and in basic-performing clusters productivity is 50 percent above average.



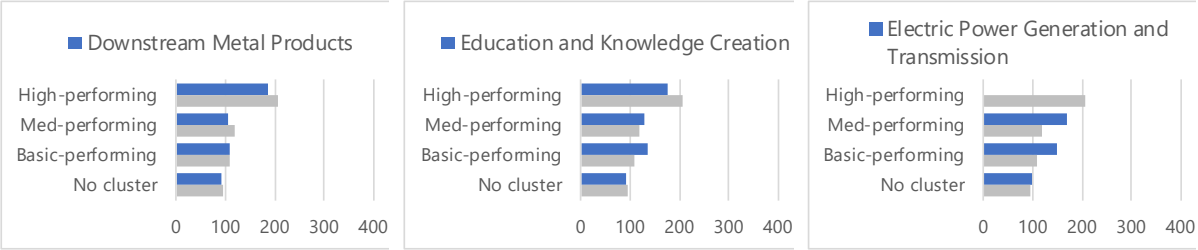
In *Business Services*, productivity in high-performing clusters is 120 percent above average productivity. In medium-performing clusters productivity is 45 percent above average productivity and in basic-performing clusters productivity is 50 percent above average. In *Coal Mining*, productivity in high-performing clusters is 60 percent above average productivity. In medium-performing clusters productivity is 35 percent above average productivity and in basic-performing clusters productivity is 30 percent below average. In *Communications Equipment and Services*, productivity in high-performing clusters is 200 percent above average productivity. In medium-performing clusters productivity is 40 percent above average productivity and in basic-performing clusters productivity is 50 percent above average.



Note: A missing top blue bar indicates one of the three sectors without identified high-performing clusters.

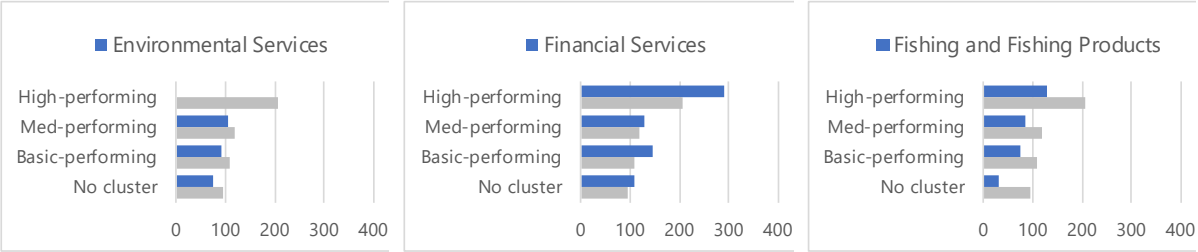
In *Construction Products and Services*, there are no high-performing clusters. In medium-performing clusters productivity is 15 percent below average productivity and in basic-performing clusters productivity is 10 percent above average. In *Distribution and Electronic Commerce*, productivity in

high-performing clusters is 65 percent above average productivity. In medium-performing clusters productivity is 25 percent above average productivity and in basic-performing clusters productivity is 10 percent above average. In *Downstream Chemical Products*, productivity in high-performing clusters is 50 percent above average productivity. In medium-performing clusters productivity is 55 percent above average productivity and in basic-performing clusters productivity is 15 percent above average.



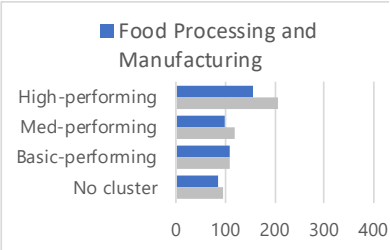
Note: A missing top blue bar indicates one of the three sectors without identified high-performing clusters.

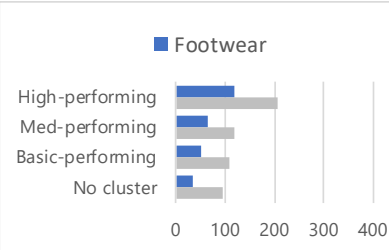
In *Downstream Metal Products*, productivity in high-performing clusters is 85 percent above average productivity. In medium-performing clusters productivity is 5 percent above average productivity and in basic-performing clusters productivity is 10 percent above average. In *Education and Knowledge Creation*, productivity in high-performing clusters is 75 percent above average productivity. In medium-performing clusters productivity is 30 percent above average productivity and in basic-performing clusters productivity is 35 percent above average. In *Electric Power Generation and Transmission*, there are no high-performing sectors. In medium-performing clusters productivity is 70 percent above average productivity and in basic-performing clusters productivity is 50 percent above average.

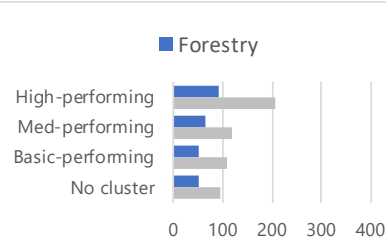


Note: A missing top blue bar indicates one of the three sectors without identified high-performing clusters.

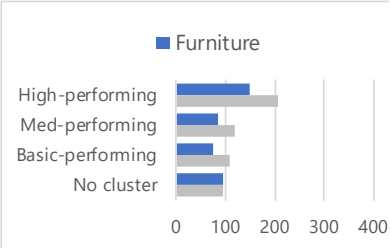
In *Environmental Services*, a ubiquitous sector with relatively low wages, the wage indicator does not enable to identify high-performing clusters. In medium-performing clusters wages are 5 percent above average productivity and in basic-performing clusters wages are 10 percent below average. In *Financial Services*, productivity in high-performing clusters is 190 percent above average productivity. In medium-performing clusters productivity is 30 percent above average productivity and in basic-performing clusters productivity is 45 percent above average. In *Fishing and Fishing Products*, productivity in high-performing clusters is 30 percent above average productivity. In medium-performing clusters productivity is 15 percent below average productivity and in basic-performing clusters productivity is 25 percent below average.

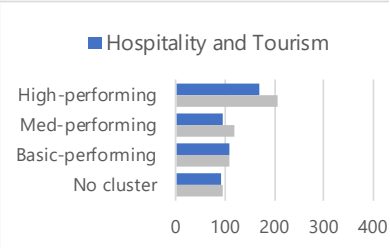


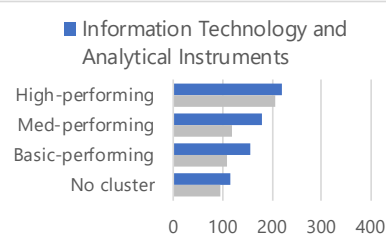




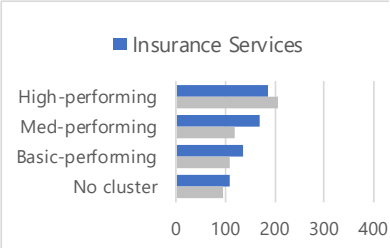
In *Food Processing and Manufacturing*, productivity in high-performing clusters is 55 percent above average productivity. In medium-performing clusters productivity is close to average productivity and in basic-performing clusters productivity is 10 percent above average. In *Footwear*, productivity in high-performing clusters is 20 percent above average productivity. In medium-performing clusters productivity is 35 percent below average productivity and in basic-performing clusters productivity is 50 percent below average. In *Forestry*, productivity in high-performing clusters is 10 percent below average productivity. In medium-performing clusters productivity is 35 percent below average productivity and in basic-performing clusters productivity is 50 percent below average.

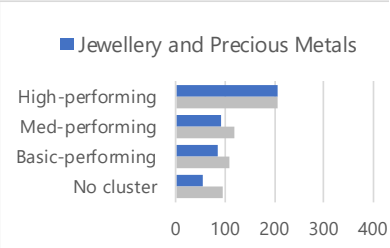


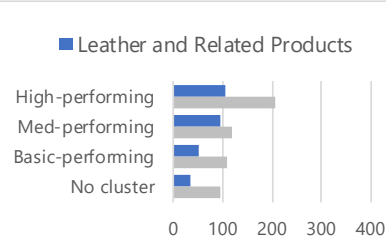




In *Furniture*, productivity in high-performing clusters is 50 percent above average productivity. In medium-performing clusters productivity is 15 percent below average productivity and in basic-performing clusters productivity is 25 percent below average. In *Hospitality and Tourism*, productivity in high-performing clusters is 70 percent above average productivity. In medium-performing clusters productivity is 5 percent below average productivity and in basic-performing clusters productivity is 10 percent above average. In *Information Technology and Analytical Instruments*, productivity in high-performing clusters is 120 percent above average productivity. In medium-performing clusters productivity is 80 percent above average productivity and in basic-performing clusters productivity is 55 percent above average.

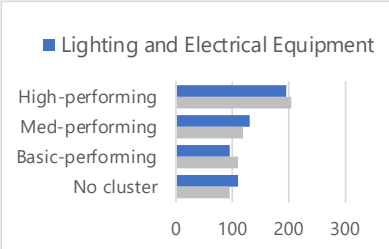


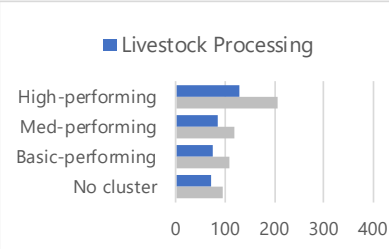


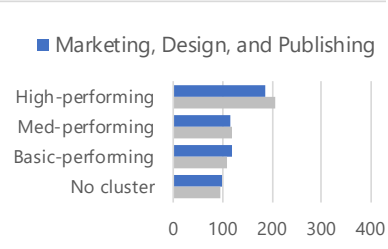


In *Insurance Services*, productivity in high-performing clusters is 85 percent above average productivity. In medium-performing clusters productivity is 70 percent above average productivity and in basic-performing clusters productivity is 35 percent above average. In *Jewellery and Precious Metals*, productivity in high-performing clusters is 105 percent above average productivity. In

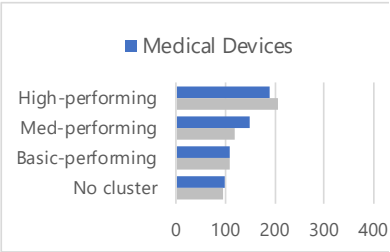
medium-performing clusters productivity is 10 percent below average productivity and in basic-performing clusters productivity is 15 percent below average. In *Leather and Related Products*, productivity in high-performing clusters is 5 percent above average productivity. In medium-performing clusters productivity is 5 percent below average productivity and in basic-performing clusters productivity is 50 percent below average.

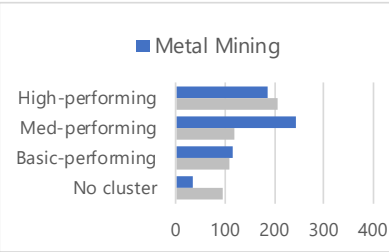


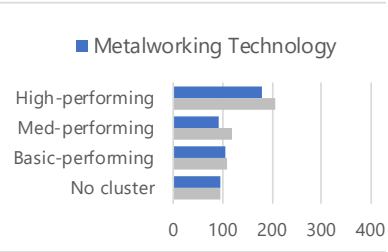




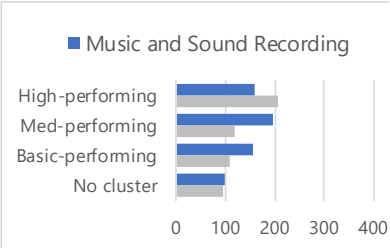
In *Lighting and Electrical Equipment*, productivity in high-performing clusters is 95 percent above average productivity. In medium-performing clusters productivity is 30 percent above average productivity and in basic-performing clusters productivity is 5 percent below average. In *Livestock Processing*, productivity in high-performing clusters is 30 percent above average productivity. In medium-performing clusters productivity is 15 percent below average productivity and in basic-performing clusters productivity is 25 percent below average. In *Marketing, Design, and Publishing*, productivity in high-performing clusters is 85 percent above average productivity. In medium-performing clusters productivity is 15 percent above average productivity and in basic-performing clusters productivity is 20 percent above average.

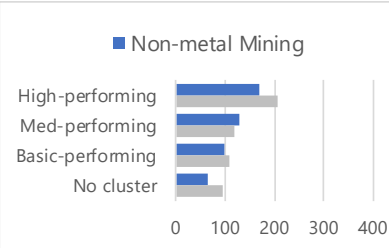


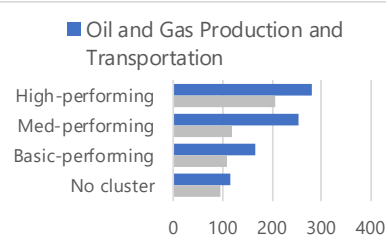




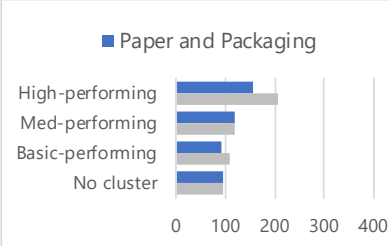
In *Medical Devices*, productivity in high-performing clusters is 90 percent above average productivity. In medium-performing clusters productivity is 50 percent above average productivity and in basic-performing clusters productivity is 10 percent above average. In *Metal Mining*, productivity in high-performing clusters is 85 percent above average productivity. In medium-performing clusters productivity is highest at 145 percent above average productivity and in basic-performing clusters productivity is 15 percent above average. In *Metalworking Technology*, productivity in high-performing clusters is 80 percent above average productivity. In medium-performing clusters productivity is 10 percent below average productivity and in basic-performing clusters productivity is 5 percent above average.

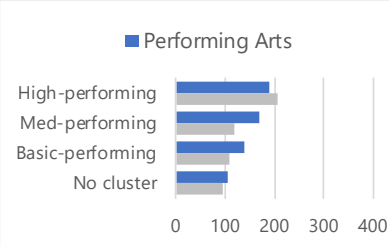


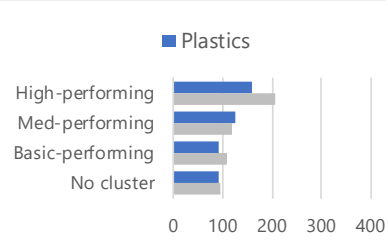




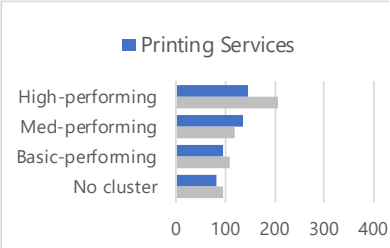
In *Music and Sound Recording*, productivity in high-performing clusters is 60 percent above average productivity. In medium-performing clusters productivity is highest at 95 percent above average productivity and in basic-performing clusters productivity is 55 percent above average. In *Non-metal Mining*, productivity in high-performing clusters is 70 percent above average productivity. In medium-performing clusters productivity is 30 percent above average productivity and in basic-performing clusters productivity is close to average. In *Oil and Gas Production and Transportation*, productivity in high-performing clusters is 180 percent above average productivity. In medium-performing clusters productivity is 155 percent above average productivity and in basic-performing clusters productivity is 65 percent above average.

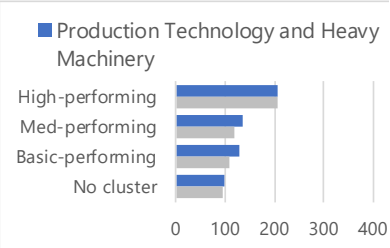


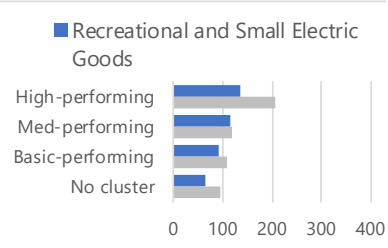




In *Paper and Packaging*, productivity in high-performing clusters is 55 percent above average productivity. In medium-performing clusters productivity is 20 percent above average productivity and in basic-performing clusters productivity is 10 percent below average. In *Performing Arts*, productivity in high-performing clusters is 90 percent above average productivity. In medium-performing clusters productivity is 70 percent above average productivity and in basic-performing clusters productivity is 40 percent above average. In *Plastics*, productivity in high-performing clusters is 60 percent above average productivity. In medium-performing clusters productivity is 25 percent above average productivity and in basic-performing clusters productivity is 10 percent below average.

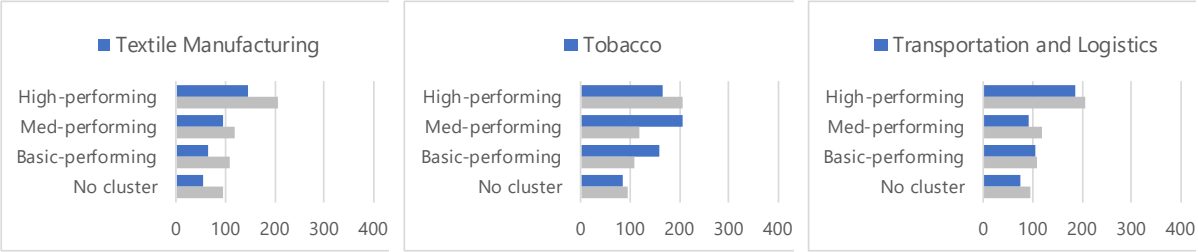




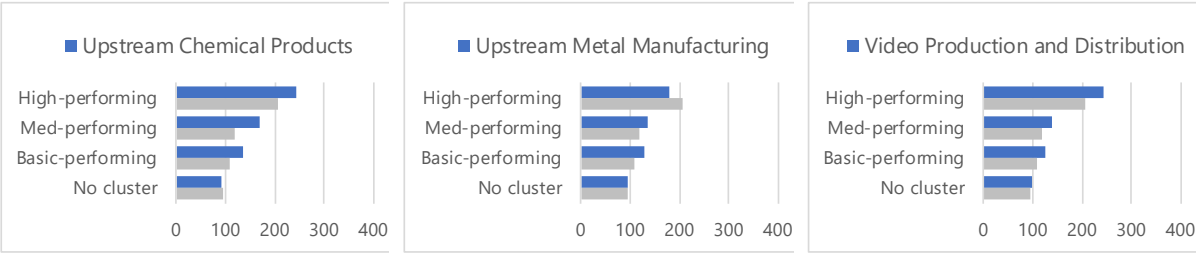


In *Printing Services*, productivity in high-performing clusters is 45 percent above average productivity. In medium-performing clusters productivity is 35 percent above average productivity and in basic-performing clusters productivity is 5 percent below average. In *Production Technology and Heavy Machinery*, productivity in high-performing clusters is 105 percent above average

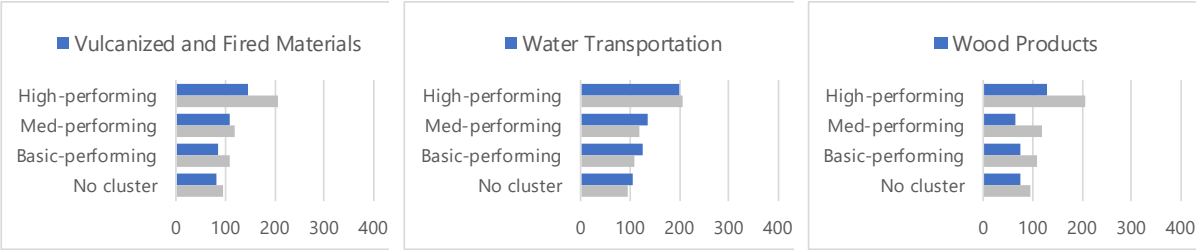
productivity. In medium-performing clusters productivity is 35 percent above average productivity and in basic-performing clusters productivity is 30 percent above average. In *Recreational and Small Electric Goods*, productivity in high-performing clusters is 35 percent above average productivity. In medium-performing clusters productivity is 15 percent above average productivity and in basic-performing clusters productivity is 10 percent below average.



In *Textile Manufacturing*, productivity in high-performing clusters is 45 percent above average productivity. In medium-performing clusters productivity is 5 percent below average productivity and in basic-performing clusters productivity is 35 percent below average. In *Tobacco*, productivity in high-performing clusters is 65 percent above average productivity. In medium-performing clusters productivity is 105 percent above average productivity and in basic-performing clusters productivity is 60 percent above average. In *Transportation and Logistics*, productivity in high-performing clusters is 85 percent above average productivity. In medium-performing clusters productivity is 10 percent below average productivity and in basic-performing clusters productivity is 5 percent above average.



In *Upstream Chemical Products*, productivity in high-performing clusters is 145 percent above average productivity. In medium-performing clusters productivity is 70 percent above average productivity and in basic-performing clusters productivity is 35 percent above average. In *Upstream Metal Manufacturing*, productivity in high-performing clusters is 80 percent above average productivity. In medium-performing clusters productivity is 35 percent above average productivity and in basic-performing clusters productivity is 30 percent above average. In *Video Production and Distribution*, productivity in high-performing clusters is 145 percent above average productivity. In medium-performing clusters productivity is 40 percent above average productivity and in basic-performing clusters productivity is 25 percent above average.



In *Vulcanized and Fired Materials*, productivity in high-performing clusters is 45 percent above average productivity. In medium-performing clusters productivity is 10 percent above average productivity and in basic-performing clusters productivity is 15 percent below average. In *Water Transportation*, productivity in high-performing clusters is 100 percent above average productivity. In medium-performing clusters productivity is 35 percent above average productivity and in basic-performing clusters productivity is 25 percent above average. In *Wood Products*, productivity in high-performing clusters is 30 percent above average productivity. In medium-performing clusters productivity is 35 percent below average productivity and in basic-performing clusters productivity is 25 percent below average.

2.3.4 Employment growth by cluster performance for 51 sectors

Table 1 shows the average annual growth rates for employment between 2014 and 2017 for the high-performing, medium-performing, basic-performing clusters and regional areas of exporting industries with no cluster strength. High-performing clusters tend, on average, to have experienced higher employment growth. For the 48 sectors of exporting industries with at least one region with a high-performing cluster, employment growth was highest for 13 of these industries or 27%. For the medium-performing clusters the corresponding percentage is 33 percent (17 out of 51), for the basic-performing clusters it is 20 percent (10 out of 51) and for exporting industries with no cluster strength it is 20 percent (11 out of 51). Although these results suggest that there is a positive link between employment growth and cluster strength, stronger clusters do not always experience higher employment growth.

Table 1 Employment growth rates by cluster performance for 51 sectors (%, 2014-2017)

	High-performing clusters	Medium-performing clusters	Basic-performing clusters	No cluster strength
Aerospace Vehicles and Defence	0.10	-0.39	1.07	-0.07
Agricultural Inputs and Services	-3.71	1.55	1.20	0.54
Apparel	-0.98	0.58	0.00	0.16
Appliances	-0.49	0.17	0.30	1.15
Automotive	0.94	1.28	1.41	0.57
Biopharmaceuticals	0.48	-0.10	1.30	0.72
Business Services	2.13	2.97	2.95	1.54
Coal Mining	2.50	-0.61	1.42	0.34
Communications Equipment and Services	2.60	0.67	0.54	0.48
Construction Products and Services	--	-0.13	0.80	0.01
Distribution and Electronic Commerce	1.19	1.69	1.16	1.22

Downstream Chemical Products	-2.66	0.24	-0.13	0.85
Downstream Metal Products	-0.97	0.45	0.26	0.57
Education and Knowledge Creation	2.28	2.74	1.17	1.19
Electric Power Generation and Transmission	--	-0.81	0.14	0.23
Environmental Services	--	0.33	0.22	0.22
Financial Services	1.76	2.37	1.17	0.61
Fishing and Fishing Products	-0.44	0.04	0.34	1.31
Food Processing and Manufacturing	-1.65	1.79	1.15	0.49
Footwear	0.66	0.13	0.04	0.44
Forestry	-1.88	-0.45	0.95	0.77
Furniture	-0.09	0.93	0.91	0.32
Hospitality and Tourism	2.28	3.60	2.26	1.60
Information Technology and Analytical Instruments	0.57	0.69	1.14	0.45
Insurance Services	0.16	0.63	1.28	0.56
Jewellery and Precious Metals	2.39	-1.17	-0.18	0.70
Leather and Related Products	3.28	1.23	1.73	1.78
Lighting and Electrical Equipment	-1.68	0.54	0.40	-0.03
Livestock Processing	-1.08	0.68	0.16	0.73
Marketing, Design, and Publishing	2.19	1.88	1.02	1.21
Medical Devices	1.19	1.74	1.45	0.96
Metal Mining	-1.75	0.60	0.51	0.58
Metalworking Technology	0.88	0.48	1.43	0.64
Music and Sound Recording	0.27	0.45	0.54	1.21
Non-metal Mining	2.73	-1.51	-0.23	0.22
Oil and Gas Production and Transportation	-1.06	-1.01	-0.57	0.18
Paper and Packaging	-0.49	-0.89	0.09	0.49
Performing Arts	0.67	1.47	0.62	0.89
Plastics	0.97	1.26	1.28	0.84
Printing Services	0.37	-0.26	-0.12	0.23
Production Technology and Heavy Machinery	-0.37	0.65	0.24	0.39
Recreational and Small Electric Goods	1.08	0.49	0.43	0.55
Textile Manufacturing	1.25	0.21	0.44	0.44
Tobacco	-3.90	0.91	1.37	1.03
Transportation and Logistics	0.24	2.70	1.93	1.26
Upstream Chemical Products	0.31	-0.44	0.01	0.19
Upstream Metal Manufacturing	-0.57	0.19	0.09	0.27
Video Production and Distribution	2.32	1.20	1.46	1.17
Vulcanized and Fired Materials	-0.24	-0.19	0.24	0.39
Water Transportation	0.16	0.86	0.33	0.62
Wood Products	1.32	0.86	-0.18	0.65

Note: Grey boxes indicate the cluster performance category with the highest growth rate.

2.3.5 Productivity growth by cluster performance for 51 sectors

Table 2 shows the average annual growth rate for productivity between 2014 and 2017 for the different cluster strengths. High-performing clusters tend to have higher productivity growth. For the 48 traded industries with at least one region with a high-performing cluster, employment growth was highest (highlighted in grey) for 33 percent of these industries. For the medium-performing clusters the corresponding percentage is 18 percent (9 out of 51), for the basic-performing clusters it is also high at 37 percent (19 out of 51) and for exporting industries with no cluster strength it is 14 percent (7 out of 51). Similar as for employment growth, these results suggest that there is positive link between productivity growth and cluster strength.

Table 2 Productivity growth rates by cluster performance for 51 sectors (%, 2014-2017)

	High-performing clusters	Medium-performing clusters	Basic-performing clusters	No cluster strength
Aerospace Vehicles and Defence	4.95	4.05	3.73	3.60
Agricultural Inputs and Services	7.38	2.80	3.95	3.99
Apparel	4.99	5.40	4.42	3.73
Appliances	4.31	3.31	4.86	3.90
Automotive	3.49	4.68	3.87	4.36
Biopharmaceuticals	6.06	4.27	5.08	4.41
Business Services	5.56	4.34	4.48	4.38
Coal Mining	1.71	4.29	5.58	3.59
Communications Equipment and Services	4.49	4.75	5.04	4.14
Construction Products and Services	--	4.67	4.18	3.81
Distribution and Electronic Commerce	3.08	3.35	3.78	3.79
Downstream Chemical Products	11.21	5.32	3.88	4.15
Downstream Metal Products	3.37	5.06	3.97	3.81
Education and Knowledge Creation	2.85	4.18	4.10	3.74
Electric Power Generation and Transmission	--	4.25	4.40	4.07
Environmental Services	--	3.48	4.40	3.69
Financial Services	4.84	3.79	4.27	4.29
Fishing and Fishing Products	3.24	4.38	5.52	3.72
Food Processing and Manufacturing	1.67	3.26	3.26	4.26
Footwear	3.80	4.00	4.90	3.28
Forestry	1.19	2.68	4.99	3.88
Furniture	3.14	3.68	4.61	4.00
Hospitality and Tourism	2.18	2.54	2.87	4.07
Information Technology and Analytical Instruments	6.86	4.77	5.19	4.56
Insurance Services	4.53	3.33	4.43	3.78
Jewellery and Precious Metals	4.84	3.21	3.47	3.56
Leather and Related Products	3.54	5.20	6.15	3.65
Lighting and Electrical Equipment	5.08	3.47	4.63	4.22
Livestock Processing	4.22	3.95	4.54	3.76
Marketing, Design, and Publishing	4.45	4.08	3.63	4.09

Medical Devices	3.23	3.51	5.02	4.16
Metal Mining	1.37	4.92	5.27	3.52
Metalworking Technology	2.28	3.44	2.88	4.09
Music and Sound Recording	1.23	5.37	3.62	3.51
Non-metal Mining	3.46	3.97	3.70	3.71
Oil and Gas Production and Transportation	3.93	2.95	4.67	3.54
Paper and Packaging	3.03	3.93	4.06	3.97
Performing Arts	3.69	2.78	3.68	4.03
Plastics	2.22	3.80	4.55	4.17
Printing Services	3.29	3.76	4.05	3.48
Production Technology and Heavy Machinery	4.40	3.75	3.59	4.00
Recreational and Small Electric Goods	6.71	4.39	4.52	3.80
Textile Manufacturing	4.83	3.82	4.79	3.64
Tobacco	13.43	7.28	4.08	3.16
Transportation and Logistics	2.56	4.51	4.22	3.80
Upstream Chemical Products	3.34	4.13	4.58	3.82
Upstream Metal Manufacturing	3.61	3.85	3.85	4.19
Video Production and Distribution	4.45	5.38	3.74	3.66
Vulcanized and Fired Materials	5.46	4.75	4.67	4.05
Water Transportation	3.11	2.84	3.24	4.16
Wood Products	5.81	4.99	4.35	3.69

Note: Grey boxes indicate the cluster performance category with the highest growth rate.

2.4 Clusters per region: region size matters

The new methodology results in the identification of 2,950 clusters, comprising 198 high-performing clusters, 898 medium-performing clusters and 1,854 basic-performing clusters across all regions in Europe. Figure 10 shows the distribution of the possible total number of cluster stars across all the regions. The highest number of cluster stars is 43 for both FR10 Ile-De-France and ITC4 Lombardia. The top-25 regions with the largest number of clusters is shown in Table 3. FR10 Ile-De-France not only has the highest number of clusters, it also has the highest number of medium-performing clusters (30). Piemonte (ITC1) and Stuttgart (DE11) have the highest number of high-performing clusters (9). Cataluña (ES52) has the highest number of basic-performing clusters (31).

Italy is the country with most regions (7) in the top-25 cluster star regions, followed by Spain (5 regions), Germany (4 regions) and France and Poland (2 regions each). Belgium, Hungary, Ireland, Sweden and the UK each have one region in the top-25. At country level, the highest number of clusters across all regions in that country is for Germany (424), followed by the UK (366), Italy (345), France (302 and Spain (267). The ranking result is strongly biased in favour of large countries. The ranking is different when considering differences in country size. Latvia now has the highest number of strong clusters per region (130), followed by Italy (12.8), Spain (10.7), Ireland (10.4) and Belgium (10.2).

Figure 10 Distribution of total number of cluster stars in exporting industries across all regions

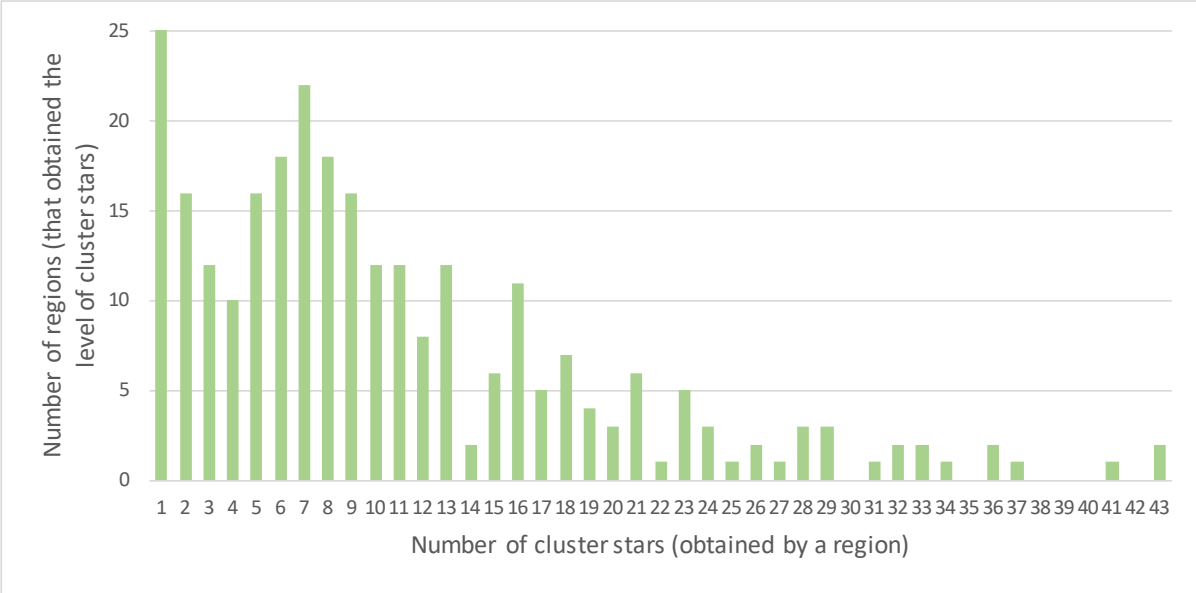
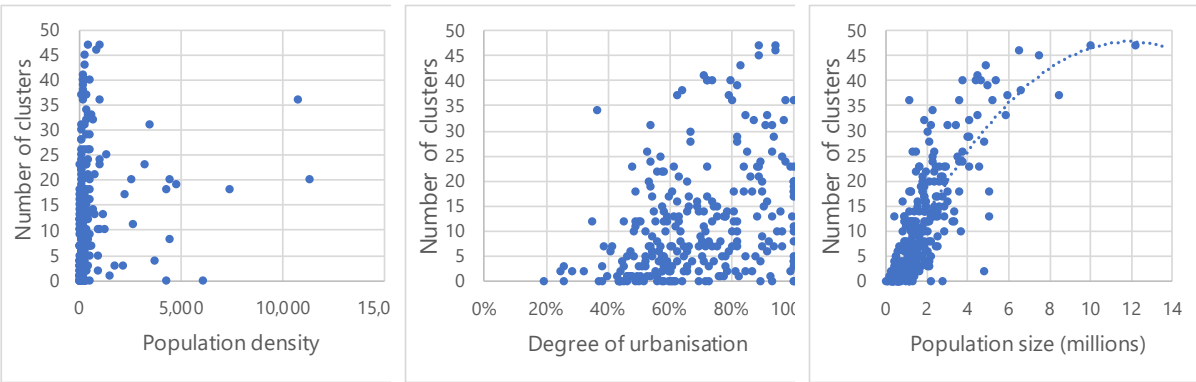


Table 3 shows the Top-25 regions which have the highest number of clusters. The results suggest that there could be a positive correlation between the number of clusters and the presence of very large cities in the region. The top-25 regions includes many metropolitan areas, including among others Paris (FR10), Barcelona (ES51), Madrid (ES30), Valencia (ES52), Stockholm (SE11), Rome (ITI4), Stuttgart (DE11), Warsaw (PL12), Cologne-Bonn (DEA2), Munich (DE21), Inner London-West (UKI3) and Budapest (HU10), which are all metropolitan areas with more than 2.5 million inhabitants. Figure 11 shows that there is no link between the number of strong clusters and both population density and the degree of urbanisation, both indicators of the presence of large urbanized and densely populated cities. However, there is a positive and significant relation between the number of strong clusters and size of the region as measured by population[8].

Figure 11 Link between clusters and size of a region



[8] The dotted line in the graph shows a second-degree polynomial regression: with increasing population size the increase in the number of clusters is declining. An increase from one to two million population results in an additional 7 clusters, from 4 to 5 million population in an additional 5 clusters, and from 7 to 8 million population in an additional 3 clusters.

Table 3 Top-25 regions with most clusters

	NUTS code	Region	Basic-performing clusters	Medium-performing clusters	High-performing clusters	Total number of strong clusters
1	FR10	Ile-De-France	10	30	3	43
	ITC4	Lombardia	20	21	2	43
3	ES51	Cataluña	31	9	1	41
4	ITH3	Veneto	22	15	0	37
5	ES30	Madrid	24	10	2	36
	ITC1	Piemonte	14	15	7	36
7	ITI1	Toscana	21	12	1	34
8	ES52	Comunidad Valenciana	26	7	0	33
	FR71	Rhone-Alpes	22	9	2	33
10	ITH5	Emilia-Romagna	20	11	1	32
	SE11	Stockholm	16	14	2	32
12	ES61	Andalucía	23	8	0	31
13	DEA1	Duesseldorf	11	14	4	29
	ITF3	Campania	13	14	2	29
	ITI4	Lazio	15	13	1	29
16	DE11	Stuttgart	15	6	7	28
	ES21	Païs Vasco	9	16	3	28
	PL12	Mazowieckie	11	17	0	28
19	DEA2	Köln	10	12	5	27
20	DE21	Oberbayern	22	4	0	26
	IE02	Southern and Eastern	14	8	4	26
22	UKI3	Inner London - West	20	5	0	25
23	BE23	East-Flanders	15	9	0	24
	HU10	Central Hungary	17	4	3	24
	PL41	Wielkopolskie	17	5	2	24

Note: Regions ordered first by total number of clusters and then alphabetically by NUTS code.

3 Emerging industries: firm size and the degree of specialisation

This chapter takes a closer look at the emerging industries, their economic performance over time and the role of firm size in clusters and more specifically in determining the degree of specialisation. The effect of firm size is first briefly discussed by reviewing the latest scientific literature. This includes a discussion of an experimental methodology for identifying the role of firm size in measuring cluster specialisation, which differentiates location quotients with a plant and size effect. These measure the impact of the concentration of firms (e.g. many SMEs) and of average firm size (e.g. larger firms) respectively. This methodology is then applied to ten emerging industries and results are presented.

3.1 Recent economic performance of ten emerging industries

Cross-sectoral, so-called emerging industries are at the heart of this chapter. However, they are by their very nature difficult to capture, since emerging industries intend to capture new development potential that will be realised only in the future. And as with most predictions about the future, there is uncertainty as to whether the potential will indeed be realised. The chapter continues to track the development of emerging industries.

The methodology behind emerging industries is explained in the 2014 Panorama Report[9]. Three steps have been made for the determination of emerging industries. First, the strongest current cross-sectoral linkages are identified, drawing on a traditional cluster mapping analysis. Second, the cluster categories of exporting industrial sectors are broadened and, in some cases, merged, to capture an additional layer of weaker linkages beyond the stronger linkages within a given cluster category. Third, a final list of the ten strongest emerging industries were selected from the wider group of candidate emerging industries that have shown the highest economic dynamism in the recent past.

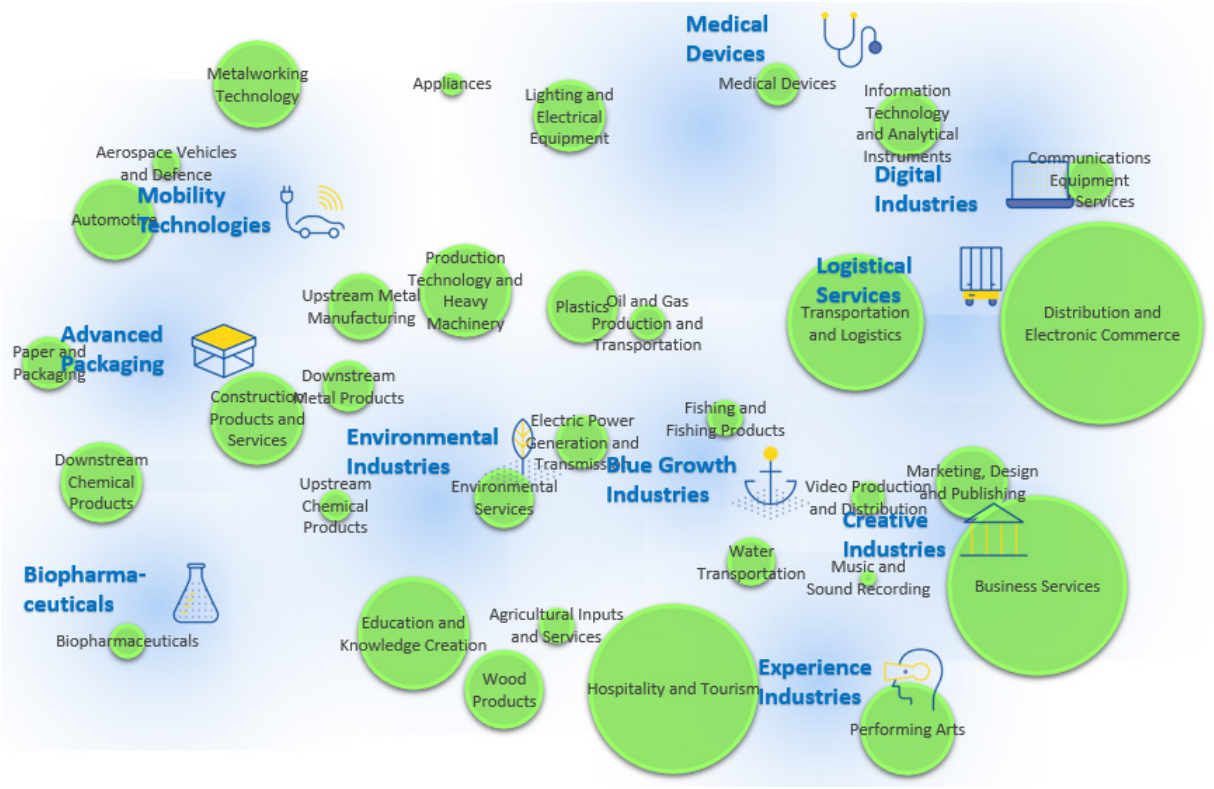
The emerging industries are part of the traded industries as shown in Figure 12. Both a compiled by aggregating multiple 4-digit NACE industries but where every 4-digit industry is assigned to only one traded industry, the same 4-digit industry can be assigned to more than one emerging industry. Figure 13 visualizes how several of the traded industries are linked to each of the ten emerging industries.

Only two emerging industries, Creative Industries and Experience Industries, have seen their employment grow faster than the average of all traded industries and the average of all industries. For eight emerging industries productivity (measured by average wages) is higher than the average of all traded industries and the average of all industries. Only for Blue Growth Industries and

[9] http://ec.europa.eu/DocsRoom/documents/7242/attachments/1/translations/en/renditions/pdf

Logistical Services productivity is below the average of all traded industries and the average of all industries.

Figure 12 Linkages between emerging industries and sectoral industries



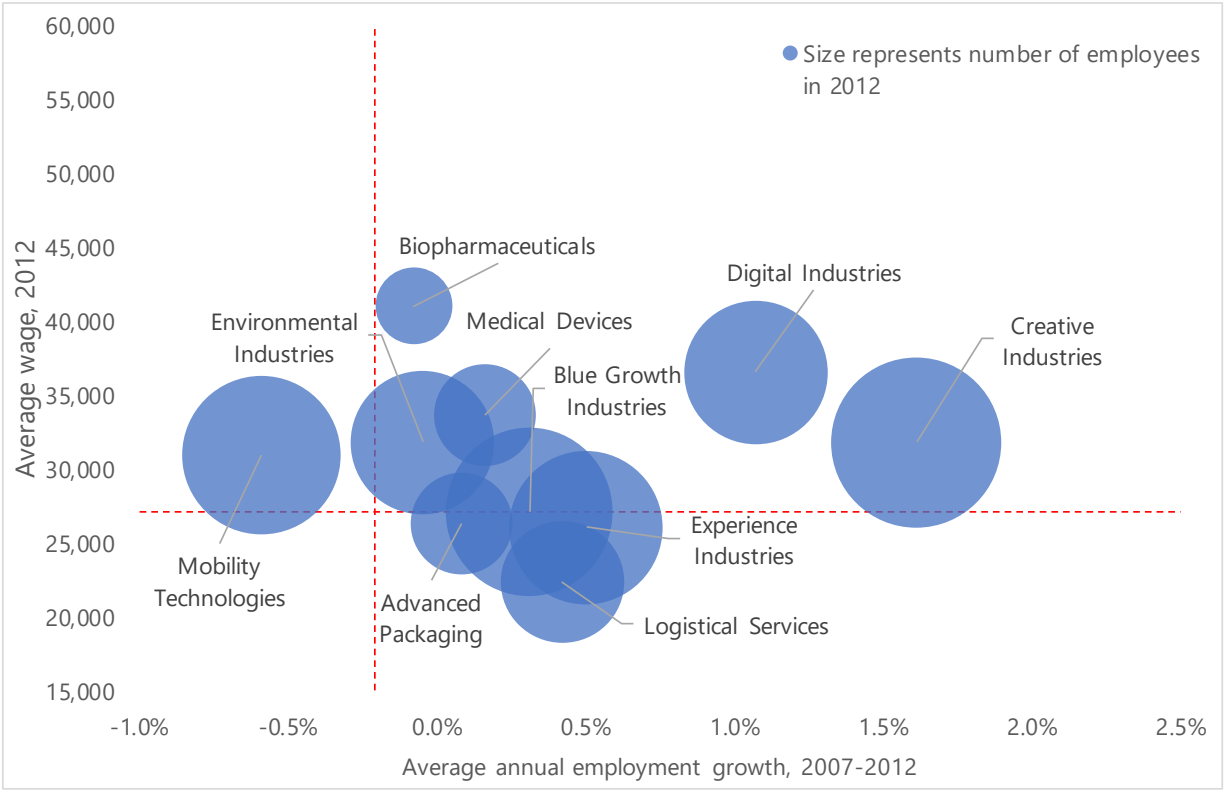
Note: The graph illustrates the relationship between emerging industries and exporting sectoral industries. Sectoral industries are presented in circles: the size is relative to the number of employees; the position shows the proximity to the related emerging industry indicated in blue colour. Source: 2019 Panorama report

Figures 13 and 14 on the next page capture emerging industries in one image, i.e. showing results for employment size, growth, and wage level for each of the ten emerging industries in two different time periods. The axes represent average wage and annual employment growth, while the bubble size represents employment size.

Figure 13 shows the results for the emerging industries as presented in the 2014 Panorama report, capturing the *2007-2012 period*. The highly positioned emerging Biopharmaceuticals industry shows the highest productivity in terms of average wages (Euros 41,000), while the emerging Creative Industries with the biggest bubble positioned furthest to the right show the highest dynamism (1.6% average annual growth rate) and employment concentration (12.2 million employees).

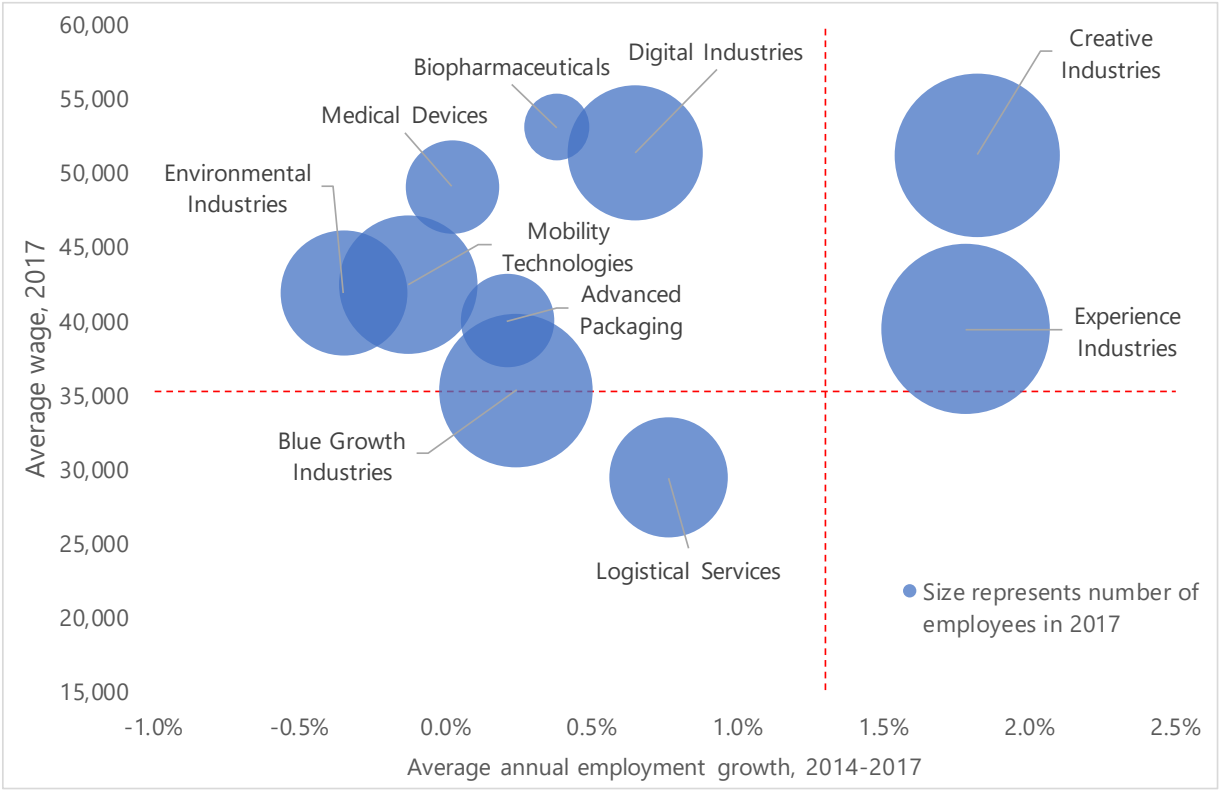
Figure 14 shows more recent results for the *2014-2017 period*. Creative Industries has experienced once again the fastest employment growth (1.8% average annual growth rate), closely followed by Experience Industries (1.8%). A comparison of the productivity or average wages on the vertical axis shows that productivity has increased significantly for all emerging industries between 2012 and 2017. Productivity for most emerging industries is above average productivity for all exporting industries except for Logistical Services (16.5% below average productivity).

Figure 13 Emerging Industries overview: a comparison between the 2014 Panorama report



Note: Red dotted lines show the average for all traded industries.

Figure 14 Emerging Industries overview: a comparison between the 2020 Panorama report



Note: Red dotted lines show the average for all traded industries.

An interesting observation from comparing the development over time is that the vertical red line has moved to the right, i.e. that the sectoral "traded industries" have picked up strongly in employment growth, much more so than the cross-sectoral "emerging industries". A possible explanation is that the emerging industries have stood their ground better during the economic crisis and therefore benefited less from the recovery than the non-emerging industries.

The following Table 4 presents also the key economic statistics for the ten cross-sectoral emerging industries.

Table 4 Key economic descriptive statistics for emerging industries

	Number of employees	%-share of exporting sectoral industries *resp. Overall economy*	Number of enterprises	%-share of exporting sectoral industries *resp. Overall economy*	Average wages (Euro)	Relative to exporting sectoral industries (100) *resp. Overall economy (100)*	Average annual employ-ment growth (2014-2017)
Advanced Packaging	4,937,000	4.0% *1.9%*	700,700	4.8% *2.1%*	39,980	113.4 *103.6*	0.21%
Biopharmaceuticals	2,392,000	1.9% *0.9%*	363,400	2.5% *1.1%*	53,080	150.5 *137.5*	0.38%
Blue Growth Industries	13,283,000	10.7% *5.0%*	2,578,500	17.7% *7.7%*	35,330	100.2 *91.5*	0.24%
Creative Industries	15,105,000	12.2% *5.7%*	3,582,300	24.6% *10.7%*	51,170	145.1 *132.6*	1.82%
Digital Industries	10,267,000	8.3% *3.9%*	2,074,600	14.2% *6.2%*	51,300	145.5 *132.9*	0.65%
Environmental Industries	8,895,000	7.2% *3.3%*	1,590,100	10.9% *4.7%*	41,870	118.7 *108.5*	-0.35%
Experience Industries	16,195,000	13.1% *6.1%*	2,895,800	19.9% *8.6%*	39,420	111.8 *102.1*	1.78%
Logistical Services	7,897,000	6.4% *3.0%*	1,301,300	8.9% *3.9%*	29,420	83.4 *76.2*	0.76%
Medical Devices	4,891,000	4.0% *1.8%*	713,600	4.9% *2.1%*	49,050	139.1 *127.4*	0.02%
Mobility Technologies	10,958,000	8.9% *4.1%*	1,535,800	10.5% *4.6%*	42,420	120.3 *109.9*	-0.13%
All exporting industries[10]	*123,693,000*	--	*14,582,000*	--	*35,260*	--	*1.30%*

[10] The definition of the 10 cross-sectoral emerging industries are based on co-location patterns and are not mutually exclusive, the same NACE 4-digit industry can thus be included in more than one cross-sectoral emerging industry. The table includes no total employment figure for all emerging industries combined. Instead, the total figure is given for all the 51 sectoral exporting industries, where there is no double counting.

3.2 Individual economic performance of emerging industries

Advanced Packaging is an increasingly important input to many other activities, from food processing to automotive supply chains. Advanced Packaging employs more than 4.9 million people in Europe and accounts for a large share of traded industry employment at 4.0%. Advanced Packaging is relatively strong in terms of productivity, as measured by average wages per employee, being 13% above average wages in traded industries. Employment growth is below average.

Biopharmaceuticals forms the scientific basis of the Life Science industries and employs some of the most educated and productive employees. Biopharmaceuticals employs almost 2.4 million people in Europe and accounts for a significant share of traded industry employment at 1.9%. Biopharmaceuticals is strong in terms of productivity, as measured by average wages per employee, being 50% above average wages in traded industries and almost 40% above those in the overall economy. Employment growth is below average.

Blue Growth Industries has been the focus of European policy in the last several years and is an area where interesting new islands of activity emerge. Blue Growth Industries employs almost 13.3 million people in Europe and accounts for a very large share of traded industry employment at 10.7%. Blue Growth Industries is relatively weak in terms of productivity, as measured by average wages per employee, with average wages at the same level as those in traded industries and below those in the overall economy. Employment growth is below average.

Creative Industries is the key sector in future European economy and has been growing faster than any emerging industry in the past two decades. Creative Industries employs more than 15.1 million people in Europe and accounts for a large share of traded industry employment at 12.2%. Creative Industries is strong in terms of productivity, as measured by average wages per employee, which are 45% higher than those in traded industries and 33% higher than in the overall economy. Employment growth is above average.

Digital Industries covers the key parts of the ICT economy: computer hardware, software, ecommerce and wireless services. Digital Industries employs more than 10.2 million people in Europe and accounts for a large share of traded industry employment at 8.3%. Digital Industries is strong in terms of productivity, as measured by average wages per employee, which are 45% above those for traded industries and more than 30% above those of the overall economy. Employment growth is below average.

Environmental Industries cuts through all sectors of the economy as the need for more sustainable operations is realised increasingly more and thus have a high growth potential. Environmental Industries employs almost 8.9 million people in Europe and accounts for a large share of traded industry employment at 7.2%. Environmental Industries is relatively strong in terms of productivity, as measured by average wages per employee, with are almost 20% higher average wages than in traded industries. Employment growth is negative and below average.

Experience Industries covers creation and consumption of 'experiences' and is composed of many SMEs at the intersection of arts and business. Experience Industries is the largest emerging industry and employs almost 16.2 million people and accounts for a large share of traded industry employment at 13.1%. Experience Industries is relatively strong in terms of productivity. Employment growth is above average.

Logistical Services is a key service sector in the modern economy and is among the leaders in job creation. Logistical Services employs almost 7.9 million people in Europe and accounts for a large share of traded industry employment at 6.4%. Logistical Services is weak in terms of productivity, as measured by average wages per employee. Employment growth is below average.

Medical Devices is another core part of the Life Sciences industry and is also connected to large and growing employment in local health care services. Medical Devices employs almost 4.9 million people in Europe and accounts for a large share of traded industry employment at 4.0%. Medical Devices is strong in terms of productivity, as measured by average wages per employee. Employment growth is below average.

Mobility Technologies is a core part of the European manufacturing industry and despite suffering during the recent crisis it is a clear focus for Europe's strategy to re-industrialize. Mobility Technologies employs more than 10.9 million people in Europe and accounts for a large share of traded industry employment at 8.9%. Mobility Technologies is relatively strong in terms of productivity, as measured by average wages per employee. Employment growth is negative and below average.

3.3 The role of firm size in determining cluster specialisation

3.3.1 A refined methodology for measuring the effect of firm size

The analysis in the previous Chapter 2 builds on three traditional cluster star dimensions and two new cluster star dimensions. One of the traditional dimensions is the degree of specialisation measured by Location Quotients. Location Quotients measure the degree a region performs under or above the national average in terms of employment.

In this chapter the specialisation effect is analysed in more detail by adding two steps. The new measures of location quotients (LQ) allow to estimate whether SMEs, large companies, or both are responsible for the above average employment share in an emerging industry, as measured by a high degree of regional industrial **specialisation** (cf. box 1). *LQ Size (i.e. large firm specialisation effect)* calculates the concentration of large firms within an emerging industry whereas *LQ Plant (i.e. SME specialisation effect)* measures the concentration of SMEs. The cut-off point for high industrial specialization is 1.5, which means LQs must be above 1.5.

Another element that has been introduced is *Beta Size (i.e. influence of large firms)* and *Beta Plant (i.e. influence of SMEs)*, measuring the degree of influence[11] or dominance of large companies and/or SMEs on the emerging industries within a region. As a result, it might be that employment in emerging industries is made up for the most part by large companies in a region, but at the same time, emerging industries within the same region might experience high levels of influence by SMEs. In this scenario, large companies create employment, but SMEs are important for attaining employment. The Beta calculations have, similar to the LQ calculations, a cut-off point (cf. box 1). A number higher than 0.55 indicates strong influence or dominance by either large companies, SMEs or both.

It should be noted though that the LQ and Beta calculations are both important when it comes to public policy decisions, where the unique profile and particularities of a region need to be taken into consideration. For instance, a region with a small concentration of SMEs could opt to focus on attracting large firms. However, if the innovation profile of emerging industries is considerable influenced by SMEs, a region might better off to develop policies targeting SMEs.

[11] Influence is understood as to the degree SMEs, large companies or both can shape specialization within an emerging industry.

Box 1 – Refined location quotients methodology for measuring the effort of firm size

Standard calculation

LQ

$$\frac{\text{Employment i, r / Employment r}}{\text{Employment i, eu / Employment eu}}$$

Employment i, r is expressed by the employment in industry i in region r, whereas Employment i, eu represents employment in the same industry at the European level. Employment r and Employment eu indicate total employment on a regional and European scale.

Revised calculation

A) ***LQ***

$$\frac{\text{Employment i, r / Employment r}}{\text{Employment i, eu / Employment eu}} =$$

Plant (Concentration SMEs)

$$\frac{\text{Number of firms i, r / Employment r}}{\text{Number of firms i, eu / Employment eu}}$$

multiplied by

Size (Concentration large firms)

$$\frac{\text{Employment i, r / Number of firms i, r}}{\text{Employment i, eu / Number of firms i, eu}}$$

B)

$$\textbf{\textit{Plant Beta (Influence SMEs)}} = \frac{\text{Covariance (Plant formula ; LQ formula)}}{\text{Variance (LQ formula)}}$$

$$\textbf{\textit{Size Beta (Influence large firms)}} = \frac{\text{Covariance (Size formula ; LQ formula)}}{\text{Variance (LQ formula)}}$$

The new LQ is the same formula as the previous one, except that a few additional calculations have been made based on the formulas by Resbeut & Gugler (2016). The new LQ formula in Panel A incorporates the number and size of plants, represented by the Plant and Size Quotient respectively. Number of firms i, r uses the number of firms in industry i in region r, while Number of firms i, eu uses the number of firms at the European level.

Panel B uses the natural logarithm of the Plant and Size Quotient in Panel A. Panel B measures the influence SMEs and/or large firms have in a region. A strong influence by number and/or size is seen if the value of beta is above 0.55. In other words, SMEs are said to exert influence on emerging industries in a region if Plant Beta is above 0.55 and Size Beta below 0.55. Large firms are seen as key influencers if the Plant Beta is below and Size Beta above the stated threshold. Both Betas can be above 0.55 as well, meaning both SMEs and large firms strongly influence emerging industries in a region.

Background on the methodology

The concept of clusters has become a crucial research tool among policymakers in Europe. As such, extensive research has been carried out in previous Panorama reports. This chapter is a continuation of that tradition by offering new insights on clusters in European regions based on an up-to-date literature review. Many sources in the literature review consist of research published after 2010 in order to incorporate the latest cluster trends (Annexes D and E include the full list of references that were analysed in this respect).

The review has been divided into three thematic themes following current cluster trends: a US-Europe analysis, national analysis and industrial analysis. Before the review deals with these three themes, it briefly recaps the founding fathers – Marshall and Porter - of agglomeration and cluster theory. In addition, the historical recap section introduces a new measurement tool to the analysis of clusters. After the introduction of cluster history, the review compares the US literature strand against the European strand. Aim of this review is to point out the need for the incorporation of differences among the various types of clusters and regions in statistics and cluster policy.

Marshall, Porter and the introduction of firm size measurement

Positive economic benefits for firms due to agglomeration were first described by Marshall in 1890. Resource sharing with closely located partners leads to higher productivity gains for firms, knowledge spillover, labour pooling and the presence of specialized suppliers (Marshall, 1890; Litzel, 2017; Wennberg and Lindqvist, 2008). Based on Marshall's geographical concentration of economic activities, Michael Porter popularized the economies of agglomeration in the 1990s and early 2000s, as his research introduced a quantifiable method and concept for the identification of geographically concentrated firms (Porter, 1990; 2003). Porter labelled agglomerated firms as clusters, which he defined as geographically proximate group of interconnected companies, suppliers, service providers and associated institutions in a particular field, linked by externalities of various types.

The Location Quotient (LQ), calculating the total employment ratio between industry and a region, was used as a means of identifying clusters. Following the US cluster mapping project of Porter, researchers such as Sölvell et al. (2008) developed the three-star cluster system for EU regions, which were employed in the Panorama reports of the European Observatory for Clusters. While Porter's cluster concept and policies to support their development gained popularity [12], Porter's analysis also led to criticism (Martin and Sunley, 2003) for the difficulties in capturing the economic phenomenon of clusters. The academic criticism concerned the vagueness of the definition of clusters, which was formulated in such a manner (e.g. clusters of "related industries") that admitted

[12] See also European Commission (2016) Smart Guide to Cluster Policy, available at https://ec.europa.eu/docsroom/documents/16903/attachments/1/translations/en/renditions/native and European Observatory for Clusters and Industrial Change (2019), Cluster Programmes in Europe and beyond, available at https://www.clustercollaboration.eu/sites/default/files/news_attachment/cluster_programmes_in_europe_and_beyond_0.pdf.

many industrial groups and specialisations. Another aspect of concern was the geographical defined boundaries of clusters in the analysis.[13]

There are also concerns that the location quotient calculated for US states might not be fit for regions in other countries. Due to the United States being one of the largest economies in the world, any US area comprises virtually every industry and cluster (Spencer et al. 2010; Resbeut and Gugler, 2016). Europe on the other hand, consists of many small countries and regions. As a result, European areas with limited economic activity might only have a couple of industries or clusters present. It might therefore be relevant to observe the characteristics of firms in each cluster from a policy perspective.

For instance, Swiss research by Resbeut and Gugler (2016) employed a location quotient, taking the number and size of firms within a cluster into account. The Swiss context showed that the number of firms determine a cluster. So far, no other study at the European level incorporated such a measurement in the location quotient. This report applies the methodology used in the Swiss study (cf. Box 1) to the European context. The *Size LQ* represents large companies, whereas the *Plant LQ* represents small and medium-sized enterprises (SMEs).

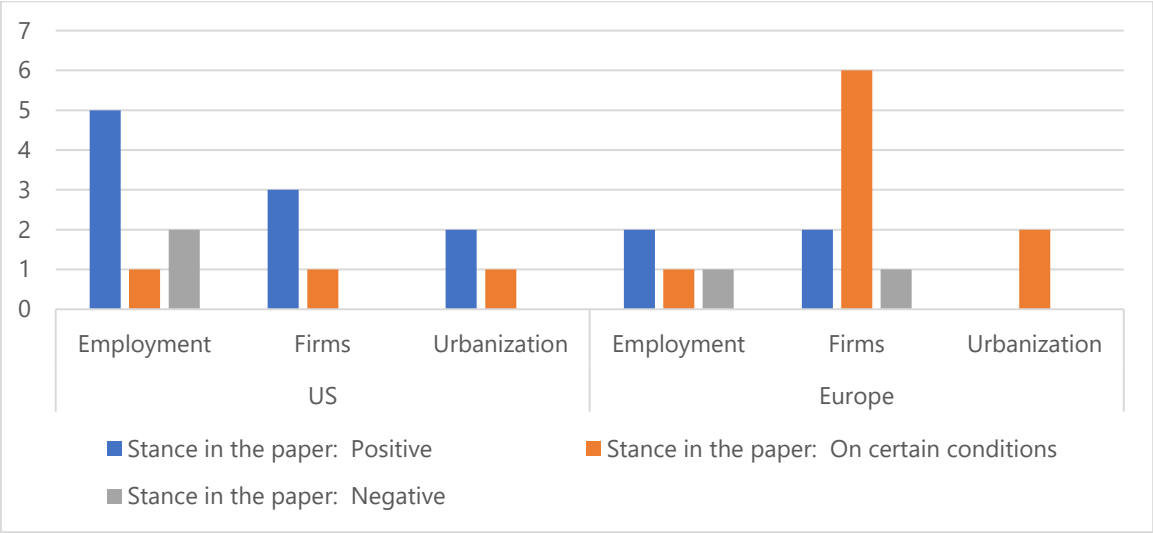
Clusters in US and European scientific literature

Due to the United States' geographical and economic size, many cluster studies have been able to research large clusters, either by taking US states, economic areas or metropolitan areas as their unit of analysis. Cluster studies of European regions, however, assess areas according to their regional classification (NUTS) level, which comprises smaller regions – thus smaller clusters. Another notable difference between European and US statistical studies is the digit code of the collected industry data. US data on industries has a digit code running up to six digits, whereas the European sectoral classification (NACE) only has a code available up to four digits, which means a not as detailed granular view of the sub-sectors. Given the different geographical definition and size, and differences in detail in industry data between US and European research, it is important to compare both research strands against each other in a meta study, which has been summarized in Figure 15. For this meta-analysis, 13 papers dealing with the US context, 11 papers on Europe and 1 paper on both the US and Europe have been assessed (cf. Annex D).

The degree of employment, firm growth and urbanization refers strictly to the results instead of the variables being used, as some papers used particular variables but did not discuss them in their results. Some studies covered more than one outcome, which led to a couple of studies being double counted. Overall, a positive effect of clusters in both strands is noted, albeit the European literature is more inclined to point out the positive effects of clusters on certain conditions. In addition, US literature is overwhelmingly positive about clusters contributing to employment. European research shows the most positive results with some side remarks on firm growth. For urbanisation, neither US research nor European research reports negative effects associated with clusters.

[13] One needs to point to the different types of definitions needed, depending on the purpose, e.g. the differ for the purpose of describing a concept, undertaking statistical analysis or selecting beneficiaries for public programmes.

Figure 15 Identified cluster effects in US and European research compared



Note: Columns show number of scientific papers in support.

Employment

A substantial part of US studies does not treat the effect of clusters on employment as an isolated case (Hartley et al., 2015, Delgado & Zeuli, 2016, Toussaint-Comeau et al., 2016). Instead, employment has been rather studied in an urban context. Particular for the US context is the use of inner cities as a unit of analysis versus other parts of metropolitan areas. Inner cities, according to US literature, tend to be economically distressed areas with a high concentration of poverty and unemployment. A strong cluster located in the inner city or a nearby region results in positive employment growth (Delgado and Zeuli, 2016). Another study by Toussaint-Comeau et al. (2016) held a survey among practitioners that also reported positive experiences in identified inner city areas with cluster-based activities or programmes. Nevertheless, the respondents of the survey also indicated that institutional perceptions against immigrants, Blacks and Latinos hinder full economic growth.

On top of inequality issues, employment growth depends on the nature of the sector. Health care and educational services, for instance, reportedly flourish in inner cities (Hartley et al., 2015). Like the US strand, European studies researched employment by accounting for other factors as well. However, contrary to US research, EU employment was primarily analysed against the context of enterprise growth. The only study amongst the analysed papers that did link employment with urbanisation focused on creative digital clusters in Portugal. It looked at the need for human capital to support those clusters and found that knowledge-intensive industries such as TV and digital media tended to cluster in urban environments, as such areas increased their chances for the attraction of human capital (Santos Cruz and Teixeira, 2015). Clusters located in urban areas are in the European context thus more seen as being relevant as a tool for increasing knowledge output, whereas the US literature sees clusters as a tool for reduced poverty and inequality.

The European strand is quite supportive towards the effect of clusters on employment in relation to firm growth. According to Ketels and Protsiv (2013), the presence of clusters has a positive effect

on the average wage and leads to higher productivity. A strong cluster environment is associated with higher employment growth rates. Strong clusters even appear to lead to larger concentrations of firms in neighbouring regions (Resbeut and Gugler, 2016). Swedish research takes a more cautious stance, although it also concludes with overall positive results concerning employment growth, higher average salary, higher tax payments and firm survival. The study measured agglomeration effects by counts and location quotients and noticed the location quotient to be weaker and inconsistent (Wennberg and Lindqvist, 2008).[14]

US research carried out by Porter and Slaper et al., make a distinction between local and traded (i.e. exporting) industries regarding the discussion of employment in a firm related context. Past research of Porter indicated that traded industries are responsible for a higher wage growth, productivity and patenting rate (2003). Recent research carried out by Slaper et al. (2018) suggest that clusters of industries that foremost serve the local market [across US metropolitan statistical areas] are as important as clusters of traded industries when it comes to GDP related growth. Especially, since one of the downsides of traded industries are their strong linkages to the international economy, which exposes traded industries to greater sensitivity of economic decline and business cycles.

Firm growth

The relation between clusters and firm growth in an urban context was analysed in the European literature (Rizov et al., 2012). Firm growth in clusters is empirically bound by the degree of urbanisation in a region. Highly urbanized areas affect firm growth negatively due to congestion. Firms face high levels of competition in highly urbanised areas, which negatively affects increased productivity associated with clustering. Agglomerated firms in moderately urbanised regions tend to perform the best in terms of productivity output. In short, the benefits of agglomeration are related to the urban density of an area. The findings of Rizov et al. corroborate with an Italian study (Bottazzi and Gragnolati, 2015) that points out the importance of both urbanisation and agglomeration[15] as a reason for firms to settle down in a particular area. However, the study also noted that agglomeration was found to be more important than urbanisation for an area to be considered attractive by firms.

US research paid attention to the effect of agglomeration on a national scale. The presence of large firms and so-called million-dollar plants (MDPs) are viewed as an attractive (foreign direct) investment by countries to boost productivity. As a result, many countries develop favourable firm policies in order to convince MDPs to settle down in their country. A comparison between 'winning' and 'losing' countries shows a productivity difference, as winning countries experience increased productivity after the first couple of years of an MDP's establishment in said country. Moreover, spill-overs of labour pools and technologies have been observed among related firms that are concentrated in proximity to an MDP, supporting the positive effects of agglomeration and clustering in general (Greenstone et al., 2010).

[14] By employing the new LQ, this report addresses the possible weakness of the location quotient.

[15] Urbanisation refers to the population shift from rural areas to urban areas whereas agglomeration refers to the location of firms next to other firms of the same sector in a given area.

Firm growth does not occur equally across all sectors (as also shown by this Panorama cf. figure 8). Firms that benefit from clustering are concentrated in the manufacturing sector, whereas only a few service industries such as financial services, retail or transportation tend to experience firm growth due to clustering (Beaudry & Swann, 2007). Because the service sector thrives on an unrelated business environment, industries operating in the service sector cannot profit from an agglomeration of related firms. Industries in the manufacturing sector on the other hand, gain the most by being located in a concentration of related firms. Clustering is thus much more relevant for the manufacturing sector than it is for the service sector (Basile et al., 2017). Especially metalworking technology, downstream metal products and automobility thrive the best in clusters, given their number of patent applications (Fang, 2019). This also echoes earlier work of the European Cluster Observatory that also found that manufacturing and production activities in the creative and cultural industries, for instance, are the most regionally concentrated activities compared to consumer orientated service activities.[16]

Clusters in Western and Eastern Europe

Western European clusters are, in general, long-established. However, some clusters such as the textile and automotive cluster have relocated part of their production towards Eastern European clusters as they experience low-cost competition from non-European countries (Crestanello and Tattara, 2011; Szanyi, 2012, p. 103; Zamborsky, 2012). These relocations present a paradoxical situation for Western European clusters. On the one hand, it keeps the mature clusters in Western Europe at a competitive pace with non-European countries. On the other hand, it presents direct competition for Western European clusters, as knowledge spill-overs partially occur to Eastern European countries. Taken together with the low-cost advantage, Eastern European clusters present an attractive alternative for companies and foreign investors.

Faced with such factors, Western European countries are highly dependent on knowledge creation and thus their cluster policies often tend to focus on fostering innovation and international collaboration. Knowledge spillover is particularly apparent in textile and clothing clusters. Once a new innovative process or product is introduced by a large leading textile company, it will soon spill over to smaller collocated companies and partially to Eastern European clusters (Lisboa Sohn et al., 2016; Smith, 2003). Here, the focus is often placed correspondingly on fostering innovation uptake and closing the productivity gap.

The comparison of cluster programs in Europe[17] also showed that in Europe, the most important objectives are to strengthen the cooperation structures of different stakeholders, to increase small and medium-sized enterprises' competitiveness, and internationalisation activities (at country level) or industrial modernisation (at regional level).

Box 2 and 3 present case studies of textile clusters in Western and Eastern Europe. Contrary to the textile and clothing clusters, mobility clusters are characterized by limited knowledge spillover due to high competition within the cluster itself. As a result, knowledge spillover to the production

[16] European Cluster Observatory (2010) Creative and Cultural Industries: Priority Sector Report

[17] European Observatory for Clusters and Industrial Change (2019), Cluster Programmes in Europe and beyond, available at https://www.clustercollaboration.eu/sites/default/files/news_attachment/cluster_programmes_in_europe_and_beyond_0.pdf

assembly in Eastern Europe happens on a lower scale compared to the textile and clothing clusters (Zamborsky, 2012; Plum and Hassink, 2011). Regardless of each cluster's knowledge creation strategy, both the textile and automotive cluster are characterised by a geographical shift towards Eastern Europe. A similar trend occurs in the aerospace industry, as research on the period 2010-2014 shows that a lot of buyer-supplier and investment linkage have moved to Eastern Europe as well (Turkina et al., 2016, p. 1231). A prime example of that is the Aviation Valley in the south eastern part of Poland[18]. Started in 2003 as a non-profit organisation, the Aviation Valley currently consists of 140 companies from the aerospace industry (cf. Box 1).

Box 1: Aviation Valley in Poland

Part of the Polish innovation strategy consists of supporting the development of the national aerospace industry. In 2003, the Ministry for Science and Higher Education started the non-profit organization Aviation Valley. Goal of this initiative was to transform south-eastern Poland into one of Europe's leading aerospace regions. According to Osuch-Rak & Holnicki (2015), this has been partly achieved. The Polish aerospace industry makes-up only 0.4% to the European industry's production. However, in terms of growth, the Polish aerospace industry grew tremendously. Between 2001 and 2008, annual average growth rates of 7.9% were reported. Aviation Valley's most important achievement though consists of its capacity to create networks, as it managed to connect Polish SME's with research centers.

Box 2: Leading firms and gate keepers of the EuroClusTex in Spain and Portugal

Lisboa Sohn et al. (2016) researched the cross-border EuroClusTex cluster situated in Galicia in Spain and northern Portugal. The EuroClusTex project was supported by various textile associations and tried to raise the visibility for firms in these regions as well as increasing cooperation. The Portuguese textile and clothing industry in the northern part of Portugal makes up 12 % of the nation's total exportation. 67 % of fabricated Portuguese textile and clothing is exported internationally, representing 3 % of the EU's total export rate. Galicia's textile and clothing industry is relatively young compared to the Portuguese industry, as it was established at the end of the twentieth century. For instance, the company Inditex revolutionised the industry in Galicia by introducing the fast-fashion concept.

Currently, Galicia's textile and clothing industry accounts for over 700 companies, which are direct competitors of each other. Portugal's long-established tradition and Spain's fast-fashion concept made clustering an appealing strategy for both. The authors found that the cross-border cluster's strategy to keep at pace with international competitors such as the Asian clothing and textile industry was by imitating innovation processes and production from leader firms or gate keepers[19] within the cluster. Usually gate keepers comprise large firms, whereas the imitators consist of SMEs. One of the characteristics of the textile and clothing industry is its seasonal cycles of products, which results in a big diversity in terms of workforce intensity. Innovation through imitation allows SMEs to timely access those seasonal markets along with gatekeepers. Imitation is thus not only born out of necessity to Asian competitors, it provides SMEs a means to keep up at pace with gatekeepers as well (Lisboa Sohn et al., 2016).

[18] http://www.dolinalotnicza.pl/en/about-us/

[19] A leader firm refers to the firm having the highest percentage of total sales revenue of a particular market.

Box 3: Capacity-building for moving up the value chain by clothing clusters in Slovakia

Relocation of production towards Eastern European countries is often thought of as an asymmetrical relationship between Western and Eastern European clusters. Smith (2003) showed a more nuanced picture to this thought. In Slovakia, the Prešov and Trenčín region have the highest number of registered clothing manufacturers. Within Prešov, 112 clothing firms have been registered, but unregistered numbers are estimated to be around 300. The number of registered firms in the Trenčín Region are unknown. Prešov and Trenčín have a regional employment share in apparel of 12.1 % and 15.6 % respectively. The share of regional industrial added value in apparel is 11.1 % for Trenčín and 8.4 % for Prešov, leaving the other Slovak regions far behind for the sector.

More than 50 % of sales in nearly 80 % of the surveyed firms went to the Western European markets. However, there appear some small changes in the asymmetric relationship between Western and Eastern European clothing clusters nowadays. A small number of firms have developed their own design capacities by previously being the production part of the Western European clothing cluster. As the partnership with Western European clusters allowed firms in Eastern European clusters to build their own networks in the Western European markets, firms in the Prešov and Trenčín region were able start their own clothing labels and export their brands to Western Europe. Another notable positive effect between the Western-Eastern cooperation has been the improved net wages for employees. Despite mass unemployment, the demand for tailoring skills is scare, which leads to skilled workers demanding better wages and benefits. Since Eastern European countries compete with low costs on the European and international market, Slovak clothing clusters provided additional benefits to their workers instead of a general wage raise. Benefits such as transportation subsidies and bonus systems leave workers with a greater net income while keeping firm costs low (Smith, 2003).

3.3.2 Emerging industries: plant and size effect

The EU in an international perspective

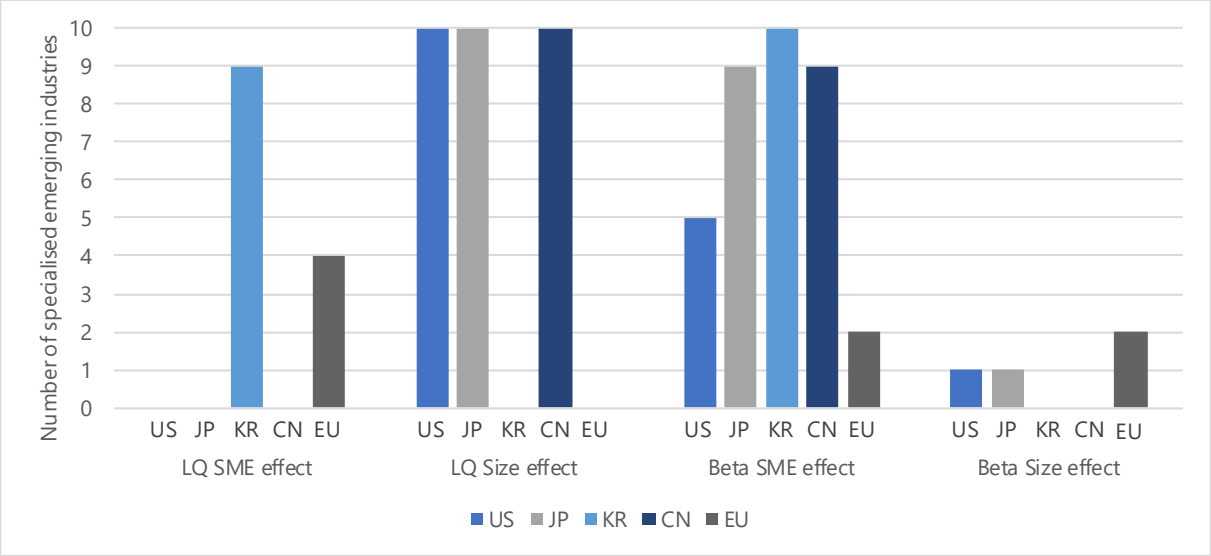
Overall, the **EU appears less strongly specialised than other large economies** such as China, Japan, South Korea, and the US – as previously reported in the 2008 European Commission Staff Working Document on clusters (European Commission, 2008)[20]. All these countries have a degree of specialisation above 1.5 in almost all emerging industries. The dominance of SMEs seems to be most important in the US, whereas large companies make up for the most part in China, Japan and South Korea. Unlike the emerging industries in large economies such as China and Japan, most emerging industries in the EU have no degree of specialisation above 1.5. Like the US, the EU has its degrees of specialisation for emerging industries primarily made up of SMEs, but limited to Blue Growth Industries, Creative Industries, Experience Industries and Logistical Services.

When it comes to the degree of influence, most of the emerging industries in China, Japan, South Korea, and the US are strongly influenced by SMEs. The EU is a special case compared to other countries in that **both large companies and SMEs have an equal share of influence on the degree of specialisation of emerging industries in the EU- representing a specialisation symbiosis** (see Figure 16).

[20] https://ec.europa.eu/transparency/regdoc/rep/1/2008/EN/1-2008-652-EN-F1-1.Pdf

For instance, Experience Industries and Logistical Services are strongly influenced by SMEs while large companies exert their influence on Biopharmaceuticals and Mobility Technologies. Again, most of the emerging industries in the EU do not experience high levels of influence by either large companies or SMEs. Internationally speaking, the Asian countries seem to be the best performers concerning employment, as China, Japan and South Korea create the most employment above the average of these five countries and can attract a significant number of employment opportunities.

Figure 16 Global comparison of firm size effects by specialisation and dominance



Note: Number of cross-sectoral emerging industries where location quotients (LQ) are above 1 indicating an above average specialisation and the value for dominance (beta) is above 0.55. Country codes are as follows: US = United States, JP = Japan, KR = South Korea, CN = China, EU = European Union

The European context

A different picture emerges for the size and location quotient within the European context. Within the European context, large companies are the driving force behind employment opportunities within the emerging industries. A possible explanation for the different result might be attributed to the unit of analysis. For the analysis of the European context, 353 European and neighbouring regions have been included, whereas the global analysis comprises solely the EU and four large economies of the world. Due to the large sample size of the European context, large companies in regions are more likely to note a higher location quotient (LQ). When it comes to the measurement of global performance, the LQ calculates the economy of a country as whole rather than regional activities, which explains why countries show more varied results. Nevertheless, nearly all emerging industries within the European context have a size LQ equal to or above 1.5. This suggests that regions in Europe are dependent on large companies when they are competing with other regions within the European context, but as soon as these regions compete on the global market, SMEs do matter more than large companies.

SME and large firm effect per emerging industry

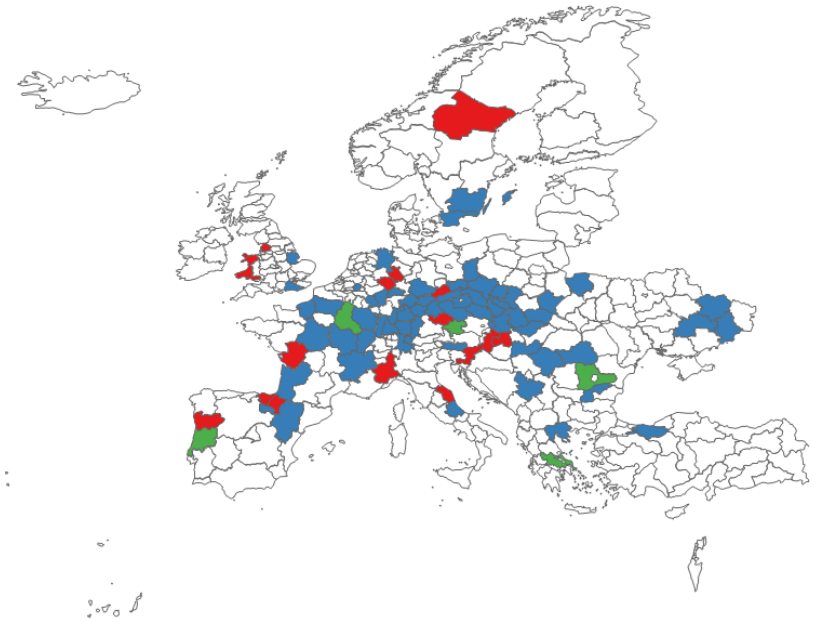
The role of the SME and large firm effect in each emerging industry is summarized in Table 5. Within specialised emerging industries the large firm effect is the most dominant factor determining the degree of specialisation. The large firm effect is dominant for, on average, 41 regions, the SME effect is dominant for, on average, 3.5 regions, and both effects are positive, but not dominant, for, on average, 11.5 regions. The fact that the large firm effect is most dominant can be explained by the fact that the degree of specialisation is determined by high numbers of employees, and large enterprises employ more people than small enterprises and contribute most to overall employment to each emerging industry in most regions.

Table 5 SME and large firm dominance effects for emerging industries

	DOMINANT LARGE FIRM EFFECT (*BETA SIZE* > 0.55)	DOMINANT SME EFFECT (*BETA PLANT* > 0.55)	BOTH LARGE FIRM AND SME EFFECT POSITIVE
Advanced Packaging	64	5	17
Biopharmaceuticals	25	2	11
Blue Growth Industries	34	9	10
Creative Industries	14	2	10
Digital Industries	27	1	6
Environmental Industries	50	0	8
Experience Industries	28	6	15
Logistical Services	60	6	32
Medical Devices	41	3	6
Mobility Technologies	68	0	0

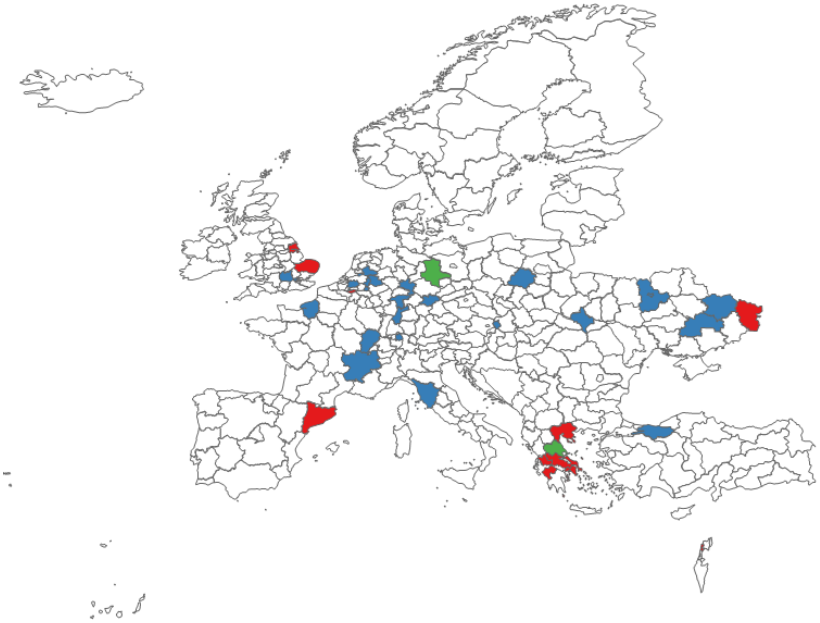
3.3.3 Firm size specialisation effects for individual emerging industries

The following pages show more details including a geographical map visualising the results for each of the 10 cross-sectoral, emerging industries. The maps show only regions, where the degree of specialisation was at least 1.5 and where the SME effect is dominant (i.e. *beta plant* > 0.55), the large firm effect is dominant (i.e. *beta size* > 0.55), or where both effects are positive but below 0.55.



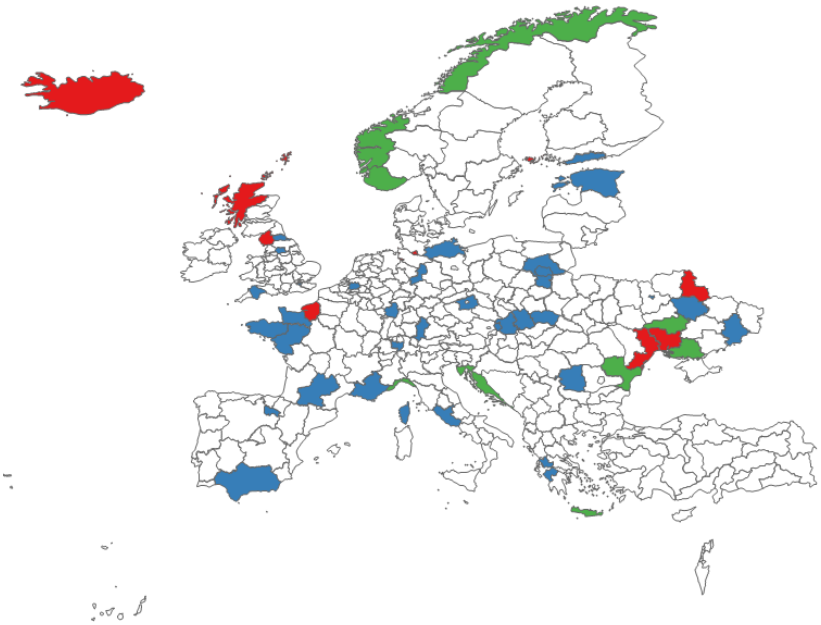
Blue: large firm effect dominant, green: SME effect dominant, Red: both effects positive

Advanced Packaging is more specialised in Central European regions, but there are also specialised regions in Eastern and Southern European countries. The SME effect is dominant in five regions: Central Greece (EL64), Centre (PT16), Champagne-Ardenne (FR21), Oberosterreich (AT31) and South-Muntenia (RO31); the large firm effect is dominant in 64 regions, and in another 17 regions both effects are positive. A dominant large firm effect is observed most in Central Europe.



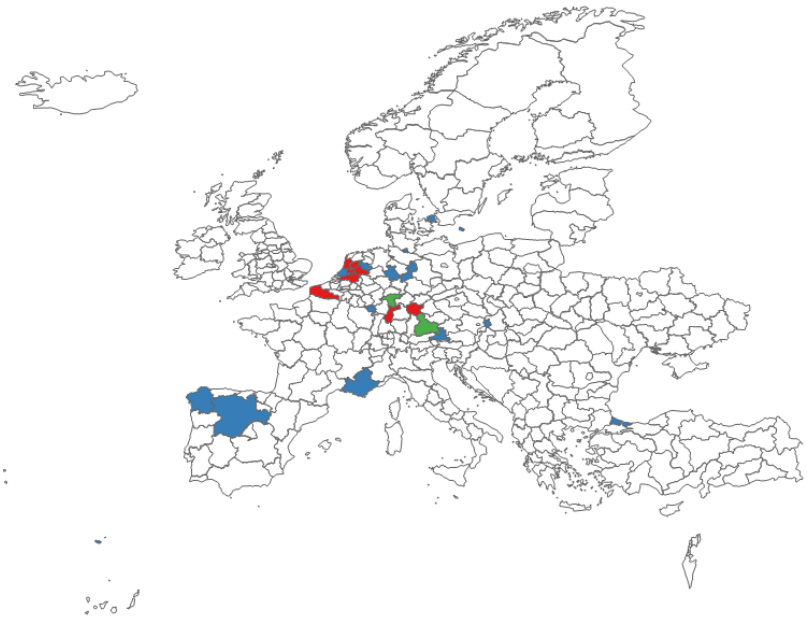
Blue: large firm effect dominant, Green: SME effect dominant, Red: both effects positive

Biopharmaceuticals shows a scattered specialisation across Europe. The SME effect is dominant in only two regions: Sachsen-Anhalt (DEE0) and Thessaly (EL61); the large firm effect is dominant in 25 regions, and in another 11 regions both effects are positive. There is no clear geographical pattern for the dominance of both effects



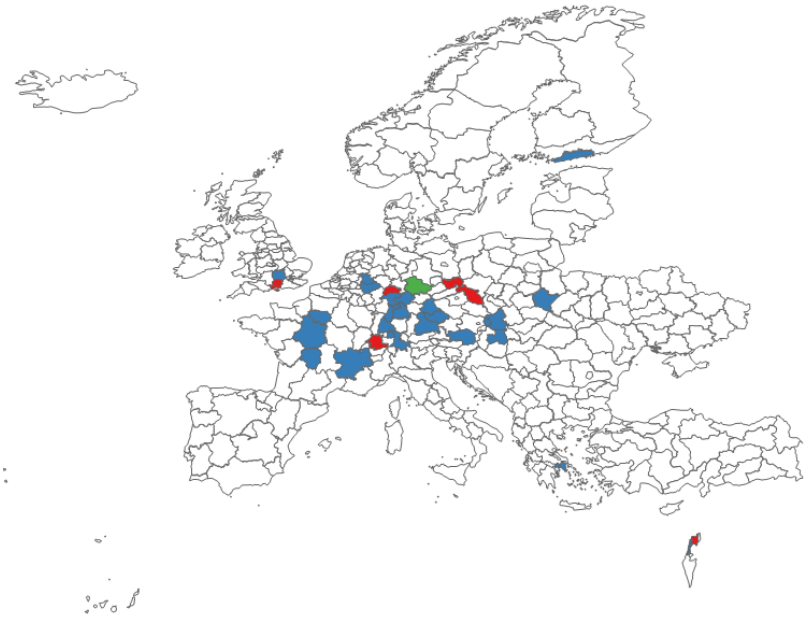
Blue: large firm effect dominant, Green: SME effect dominant, Red: both effects positive

For **Blue Growth Industries** the SME effect is dominant in nine regions: Adriatic Croatia (HR03), Agder og Rogaland (NO04), Crete (EL43), Khersonska (UA09), Kirovohradska (UA11), Liguria (ITC3), Nord-Norge (NO07), South-East (RO22) and Vestlandet (NO05); the large firm effect in 34 regions, and in another 10 regions both effects are positive. The geopraphical distribution shows that there is no clear geographical pattern.



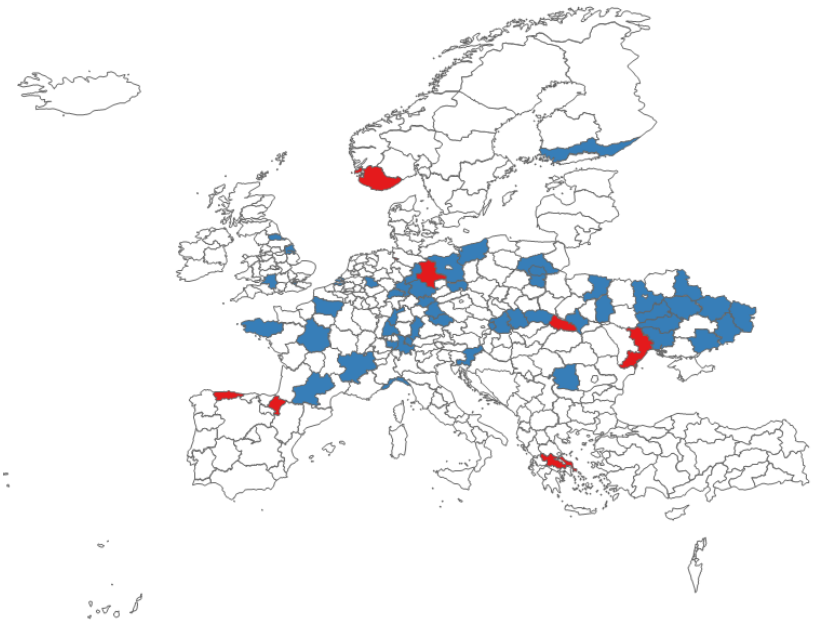
Blue: large firm effect dominant, Green: SME effect dominant, Red: both effects positive

For **Creative Industries** the SME effect is dominant in only two regions: Oberbayern (DE21) and Darmstadt (DE71); the large firm effect in 14 regions, and in another 10 regions both effects are positive. The geopraphical distribution reveals a concentration in two or more regions in only a few European countries, including France, Germany, the Netherlands and Spain.



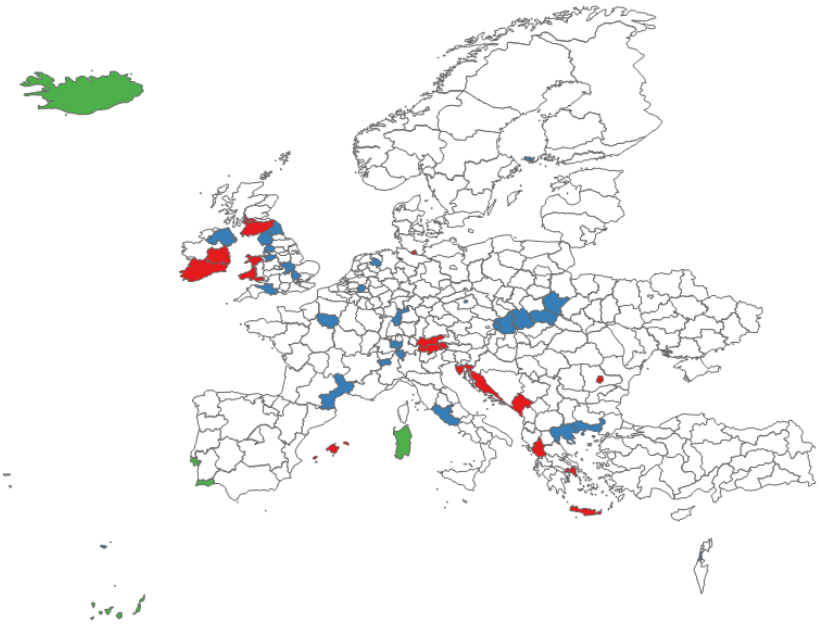
Blue: large firm effect dominant, Green: SME effect dominant, Red: both effects positive

For **Digital Industries** the SME effect is dominant in only one region, Thüringen (DEG0). The large firm effect is dominant in 27 regions, and in another six regions both effects are positive. The geopraphical distribution across Europe reveals that strong SME and large firm effects are concentrated in Central Europe.



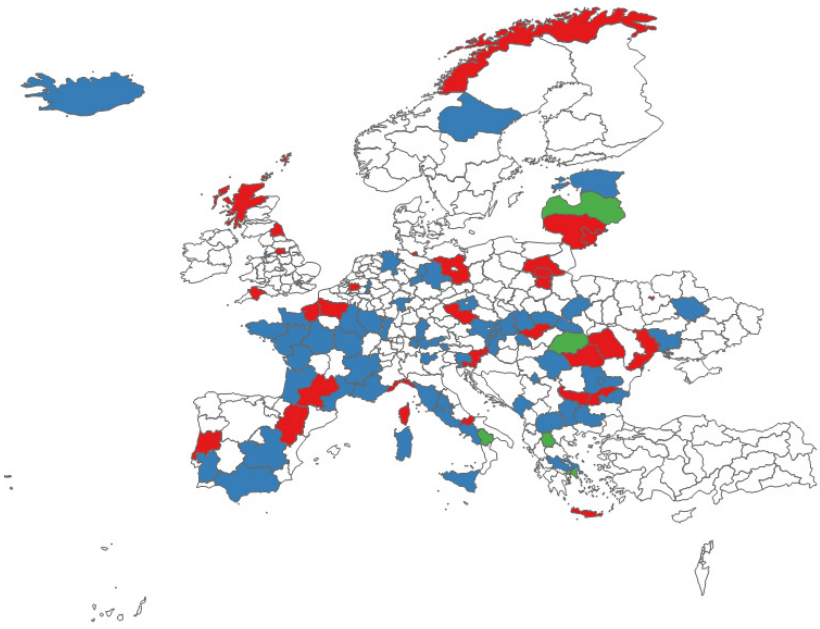
Blue: large firm effect dominant, Green: SME effect dominant, Red: both effects positive

For **Environmental Industries** there is no region where the SME effect is dominant. The large firm effect is dominant in 50 regions, including 13 regions each in Germany and Ukraine, five regions in France, four regions each in Slovakia (i.e. all Slovak regions) and United Kingdom, and two regions each in Poland and Switzerland. In another eight regions both effects are positive, including two regions each in Germany, Spain and Ukraine, and one region each in Greece and Norway



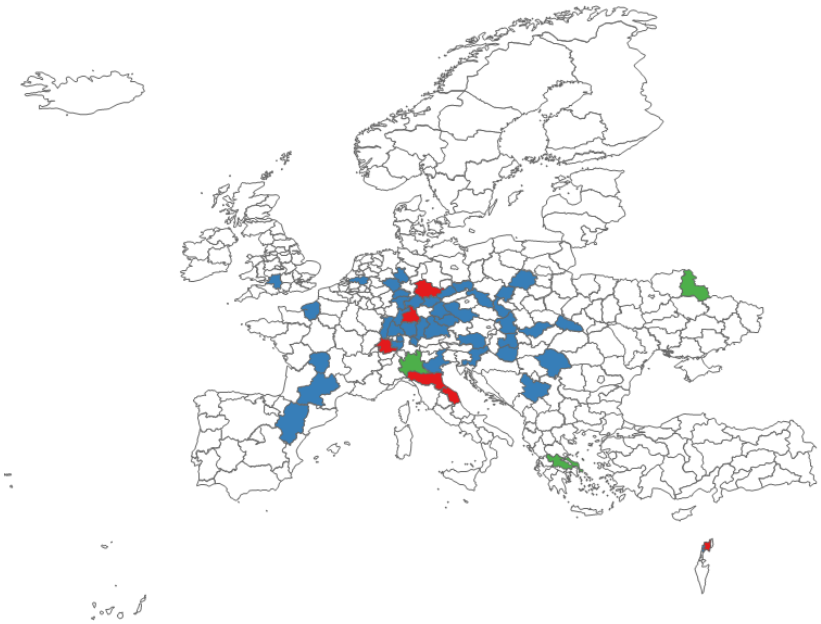
Blue: large firm effect dominant, Green: SME effect dominant, Red: both effects positive

For **Experience Industries** the SME effect is dominant in six regions, including Iceland and five regions in Southern Europe: Algarve (PT15), Lisboa (PT17), Canary Islands (ES70), Central district (IL04), and Sardegna (ITG2). The large firm effect is dominant in 28 regions in 14 different countries, including among others all four Slovak regions and eight UK regions. In another 15 regions both effects are positive, including three regions in Greece and two regions each in Germany and the United Kingdom. There is no clear geographical pattern with dominant effects scattered across Europe.



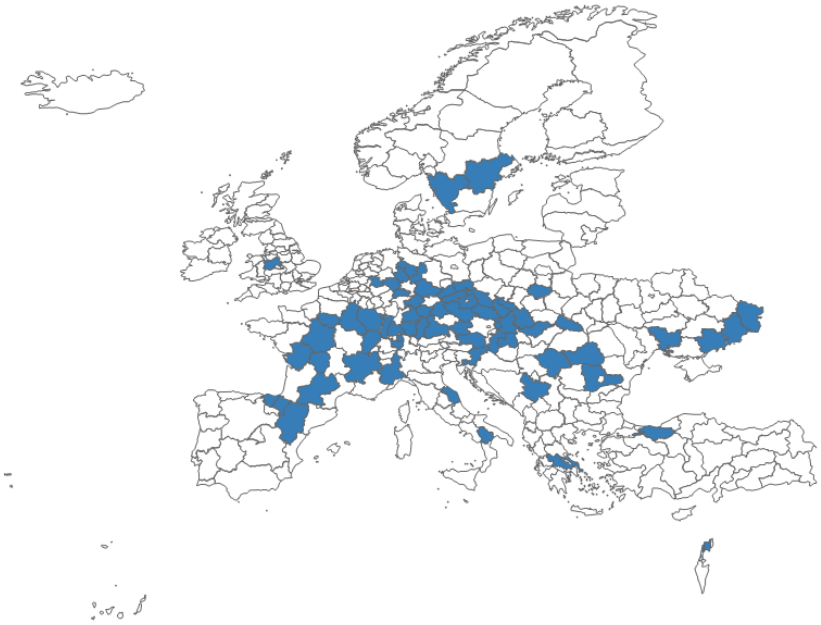
Blue: large firm effect dominant, Green: SME effect dominant, Red: both effects positive

For **Logistical Services**, the SME effect is dominant in six regions: Attica (EL30), Basilicata (ITF5), Latvia (LV), North-West (RO11), Outer London - West and North West (UKI7), and West Macedonia (EL53). The large firm effect is dominant in 60 regions, including 13 regions in France, seven regions in Italy, five regions in Germany, four regions each in Austria and Slovakia, and three regions each in Bulgaria and Romania. In another 32 regions both effects are positive, including five regions in France and four regions in the United Kingdom. The geopraphical distribution across Europe shows that dominant effects occur in most European countries.



Blue: large firm effect dominant, Green: SME effect dominant, Red: both effects positive

For **Medical Devices** the SME effect is dominant in only three regions, Central Greece (EL64), Lombardia (ITC4) and Sumska in the Ukraine. The large firm effect is dominant in 41 regions, including 15 regions in Germany, four regions in France, three regions each in Czechia and Hungary, and two regions each in Austria, Poland and Switzxerland. In another six regions both effects are positive: Emilia-Romagna (ITH5), Espace Mittelland (CH02), Marche (ITI3), Northern district (IL02), Stuttgart (DE11) and Thüringen (DEG0). The geopraphical distribution across Europe reveals that there is a concentration in Central Europe.



Blue: large firm effect dominant, Green: SME effect dominant, Red: both effects positive

For **Mobility Technologies** there are no regions where the SME effect is dominant or where both the SME and large firm are positive. The large firm effect is dominant in 68 regions, including 17 regions in Germany, seven (out of eight) regions in Czechia, five regions in Ukraine, and three regions each in Hungary, Italy, Romania and Spain. The geographical distribution across Europe shows that the large firm effect is dominant mostly in more centrally European regions.

Annex A - Cluster strengths across 51 individual exporting industry sectors

The European Cluster Observatory defined 51 exporting industry sectors, also referred to as traded industries, using combinations of NACE 4-digit industries. The definitions for the 51 exporting sectors are provided in the methodology report[21]. In this section the results for cluster strength are summarised for each sector. The results include a visualisation showing cluster strengths across Europe in a geographical map and a brief listing of the countries and regions where strong clusters appear.

The individual names of regions are provided for the high-performing and medium-performing clusters while for the basic-performing clusters only the number of regions is provided. The detailed results can be found in the online cluster mapping tool available at https://interactivetool.eu/EASME-TST/EOCIC/EOCIC_2.html

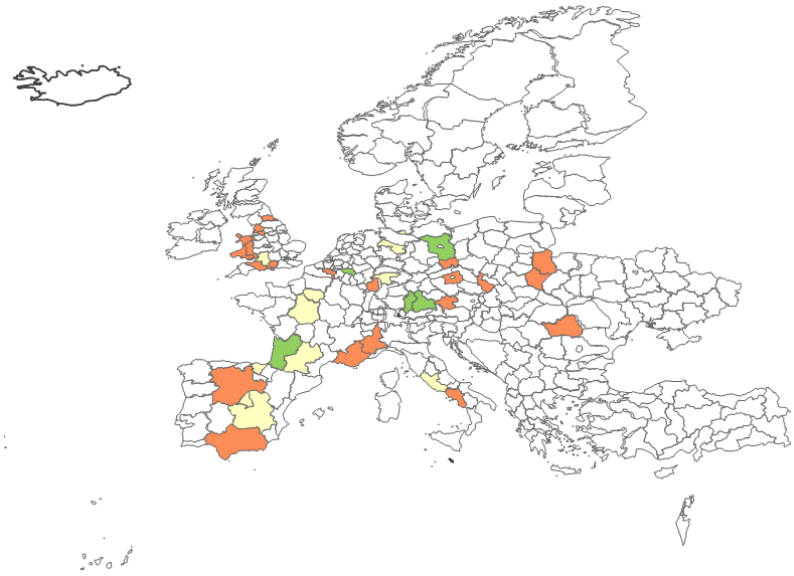
In each of the maps the following colour codes have been used:

- Green: high-performing clusters
- Yellow: medium-performing clusters
- Orange: basic-performing clusters

The maps are drawn using the NUTS 2016 classification. The data on cluster strength are calculated using the NUTS 2013 classification for two reasons of both continuity (the data build on the data from the European Cluster Observatory which used the NUTS 2013 classification) and data availability (Orbis data are available for NUTS 2013 only). In the maps the following 'corrections' have been made (NUTS 2013 (data) resp. *NUTS 2016* (maps)):

- Ireland: IE01 for *IE04*; IE02 for *IE05*; IE02 for *IE06*;
- France: FR24 for *FRB0*; FR26 for *FRC1*; FR43 for *FRC2*; FR25 for *FRD1*; FR23 for *FRD2*; FR30 for *FRE1*; FR22 for *FRE2*; FR42 for *FRF1*; FR21 for *FRF2*; FR41 for *FRF3*; FR51 for *FRG0*; FR52 for *FRH0*; FR61 for *FRI1*; FR63 for *FRI2*; FR53 for *FRI3*; FR81 for *FRJ1*; FR62 for *FRJ2*; FR72 for *FRK1*; FR71 for *FRK2*; FR82 for *FRL0*; FR83 for *FRM0*; FRA for *FRY*;
- Hungary: HU10 for *HU11*; HU10 for *HU12*;
- Lithuania: LT for *LT01*; LT for *LT02*;
- Poland: PL11 for *PL71*; PL33 for *PL72*; PL31 for *PL81*; PL32 for *PL84*; PL12 for *PL01*; PL12 for *PL92*;
- United Kingdom: UKM2 for *UKM7*; UKM3 for *UMK8*; UKM3 for *UKM9*.

[21] Methodology report for the European Panorama of Clusters and Industrial Change and European cluster database (European Commission, 2019d).

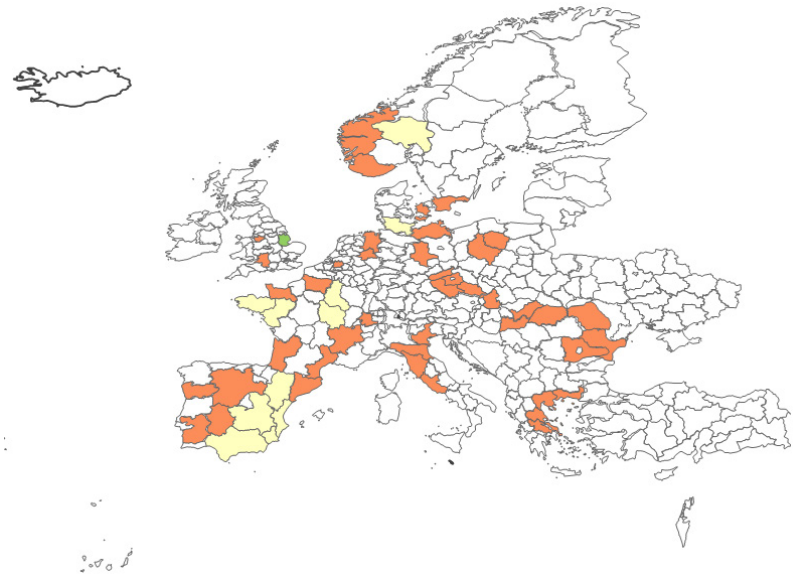


In **Aerospace Vehicles and Defence** there are 38 clusters, including 5 high, 12 medium and 21 basic-performing clusters.

The high-performing clusters are in Belgium (BE33 Liege), Germany (DE21 Oberbayern, DE27 Schwaben, DE40 Brandenburg) and France (FR61 Aquitaine.

The medium-performing clusters are in Germany (DE60 Hamburg, DE71 Darmstadt, DE92 Hannover), Spain (ES21 Païs Vasco, ES30 Madrid, ES42 Castilla-La Mancha), France (FR10 Ile-De-France, FR24 Centre, FR62 Midi-Pyrenees), Italy (ITI4 Lazio) and the UK (UKG3 West Midlands, UKK1 Gloucestershire, Wiltshire and Bristol/Bath area).

The basic-performing clusters are in Belgium (1 region), Czechia (2 regions), Germany (2 regions), Spain (2 regions), France (1 region), Italy (2 regions), Austria (1 region), Poland (2 regions), Romania (1 region) and the UK (7 regions).

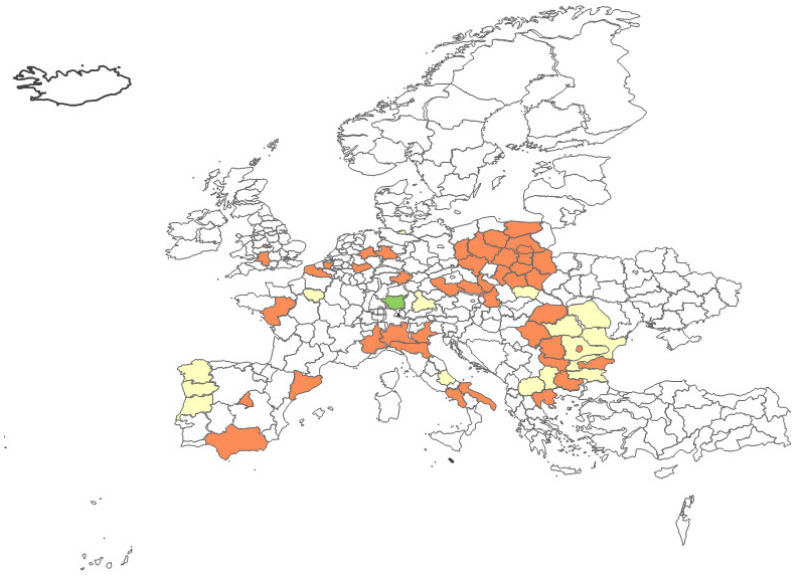


In **Agricultural Inputs and Services** there are 55 clusters, including one high, 11 medium and 43 basic-performing clusters.

The high-performing cluster is in the UK (UKF3 Lincolnshire).

The medium-performing clusters are in Germany (DEF0 Schleswig-Holstein), Spain (ES24 Aragon, ES42 Castilla-La Mancha, ES52 Comunidad Valenciana, ES61 Andalucía, ES62 Murcia), France (FR21 Champagne-Ardenne, FR26 Bourgogne, FR51 Pays-de-la-Loire, FR52 Bretagne) and Norway (NO02 Hedemark og Oppland).

The basic-performing clusters are in Belgium (1 region), Czechia (4 regions), Denmark (1 region), Germany (4 regions), Greece (4 regions), Spain (3 regions), France (5 regions), Italy (4 regions), Hungary (2 regions), Poland (2 regions), Portugal (2 regions), Romania (4 regions), Slovakia (1 region), Sweden (1 region), the UK (2 regions), Switzerland (1 region) and Norway (2 regions).

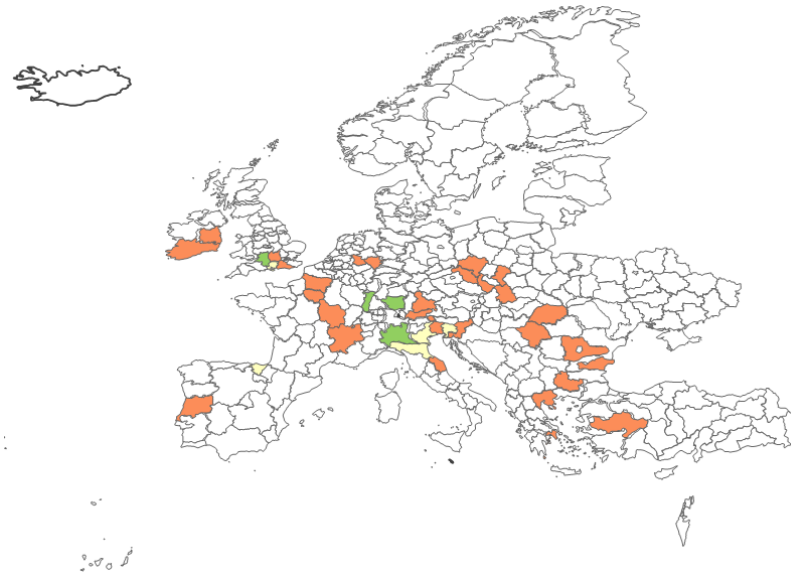


In **Apparel** there are 60 clusters, including one high, 16 medium and 43 basic-performing clusters.

The high-performing cluster is in Germany (DE14 Tübingen).

The medium-performing clusters are in Bulgaria (BG32 Severen Tsentralen, BG34 Yugoiztochen, BG41 Yugozapaden), Germany (DE21 Oberbayern, DE60 Hamburg), Spain (ES11 Galicia), France (FR10 Ile-De-France), Italy (ITF1 Abruzzo), Portugal (PT11 North, PT16 Centre), Romania (RO12 Centre, RO21 North-East, RO22 South-East, RO31 South-Muntenia), Slovakia (SK04 Eastern Slovakia) and North Macedonia.

The basic-performing clusters are in Belgium (1 region), Bulgaria (3 regions), Czechia (3 regions), Germany (4 regions), Greece (1 region), Spain (3 regions), France (2 regions), Italy (6 regions), Poland (12 regions), Romania (4 regions), Slovakia (1 region) and the UK (regions).

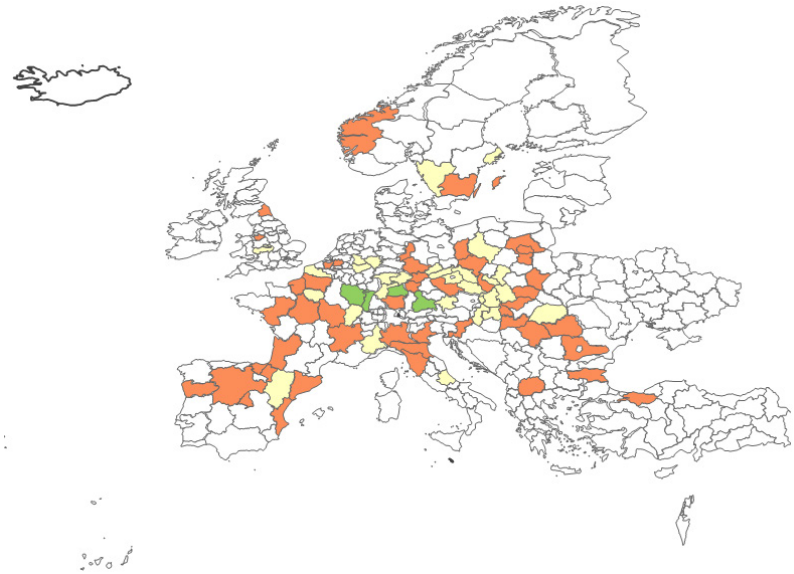


In **Appliances** there are 37 clusters, including 4 high, 5 medium and 28 basic-performing clusters.

The high-performing clusters are in Germany (DE14 Tübingen), France (FR42 Alsace), Italy (ITC4 Lombardia) and the UK (UKK1 Gloucestershire, Wiltshire and Bristol/Bath area).

The medium-performing clusters are in Spain (ES21 Païs Vasco), Italy (ITH3 Veneto, ITH5 Emilia-Romagna), Slovenia (SI04 Western Slovenia) and the UK (UKJ3 Hampshire and Isle of Wight).

The basic-performing clusters are in Bulgaria (2 regions), Czechia (2 regions), Germany (3 regions), Ireland (1 region), Greece (2 regions), France (4 regions), Italy (2 regions), Austria (1 region), Poland (2 regions), Portugal (1 region), Romania (3 regions), Slovenia (1 region), Slovakia (1 region), the UK (2 regions) and Turkey (1 region).

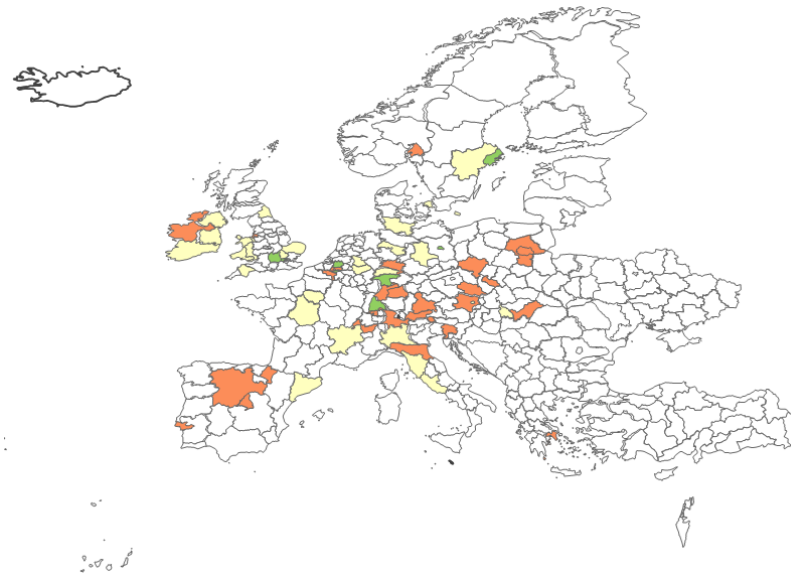


In **Automotive** there are 82 clusters, including 4 high, 31 medium and 47 basic-performing clusters.

The high-performing clusters are in Germany (DE11 Stuttgart, DE21 Oberbayern) and France (FR41 Lorraine, FR42 Alsace).

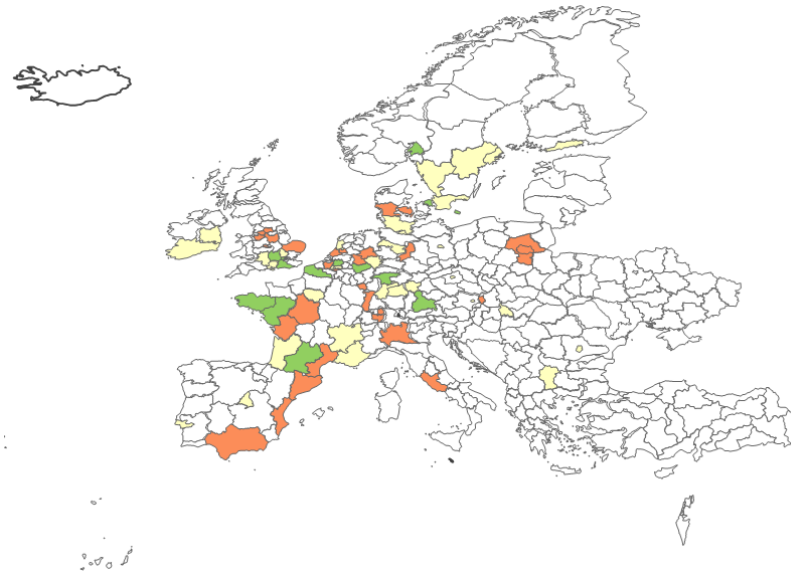
The medium-performing clusters are in Czechia (CZ02 Central Bohemia, CZ04 Northwest, CZ05 Northeast, CZ06 Southeast, CZ08 Moravskoslezsko), Germany (DE12 Karlsruhe, DE26 Unterfranken, DE71 Darmstadt, DEA1 Düsseldorf, DEA2 Köln, DEA5 Arnsberg, DED4 Chemnitz), Spain (ES24 Aragon), FR10 Ile-De-France, FR30 Nord-Pas-De-Calais, FR43 Franche-Comte), Italy (ITC1 Piemonte, ITF1 Abruzzo), Hungary (HU21 Central Transdanubia, HU22 Western Transdanubia), Austria (AT31 Oberösterreich), Poland (PL22 Slaskie, PL41 Wielkopolskie), Romania (RO11 North-West), Slovakia (SK01 Bratislava Region, SK02 Western Slovakia, SK03 Central Slovakia), Sweden (SE11 Stockholm, SE23 West Sweden) and the UK (UKG1 Herefordshire, Worcestershire and Warwickshire, UKG3 West Midlands).

The basic-performing clusters are in Belgium (3 regions), Bulgaria (1 region), Czechia (2 regions), Germany (5 regions), Spain (6 regions), France (7 regions), Italy (4 regions), Hungary (3 regions), Poland (4 regions), Portugal (1 region), Romania (3 regions), Slovenia (1 region), Slovakia (1 region), Sweden (1 region), the UK (2 regions), Norway (1 region), North Macedonia and Turkey (1 region).



In **Biopharmaceuticals** there are 60 clusters, including 8 high, 25 medium and 27 basic-performing clusters.

The high-performing clusters are in Belgium (BE21, Antwerp, BE31 Walloon Brabant), Germany (DE13 Freiburg, DE30 Berlin, DE71 Darmstadt), Sweden (SE11 Stockholm) and the UK (UKI7 Outer London - West and North West, UKJ1 Berkshire, Buckinghamshire and Oxfordshire). The medium-performing clusters are in Denmark (DK01 Hovedstaden), Germany (DE72 Giessen, DE92 Hannover, DEA1 Düsseldorf, DEA2 Köln, DEE0 Sachsen-Anhalt, DEF0 Schleswig-Holstein), Ireland (IE02 Southern and Eastern), Spain (ES51 Cataluña), France (FR10 Ile-De-France, FR24 Centre, FR71 Rhone-Alpes), Italy (ITC4 Lombardia, ITI1 Toscana, ITI4 Lazio), Hungary (HU10 Central Hungary), Austria (AT13 Wien), Sweden (SE12 East Middle Sweden) and the UK (UKC2 Northumberland and Tyne and Wear, UKH1 East Anglia, UKH2 Bedfordshire and Hertfordshire, UKK4 Devon, UKL1 West Wales and The Valleys, UKL2 East Wales, UKN0 Northern Ireland). The basic-performing clusters are in Belgium (3 regions), Czechia (2 regions), Germany (4 regions), Ireland (1 region), Greece (1 region), Spain (3 regions), Italy (1 region), Hungary (1 region), Austria (2 regions), Poland (2 regions), Portugal (1 region), Slovenia (1 region), the UK 1 region), Switzerland (3 regions) and Norway (1 region).

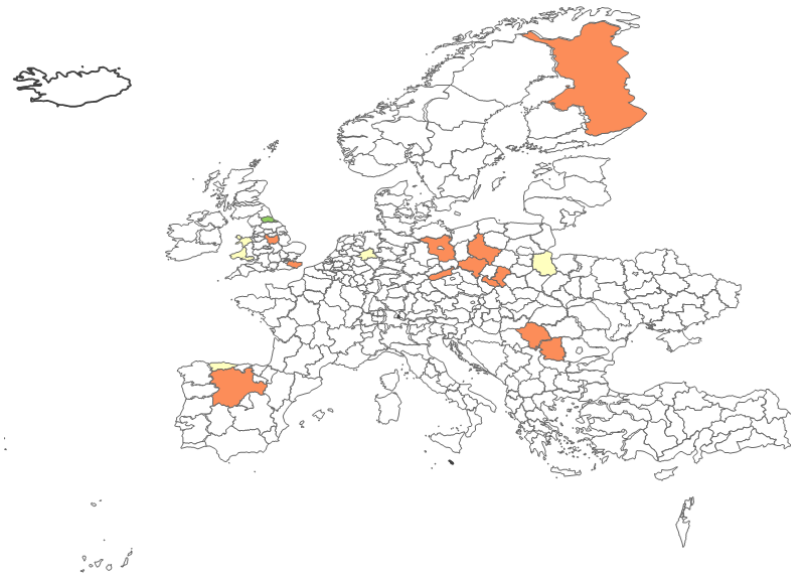


In **Business Services** there are 74 clusters, including 15 high, 31 medium and 28 basic-performing clusters.

The high-performing clusters are in Belgium (BE21 Antwerp), Denmark (DK01 Hovedstaden), Germany (DE21 Oberbayern, DE71 Darmstadt, DEA2 Köln), France FR30 Nord-Pas-De-Calais, FR51 Pays-de-la-Loire, FR52 Bretagne, FR62 Midi-Pyrenees), the UK (UKI3 Inner London – West, UKI4 Inner London – East, UKI7 Outer London - West and North West, UKJ1 Berkshire, Buckinghamshire and Oxford-shire, UKJ2 Surrey, East and West Sussex) and Norway (NO01 Oslo og Akershus).

The medium-performing clusters are in Belgium (BE10 Brussels-Capital Region, BE24 Flemish Brabant), Bulgaria (BG41 Yugozapaden), Czechia (CZ01 Prague), Germany (DE11 Stuttgart, DE12 Karlsruhe, DE25 Mittelfranken, DE30 Berlin, DE60 Hamburg, DE92 Hannover, DEA5 Arnsberg, DEF0 Schleswig-Holstein), Ireland (IE02 Southern and Eastern), Spain (ES30 Madrid), France (FR10 Ile-De-France, FR61 Aquitaine, FR71 Rhone-Alpes, FR82 Provence-Alpes-Cote D'Azur), Hungary (HU10 Central Hungary), Netherlands (NL32 Noord-Holland), Austria (AT13 Wien), Portugal (PT17 Lisboa), Romania (RO32 Bucharest-Ilfov), Finland (FI19 Western Finland), Sweden (SE11 Stockholm, SE12 East Middle Sweden, SE22 South Sweden, SE23 West Sweden) and the UK (UKH2 Bedfordshire and Hertfordshire, UKJ3 Hampshire and Isle of Wight, UKK1 Gloucestershire, Wiltshire and Bristol/Bath area).

The basic-performing clusters are in Belgium (2 regions), Denmark (1 Region), Germany (4 regions), Spain (3 regions), France (4 regions), Italy (2 regions), Netherlands (2 regions), Poland (1 region), Slovakia (1 region), the UK (6 regions) and Switzerland (2 regions).

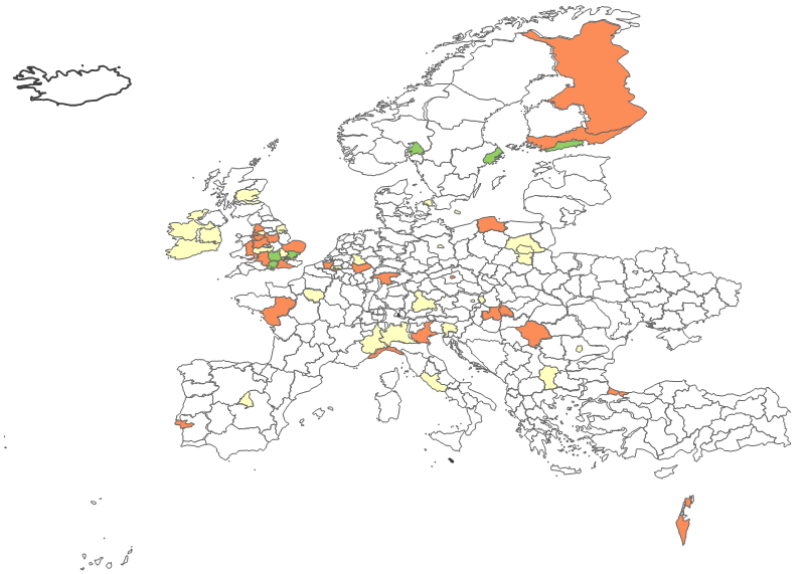


In **Coal Mining** there are 17 clusters, including one high, 4 medium and 12 basic-performing clusters.

The high-performing cluster is in the UK (UKC1 Tees Valley and Durham).

The medium-performing clusters are in Germany (DEA3 Münster), Spain (ES12 Asturias), Poland (PL31 Lubelskie) and the UK (UKL1 West Wales and The Valleys).

The basic-performing clusters are in Czechia (CZ04 Northwest, CZ08 Moravskoslezsko), Germany (DE40 Brandenburg), Spain (ES41 Castilla y Leon), Poland (PL22 Slaskie, PL41 Wielkopolskie, PL51 Dolnoslaskie), Romania (RO41 South-West Oltenia, RO42 West), Finland (FI1D Northern and Eastern Finland) and the UK (UKF1 Derbyshire and Nottinghamshire, UKJ4 Kent).

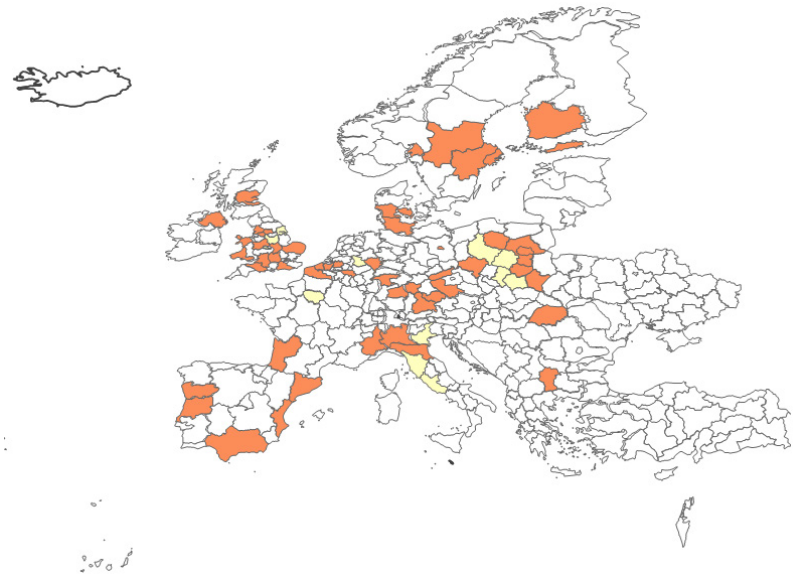


In **Communications Equipment and Services** there are 62 clusters, including 11 high, 24 medium and 27 basic-performing clusters.

The high-performing clusters are in Belgium (BE10 Brussels-Capital Region), Finland (FI19 Western Finland), Sweden (SE11 Stockholm), the UK (UKH3 Essex, UKI3 Inner London - West, UKI4 Inner London - East, UKI7 Outer London - West and North West, UKJ1 Berkshire, Buckinghamshire and Oxfordshire, UKJ3 Hampshire and Isle of Wight) and Norway (NO01 Oslo og Akershus).

The medium-performing clusters are in Belgium (BE24 Flemish Brabant), Bulgaria (BG41 Yugozapaden), Denmark (DK01 Hovedstaden), Germany (DE21 Oberbayern, DE30 Berlin, DEA1 Düsseldorf), Ireland (IE01 Border, Midland and Western, IE02 Southern and Eastern), Spain (ES30 Madrid), France (FR10 Ile-De-France), Italy (ITC1 Piemonte, ITC4 Lombardia, ITI4 Lazio), Austria (AT13 Wien), Poland (PL12 Mazowieckie), Romania (RO32 Bucharest-Ilfov), Slovenia (SI04 Western Slovenia), Slovakia (SK01 Bratislava Region) and the UK (UKD3 Greater Manchester, UKE1 East Yorkshire and Northern Lincolnshire, UKG1 Herefordshire, Worcestershire and Warwickshire, UKH2 Bedfordshire and Hertfordshire, UKI6 Outer London - South, UKM2 Eastern Scotland).

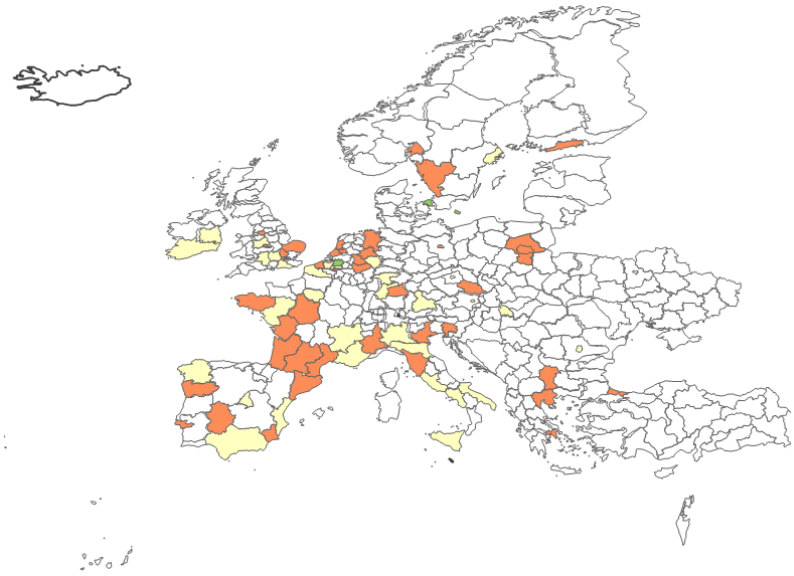
The basic-performing clusters are located in Belgium (2 regions), Czechia (1 region), Germany (2 regions), France (1 Region), Italy (2 regions), Hungary (2 regions), Poland (1 region), Portugal (1 region), Romania (1 region), Finland (2 regions), the UK (9 regions), Turkey (1 region) and Israel (2 regions).



In **Construction Products and Services** there are 64 clusters, including no high, 12 medium and 52 basic-performing clusters.

The medium-performing clusters are in Germany (DEA1 Düsseldorf), France (FR10 Ile-De-France), Italy (ITH3 Veneto, ITI1 Toscana, ITI4 Lazio), Poland (PL11 Lódzkie. PL21 Malopolskie, PL22 Slaskie, PL41 Wielkopolskie) and the UK (UKE1 East Yorkshire and Northern Lincolnshire, UKF1 Derbyshire and Nottingham-shire, UKG3 West Midlands).

The basic-performing clusters are in Belgium (4 regions), Bulgaria (1 region), Czechia (2 regions), Denmark (1 region), Germany (8 regions), Spain (3 regions), France (2 regions), Italy (3 regions), Poland (5 regions), Portugal (2 regions), Romania (1 region), Finland (2 regions), Sweden (3 regions), the UK (14 regions) and Norway (1 region).

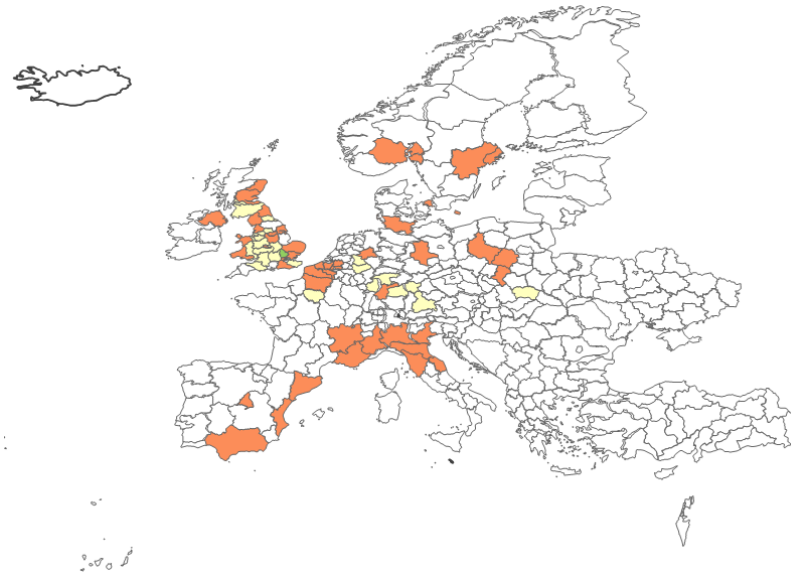


In **Distribution and Electronic Commerce** there are 76 clusters, including 2 high, 31 medium and 43 basic-performing clusters.

The high-performing clusters are in Belgium (BE21 Antwerp) and Denmark (DK01 Hovedstaden).

The medium-performing clusters are in Belgium (BE23 East-Flanders, BE24 Flemish Brabant), Czechia (CZ01 Prague), Germany (DE12 Karlsruhe, DE21 Oberbayern, DE71 Darmstadt, DEA5 Arnsberg), Ireland (IE02 Southern and Eastern), Spain (ES11 Galicia, ES30 Madrid, ES52 Comunidad Valenciana, ES61 Andalucía), France (FR10 Ile-De-France, FR30 Nord-Pas-De-Calais, FR51 Pays-de-la-Loire, FR71 Rhone-Alpes, FR82 Provence-Alpes-Cote D'Azur), Italy (ITC4 Lombardia, ITH5 Emilia-Romagna, ITI4 Lazio, ITF3 Campania, ITF4 Puglia, ITG1 Sicilia), Hungary (HU10 Central Hungary), Austria (AT13 Wien), Romania (RO32 Bucharest-Ilfov), Sweden (SE11 Stockholm) and the UK (UKG2 Shropshire and Staffordshire, UKJ1 Berkshire, Buckinghamshire and Oxfordshire, UKJ2 Surrey, East and West Sussex, UKK1 Gloucestershire, Wiltshire and Bristol/Bath area).

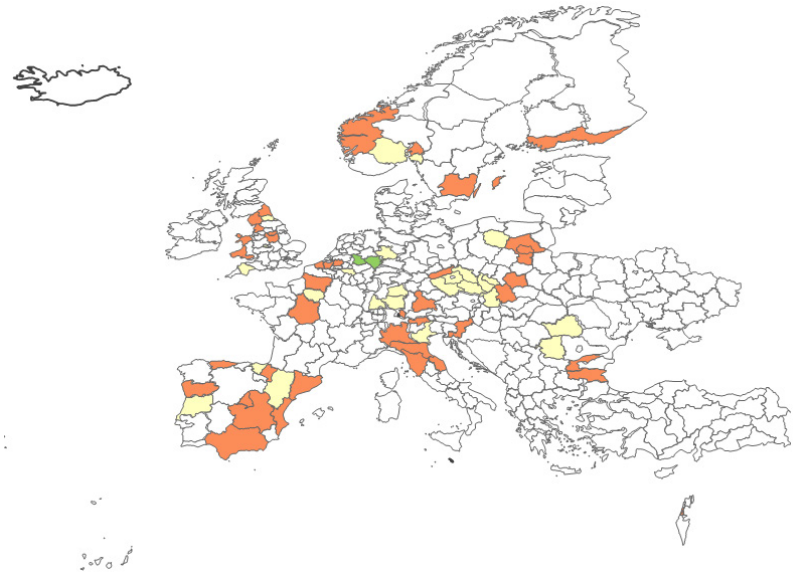
The basic-performing clusters are in Belgium (3 regions), Bulgaria (1 region), Czechia (1 region), Germany (6 regions), Greece (2 regions), Spain (3 regions), France (6 regions), Italy (3 regions), Netherlands (3 regions), Poland (1 region), Portugal (2 regions), Slovenia (1 region), Finland (1 region), Sweden (1 region), the UK (7 regions), Norway (1 region) and Turkey (1 region).



In **Downstream Chemical Products** there are 72 clusters, including one high, 23 medium and 48 basic-performing clusters.

The high-performing cluster is in the UK (UKH2 Bedfordshire and Hertfordshire).

The medium-performing clusters are in Germany (DE11 Stuttgart, DE21 Oberbayern, DE25 Mittelfranken, DE71 Darmstadt, DEA1 Düsseldorf, DEA2 Köln, DEB3 Rheinhessen-Pfalz), France (FR10 Ile-De-France), Slovakia (SK04 Eastern Slovakia) and the UK (UKC1 Tees Valley and Durham, UKD3 Greater Manchester, UKD6 Cheshire, UKD7 Merseyside, UKE4 West Yorkshire, UKF2 Leicestershire, Rutland and Northamptonshire, UKG1 Herefordshire, Worcestershire and Warwickshire, UKG2 Shropshire and Staffordshire, UKJ1 Berkshire, Buckinghamshire and Oxfordshire, UKJ4 Kent, UKK1 Gloucestershire, Wiltshire and Bristol/Bath area, UKK2 Dorset and Somerset, UKL2 East Wales, UKM3 South Western Scotland). The basic-performing clusters are in Belgium (5 regions), Denmark (1 region), Germany (4 regions), Spain (4 regions), France (4 regions), Italy (6 regions), Poland (3 regions), Sweden (2 regions), the UK (17 regions) and Norway (2 regions).

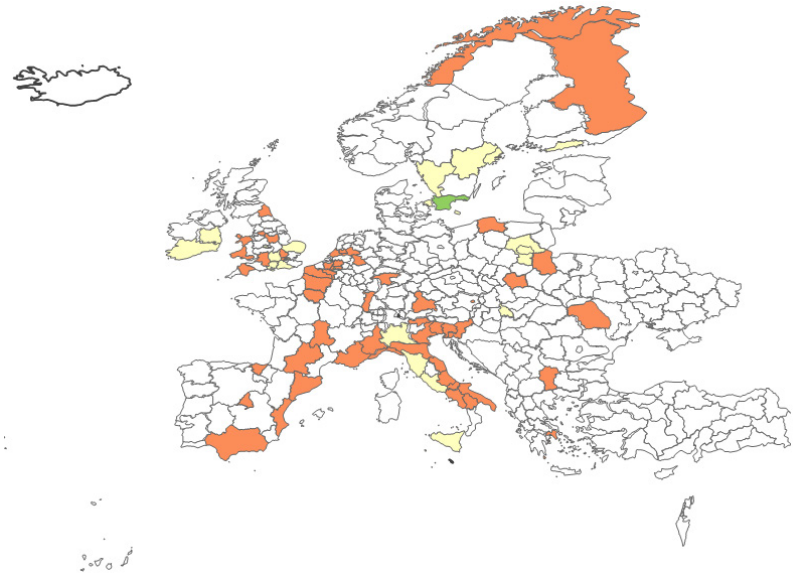


In **Downstream Metal Products** there are 65 clusters, including 2 high, 24 medium and 39 basic-performing clusters.

The high-performing clusters are in Germany (DEA1 Düsseldorf, DEA5 Arnsberg).

The medium-performing clusters are in Belgium (BE33 Liege), Czechia (CZ02 Central Bohemia, CZ03 Southwest, CZ05 Northeast, CZ06 Southeast, CZ07 Central Moravia, CZ08 Moravs-koslezsko), Germany (DE11 Stuttgart, DE13 Freiburg, DE14 Tübingen, DEA4 Detmold), Spain (ES21 Païs Vasco, ES24 Aragon), France (FR10 Ile-De-France), Italy (ITH3 Veneto), Poland (PL61 Kujawsko-Pomorskie), Portugal (PT16 Centre), Romania (RO12 Centre, RO41 South-West Oltenia), Slovakia (SK02 Western Slovakia), the UK (UKC1 Tees Valley and Durham, UKG3 West Midlands, UKK4 Devon) and Norway (NO03 Sor-Ostlandet).

The basic-performing clusters are in Belgium (3 regions), Bulgaria (2 regions), Czechia (1 region), Germany (1 region), Spain (7 regions), France (2 regions), Italy (5 regions), Austria (1 region), Poland (2 regions), Portugal (1 region), Slovenia (1 region), Slovakia (1 region), Finland (1 region), Sweden (1 region), the UK (7 regions), Norway (2 regions) and Israel (1 region).

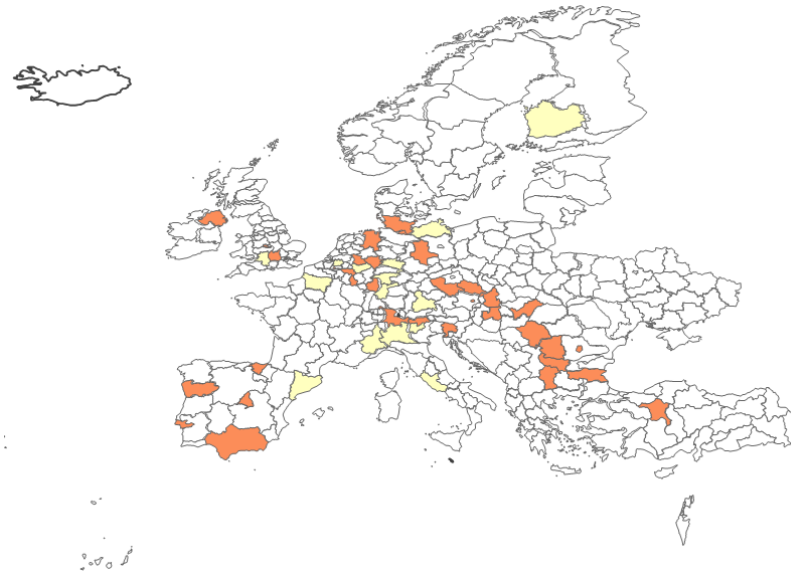


In **Education and Knowledge Creation** there are 75 clusters, including 3 high, 19 medium and 53 basic-performing clusters.

The high-performing clusters are in Belgium (BE10 Brussels-Capital Region), Sweden (SE22 South Sweden) and the UK (UKI3 Inner London - West).

The medium-performing clusters are in Denmark (DK01 Hovedstaden), Ireland (IE02 Southern and Eastern), Italy (ITC4 Lombardia, ITI1 Toscana, ITI4 Lazio, ITG1 Sicilia), Hungary (HU10 Central Hungary), Poland (PL12 Mazowieckie), Finland (FI19 Western Finland), Sweden (SE11 Stockholm, SE12 East Middle Sweden, SE23 West Sweden) and the UK (UKG3 West Midlands, UKH1 East Anglia, UKI4 Inner London - East, UKI5 Outer London - East and North East, UKJ1 Berkshire, Buckinghamshire and Oxfordshire, UKJ2 Surrey, East and West Sussex, UKJ3 Hampshire and Isle of Wight.

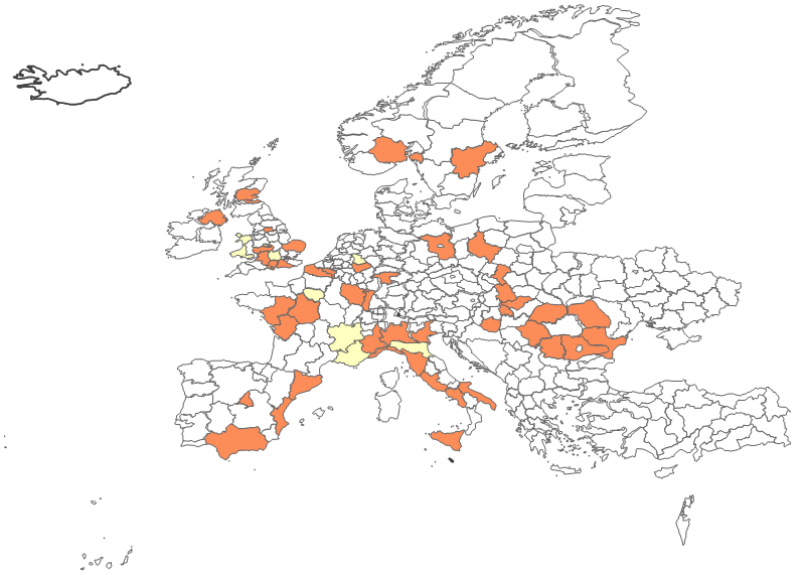
The basic-performing clusters are in Belgium (4 regions), Bulgaria (1 region), Germany (3 regions), Greece (1 region), Spain (5 regions), France (7 regions), Italy (12 regions), Netherlands (3 regions), Austria (1 region), Poland (3 regions), Romania (1 region), Slovenia (2 regions), Finland (1 region), the UK (8 regions) and Norway (1 region).



In **Electric Power Generation and Transmission** there are 51 clusters, including no high, 15 medium and 36 basic-performing clusters.

The medium-performing clusters are in Belgium (BE21 Antwerp), Germany (DE12 Karlsruhe, DE21 Oberbayern, DE71 Darmstadt, DE73 Kassel, DE80 Mecklenburg-Vorpommern, DEA2 Köln), Spain (ES51 Cataluña), France (FR22 Picardie), Italy (ITC1 Piemonte, ITC4 Lombardia, ITH2 Provincia Autonoma di Trento, ITI4 Lazio), Finland (FI1B Helsinki-Uusimaa) and the UK (UKK1 Gloucestershire, Wiltshire and Bristol/Bath area).

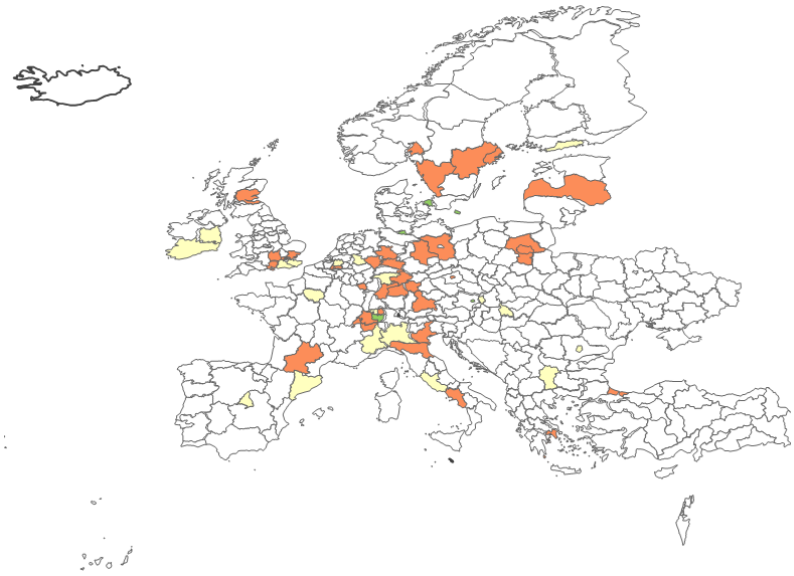
The basic-performing clusters are in Belgium (2 regions), Bulgaria (3 regions), Czechia (2 regions), Germany (7 regions), Spain (3 regions), Italy (1 region), Luxembourg), Hungary (2 regions), Austria (1 region), Portugal (2 regions), Romania (3 regions), Slovenia (1 region), Slovakia (1 region), the UK (5 regions), Switzerland (1 region), and Turkey (1 region).



In **Environmental Services** there are 54 clusters, including no high, 8 medium and 46 basic-performing clusters.

The medium-performing clusters are in Germany (DEA1 Duesseldorf), France (FR10 Ile-De-France, FR71 Rhone-Alpes, FR82 Provence-Alpes-Cote D'Azur), Italy (ITH5 Emilia-Romagna) and the UK (UKG3 West Midlands, UKJ1 Berkshire, Buckinghamshire and Oxford-shire, UKL1 West Wales and The Valleys).

The basic-performing clusters are in Belgium (1 region), Germany (3 regions), Spain (4 regions), France (6 regions), Italy (9 regions), Hungary (3 regions), Poland (2 regions), Romania (6 regions), Slovakia (1 region), Sweden (1 region), the UK (9 regions), and Norway (1 region).

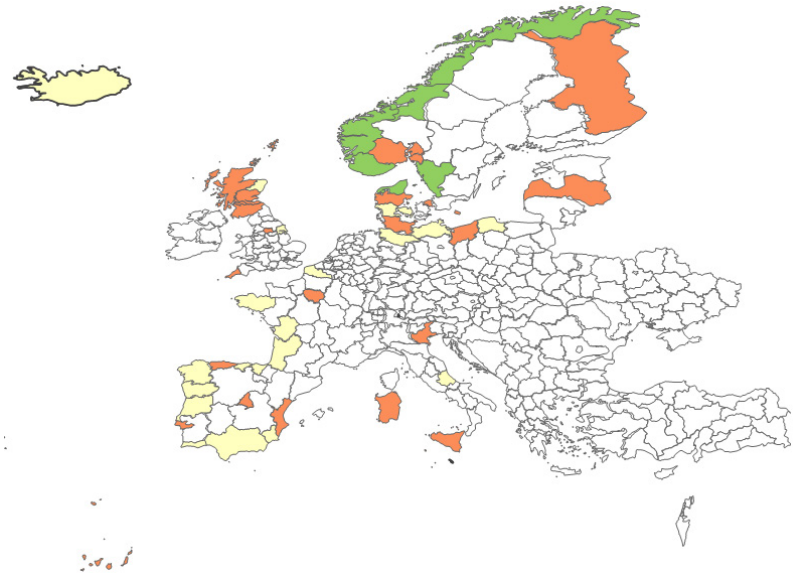


In **Financial Services** there are 59 clusters, including 6 high, 18 medium and 35 basic-performing clusters.

The high-performing clusters are both in Denmark (DK01 Hovedstaden), Germany (DE60 Hamburg), Austria (AT13 Wien), the UK (UKI3 Inner London - West, UKI4 Inner London - East) and Switzerland (CH06 Zentral-schweiz).

The medium-performing clusters are in Belgium (BE21 Antwerp) Bulgaria (BG41 Yugozapaden), Germany (DE71 Darmstadt, DEA1 Düsseldorf), Ireland (IE02 Southern and Eastern), Spain (ES30 Madrid, ES51 Cataluña), France (FR10 Ile-De-France), Italy (ITC1 Piemonte, ITC4 Lombardia, ITI4 Lazio), Hungary (HU10 Central Hungary), Romania (RO32 Bucharest-Ilfov), Slovakia (SK01 Bratislava Region), Finland (FI19 Western Finland), the UK (UKJ2 Surrey, East and West Sussex, UKJ4 Kent) and Switzerland CH03 Nordwestschweiz).

The basic-performing clusters are in Belgium (2 regions), Czechia (1 region), Germany (11 regions), Greece (1 region), France (1 region), Italy (3 regions), Latvia, Poland (1 region), Sweden (3 region), the UK (6 regions), Switzerland (3 regions), Norway (1 region) and Turkey (1 region).

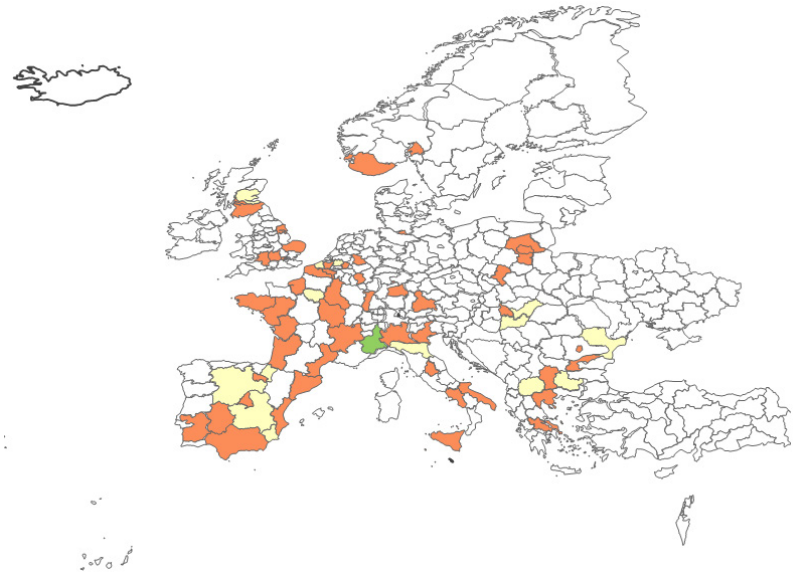


In **Fishing and Fishing Products** there are 51 clusters, including 6 high, 21 medium and 24 basic-performing clusters.

The high-performing clusters are in Denmark (DK05 Nordjylland), Sweden (SE23 West Sweden) and Norway (NO04 Agder og Rogaland, NO05 Vestlandet, NO06 Trøndelag, NO07 Nord-Norge).

The medium-performing clusters are in Denmark (DK03 Syddanmark), Germany (DE50 Bremen, DE80 Mecklenburg-Vorpommern, DE93 Lüneburg), Spain (ES11 Galicia, ES13 Cantabria, ES21 Païs Vasco, ES61 Andalucía, ES62 Murcia), France (FR30 Nord-Pas-De-Calais, FR52 Bretagne, FR53 Poitou-Charentes, FR61 Aquitaine), Italy (ITF1 Abruzzo), Poland (PL63 Pomorskie), Portugal (PT11 North, PT15 Algarve, PT16 Centre), the UK (UKE1 East Yorkshire and Northern Lincolnshire, UKM5 North Eastern Scotland) and Iceland.

The basic-performing clusters are in Denmark (2 regions), Germany (1 region), Spain (4 regions), France (1 region), Italy (3 regions), Latvia, Poland (1 region), Portugal (3 regions), Finland (1 region), the UK (5 regions) and Norway (2 regions).

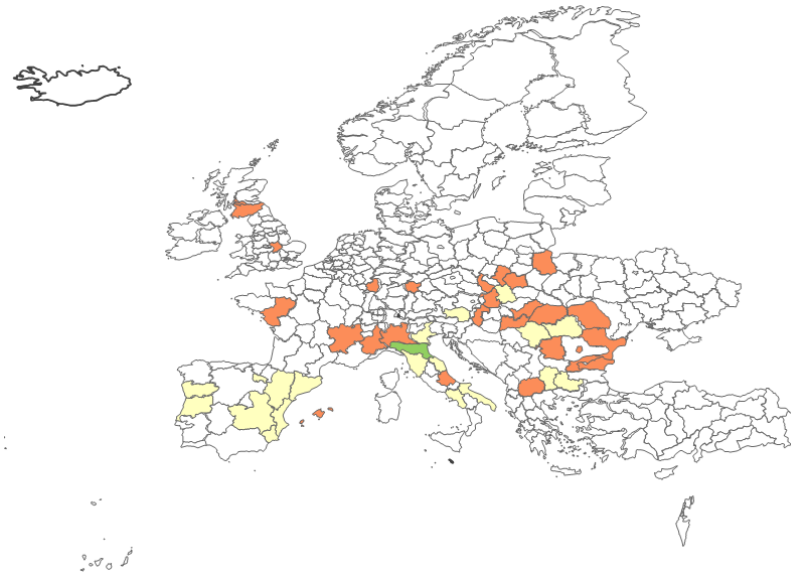


In **Food Processing and Manufacturing** there are 63 clusters, including one high, 14 medium and 48 basic-performing clusters.

The high-performing cluster is in Italy (ITC1 Piemonte).

The medium-performing clusters are in Belgium (BE21 Antwerp, BE25 West-Flanders), Bulgaria (BG42 Yuzhen Tsentralen), Spain (ES22 Navarra, ES41 Castilla y Leon, ES42 Castilla-La Mancha, ES62 Murcia), France (FR10 Ile-De-France), Italy (ITH5 Emilia-Romagna), Hungary (HU32 Northern Great Plain, HU33 Southern Great Plain), Romania (RO22 South-East), the UK (UKM2 Eastern Scotland) and North Macedonia.

The basic-performing clusters are in Belgium (3 regions), Bulgaria (2 regions), Germany (5 regions), Greece (2 regions), Spain (6 regions), France (11 regions), Italy (6 regions), Hungary (1 region), Poland (2 regions), Portugal (1 region), Romania (1 region), the UK (6 regions) and Norway (2 regions).

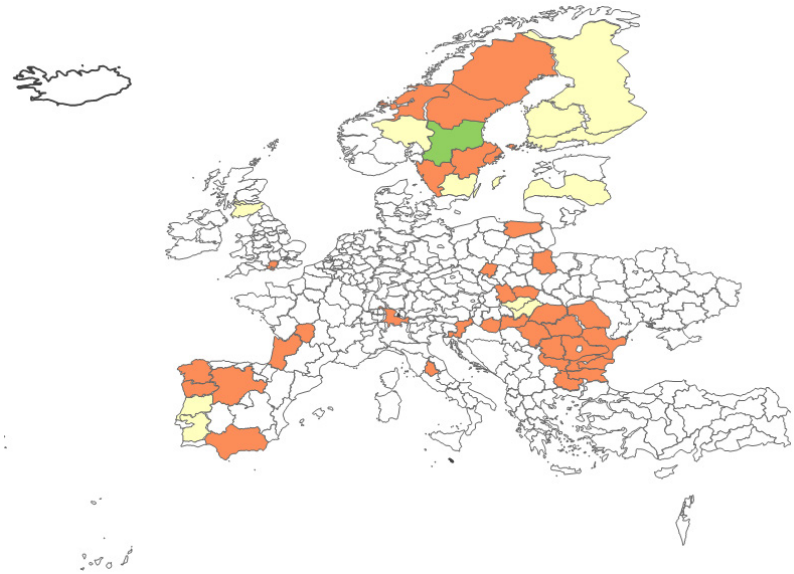


In **Footwear** there are 46 clusters, including one high, 19 medium and 26 basic-performing clusters.

The high-performing cluster is in Italy (ITH5 Emilia-Romagna).

The medium-performing clusters are in Bulgaria (BG41 Yugozapaden, BG42 Yuzhen Tsentralen), Spain (ES23 La Rioja, ES24 Aragon, ES42 Castilla-La Mancha, ES51 Cataluña, ES52 Comunidad Valenciana, ES62 Murcia), Italy (ITH3 Veneto, ITI1 Toscana, ITI3 Marche, ITF3 Campania, ITF4 Puglia), Austria (AT22 Steiermark), Portugal (PT11 North, PT16 Centre), Romania (RO12 Centre, RO42 West) and Slovakia (SK03 Central Slovakia).

The basic-performing clusters are in Bulgaria (2 regions), Czechia (1 region), Germany (2 regions), Spain (1 region), France (2 regions), Italy (3 regions), Hungary (3 regions), Poland (3 regions), Romania (5 regions), Slovakia (1 region), the UK (2 regions) and North Macedonia.

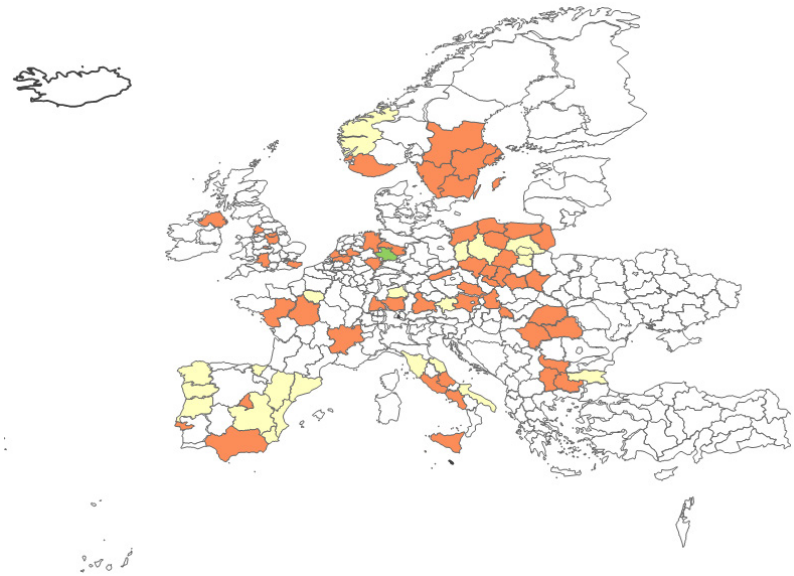


In **Forestry** there are 48 clusters, including one high, 11 medium and 36 basic-performing clusters.

The high-performing cluster is in Sweden (SE31 North Middle Sweden).

The medium-performing clusters are in Latvia, Hungary (HU31 Northern Hungary, HU32 Northern Great Plain), Portugal (PT16 Centre, PT18 Alentejo), Finland (FI1B Helsinki-Uusimaa, FI1C Southern Finland, FI1D Northern and Eastern Finland), Sweden (SE21 Smaland and the islands), the UK (UKM3 South Western Scotland) and Norway (NO02 Hedemark og Oppland).

The basic-performing clusters are in Bulgaria (5 regions), Spain (3 regions), France (2 regions), Italy (1 region), Hungary (2 regions), Poland (3 regions), Portugal (1 region), Romania (7 regions), Slovenia (1 region), Slovakia (2 regions), Finland (1 region), Sweden (5 regions), the UK (1 region), Switzerland (1 region) and Norway (1 region).

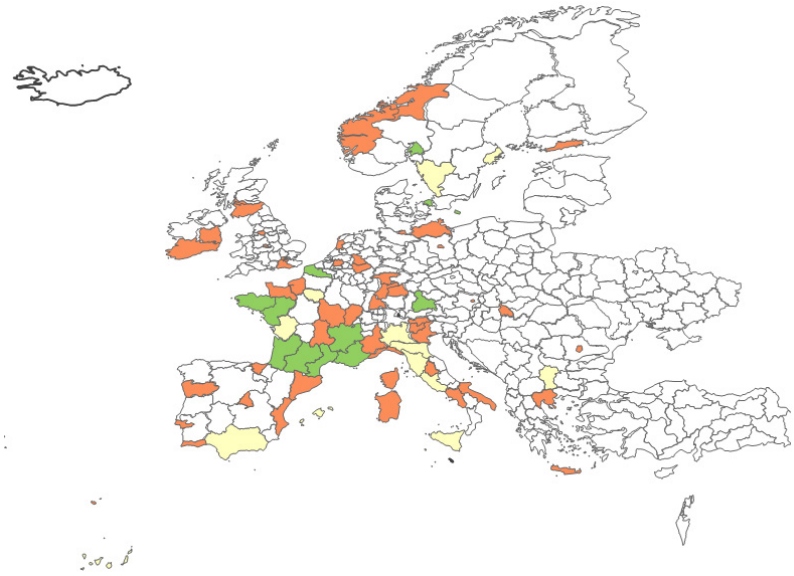


In **Furniture** there are 76 clusters, including one high, 20 medium and 55 basic-performing clusters.

The high-performing cluster is in Germany (DEA4 Detmold).

The medium-performing clusters are in Bulgaria (BG34 Yugoiztochen), Germany (DE11 Stuttgart), Spain (ES11 Galicia, ES21 Païs Vasco, ES24 Aragon, ES52 Comunidad Valenciana, ES42 Castilla-La Mancha, ES51 Cataluña, ES62 Murcia), France (FR10 Ile-De-France), Italy (ITI1 Toscana, ITI3 Marche, ITF4 Puglia), Austria (AT31 Ober-österreich), Poland (PL12 Mazowieckie, PL41 Wielkopolskie, PL43 Lubuskie), Portugal (PT11 North, PT16 Centre) and Norway (NO05 Vestlandet).

The basic-performing clusters are in Bulgaria (3 regions), Czechia (3 regions), Germany (6 regions), Spain (2 regions), France (3 regions), Italy (4 regions), Hungary (1 region), Netherlands (3 regions), Austria (1 region), Poland (11 regions), Portugal (1 region), Romania (3 regions), Slovakia (1 region), Sweden (5 regions), the UK (7 regions) and Norway (1 region).

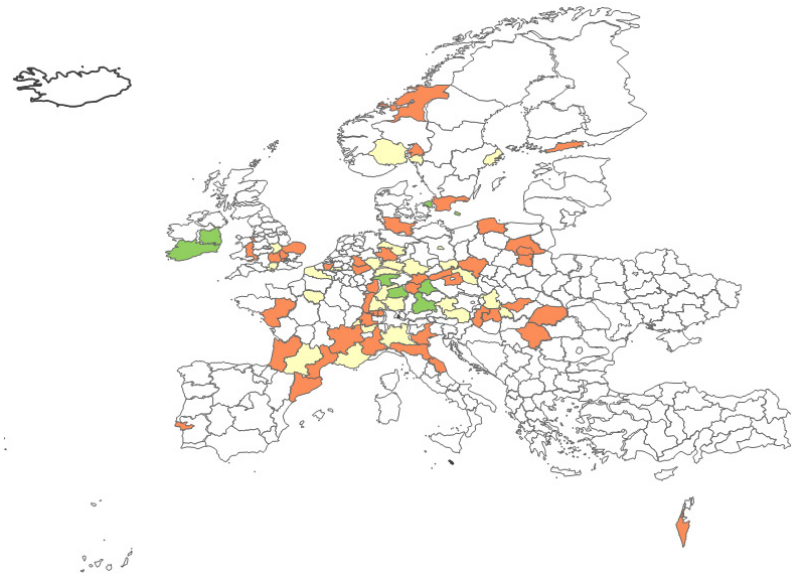


In **Hospitality and Tourism** there are 76 clusters, including 12 high, 14 medium and 50 basic-performing clusters.

The high-performing clusters are in Denmark (DK01 Hovedstaden), Germany (DE21 Oberbayern), France (FR30 Nord-Pas-De-Calais, FR51 Pays-de-la-Loire, FR52 Bretagne, FR61 Aquitaine, FR62 Midi-Pyrenees, FR71 Rhone-Alpes, FR81 Languedoc Roussillon, FR82 Provence-Alpes-Cote D'Azur), the UK (UKI3 Inner London - West) and Norway (NO01 Oslo og Akershus).

The medium-performing clusters are in Belgium (BE10 Brussels-Capital Region), Bulgaria (BG41 Yugozapaden), Spain (ES53 Islas Baleares, ES61 Andalucía, ES70 Canary Islands), France (FR10 Ile-De-France, FR53 Poitou-Charentes), Italy (ITC4 Lombardia, ITH5 Emilia-Romagna, ITI1 Toscana, ITI4 Lazio, ITG1 Sicilia) and Sweden (SE11 Stockholm, SE23 West Sweden).

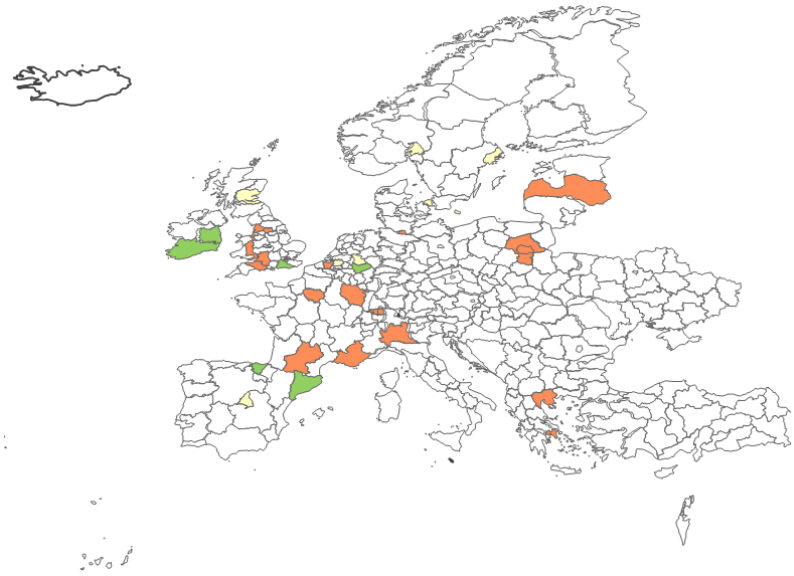
The basic-performing clusters are in Belgium (1 region), Germany (9 regions), Ireland (1 region), Greece (2 regions), Spain (4 regions), France (6 regions), Italy (9 regions), Hungary (1 region), Netherlands (1 region), Austria (1 region), Portugal (4 regions), Romania (1 region), Finland (1 region), the UK (7 regions), and Norway (2 regions).



In **Information Technology and Analytical Instruments** there are 76 clusters, including 6 high, 26 medium and 44 basic-performing clusters.

The high-performing clusters are in Denmark (DK01 Hovedstaden), Germany (DE11 Stuttgart, DE21 Oberbayern, DE23 Oberpfalz, DE71 Darmstadt) and Ireland (IE02 Southern and Eastern).

The medium-performing clusters are in Belgium (BE24 Flemish Brabant), Czechia (CZ05 Northeast), Germany (DE12 Karlsruhe, DE13 Freiburg, DE14 Tübingen, DE30 Berlin, DE72 Giessen, DE73 Kassel, DE92 Hannover, DEA5 Arnsberg, DED2 Dresden, DEG0 Thüringen), France (FR10 Ile-De-France, FR30 Nord-Pas-De-Calais, FR62 Midi-Pyrenees, FR82 Provence-Alpes-Cote D'Azur), Italy (ITC4 Lombardia), Hungary (HU10 Central Hungary), Austria (AT22 Steiermark, AT31 Oberösterreich), Slovakia (SK02 Western Slovakia), Sweden (SE11 Stockholm), the UK (UKF2 Leicestershire, Rutland and Northamptonshire, UKJ3 Hampshire and Isle of Wight), Switzerland (CH01 Region Lémanique) and Norway (NO03 Sor-Ostlandet). The basic-performing clusters are in Belgium (1 region), Czechia (2 regions), Germany (7 regions), Spain (1 region), France (5 regions), Italy (4 regions), Hungary (3 regions), Poland (3 regions), Portugal (1 region), Romania (2 regions), Finland (1 regions), Sweden (1 region), the UK (6 regions), Switzerland (3 regions), Norway (2 regions) and Israel (2 regions).



In **Insurance Services** there are 32 clusters, including 6 high, 7 medium and 19 basic-performing clusters.

The high-performing clusters are in Germany (DEA2 Köln), Ireland (IE02 Southern and Eastern), Spain (ES21 Païs Vasco, ES51 Cataluña) and the UK (UKI3 Inner London - West, UKJ2 Surrey, East and West Sussex).

The medium-performing clusters are in Belgium (BE21 Antwerp), Denmark (DK01 Hovedstaden), Germany (DEA1 Düsseldorf), Spain (ES30 Madrid), Sweden (SE11 Stockholm), the UK (UKM2 Eastern Scotland) and Norway (NO01 Oslo og Akershus).

The basic-performing clusters are in Belgium (1 region), Germany (1 region), Greece (2 regions), France (4 regions), Italy (1 region), Latvia, Poland (1 region), the UK (6 region) and Switzerland (2 regions).

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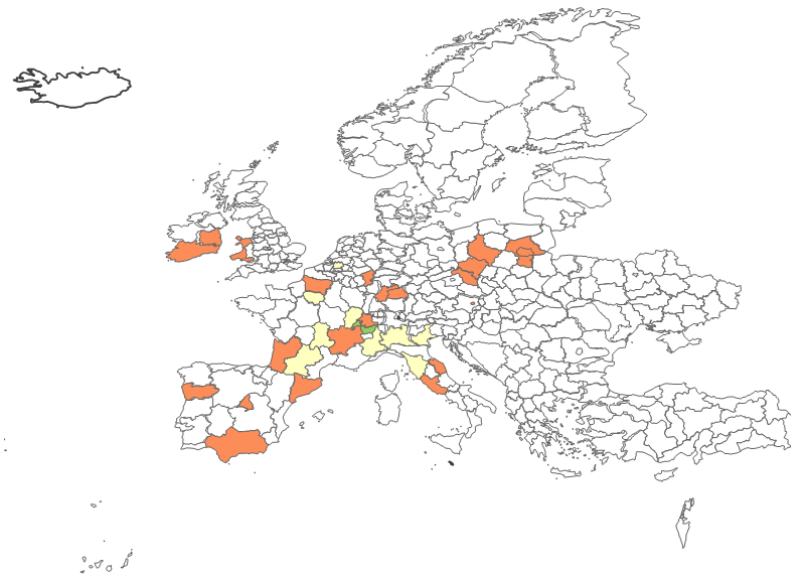
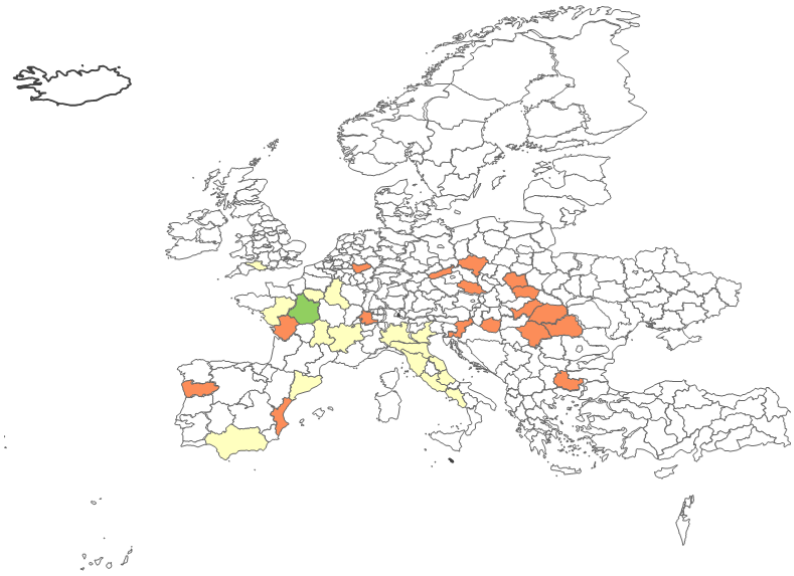


In **Jewellery and Precious Metals** there are 30 clusters, including one high, 9 medium and 20 basic-performing clusters.

The high-performing cluster is in Switzerland (CH01 Region Lémanique).

The medium-performing clusters are in Belgium (BE21 Antwerp), France (FR10 Ile-De-France, FR43 Franche-Comte, FR62 Midi-Pyrenees, FR72 Auvergne) and Italy (ITC1 Piemonte, ITC4 Lombardia, ITH3 Veneto, ITI1 Toscana).

The basic-performing clusters are in Czechia (1 region), Germany (3 regions), Ireland (1 region), Spain (3 regions), France (3 regions), Italy (2 regions), Austria (1 region), Poland (3 regions), Portugal (1 region), the UK (1 region) and Switzerland (1 region).

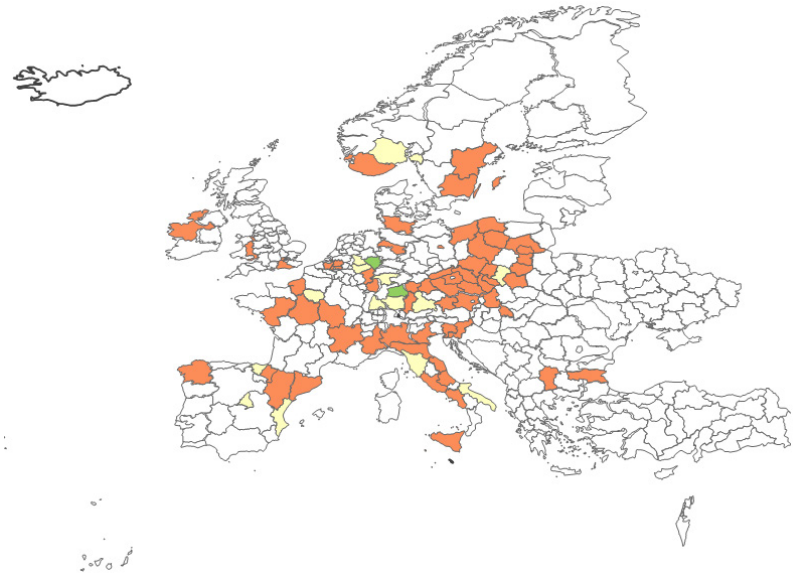


In **Leather and Related Products** there are 34 clusters, including one high, 16 medium and 17 basic-performing clusters.

The high-performing cluster is in France (FR24 Centre).

The medium-performing clusters are in Spain (ES51 Cataluña, ES61 Andalucía), France (FR10 Ile-De-France, FR21 Champagne-Ardenne, FR51 Pays-de-la-Loire, FR71 Rhone-Alpes, FR72 Auvergne) and Italy (ITC4 Lombardia, ITF1 Abruzzo, ITF3 Campania, ITH3 Veneto, ITH5 Emilia-Romagna, ITI1 Toscana, ITI3 Marche, ITI4 Lazio) and the UK (UKK2 - Dorset and Somerset).

The basic-performing clusters are in Bulgaria (1 region), Czechia (2 regions), Germany (1 region), Spain (1 region), France (1 region), Hungary (2 regions), Poland (2 regions), Portugal (1 region), Romania (3 regions), Slovenia (1 region), Slovakia (1 region), and Switzerland (1 region).

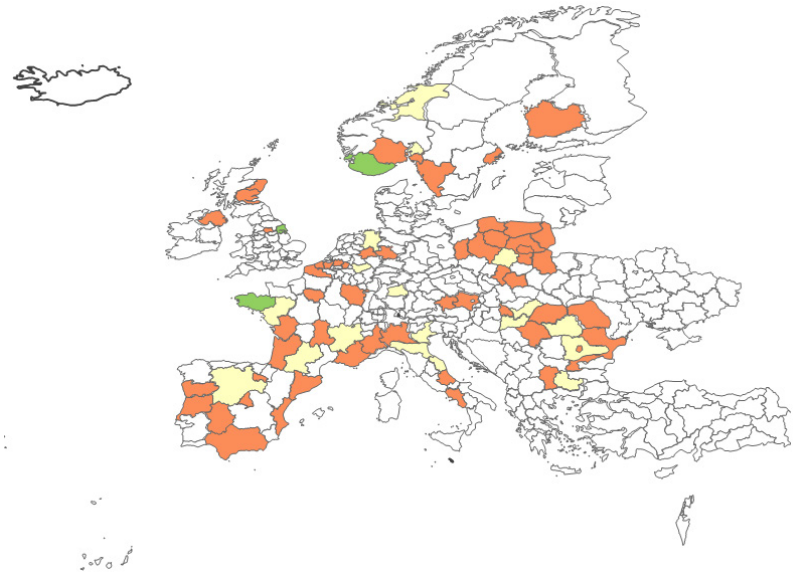


In **Lighting and Electrical Equipment** there are 77 clusters, including 2 high, 14 medium and 61 basic-performing clusters.

The high-performing clusters are in Germany (DE11 Stuttgart, DEA5 Arnsberg).

The medium-performing clusters are in Germany (DE13 Freiburg, DE14 Tübingen, DE21 Oberbayern, DE71 Darmstadt, DEA1 Düsseldorf, DEA2 Köln), Spain (ES21 Païs Vasco, ES30 Madrid, ES52 Comunidad Valenciana), France (FR10 Ile-De-France), Italy (ITF4 Puglia, ITI1 Toscana), Poland (PL22 Slaskie) and Norway (NO03 Sor-Ostlandet).

The basic-performing clusters are in Belgium (3 regions), Bulgaria (2 regions), Czechia (7 regions), Germany (8 regions), Ireland (1 region), Spain (4 regions), France (5 regions), Italy (9 regions), Hungary (1 region), Austria (2 regions), Poland (9 regions), Slovenia (2 regions), Slovakia (1 region), Sweden (2 regions), the UK (4 regions) and Norway (1 region).

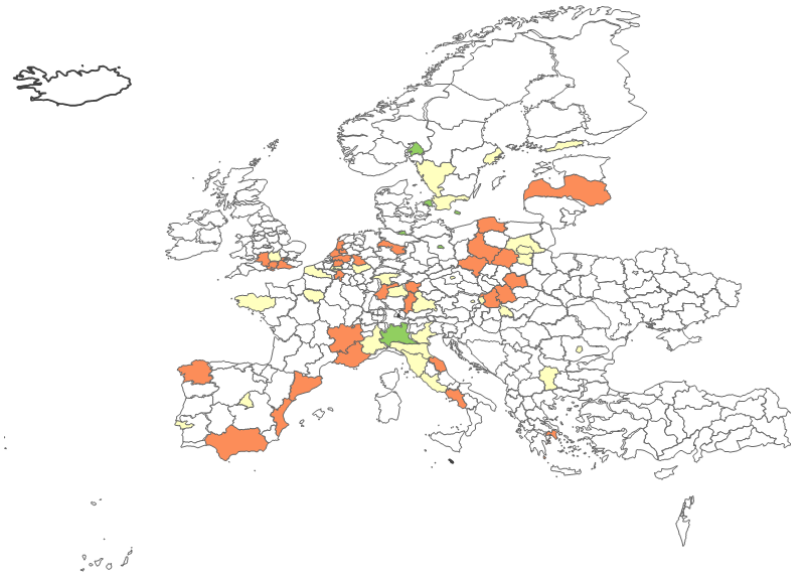


In **Livestock Processing** there are 74 clusters, including 3 high, 18 medium and 53 basic-performing clusters.

The high-performing clusters are in France (FR52 Bretagne), the UK (UKE1 East Yorkshire and Northern Lincolnshire), and Norway (NO04 Agder og Rogaland).

The medium-performing clusters are in Bulgaria (BG42 Yuzhen Tsentralen), Germany (DE11 Stuttgart, DE94 Weser-Ems, DEA2 Köln), Spain (ES41 Castilla y Leon), France (FR51 Pays-de-la-Loire, FR62 Midi-Pyrenees, FR71 Rhone-Alpes), Italy (ITH3 Veneto, ITH5 Emilia-Romagna, ITI3 Marche), Hungary (HU32 Northern Great Plain, HU33 Southern Great Plain), Poland (PL11 Lódzkie), Romania (RO12 Centre, RO31 South-Muntenia), and Norway (NO01 Oslo og Akershus, NO06 Trøndelag).

The basic-performing clusters are in Belgium (4 regions), Bulgaria (2 regions), Germany (2 regions), Spain (6 regions), France (7 regions), Italy (4 regions), Hungary (1 region), Austria (2 regions), Poland (10 regions), Portugal (2 regions), Finland (1 region), Romania (5 regions), Sweden (2 regions) and the UK (4 regions) and Norway (1 region).

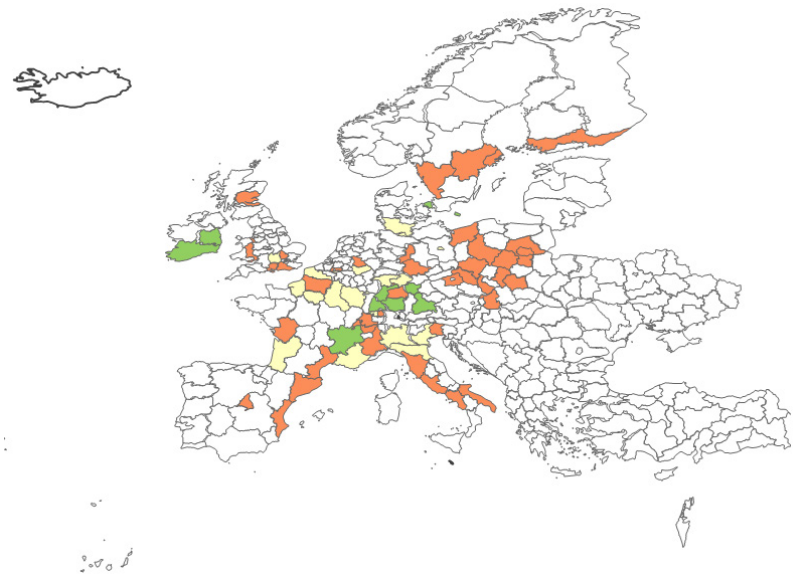


In **Marketing, Design, and Publishing** there are 68 clusters, including 8 high, 28 medium and 32 basic-performing clusters.

The high-performing clusters are in Belgium (BE10 Brussels-Capital Region), Denmark (DK01 Hovedstaden), Germany (DE30 Berlin, DE60 Hamburg), Italy (ITC4 Lombardia), the UK (UKI3 Inner London - West, UKI4 Inner London - East) and Norway (NO01 Oslo og Akershus).

The medium-performing clusters are in Belgium (BE24 Flemish Brabant, BE31 Walloon Brabant), Bulgaria (BG41 Yugozapaden), Czechia (CZ01 Prague), Germany (DE11 Stuttgart, DE21 Oberbayern, DE71 Darmstadt, DEA2 Köln), Spain (ES30 Madrid), France (FR10 Ile-De-France, FR30 Nord-Pas-De-Calais, FR52 Bretagne), Italy (ITC1 Piemonte, ITH3 Veneto, ITH5 Emilia-Romagna, ITI1 Toscana, ITI4 Lazio), Hungary (HU10 Central Hungary), Austria (AT13 Wien), Poland (PL12 Mazowieckie), Portugal (PT17 Lisboa), Romania (RO32 Bucharest-Ilfov), Slovakia (SK01 Bratislava Region), Finland (FI19 Western Finland), Sweden (SE11 Stockholm, SE22 South Sweden, SE23 West Sweden) and the UK (UKJ1 Berkshire, Buckinghamshire and Oxfordshire).

The basic-performing clusters are in Belgium (2 regions), Germany (5 regions), Greece (1 region), Spain (4 regions), France (2 regions), Italy (2 regions), Latvia, Netherlands (4 regions), Poland (5 regions), Slovakia (2 regions) and the UK (4 regions).

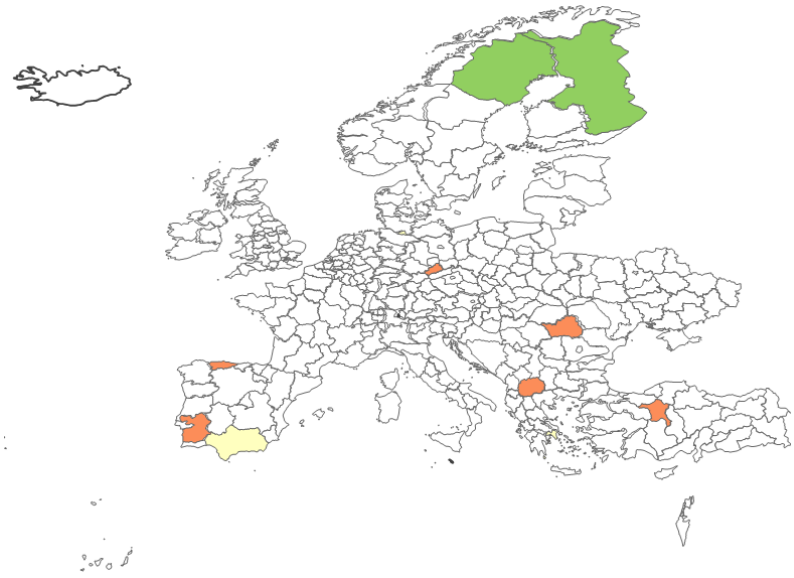


In **Medical Devices** there are 67 clusters, including 8 high, 19 medium and 40 basic-performing clusters.

The high-performing clusters are in Denmark (DK01 Hovedstaden), Germany (DE12 Karlsruhe, DE13 Freiburg, DE14 Tübingen, DE21 Oberbayern, DE25 Mittel-franken), Ireland (IE02 Southern and Eastern) and France (FR71 Rhone-Alpes).

The medium-performing clusters are in Belgium (BE31 Walloon Brabant), Germany (DE26 Unterfranken, DE30 Berlin, DE60 Hamburg, DE71 Darmstadt, DEA2 Köln, DEF0 Schleswig-Holstein), France (FR10 Ile-De-France, FR21 Champagne-Ardenne, FR23 Haute-Normandie, FR30 Nord-Pas-De-Calais, FR41 Lorraine, FR61 Aquitaine, FR82 Provence-Alpes-Cote D'Azur), Italy (ITC4 Lombardia, ITH3 Veneto, ITH5 Emilia-Romagna), the UK (UKJ1 Berkshire, Buckinghamshire and Oxfordshire) and Switzerland (CH03 Nordwestschweiz).

The basic-performing clusters are in Belgium (1 region), Czechia (3 regions), Germany (4 regions), Spain (3 regions), France (3 regions), Italy (6 regions), Poland (7 regions), Slovakia (1 region), Finland (1 region), Sweden (3 regions), the UK (5 regions) and Switzerland (3 regions).

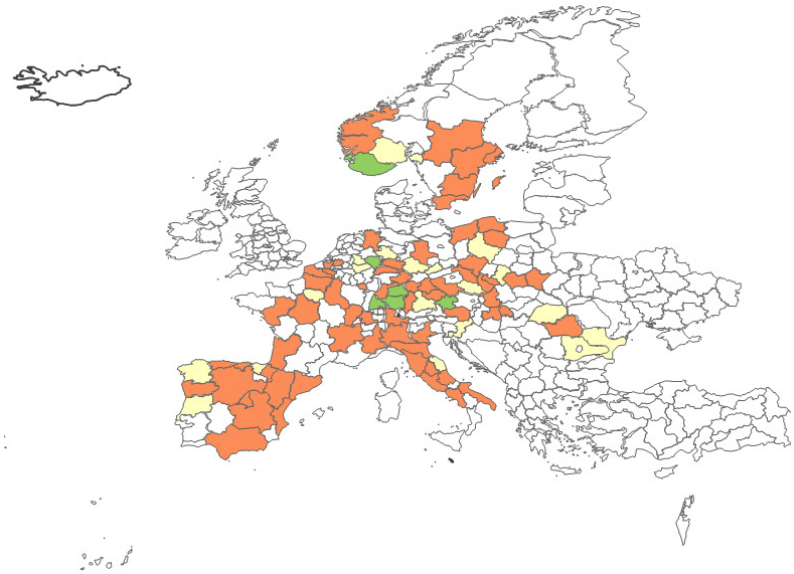


In **Metal Mining** there are 12 clusters, including 2 high, 4 medium and 6 basic-performing clusters.

The high-performing clusters are in Finland (FI1D Northern and Eastern Finland) and Sweden (SE33 Upper Norrland).

The medium-performing clusters are in Germany (DE60 Hamburg), Greece (EL30 Attica), Spain (ES61 Andalucía) and the UK (UKI3 Inner London - West).

The basic-performing clusters are in Germany (DED4 Chemnitz), Spain (ES12 Asturias), Portugal (PT18 Alentejo), Romania (RO12 Centre), Northern Macedonia, and Turkey (TR51 Ankara Subregion).

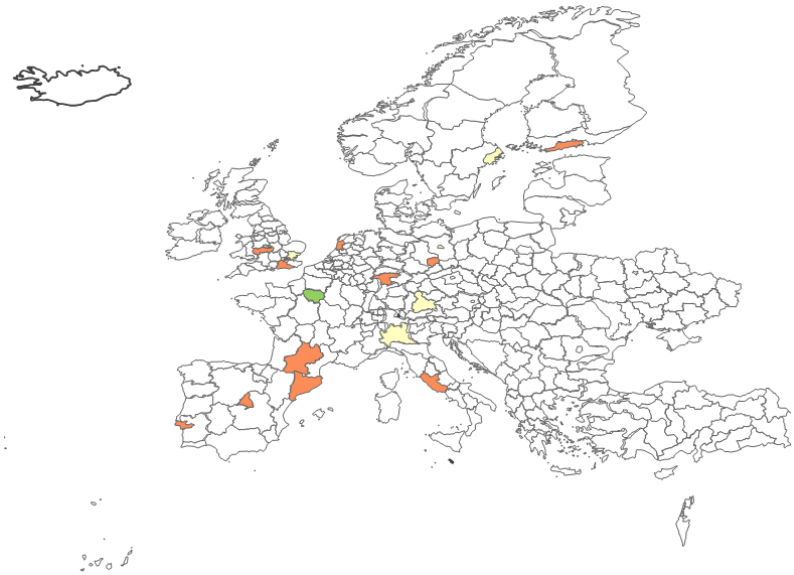


In **Metalworking Technology** there are 91 clusters, including 6 high, 19 medium and 66 basic-performing clusters.

The high-performing clusters are in Germany (DE11 Stuttgart, DE13 Freiburg, DE14 Tübingen, DEA5 Arnsberg), Austria (AT31 Oberösterreich) and Norway (NO04 Agder og Rogaland).

The medium-performing clusters are in Czechia (CZ06 Southeast), Germany (DE21 Oberbayern, DEA1 Düsseldorf, DEA2 Köln, DEA4 Detmold, DED4 Chemnitz, DEG0 Thüringen), Spain (ES11 Galicia, ES21 Païs Vasco), France (FR10 Ile-De-France), Italy (ITI3 Marche), Poland (PL22 Slaskie, PL41 Wielkopolskie), Portugal (PT16 Centre), Romania (RO11 North-West, RO22 South-East, RO31 South-Muntenia), Slovenia (SI03 Eastern Slovenia) and Norway (NO03 Sor-Ostlandet).

The basic-performing clusters are in Belgium (3 regions), Czechia (4 regions), Germany (11 regions), Spain (10 regions), France (8 regions), Italy (10 regions), Hungary (2 regions), Austria (1 region), Poland (6 regions), Portugal (1 region), Romania (1 region), Slovakia (1 region), Sweden (5 regions), Switzerland (2 regions) and Norway (1 region).

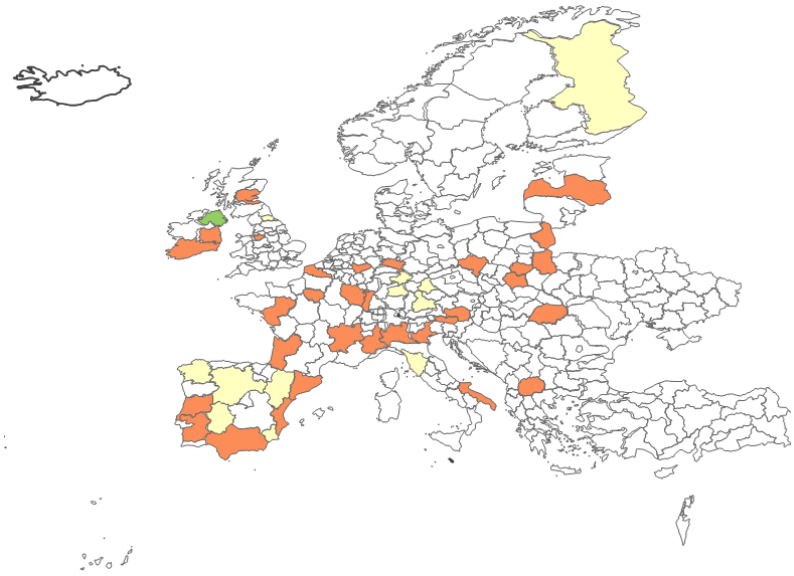


In **Music and Sound Recording** there are 19 clusters, including one high, 7 medium and 11 basic-performing clusters.

The high-performing cluster is in France (FR10 Ile-De-France).

The medium-performing clusters are in Germany (DE21 Oberbayern, DE30 Berlin), Italy (ITC4 Lombardia), Sweden (SE11 Stockholm) and the UK (UKH3 Essex, UKI4 Inner London - East, UKI7 Outer London - West and North West).

The basic-performing clusters are in Germany (DE71 Darmstadt, DED5 Leipzig), Spain (ES30 Madrid, ES51 Cataluña), France (FR62 Midi-Pyrenees), Italy (ITI4 Lazio), Netherlands (NL32 Noord-Holland), Portugal (PT17 Lisboa), Finland (FI19 Western Finland) and the UK (UKG1 Herefordshire, Worcestershire and Warwickshire, UKJ2 Surrey, East and West Sussex).

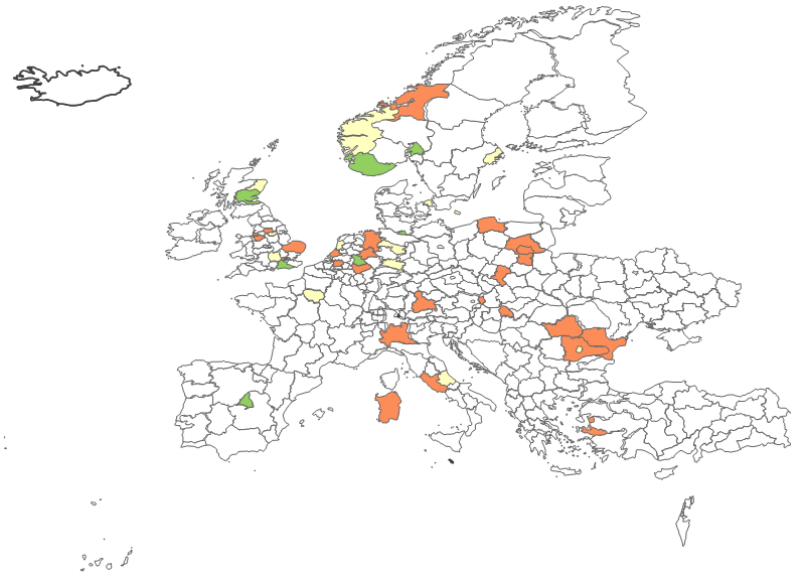


In **Non-metal Mining** there are 44 clusters, including one high, 12 medium and 31 basic-performing clusters.

The high-performing cluster is in the UK (UKN0 Northern Ireland).

The medium-performing clusters are in Germany (DE11 Stuttgart, DE21 Oberbayern, DE23 Oberpfalz, DE26 Unterfranken), Spain (ES11 Galicia, ES24 Aragon, ES41 Castilla y Leon, ES43 Extremadura, ES62 Murcia), Italy (ITI1 Toscana), Finland (FI1D Northern and Eastern Finland) and the UK (UKC1 Tees Valley and Durham).

The basic-performing clusters are in Germany (2 regions), Ireland (1 region), Spain (3 regions), France (7 regions), Italy (4 regions), Latvia, Austria (2 regions), Poland (5 regions), Portugal (2 regions), Romania (1 region), the UK (2 regions) and North Macedonia.

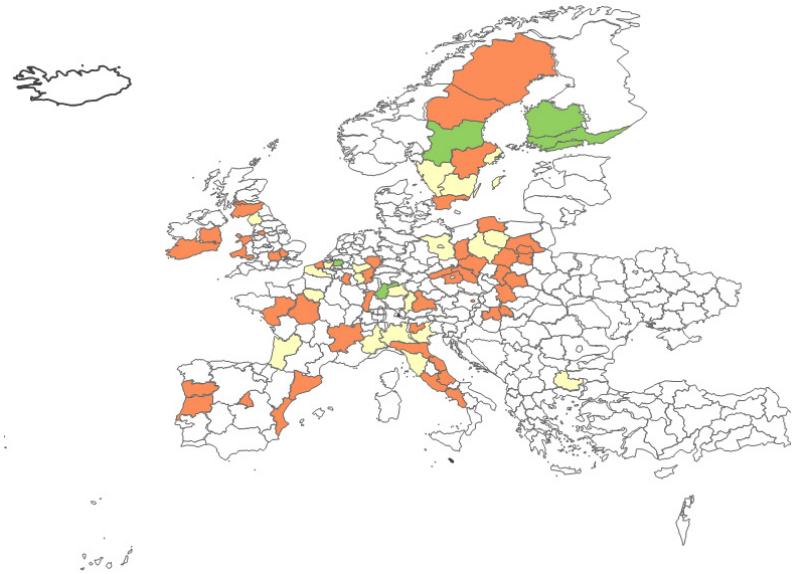


In **Oil and Gas Production and Transportation** there are 46 clusters, including 9 high, 13 medium and 24 basic-performing clusters.

The high-performing clusters are in Germany (DE60 Hamburg, DEA1 Düsseldorf), Spain (ES30 Madrid), the UK (UKI3 Inner London - West, UKI4 Inner London - East, UKJ2 Surrey, East and West Sussex, UKM2 Eastern Scotland), and Norway (NO01 Oslo og Akershus, NO04 Agder og Rogaland).

The medium-performing clusters are in Denmark (DK01 Hovedstaden), Germany (DE73 Kassel, DE92 Hannover), France (FR10 Ile-De-France), Italy (ITF1 Abruzzo), Cyprus, Netherlands (NL32 Noord-Holland), Romania (RO32 Bucharest-Ilfov), Sweden (SE11 Stockholm), the UK (UKE3 South Yorkshire, UKJ1 Berkshire, Buckinghamshire and Oxfordshire, UKM5 North Eastern Scotland) and Norway (NO05 Vestlandet).

The basic-performing clusters are in Belgium (1 region), Germany (4 regions), Italy (3 regions), Hungary (1 region), Netherlands (1 region), Poland (3 regions), Romania (3 regions), Slovakia (1 region the UK (5 regions) and Turkey (1 region).

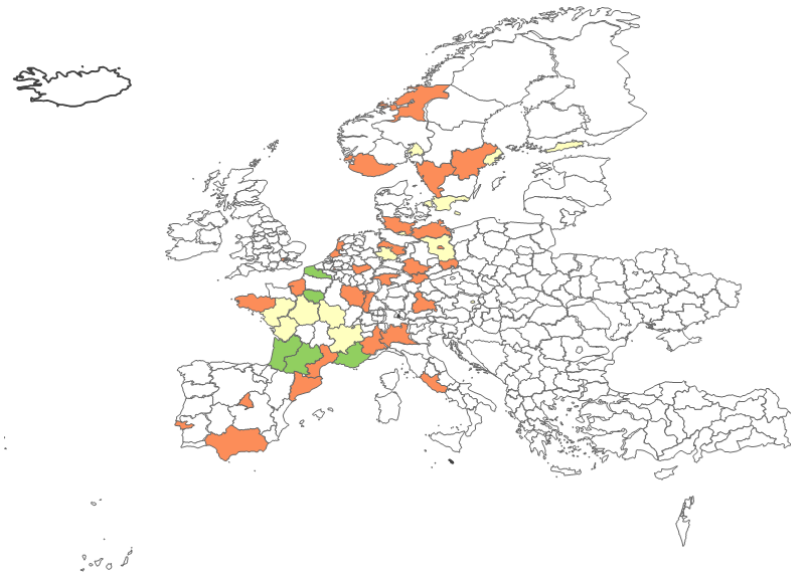


In **Paper and Packaging** there are 71 clusters, including 6 high, 20 medium and 45 basic-performing clusters.

The high-performing clusters are in Belgium (BE21 Antwerp), Germany (DE12 Karlsruhe), Finland (FI19 Western Finland, FI1B Helsinki-Uusimaa, FI1C Southern Finland) and Sweden (SE31 North Middle Sweden).

The medium-performing clusters are in Belgium (BE23 East-Flanders), Bulgaria (BG42 Yuzhen Tsentralen), Germany (DE11 Stuttgart, DE27 Schwaben, DE40 Brandenburg, DEA2 Köln, DEB2 Trier), France (FR10 Ile-De-France, FR30 Nord-Pas-De-Calais, FR61 Aquitaine), Italy (ITC1 Piemonte, ITC4 Lombardia, ITH3 Veneto, ITI1 Toscana), Poland (PL41 Wielkopolskie, PL61 Kujawsko-Pomorskie), Sweden (SE11 Stockholm, SE21 Smaland and the islands, SE23 West Sweden) and the UK (UKD1 Cumbria).

The basic-performing clusters are in Belgium (2 regions), Czechia (3 regions), Germany (3 regions), Ireland (1 region), Spain (3 regions), France (4 regions), Italy (6 regions), Hungary (2 regions), Austria (1 region), Poland (7 regions), Portugal (2 regions), Slovakia (1 region), Sweden (4 regions) and the UK (6 regions).

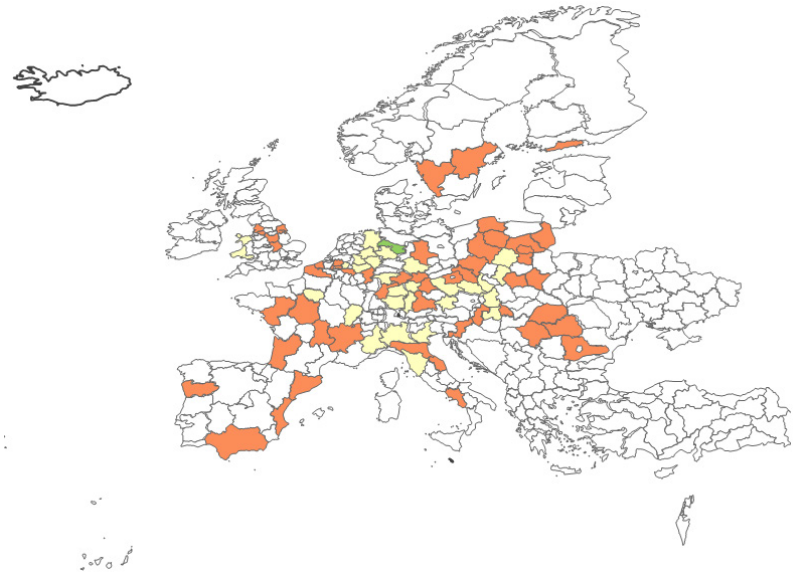


In **Performing Arts** there are 51 clusters, including 5 high, 14 medium and 32 basic-performing clusters.

The high-performing clusters are all in France (FR10 Ile-De-France, FR30 Nord-Pas-De-Calais, FR61 Aquitaine, FR62 Midi-Pyrenees, FR82 Provence-Alpes-Cote D'Azur).

The medium-performing clusters are in Denmark (DK01 Hovedstaden), Germany (DE40 Brandenburg, DE60 Hamburg, DEA4 Detmold), France (FR24 Centre, FR26 Bourgogne, FR51 Pays-de-la-Loire, FR53 Poitou-Charentes, FR71 Rhone-Alpes), Austria (AT13 Wien), Finland (FI19 Western Finland), Sweden (SE11 Stockholm, SE22 South Sweden) and Norway (NO01 Oslo og Akershus).

The basic-performing clusters are in Belgium (1 region), Germany (10 regions), Spain (3 regions), France (5 regions), Italy (3 regions), Netherlands (2 regions), Portugal (1 region), Sweden (2 regions), the UK (3 regions) and Norway (2 regions).

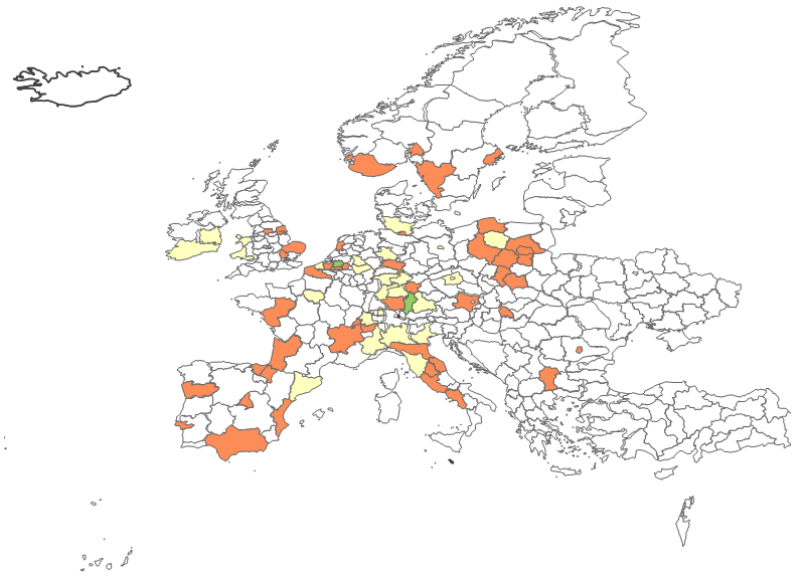


In **Plastics** there are 79 clusters, including one high, 28 medium and 50 basic-performing clusters.

The high-performing cluster is in Germany (DE92 Hannover).

The medium-performing clusters are in Belgium (BE22 Limburg), Czechia (CZ03 Southwest, CZ06 Southeast, CZ07 Central Moravia), Germany (DE11 Stuttgart, DE14 Tübingen, DE25 Mittelfranken, DE27 Schwaben, DE71 Darmstadt, DE94 Weser-Ems, DEA1 Düsseldorf, DEA2 Köln, DEA3 Muenster, DEA4 Detmold, DEA5 Arnsberg, DEG0 Thüringen), France (FR10 Ile-De-France, FR43 Franche-Comte), Italy (ITC1 Piemonte, ITC4 Lombardia, ITH3 Veneto, ITI1 Toscana), Hungary (HU21 Central Transdanubia), Austria (AT31 Oberösterreich), Poland (PL11 Lódzkie, PL22 Slaskie), Slovakia (SK02 Western Slovakia) and the UK (UKL1 West Wales and The Valleys).

The basic-performing clusters are in Belgium (4 regions), Czechia (2 regions), Germany (7 regions), Spain (3 regions), France (6 regions), Italy (3 regions), Hungary (2 regions), Poland (8 regions), Portugal (1 region), Romania (4 regions), Slovenia (1 region), Finland (1 region), Sweden (2 regions) and the UK (6 regions).

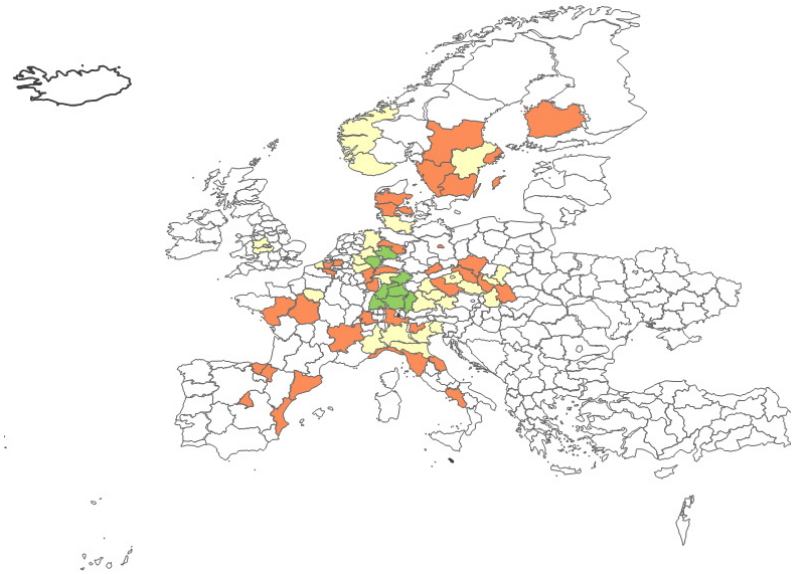


In **Printing Services** there are 71 clusters, including 2 high, 23 medium and 46 basic-performing clusters.

The high-performing clusters are in Belgium (BE21 Antwerp) and Germany (DE27 Schwaben).

The medium-performing clusters are in Belgium (BE25 West-Flanders), Czechia (CZ02 Central Bohemia), Germany (DE11 Stuttgart, DE12 Karlsruhe, DE21 Oberbayern, DE26 Unterfranken, DE30 Berlin, DE71 Darmstadt, DEA1 Düsseldorf, DEA2 Köln, DEA4 Detmold, DEF0 Schleswig-Holstein), Ireland (IE02 Southern and Eastern), Spain (ES51 Cataluña), France (FR10 Ile-De-France), Italy (ITC1 Piemonte, ITC4 Lombardia, ITH3 Veneto, ITI1 Toscana), Poland (PL61 Kujawsko-Pomorskie), the UK (UKL1 West Wales and The Valleys) and Switzerland (CH02 Espace Mittelland, CH04 Zurich).

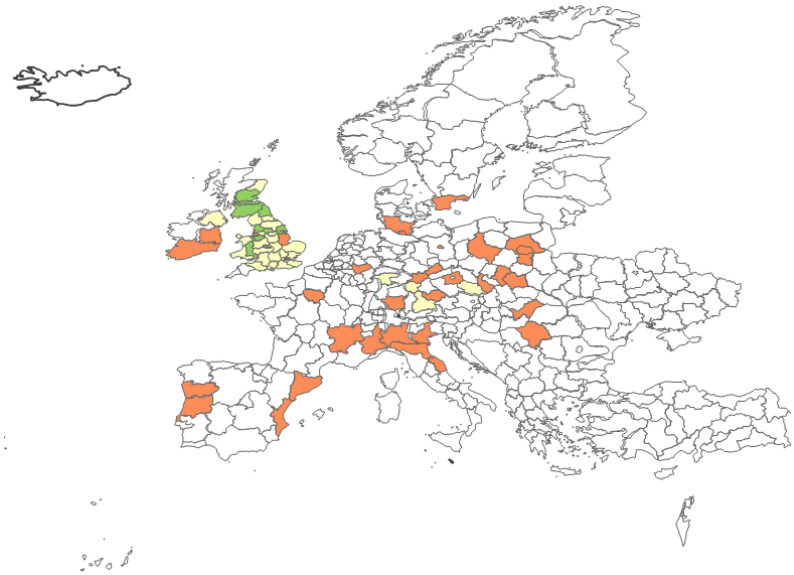
The basic-performing clusters are in Belgium (3 regions), Bulgaria (1 region), Germany (4 regions), Spain (5 regions), France (4 regions), Italy (5 regions), Hungary (1 region), Malta, Netherlands (1 region), Austria (1 region), Poland (6 regions), Portugal (2 regions), Romania (2 region), Sweden (2 regions), the UK (6 regions), Switzerland (1 region) and Norway (2 regions).



In **Production Technology and Heavy Machinery** there are 71 clusters, including 8 high, 27 medium and 36 basic-performing clusters.

The high-performing clusters are all in Germany (DE11 Stuttgart, DE12 Karlsruhe, DE13 Freiburg, DE14 Tübingen, DE26 Unterfranken, DE27 Schwaben, DEA4 Detmold, DEA5 Arnsberg).

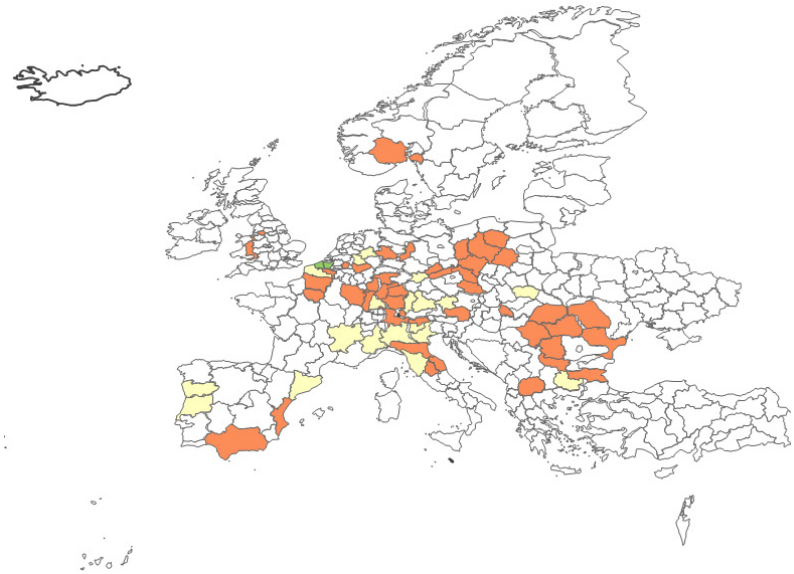
The medium-performing clusters are in Belgium (BE25 West-Flanders), Czechia (CZ02 Central Bohemia, CZ06 Southeast, CZ08 Moravskoslezsko), Germany (DE21 Oberbayern, DE22 Niederbayern, DE23 Oberpfalz, DE71 Darmstadt, DE94 Weser-Ems, DEA1 Düsseldorf, DEA2 Köln, DEA3 Münster, DEF0 Schleswig-Holstein), France (FR10 Ile-De-France), Italy (ITC1 Piemonte, ITC4 Lombardia, ITH3 Veneto, ITH4 Friuli-Venezia Giulia, ITH5 Emilia-Romagna), Austria (AT31 Oberösterreich), Poland (PL22 Slaskie), Slovakia (SK02 Western Slovakia), Sweden (SE12 East Middle Sweden), the UK (UKG1 Herefordshire, Worcestershire and Warwickshire, UKG2 Shropshire and Staffordshire) and Norway (NO04 Agder og Rogaland, NO05 Vestlandet). The basic-performing clusters are located in Belgium (3 regions), Czechia (3 regions), Denmark (2 regions), Germany (6 regions), Spain (5 regions), France (3 regions), Italy (5 regions), Poland (1 region), Slovakia (1 region), Finland (1 region), Sweden (4 regions) and Switzerland (2 regions).



In **Recreational and Small Electric Goods** there are 67 clusters, including 9 high, 29 medium and 31 basic-performing clusters.

The high-performing clusters are all in the UK (UKC2 Northumberland and Tyne and Wear, UKD4 Lancashire, UKD6 Cheshire, UKE1 East Yorkshire and Northern Lincolnshire, UKE4 West Yorkshire, UKG3 West Midlands, UKL2 East Wales, UKM2 Eastern Scotland, UKM3 South Western Scotland).

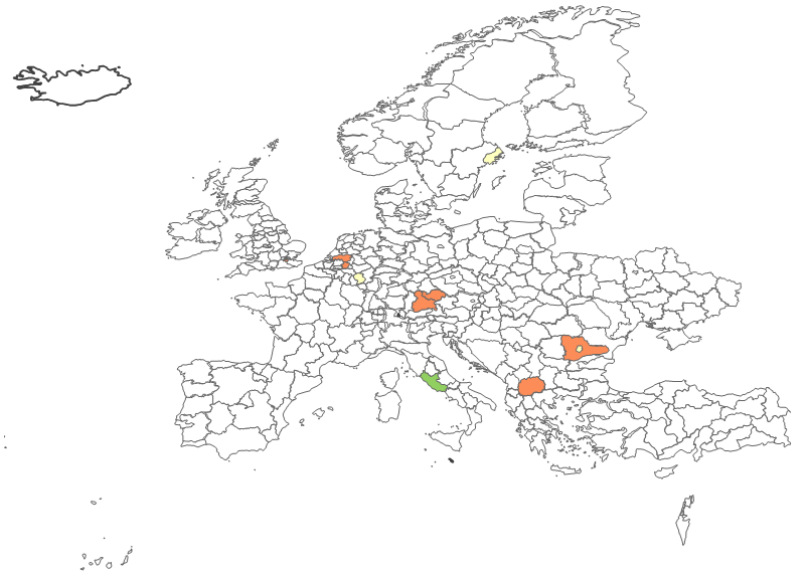
The medium-performing clusters are in Czechia (CZ06 Southeast), Germany (DE21 Oberbayern, DE25 Mittelfranken, DE71 Darmstadt) and the UK (UKC1 Tees Valley and Durham, UKD1 Cumbria, UKD3 Greater Manchester, UKE2 North Yorkshire, UKE3 South Yorkshire, UKF1 Derbyshire and Nottinghamshire, UKF2 Leicestershire, Rutland and Northamptonshire, UKG1 Herefordshire, Worcestershire and Warwickshire, UKG2 Shropshire and Staffordshire, UKH1 East Anglia, UKH2 Bedfordshire and Hertfordshire, UKH3 Essex, UKI4 Inner London - East, UKI5 Outer London - East and North East, UKJ1 Berkshire, Buckinghamshire and Oxfordshire, UKJ2 Surrey, East and West Sussex, UKJ3 Hampshire and Isle of Wight, UKJ4 Kent, UKK1 Gloucestershire, Wiltshire and Bristol/Bath area, UKK2 Dorset and Somerset, UKL1 West Wales and The Valleys, UKM5 North Eastern Scotland, UKN0 Northern Ireland). The basic-performing clusters are in 12 different European countries.



In **Textile Manufacturing** there are 67 clusters, including 2 high, 19 medium and 46 basic-performing clusters.

The high-performing clusters are in Belgium (BE23 East-Flanders, BE25 West-Flanders). The medium-performing clusters are in Bulgaria (BG42 Yuzhen Tsentralen), Germany (DE13 Freiburg, DE21 Oberbayern, DE24 Oberfranken, DE27 Schwaben, DEA1 Düsseldorf, DEA3 Münster), Spain (ES51 Cataluña), France (FR30 Nord-Pas-De-Calais, FR71 Rhone-Alpes), Italy (ITC1 Piemonte, ITC4 Lombardia, ITH2 Provincia Autonoma di Trento, ITH3 Veneto, ITI1 Toscana), Austria (AT31 Oberösterreich), Portugal (PT11 North, PT16 Centre) and Slovakia (SK04 Eastern Slovakia).

The basic-performing clusters are in Belgium (2 regions), Bulgaria (2 regions), Czechia (3 regions), Germany (9 regions), Spain (2 regions), France (4 regions), Italy (4 regions), Hungary (1 region), Austria (2 regions), Poland (5 regions), Romania (6 regions), the UK (3 regions), Switzerland (1 region), Norway (1 region) and North Macedonia.

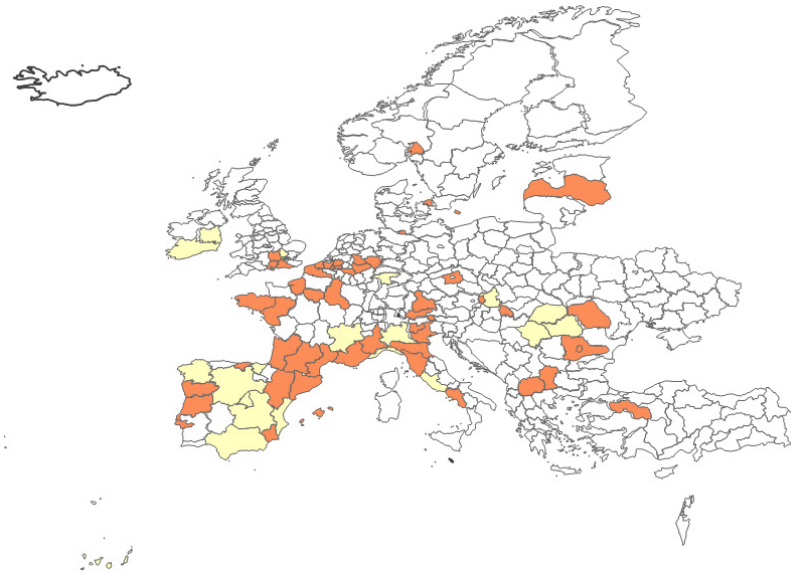


In **Tobacco** there are 11 clusters, including one high, 3 medium and 7 basic-performing clusters.

The high-performing cluster is in Italy (ITI4 Lazio).

The medium-performing clusters are in Germany (DEB2 Trier), Romania (RO32 Bucharest-Ilfov) and Sweden (SE11 Stockholm).

The basic-performing clusters are in Belgium (BE22 Limburg), Germany (DE21 Oberbayern, DE22 Niederbayern), Nether-lands (NL41 Noord-Brabant), Romani (RO31 South-Muntenia), the UK (UKI6 Outer London - South) and North Macedonia).

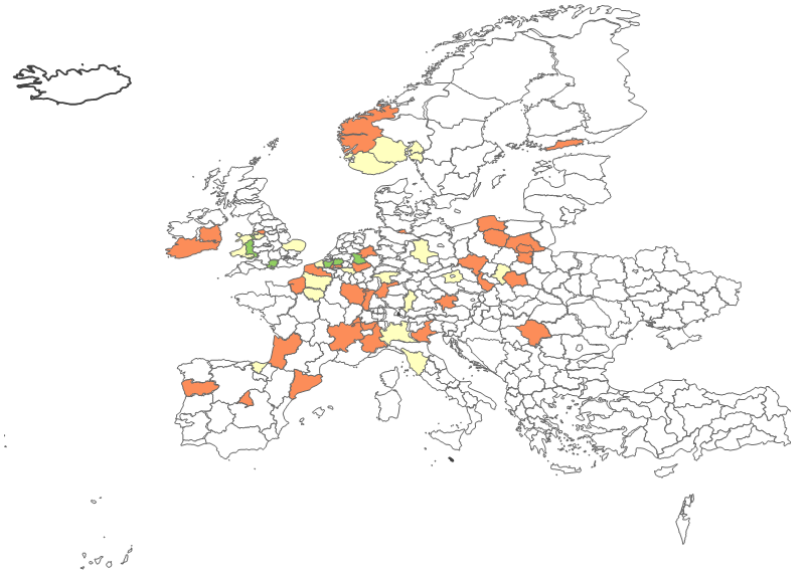


In **Transportation and Logistics** there are 72 clusters, including one high, 19 medium and 52 basic-performing clusters.

The high-performing cluster is in the UK (UKI7 Outer London - West and North West).

The medium-performing clusters are in Germany (DE71 Darmstadt), Ireland (IE02 Southern and Eastern), Spain (ES11 Galicia, ES21 Païs Vasco, ES30 Madrid, ES41 Castilla y Leon, ES42 Castilla-La Mancha, ES52 Comunidad Valenciana, ES61 Andalucía, ES70 Canary Islands), France (FR71 Rhone-Alpes), Italy (ITC3 Liguria, ITC4 Lombardia, ITI4 Lazio), Romania (RO11 North-West, RO12 Centre, RO42 West), Slovakia (SK02 Western Slovakia) and the UK (UKH2 Bedfordshire and Hertfordshire).

The basic-performing clusters are in Belgium (6 regions), Bulgaria (1 region), Czechia (1 region), Denmark (1 region), Germany (5 regions), Spain (5 regions), France (10 regions), Italy (6 regions), Latvia, Hungary (1 region), Austria (1 region), Portugal (3 regions), Romania (3 regions), Slovakia (1 region), the UK (4 regions), Norway (1 region), North Macedonia and Turkey (1 region).

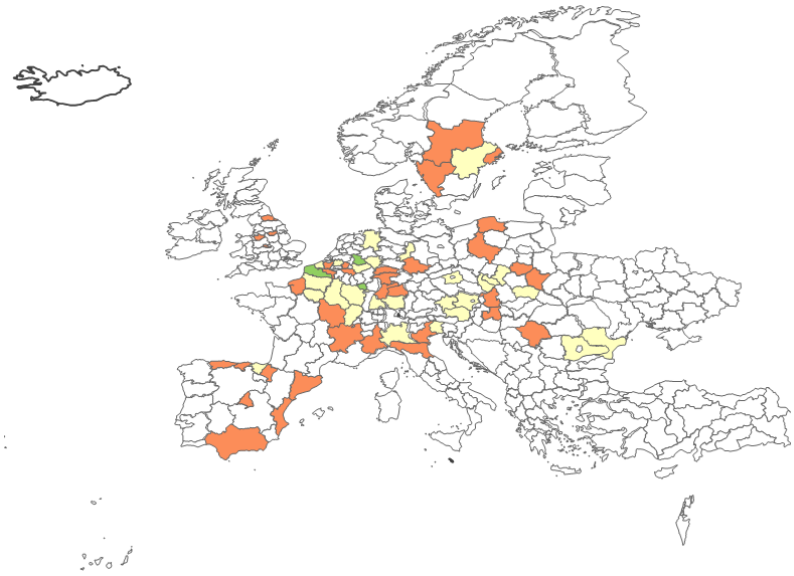


In **Upstream Chemical Products** there are 53 clusters, including 5 high, 19 medium and 29 basic-performing clusters.

The high-performing clusters are in Belgium (BE21 Antwerp, BE23 East-Flanders), Germany (DEA1 Düsseldorf) and the UK (UKJ3 Hampshire and Isle of Wight, UKL2 East Wales).

The medium-performing clusters are in Belgium (BE25 West-Flanders, BE33 Liege), Czechia (CZ02 Central Bohemia), Germany (DE27 Schwaben, DE71 Darmstadt, DEE0 Sachsen-Anhalt), Spain (ES21 Païs Vasco), France (FR10 Ile-De-France, FR22 Picardie), Italy (ITC4 Lombardia, ITI1 Toscana), Poland (PL22 Slaskie), the UK (UKD6 Cheshire, UKD7 Merseyside, UKH1 East Anglia, UKL1 West Wales and The Valleys) and Norway (NO01 Oslo og Akershus, NO03 Sor-Ostlandet).

The basic-performing clusters are in Belgium (1 region), Czechia (1 region), Germany (4 regions), Ireland (1 region), Spain (2 regions), France (6 regions), Italy (2 regions), Austria (1 region), Poland (5 regions), Portugal (1 region), Romania (1 region), Finland (1 region), the UK (1 region), Switzerland (1 region) and Norway (1 region).

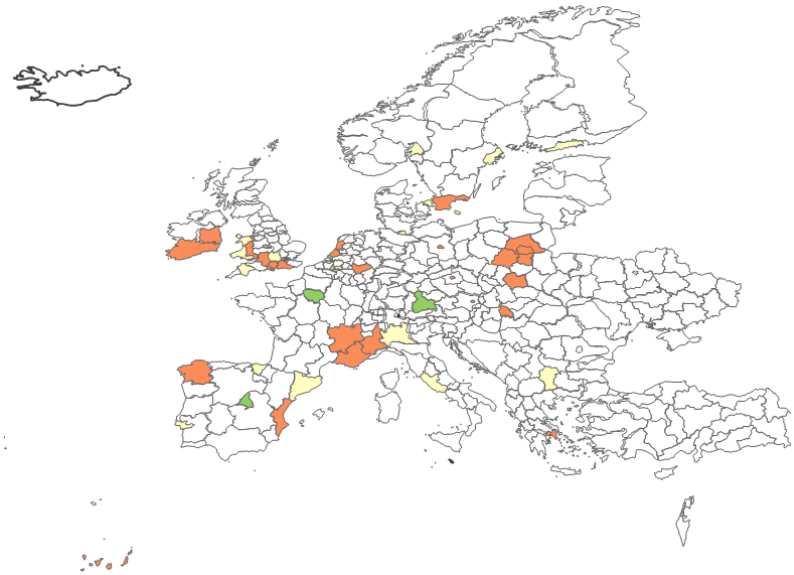


In **Upstream Metal Manufacturing** there are 67 clusters, including 3 high, 28 medium and 36 basic-performing clusters.

The high-performing clusters are in Germany (DEA1 Düsseldorf, DEC0 Saarland) and France (FR30 - Nord-Pas-De-Calais).

The medium-performing clusters are in Belgium (BE21 Antwerp, BE25 West-Flanders), Czechia (CZ02 Central Bohemia, CZ07 Central Moravia, CZ08 Moravskoslezsko), Germany (DE13 Freiburg, DE14 Tübingen, DE91 Braunschweig, DE94 Weser-Ems, DEA2 Köln, DEA5 Arnsberg), Spain (ES21 Païs Vasco), France (FR10 Ile-De-France, FR21 Champagne-Ardenne, FR22 Picardie, FR41 Lorraine, FR43 Franche-Comte), Italy (ITC4 Lombardia, ITH4 Friuli-Venezia Giulia), Austria (AT12 Niederösterreich, AT22 Steiermark, AT31 Oberösterreich), Poland (PL22 Slaskie), Romania (RO22 South-East, RO31 South-Muntenia), Slovakia (SK04 Eastern Slovakia), Sweden (SE12 East Middle Sweden) and the UK (UKI3 Inner London - West).

The basic-performing clusters are in Belgium (4 regions), Germany (5 regions), Spain (7 regions), France (3 regions), Italy (3 regions), Hungary (1 region), Poland (4 regions), Romania (1 region), Slovakia (1 region), Sweden (3 regions) and the UK (4 regions).

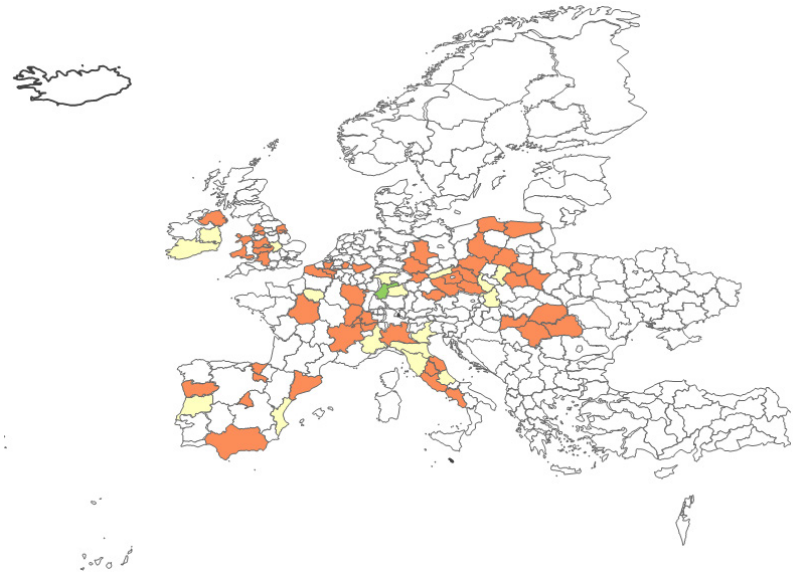


In **Video Production and Distribution** there are 46 clusters, including 6 high, 16 medium and 24 basic-performing clusters.

The high-performing clusters are in Belgium (BE10 Brussels-Capital Region), Germany (DE21 Oberbayern), Spain (ES30 Madrid), France (FR10 Ile-De-France) and the UK (UKI3 Inner London - West, UKI7 Outer London - West and North West).

The medium-performing clusters are in Belgium (BE24 Flemish Brabant), Bulgaria (BG41 Yugozapaden), Denmark (DK01 Hovedstaden), Germany (DE60 Hamburg), Spain (ES21 Païs Vasco, ES51 Cataluña), Italy (ITC4 Lombardia, ITI4 Lazio) ,Portugal (PT17 Lisboa), Finland (FI19 Western Finland), Sweden (SE11 Stockholm), the UK (UKI4 Inner London - East, UKJ1 Berkshire, Buckinghamshire and Oxfordshire, UKK4 Devon, UKL1 West Wales and The Valleys) and Norway (NO01 Oslo og Akershus).

The basic-performing clusters are in Czechia (1 region), Germany (2 regions), Ireland (1 region), Greece (1 region), Spain (3 regions), France (2 regions), Italy (1 region), Hungary (1 region), Netherlands (2 regions), Austria (1 region), Poland (3 regions), Sweden (1 region) and the UK (5 regions).

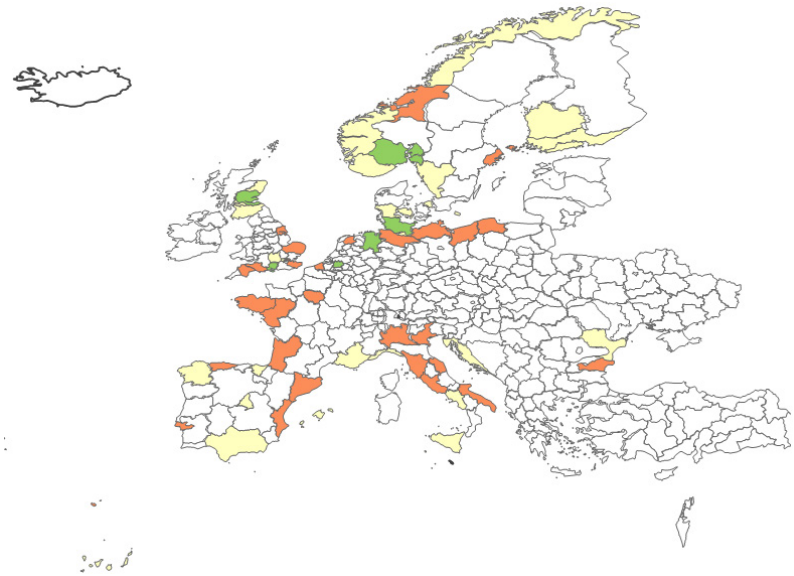


In **Vulcanized and Fired Materials** there are 69 clusters, including one high, 17 medium and 51 basic-performing clusters.

The high-performing cluster is in Germany (DE12 Karlsruhe).

The medium-performing clusters are in Czechia (CZ04 Northwest, CZ07 Central Moravia), Germany (DE11 Stuttgart, DE71 Darmstadt), Ireland (IE02 Southern and Eastern), Spain (ES52 Comunidad Valenciana), France (FR10 Ile-De-France), Italy (ITC1 Piemonte, ITH3 Veneto, ITH5 Emilia-Romagna, ITI1 Toscana, ITF1 Abruzzo), Poland (PL22 Slaskie), Portugal (PT16 Centre), Slovakia (SK02 Western Slovakia) and the UK (UKF2 Leicestershire, Rutland and Northamptonshire, UKG3 West Midlands).

The basic-performing clusters are in Belgium (4 regions), Czechia (4 regions), Germany (5 regions), Spain (5 regions), France (5 regions), Italy (5 regions), Hungary (1 region), Poland (8 regions), Portugal (1 region), Romania (3 regions), the UK (8 regions) and Switzerland (2 regions).

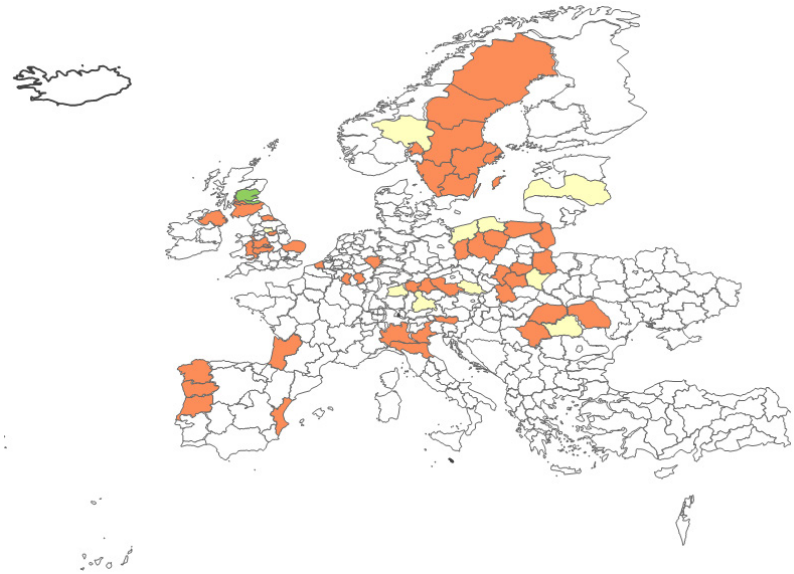


In **Water Transportation** there are 67 clusters, including 7 high, 28 medium and 32 basic-performing clusters.

The high-performing clusters are in Belgium (BE21 Antwerp), Germany (DE94 Weser-Ems, DEF0 Schleswig-Holstein), the UK (UKJ3 Hampshire and Isle of Wight, UKM2 Eastern Scotland) and Norway (NO01 Oslo og Akershus, NO03 Sor-Ostlandet).

The medium-performing clusters are in Denmark (DK01 Hovedstaden, DK03 Syd-danmark), Germany (DE50 Bremen, DE60 Hamburg), Spain (ES11 Galicia, ES21 Païs Vasco, ES30 Madrid, ES53 Islas Baleares, ES61 Andalucía, ES70 Canary Islands), France (FR82 Provence-Alpes-Cote D'Azur), Croatia (HR03 Adriatic Croatia), Italy (ITC3 Liguria, ITF3 Campania, ITG1 Sicilia), Romania (RO22 South-East), Finland (FI19 Western Finland, FI1B Helsinki-Uusimaa, FI1C Southern Finland), Sweden (SE23 West Sweden), the UK (UKI4 Inner London - East, UKI7 Outer London - West and North West, UKJ1 Berkshire, Buckinghamshire and Oxfordshire, UKM3 South Western Scotland, UKM5 North Eastern Scotland) and Norway (NO04 Agder og Rogaland, NO05 Vestlandet, NO07 Nord-Norge).

The basic-performing clusters are located in Belgium (1 region), Bulgaria (1 region), Germany (2 regions), Spain (3 regions), France (4 regions), Italy (6 regions), Netherlands (1 region), Poland (2 regions), Portugal (2 regions), Finland (1 region), Sweden (1 region), the UK (7 regions) and Norway (1 region).



In **Wood Products** there are 57 clusters, including one high, 10 medium and 46 basic-performing clusters.

The high-performing cluster is in the UK (UKM2 Eastern Scotland).

The medium-performing clusters are in Czechia (CZ06 Southeast), Germany (DE11 Stuttgart, DE21 Oberbayern), Latvia, Poland (PL32 Podkarpackie, PL42 Zachodniopomorskie, PL63 Pomorskie), Romania (RO12 Centre), the UK (UKE4 West Yorkshire) and Norway (NO02 Hedemark og Oppland).

The basic-performing clusters are in Belgium (2 regions), Czechia (1 region), Germany (4 regions), Spain (2 regions), France (1 region), Italy (3 regions), Austria (1 region), Poland (9 regions), Portugal (2 regions), Romania (3 regions), Slovakia (1 region), Sweden (7 regions), the UK (9 regions) and Norway (1 region).

Annex B - Employment shares in clusters across 51 exporting industry sectors

	High-performing clusters	Medium-performing clusters	Basic-performing clusters	No cluster strength
All 51 exporting industry sectors (or traded industries)	**5.5**	**21.5**	**23.5**	**49.5**
Aerospace Vehicles and Defence	8.0	19.0	20.0	52.5
Agricultural Inputs and Services	1.0	14.0	32.5	53.0
Apparel	0.5	28.0	35.0	36.5
Appliances	7.0	7.5	38.0	47.5
Automotive	5.5	27.0	30.5	37.5
Biopharmaceuticals	11.0	32.0	23.0	34.0
Business Services	12.5	31.5	16.0	40.5
Coal Mining	1.5	5.0	32.0	61.5
Communications Equipment and Services	9.5	38.5	14.0	38.0
Construction Products and Services	0.0	12.0	27.5	60.5
Distribution and Electronic Commerce	1.0	25.5	24.0	50.0
Downstream Chemical Products	0.5	17.5	26.5	55.5
Downstream Metal Products	3.5	21.0	21.5	54.0
Education and Knowledge Creation	2.0	19.0	26.5	52.5
Electric Power Generation and Transmission	0.0	14.5	23.5	62.0
Environmental Services	0.0	12.0	27.0	61.0
Financial Services	5.0	24.0	24.5	46.0
Fishing and Fishing Products	8.5	21.0	9.5	61.5
Food Processing and Manufacturing	1.0	8.0	24.0	66.5
Footwear	2.0	46.0	23.5	28.5
Forestry	1.0	16.5	28.5	54.0
Furniture	0.5	18.5	34.5	46.5
Hospitality and Tourism	9.5	18.0	23.5	49.0
Information Technology and Analytical Instruments	11.0	22.5	23.5	43.0
Insurance Services	8.5	7.5	15.0	69.5

	High-performing clusters	Medium-performing clusters	Basic-performing clusters	No cluster strength
Jewellery and Precious Metals	1.0	23.0	26.0	50.0
Leather and Related Products	1.0	55.5	29.0	14.5
Lighting and Electrical Equipment	2.5	16.5	35.0	46.0
Livestock Processing	2.5	18.5	36.0	43.5
Marketing, Design, and Publishing	9.0	34.5	20.0	36.5
Medical Devices	11.5	20.0	27.0	42.0
Metal Mining	5.5	9.5	14.0	71.0
Metalworking Technology	7.0	16.0	36.5	40.5
Music and Sound Recording	5.5	12.5	11.0	70.5
Non-metal Mining	1.0	10.5	24.5	64.0
Oil and Gas Production and Transportation	19.0	24.0	19.5	37.5
Paper and Packaging	5.5	19.0	24.0	51.5
Performing Arts	17.5	11.0	21.0	50.5
Plastics	1.0	26.0	28.0	45.5
Printing Services	1.0	23.5	28.5	47.0
Production Technology and Heavy Machinery	10.5	28.5	16.0	45.5
Recreational and Small Electric Goods	7.5	25.5	17.5	49.5
Textile Manufacturing	1.0	23.5	23.5	51.5
Tobacco	4.0	16.0	29.0	51.0
Transportation and Logistics	0.5	15.5	20.5	63.5
Upstream Chemical Products	5.5	18.0	20.5	56.0
Upstream Metal Manufacturing	4.5	27.0	19.5	49.0
Video Production and Distribution	28.0	21.0	21.5	29.5
Vulcanized and Fired Materials	1.0	17.5	26.5	55.0
Water Transportation	8.0	40.5	20.0	31.5
Wood Products	1.0	7.0	25.0	67.0

Annex C - Average wages indicating productivity in clusters across 51 exporting industry sectors

	High-performing clusters	Medium-performing clusters	Basic-performing clusters	No cluster strength
All 51 exporting industry sectors (or traded industries)	**71,700**	**43,200**	**39,600**	**32,700**
Aerospace Vehicles and Defence	129,400	72,600	44,400	15,900
Agricultural Inputs and Services	35,700	19,100	22,300	22,300
Apparel	51,300	13,300	13,500	14,600
Appliances	63,200	40,600	26,300	21,200
Automotive	73,800	39,400	37,800	37,000
Biopharmaceuticals	97,200	66,000	52,800	43,800
Business Services	78,400	51,000	53,800	42,600
Coal Mining	56,200	48,500	24,200	18,400
Communications Equipment and Services	106,000	50,000	53,700	39,100
Construction Products and Services	--	29,700	38,200	28,400
Distribution and Electronic Commerce	58,400	43,300	38,400	33,400
Downstream Chemical Products	52,600	54,300	40,200	22,400
Downstream Metal Products	65,500	37,000	39,700	32,100
Education and Knowledge Creation	61,800	46,400	47,400	31,900
Electric Power Generation and Transmission	--	59,600	52,500	35,300
Environmental Services	--	36,500	31,000	27,200
Financial Services	102,100	46,500	51,300	39,100
Fishing and Fishing Products	46,400	29,500	26,600	10,400
Food Processing and Manufacturing	55,500	34,700	39,300	29,200
Footwear	42,000	22,800	17,800	12,900
Forestry	32,500	23,600	17,600	18,500
Furniture	52,600	30,300	26,900	33,900
Hospitality and Tourism	59,500	32,800	38,800	32,600

	High-performing clusters	Medium-performing clusters	Basic-performing clusters	No cluster strength
Information Technology and Analytical Instruments	78,300	64,100	54,200	40,200
Insurance Services	64,800	60,400	48,500	39,300
Jewellery and Precious Metals	72,400	31,800	30,400	18,700
Leather and Related Products	37,500	33,500	17,200	12,000
Lighting and Electrical Equipment	68,100	45,200	34,400	39,500
Livestock Processing	45,100	30,500	25,600	25,000
Marketing, Design, and Publishing	65,700	41,200	42,100	36,000
Medical Devices	67,500	53,000	39,500	36,100
Metal Mining	65,500	86,900	40,500	12,800
Metalworking Technology	64,000	32,200	36,500	33,100
Music and Sound Recording	56,200	68,200	54,200	34,600
Non-metal Mining	60,400	46,300	34,600	22,900
Oil and Gas Production and Transportation	98,900	89,300	58,300	40,700
Paper and Packaging	54,400	43,100	31,500	33,100
Performing Arts	66,700	60,700	48,900	36,700
Plastics	56,700	43,400	32,100	31,200
Printing Services	50,500	47,800	34,300	28,700
Production Technology and Heavy Machinery	71,800	48,200	46,000	36,000
Recreational and Small Electric Goods	47,900	40,700	31,500	22,600
Textile Manufacturing	51,200	34,300	22,600	19,000
Tobacco	57,800	72,200	55,700	30,400
Transportation and Logistics	65,000	32,400	37,900	25,900
Upstream Chemical Products	86,300	60,000	48,300	31,400
Upstream Metal Manufacturing	64,300	47,000	45,100	34,400
Video Production and Distribution	85,800	49,800	43,500	35,500
Vulcanized and Fired Materials	50,900	39,700	30,800	28,200
Water Transportation	70,400	47,400	44,200	37,300
Wood Products	46,400	23,300	26,000	26,600

Annex D - References for review of cluster effects identified in US and EU literature

The following references were used in the meta analysis in Section 3.3 discussing the role of SMEs and large firms in determining the degree of specialisation.

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Annex E - General list of references

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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 policymakers, 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 a 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) [22]. 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;

[22] https://www.clustercollaboration.eu/

- "**Regional Eco-system Scoreboard for Clusters and Industrial Change"** that identifies and captures favourable framework conditions for industrial change, innovation, entrepreneurship and cluster development;
- **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 policymakers; and
- **Brings together Europe's cluster policy-makers and stakeholders** at four European Cluster Policy Forum events, the EU Cluster Weeks, and at the European Cluster Conference In order to facilitate high-level cluster policy dialogues, exchanges with experts and mutual cluster policy learning. Four European Cluster Policy Forums took place in February, April, November 2018 and March 2019 in Brussels. The European Cluster Conference took place from 14 to 16 May 2019 in Bucharest (Romania) with support of the Romanian Presidency to the EU.
- 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.

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