



European
Commission

European Innovation Scoreboard **2023**



Innovation

European Innovation Scoreboard 2023

European Commission

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EUROPEAN COMMISSION

European Innovation Scoreboard 2023

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The European Innovation Scoreboard report and annexes, and the indicators database are available at:
https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

Foreword

Bold policies and increased investments in Research & Development are necessary to contribute to the success of Europe's digital and green agenda. This can help enhance resilience and technological sovereignty, and strengthen the competitiveness of our single market. Science, research, and innovation can address our environmental, economic, and social challenges.

The European Innovation Scoreboard is a valuable tool to inform our policy actions and implement innovation-friendly policies to support European and Member States policy makers to address current challenges. It provides the state of play of innovation performance in Europe and supports the design and implementation of EU policies.

The EU is currently confronted with multiple global crises. These include the COVID-19 pandemic, and more recently, Russia's aggression against Ukraine, a challenging geo-political reality, as well as the energy crisis and high inflation, which, altogether, have far-reaching implications for the future.

The EU's goal of open strategic autonomy calls for a strengthening of the resilience of supply chains. Strategic dependencies and choke points in critical inputs such as raw materials need to be curbed to make Europe's green and digital transformation a success. Industrial alliances and IPCEI projects in high growth areas such as batteries, chips or hydrogen build up domestic industrial capacity, underpinned by large public and private investments. A well-functioning Single Market creates a strong economic base in the EU. It grants businesses a large demand pool, diversified supply sources and immense opportunities for innovation, including for small and medium sized enterprises.

The European Innovation Scoreboard 2023 confirms Europe's commitment to innovation. Innovation performance in Europe has increased by about 8.5% increase between 2016 and 2023. During this period, the innovation performance of most EU Member States has improved, confirming that the EU is a favourable environment for innovation. Nevertheless, an innovation divide remains since countries with less strong innovation systems are progressing at a slower pace than the EU average.

Within this context, the New European Innovation Agenda, adopted in July 2022 and currently being implemented, aims to position Europe as a leader of the new wave of deep tech innovation and start-ups. During the past year, significant progress has been made in implementing actions under the five priorities of the Agenda. These include the implementation of a revised State Aid Research & Innovation & Development Framework, a draft Listing Act aimed at reducing costs and increasing legal certainty for certain type of companies, the creation of a Deep Tech Talent Initiative targeting one million deep tech talents across Europe until 2025, and the establishment of an Innovation Talent Platform to help European businesses attract talents from outside the EU. In addition, the recent launch of the Regional Innovation Valleys aims to transform regions into hotspots for collaboration, innovation, and development.

In parallel, Horizon Europe, the European Framework Programme for Research and Innovation, is designed to promote excellence-based Research and Innovation and support top-quality researchers and innovators to realise the EU's objectives. Cross-border cooperation on technology development in European Partnerships with industry, including Clean Hydrogen, Clean Steel, Processes4Planet, Innovative Health Initiative and Key Digital Technologies, are important to support innovative technologies for climate-neutrality, independence from fossil fuels, and circularity.

The BATTEU Partnership, for example, supports a competitive, sustainable and circular European battery value chain. The Green Deal Industrial Plan and the recent proposals for the Net-Zero Industry Act and Critical Raw Materials Act are essential to promote the net-zero industry in Europe and make Europe the home of clean-tech innovation. Horizon Europe also contributes to the EU's cutting edge and sustainable competitiveness in critical and emerging technologies. For Europe to lead on the markets of the future, Horizon contributes, amongst others, through patents from research projects and innovations generated in the EU's Single Market.

As you can see, the European Innovation Scoreboard informs our policy action. We encourage you – businesses, researchers, innovators, investors, and policymakers – to join forces in a collective effort to build a knowledge-based and innovation-driven economy and society that leaves no one behind. With innovation at the forefront, we can pave the way for a brighter future.



Margrethe Vestager

Executive Vice-President of the European Commission
in charge of Europe for the Digital Age

A handwritten signature in blue ink, reading 'Margrethe Vestager'.

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Executive summary

The annual European Innovation Scoreboard (EIS) provides a comparative assessment of the research and innovation performance of EU Member States and selected third countries, and the relative strengths and weaknesses of their research and innovation systems. It helps countries assess areas in which they need to concentrate their efforts in order to boost their innovation performance.

The EIS 2023 is the third edition based on the new measurement framework introduced in 2021. The EIS 2023 covers all EU Member States, 11 other European countries, and, at a less detailed level, 11 global competitors. Compared to previous reports, Israel is no longer included due to a lack of statistical data.

Innovation performance of EU Member States

Based on their performance relative to the EU average, Member States fall into four different performance groups (Figure 1).

Belgium, Denmark, Finland, the Netherlands, and Sweden are Innovation Leaders with innovation performance well above the EU average (>125% of EU average). Austria, Cyprus, France, Germany, Ireland, and Luxembourg are Strong Innovators with performance above the EU average. Czechia, Estonia, Greece, Hungary, Italy, Lithuania, Malta, Portugal, Slovenia, and Spain are Moderate Innovators with performance below the EU average. Bulgaria, Croatia, Latvia, Poland, Romania and Slovakia are Emerging Innovators with performance well below the EU average (<70% of EU average).

Most EU Member States have increased their innovation performance over the past 8 years

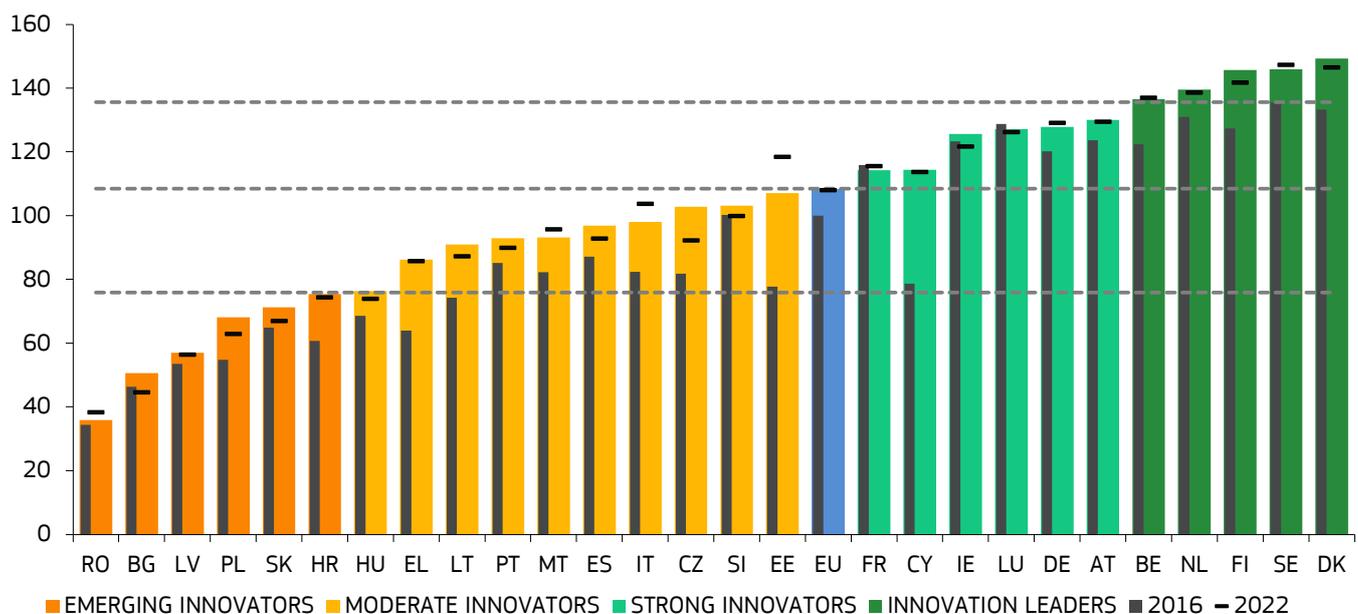
The innovation performance of the EU has increased by 8.5 percentage points since 2016. Innovation performance increased in 25 EU Member States and performance has increased most in Cyprus, Estonia, Greece, and Czechia (by 20 percentage points or more). Overall, the following indicators recorded the highest improvements: business process innovators, international scientific co-publications, job-to-job mobility of human resources in science & technology, and venture capital expenditures.

Between 2016 and 2023, performance differences among the 27 Member States have become somewhat smaller. Performance differences have narrowed most within the groups of Strong Innovators and Moderate Innovators. At the same time, the performance differences within the group of Emerging Innovators have not narrowed and they are not catching up to the next group of Moderate Innovators.

Compared to last year, innovation performance is growing at a slower pace

Between 2022 and 2023, the annual innovation performance of the EU has improved at a reduced rate of 0.6 percentage points. Innovation performance increased in 19 Member States, most in Czechia, Bulgaria and Poland (by 5 percentage points or more) and has declined in eight Member States.

Figure 1: Performance of EU Member States' innovation systems



All performance scores are relative to that of the EU in 2016. Coloured columns show countries' performance in 2023, using the most recent data for 32 indicators. The horizontal hyphens show performance in 2022, using the next most recent data. Grey columns show countries' performance in 2016. The dashed lines show the threshold values between the performance groups, where the threshold values of 70%, 100%, and 125%, when using the latest 2023 data, have been adjusted upward by multiplying with 1.085 to reflect the performance increase of the EU between 2016 and 2023 as the graph shows performance scores relative to the EU in 2016.

Compared to the results of the EIS 2022, the top EU innovation performer has changed

Denmark has become the most innovative Member State, overtaking Sweden, which was leading for many years. This was partly due to much stronger performance on indicators of Non-R&D innovation expenditures and Sales of innovative products, and partly due to a decline in the innovation performance of Sweden between 2022 and 2023.

Additionally, Hungary has progressed to the group of Moderate Innovators, mainly due to improved performance on indicators of Foreign doctorate students and Broadband penetration. Otherwise, the results have been stable.

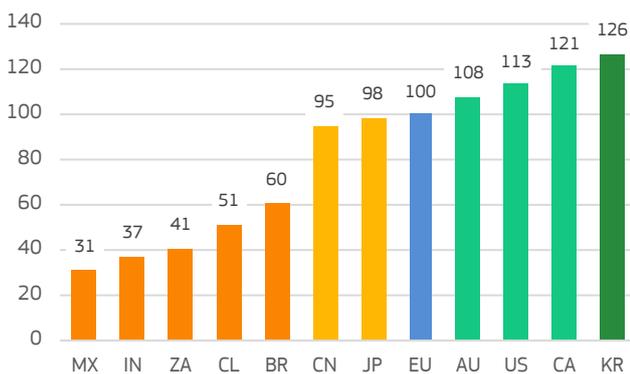
Switzerland is the most innovative European country

An extended analysis, which also includes 11 other European countries, shows that Switzerland is the most innovative country in Europe thanks to the highest performance on education-related indicators, scientific publications, and environment-related indicators.

At the global level, the EU has closed part of its performance gap to some of its other competitors

In an international comparison, the EU has an innovation performance gap with South Korea, which is the best performing country in the EIS 2023, as well as Canada, the United States, and Australia (Figure 2). The EU has a performance lead over China and Japan as well as a group of Emerging Innovators, which includes Brazil, Chile, India, Mexico, and South Africa.

Figure 2: Performance global competitors



Coloured columns show performance in 2023 relative to that of the EU in 2023.

Between 2016 and 2023, the innovation performance of the EU has grown at a faster rate than that of five global competitors (Australia, India, Japan, Mexico, and South Africa) and at a lower rate than that of six global competitors (Brazil, Canada, Chile, China, South Korea, and the United States). (Figure 3).

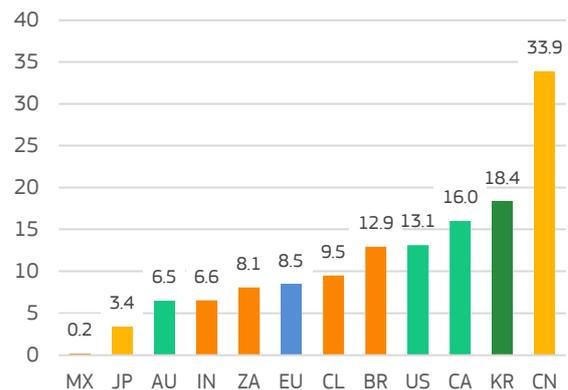
Impact of external factors on innovation performance

The report discusses several factors that may impact the EU's innovation performance, including Russia's war of aggression against Ukraine, the resulting energy crisis, and the current period of high inflation. Analysis on the impact of the Covid-19 pandemic confirms that the Covid-19 pandemic has had a negative impact on several indicators such as innovation expenditures, innovative sales, and venture capital expenditures, all of which experienced a decline in 2020.

Methodological continuity and refinement

After the revision of the measurement framework in 2021, no fundamental changes have been made to the methodology in this year's report.

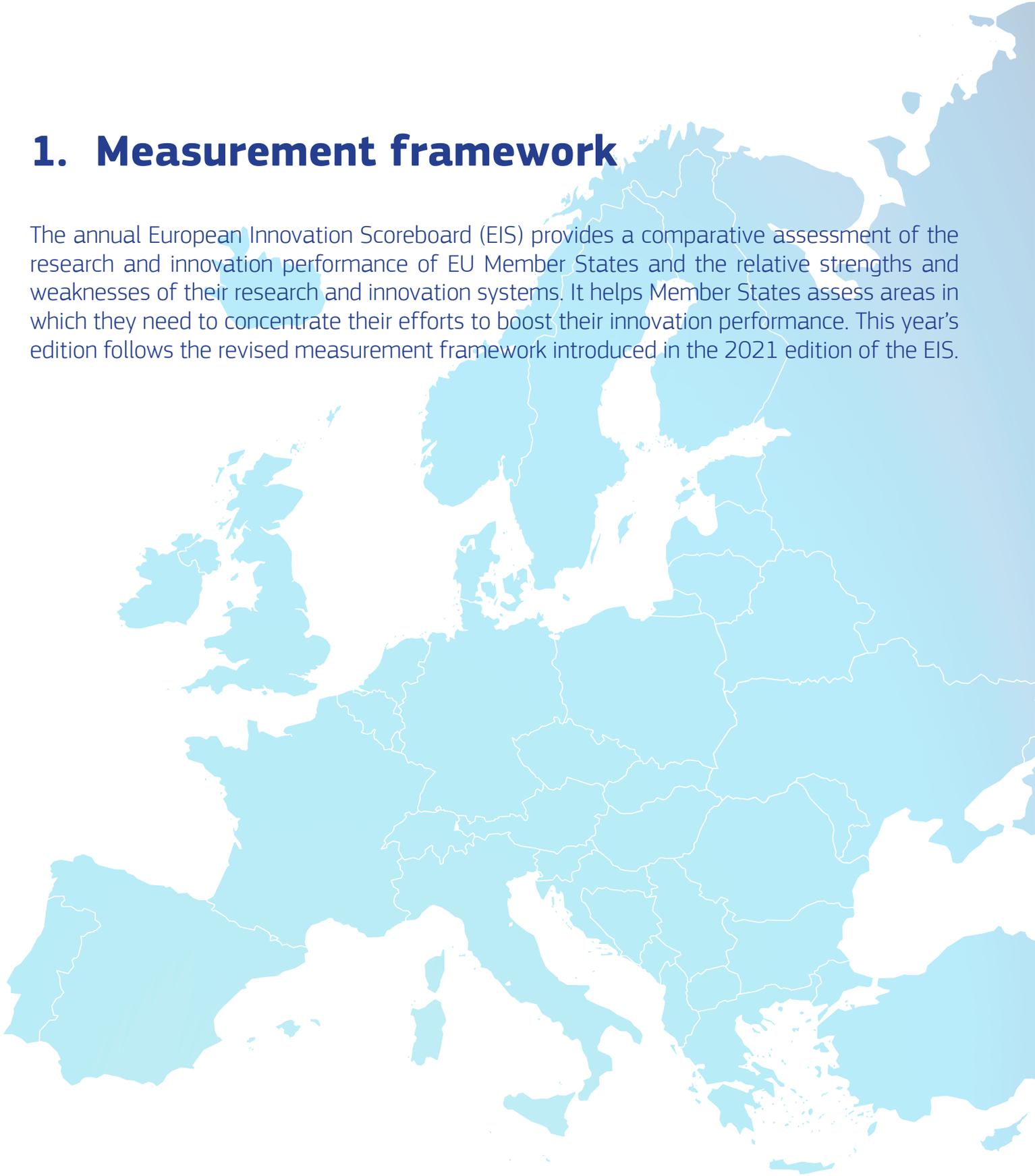
Figure 3: Performance change between 2016 and 2023



Performance change is measured as the difference between the 2023 and 2016 scores relative to that of the EU in 2016.

1. Measurement framework

The annual European Innovation Scoreboard (EIS) provides a comparative assessment of the research and innovation performance of EU Member States and the relative strengths and weaknesses of their research and innovation systems. It helps Member States assess areas in which they need to concentrate their efforts to boost their innovation performance. This year's edition follows the revised measurement framework introduced in the 2021 edition of the EIS.



The EIS 2023 distinguishes between four main types of activities – Framework conditions, Investments, Innovation activities, and Impacts – with 12 innovation dimensions, capturing in total 32 indicators.

Each main group includes an equal number of indicators and has an equal weight in the average performance score, or the Summary Innovation Index (SII). Within each group every indicator has the same weight. Indicators that are included in the measurement framework are presented in [Table 1](#).

Table 1: Measurement framework

FRAMEWORK CONDITIONS	INNOVATION ACTIVITIES
<ul style="list-style-type: none"> • Human resources <ul style="list-style-type: none"> 1.1.1 New doctorate graduates (in STEM) 1.1.2 Population aged 25-34 with tertiary education 1.1.3 Lifelong learning • Attractive research systems <ul style="list-style-type: none"> 1.2.1 International scientific co-publications 1.2.2 Top 10% most cited publications 1.2.3 Foreign doctorate students • Digitalisation <ul style="list-style-type: none"> 1.3.1 Broadband penetration 1.3.2 Individuals who have above basic overall digital skills 	<ul style="list-style-type: none"> • Innovators <ul style="list-style-type: none"> 3.1.1 SMEs with product innovations 3.1.2 SMEs with business process innovations • Linkages <ul style="list-style-type: none"> 3.2.1 Innovative SMEs collaborating with others 3.2.2 Public-private co-publications 3.2.3 Job-to-job mobility of Human Resources in Science & Technology • Intellectual assets <ul style="list-style-type: none"> 3.3.1 PCT patent applications 3.3.2 Trademark applications 3.3.3 Design applications
INVESTMENTS	IMPACTS
<ul style="list-style-type: none"> • Finance and support <ul style="list-style-type: none"> 2.1.1 R&D expenditure in the public sector 2.1.2 Venture capital expenditures 2.1.3 Direct government funding and government tax support for business R&D • Firm investments <ul style="list-style-type: none"> 2.2.1 R&D expenditure in the business sector 2.2.2 Non-R&D innovation expenditures 2.2.3 Innovation expenditures per person employed in innovation-active enterprises • Use of information technologies <ul style="list-style-type: none"> 2.3.1 Enterprises providing training to develop or upgrade ICT skills of their personnel 2.3.2 Employed ICT specialists 	<ul style="list-style-type: none"> • Employment impacts <ul style="list-style-type: none"> 4.1.1 Employment in knowledge-intensive activities 4.1.2 Employment in innovative enterprises • Sales impacts <ul style="list-style-type: none"> 4.2.1 Medium and high-tech product exports 4.2.2 Knowledge-intensive services exports 4.2.3 Sales of product innovations • Environmental sustainability <ul style="list-style-type: none"> 4.3.1 Resource productivity 4.3.2 Air emissions by fine particulates PM2.5 in Industry 4.3.3 Development of environment-related technologies

Framework conditions captures the main drivers of innovation performance external to the firm and differentiates between three innovation dimensions:

- *Human resources* dimension includes three indicators and measures the availability of a high-skilled and educated workforce. Human resources includes New doctorate graduates in STEM, Population aged 25-34 with completed tertiary education, and Population aged 25-64 involved in lifelong learning activities.
- *Attractive research systems* dimension includes three indicators and measures the international competitiveness of the science base by focusing on International scientific co-publications, Most cited publications, and Foreign doctorate students.
- *Digitalisation* dimension measures the level of digital technologies and includes two indicators: Broadband penetration among enterprises and Individuals with above basic overall digital skills.

Investments captures investments made in both the public and business sectors and differentiates between three innovation dimensions:

- *Finance and support* dimension includes three indicators including private funding (Venture capital investments), R&D expenditures in universities and government research organisations and Direct government funding and government tax support for business R&D.
- The *Firm investments* dimension includes three indicators on R&D and Non-R&D investments that firms make to generate innovations including Business R&D expenditures, Non-R&D innovation expenditures, and Innovation expenditures per person employed.
- The *Use of information technologies* dimension captures the use of information technologies including two indicators: Enterprises actively increasing the ICT skills of their personnel and Employed ICT specialists.

Innovation activities captures different aspects of innovation in the business sector and differentiates between three innovation dimensions:

- The *Innovators* dimension includes two indicators measuring the share of SMEs that have introduced innovations on the market or within their organisations, covering SMEs that introduced both product and business process innovations.
- The *Linkages* dimension includes three indicators measuring innovation capabilities by looking at Collaboration efforts between innovating firms, Research collaboration between the private and public sector, and Job-to-job mobility of Human Resources in Science & Technology (HRST).
- The *Intellectual assets* dimension captures different forms of Intellectual Property Rights (IPR) generated by the innovation process, including PCT patent applications, Trademark applications, and Design applications.

Impacts captures the effects of enterprises' innovation activities and differentiates between three innovation dimensions:

- The *Employment impacts* dimension measures the impact on employment and includes two indicators: Employment in knowledge-intensive activities and Employment in innovative enterprises.
- The *Sales impacts* dimension measures the economic impact of innovation and includes three indicators: Exports of medium and high-tech products, Exports of knowledge-intensive services, and Sales resulting from innovative products.
- The *Environmental sustainability* dimension captures improvements to reducing the negative impact on the environment including three indicators: Resource productivity, Exposure to Air pollution by fine particulates PM2.5, and the Development of environment-related technologies.

2. Innovation performance and trends

This chapter discusses the most recent innovation performance of EU Member States differentiating between four innovation performance groups: Innovation Leaders, Strong Innovators, Moderate Innovators, and Emerging Innovators. Performance changes over time are discussed for each of Member States.

For both the full eight-year period and the most recent annual performance change, the fastest and slowest progressing Member States are identified. A detailed analysis of the performance changes for the Member States within each performance group is also provided.

At EU level, main strengths and weaknesses and the main drivers of EU performance improvements over time are discussed.

2.1 Most recent innovation performance

The performance of EU national innovation systems is measured by the Summary Innovation Index, which is a composite indicator obtained by taking an unweighted average of the 32 indicators (cf. Table 1)¹. Figure 4 shows the scores for the Summary Innovation Index for all EU Member States in 2023 (the most recent year), in 2022, and the reference year 2016, all relative to the Summary Innovation Index of the EU in 2016. Based on the 2023 results, the Member States fall into four performance groups²:

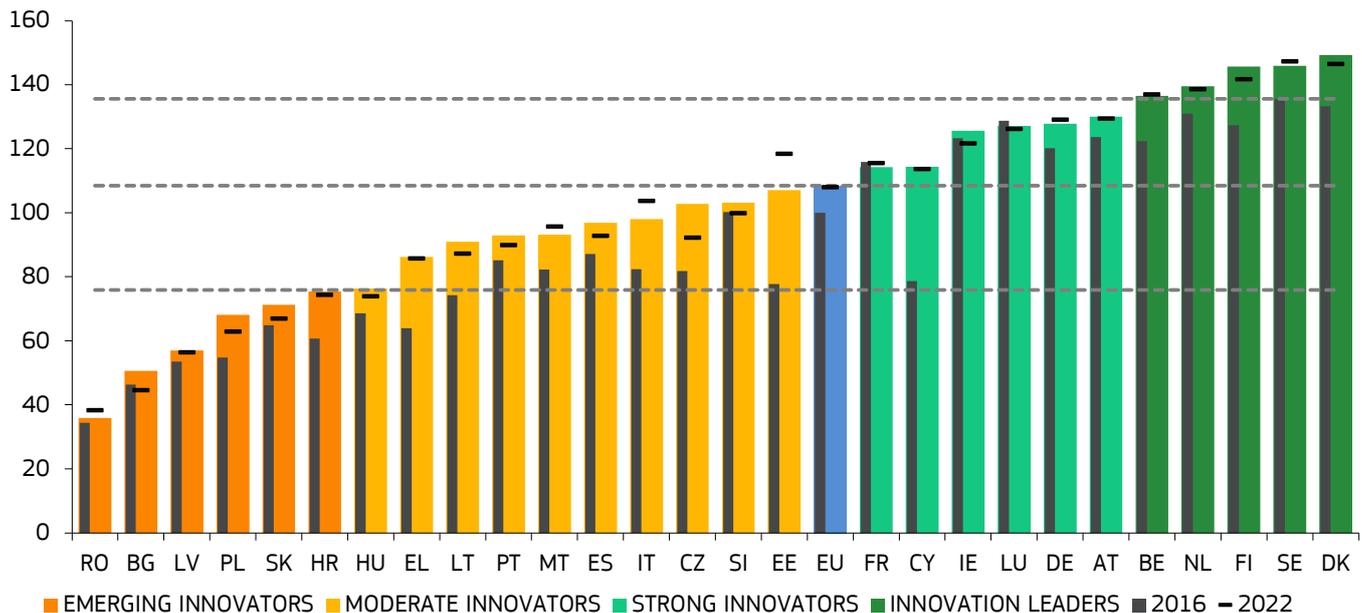
- The first group of **Innovation Leaders** includes five Member States where performance is above 125% of the EU average. This group includes (in alphabetical order) Belgium, Denmark, Finland, the Netherlands, and Sweden.
- The second group of **Strong Innovators** includes six Member States with a performance between 100% and 125% of the EU average. This group includes Austria, Cyprus, France, Germany, Ireland, and Luxembourg.
- The third group of **Moderate Innovators** includes 10 Member States where performance is between 70% and 100% of the EU average. This group includes Czechia, Estonia, Greece, Hungary, Italy, Lithuania, Malta, Portugal, Slovenia, and Spain.

- The fourth group of **Emerging Innovators** includes six Member States that show a performance level below 70% of the EU average. This group includes Bulgaria, Croatia, Latvia, Poland, Romania, and Slovakia.

Compared to last year's EIS 2022 edition, one Member State has successfully moved up to a higher performance group: Hungary is now a Moderate Innovator.

Performance in 2023, when compared to 2016, has increased for almost all Member States, except France and Luxembourg (Figure 4). Compared to 2022, performance in 2023 has improved for 19 Member States and worsened for eight Member States. Section 2.3 discusses the performance changes in more detail. As shown on the map in Figure 5, the performance groups tend to be geographically concentrated, with the Innovation Leaders and most of the Strong Innovators located in Northern and Western Europe, and most of the Moderate and Emerging Innovators in Southern and Eastern Europe.

Figure 4: Performance of EU Member States' innovation systems

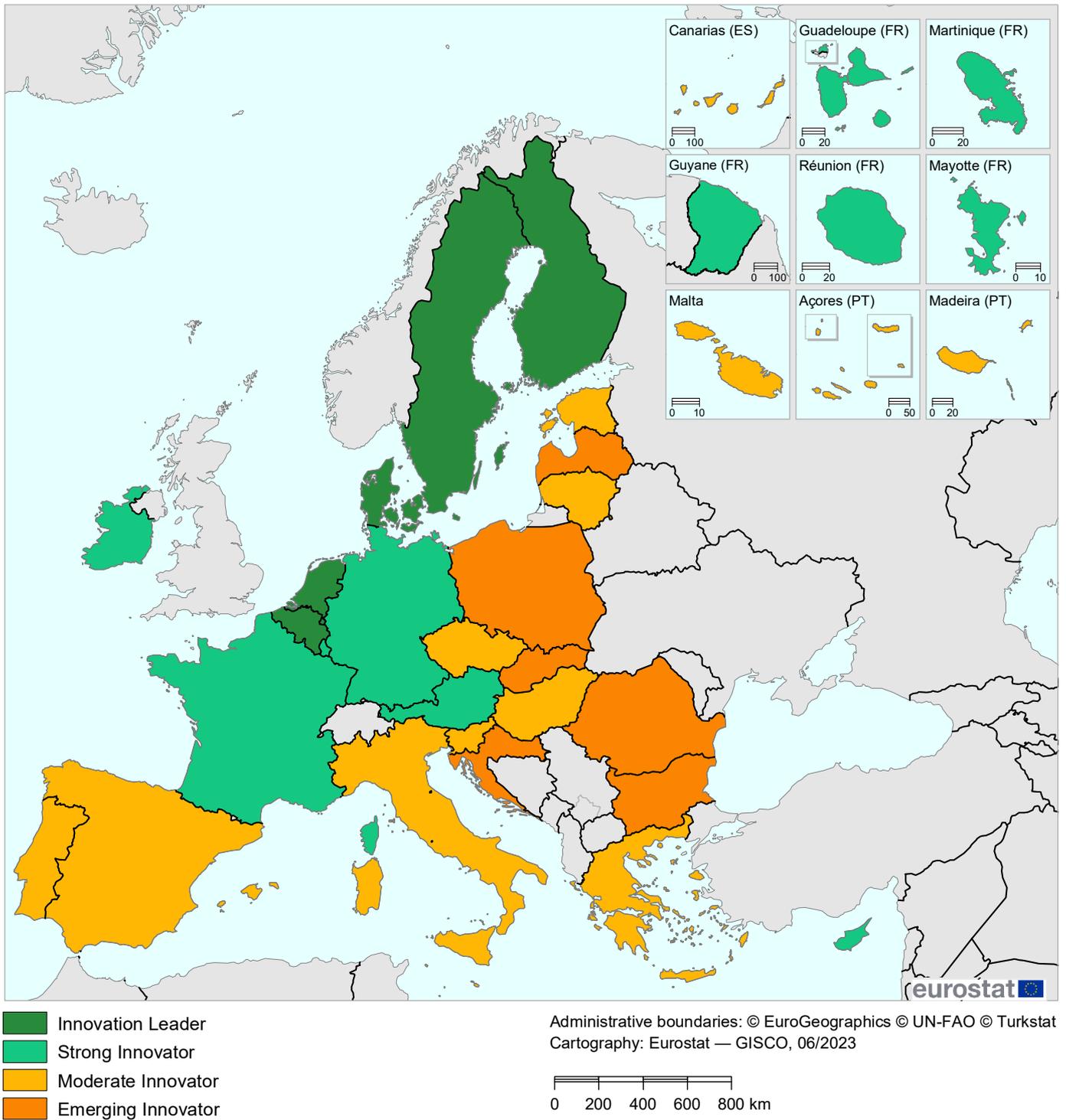


All performance scores are relative to that of the EU in 2016. Coloured columns show countries' performance in 2023, using the most recent data for 32 indicators. The horizontal hyphens show performance in 2022, using the next most recent data. Grey columns show countries' performance in 2016. The dashed lines show the threshold values between the performance groups, where the threshold values of 70%, 100%, and 125%, when using the latest 2023 data, have been adjusted upward by multiplying with 1.085 to reflect the performance increase of the EU between 2016 and 2023 as the graph shows performance scores relative to the EU in 2016.

¹ Chapter 8 gives a brief explanation of the calculation methodology. The EIS 2023 Methodology Report provides a detailed explanation.

² The EIS performance groups are relative performance groups with countries' group membership depending on their performance relative to that of the EU. With the improved EU innovation performance, the absolute thresholds between these groups will also increase over time, explaining why the dashed horizontal lines cross the vertical axis at higher percentage scores (also compared to threshold values in previous reports).

Figure 5: Map showing the performance of EU Member States' innovation systems



Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the European Union.

Source: European Commission – European Innovation Scoreboard 2023

2.2 Performance of the EU innovation system

Performance of the EU innovation system, has improved by 8.5 percentage points between 2016 and 2023, showing a modest increase between 2016 and 2018, a more rapid increase between 2019 and 2022, followed by a smaller increase in 2023 (Figure 6). The score of the innovation index is measured as the average of the normalised scores of the 32 indicators included in the measurement framework.

There are substantial differences in the performance change of the EU for the different dimensions and indicators. Figure 7 shows the performance in 2023 for each dimension (dark blue coloured bars) and indicator (light blue coloured bars) and in 2022 (grey coloured bars) compared to performance in 2016. The difference between the respective blue and grey coloured bar shows the change between the previous and the most recent year. Performance changes are defined as the difference between the respective relative to EU scores shown in Figure 7 and 100, where 100 equals the EU score in 2016 for each indicator and dimension.

Compared to 2016, performance for the EU has improved most in:

- *Innovators* due to strong performance increases in both indicators
- In *Linkages* due to strong performance increases in all three indicators
- In *Finance and support*, due to a strong increase in both Venture capital expenditures and Government support for business R&D

Performance increased in most other dimensions but at lower rates.

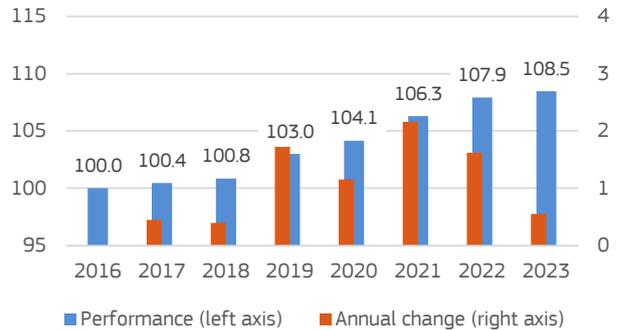
Performance for the EU declined most in:

- *Human resources* due to a strong decline in New doctorate graduates
- *Intellectual assets* due to a decline in both Patent applications and Design applications

Individual indicators showing a strong increase (40%-points or more) compared to 2016 include:

- Business process innovators
- International scientific co-publications
- Venture capital expenditures
- Job-to-job mobility of Human Resources in Science and Technology.

Figure 6: Improvement in performance of the EU



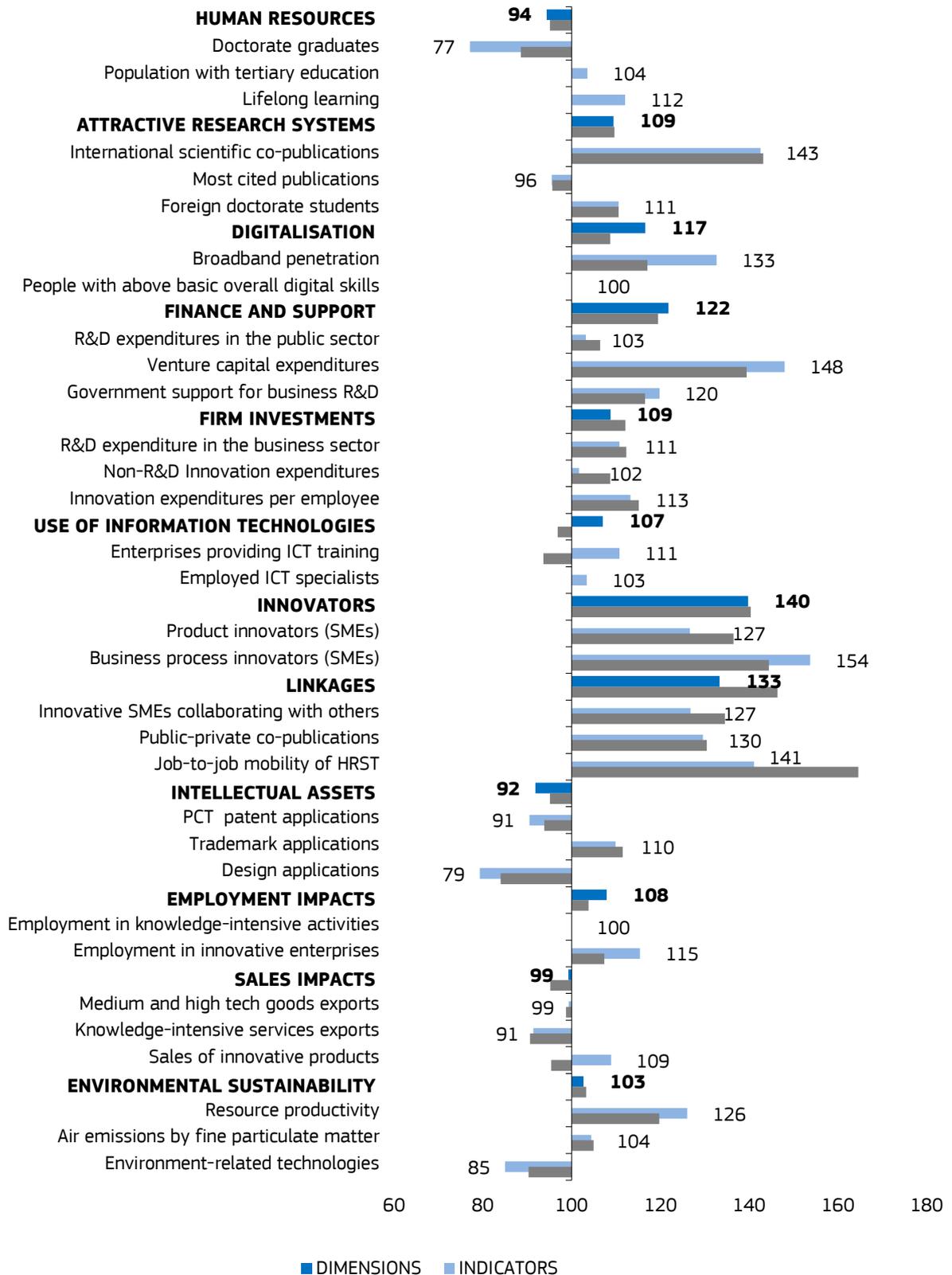
Performance is measured relative to that of the EU in 2016. The blue bars show performance over time measured on the left axis starting at 100 in 2016. The red bars show the annual changes between two consecutive years (i.e. the vertical difference between two blue bars) measured on the right axis.

Indicators showing a strong decline (-20%-points or less) compared to 2016 include:

- Design applications
- New doctorate graduates

Compared to 2022, performance for the EU has improved in five dimensions, the strongest in the *Use of information technologies* and *Digitalisation*, and decreased in seven dimensions, most strongly in *Linkages*. For the individual indicators, the highest increase is in Enterprises providing ICT training, Broadband penetration, and Sales of innovative products, and the highest decrease in Job-to-job mobility of Human Resources in Science and Technology and New doctorate graduates.

Figure 7: EU Performance change by dimension and indicator



Normalised scores in 2023 (blue coloured bars) and 2022 (grey coloured bars) relative to those in 2016 (=100). Bars will not be visible when relative results are very close to 100.

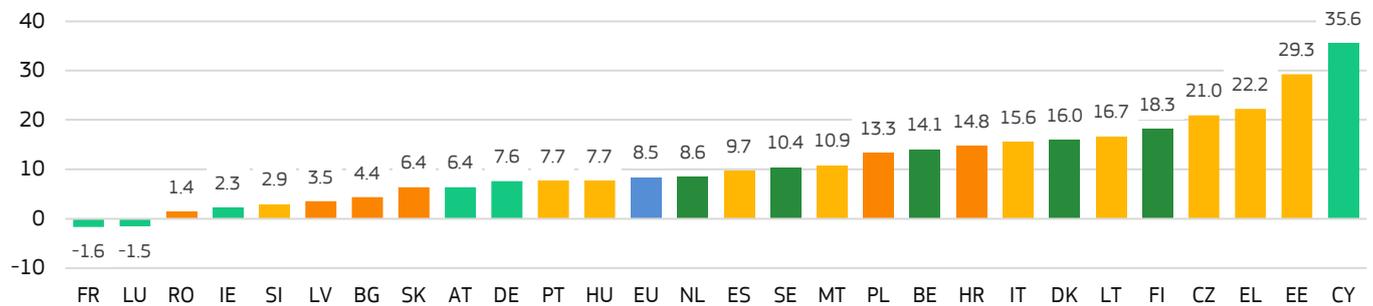
2.3 Member States' changes in innovation performance

This section discusses performance changes over time for each of the innovation performance groups and the Member States included in each of the groups.

Between 2016 and 2023, performance improved for 25 Member States (Figure 8). For 15 Member states performance has grown faster than that of the EU. For four Member States performance improved by 20 percentage points or more (in descending order): Cyprus, Estonia, Greece, and Czechia. For four Member States performance improved between 15 and 20 percentage points: Finland, Lithuania, Denmark, and Italy. For five Member States performance improved between 10 and 15 percentage points: Croatia, Belgium, Poland, Malta, and Sweden. For two Member States performance improved by less than 10 but more than 8.5 percentage points: Spain and the Netherlands.

For 12 Member States performance has grown slower than that of the EU or even declined. For five Member States performance improved by more than 5 percentage points: Hungary, Portugal, Germany, Austria, and Slovakia. For five Member States performance improved between 0 and 5 percentage points: Bulgaria, Latvia, Slovenia, Ireland, and Romania. For two Member States performance worsened: Luxembourg and France.

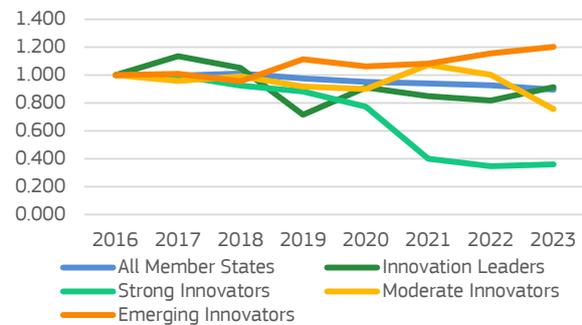
Figure 8: Performance change between 2016 and 2023



Performance change is measured as the difference between the 2023 and 2016 scores relative to that of the EU in 2016.

Between 2016 and 2023, there has been a convergence of innovation performance between Member States as measured by a decreasing coefficient of variation (Figure 9). This overall convergence is mostly driven by reduced performance differences within the groups of Strong Innovators and Moderate Innovators. For the Strong Innovators reduced performance differences are mainly due to the substantial performance increase for Cyprus. Within the Emerging Innovators performance differences have increased, due to more rapid improvements for the top three Emerging Innovators (Croatia, Poland, Slovakia) and lower improvements for the bottom three Emerging Innovators (Bulgaria, Latvia, Romania).

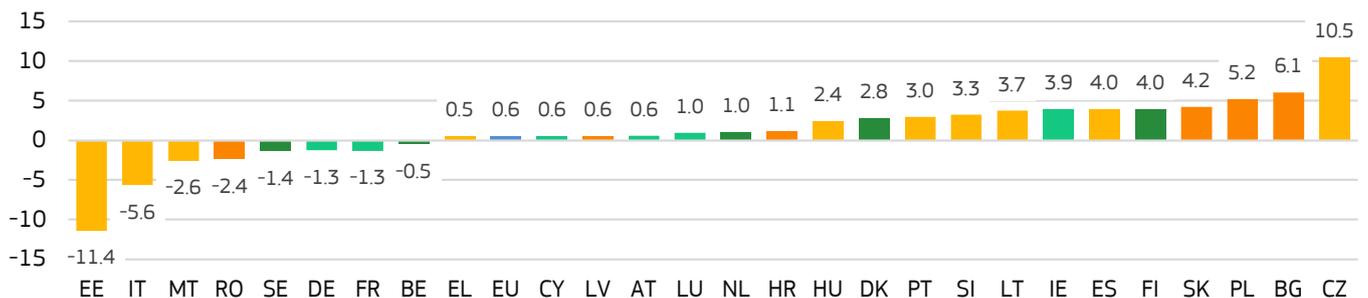
Figure 9: Convergence in innovation performance



Lines show the coefficient of variation which is defined as the ratio of the standard deviation to the mean indexed to 2016.

Compared to 2022, performance in 2023 has improved for 19 Member States, most strongly for Czechia, Bulgaria, and Poland, and performance has declined for eight Member States, most strongly for Estonia and Italy (Figure 10).

Figure 10: Performance change between 2022 and 2023



Performance change is measured as the difference between the 2023 and 2022 scores relative to that of the EU in 2016.

2.4 Innovation performance groups

This section will explore differences in performance over time within each of the four performance groups, allowing a closer comparison of performance and performance changes between Member States in the same performance group.

Innovation Leaders

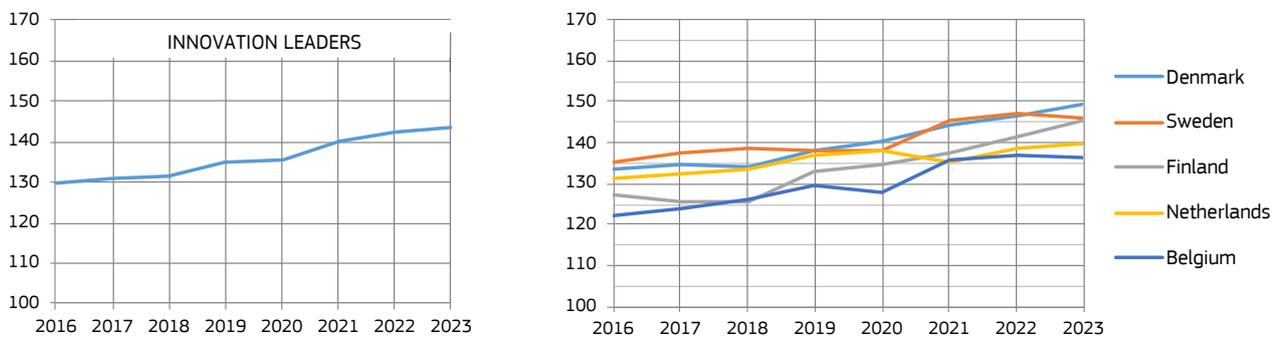
Performance of the Innovation Leaders improved from 2016 onwards, with an acceleration since 2021. Compared to 2016, performance has improved by 13.5 percentage points³, which is above the average of the EU. Performance has improved the most in Finland (18.3%-points), with high annual increases in 2022 and 2023 (in both years among others due to strong increases in SMEs with business process innovations, Sales of innovative products, and Broadband penetration). Finland has shown an increase in performance since 2017 and recently closed in on Denmark, in 2023 the most innovative EU Member State.

Performance over time from 2016 to 2023 has also improved at a rate above or equal to that of the EU average for all other Innovation leaders. For both Denmark (16.0%-points) and Belgium (14.1%-points), performance

increased very strongly in 2021. For Denmark this was due to substantial increases in SMEs with product innovations, SMEs with business process innovations, and Employment in innovative enterprises. For Belgium this was due to substantial increases in Foreign doctorate students, SMEs with business process innovations, and Non-R&D innovation expenditures.

For Sweden (10.4%-points), performance improved strongest in 2021, due to substantial increases in SMEs with product innovations, SMEs with business process innovations, and Sales of innovative products. For the Netherlands (8.6%-points), performance growth is just above that of the EU. Performance declined in 2021 but recovered in 2022 and continued to grow in 2023. Recovery in 2022 was due to substantial increases in Venture capital expenditures, Doctorate graduates, and Broadband penetration.

Figure 11: Performance Innovation Leaders



Performance is relative to that of the EU in 2016. The graph on the left shows the average performance of the Innovation Leaders, calculated as the unweighted average of the respective Member States. All vertical scales in Figures 11-14 span a range of 70%-points to allow an easy comparison of the results between the four performance groups.

Strong Innovators

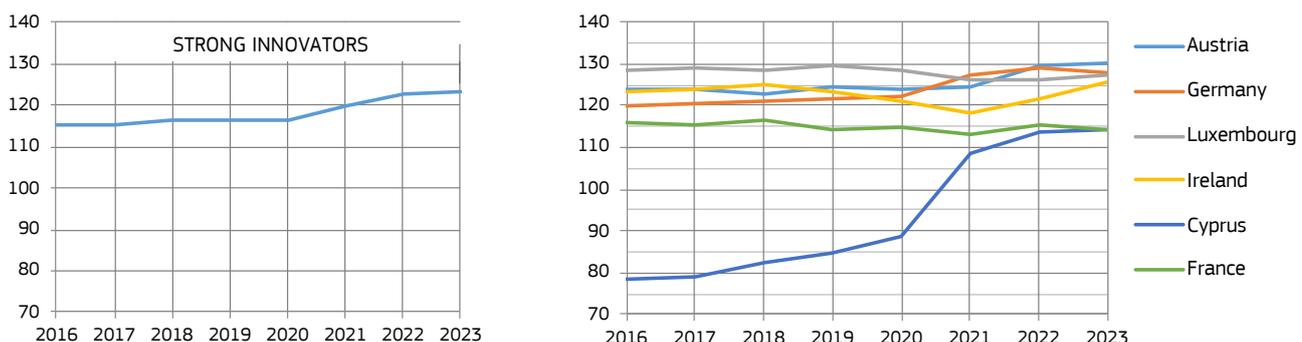
For the Strong Innovators performance increased by 8.1 percentage points between 2016 and 2023, a rate below that of the EU and that of the Innovation Leaders. The performance gap to the Innovation Leaders has widened over time. Cyprus shows a rapid improvement over time (35.6%-points). For Cyprus performance improved strongly in 2021, due to substantial increases in Government support for business R&D, SMEs with product innovations, SMEs with business process innovations, Innovative SMEs collaborating with others, Employment in innovative enterprises, and Environment-related technologies.

Performance increased between 2016 and 2023 for Germany (7.6%-points), Austria (6.4%-points) and Ireland (2.3%-points), but this is below the rate of the EU. For Germany performance increased strongest in 2021 due to higher shares of SMEs with product innovations, SMEs with business process innovations, and Innovative SMEs collaborating

with others. More recently performance declined in 2023. For Austria performance increased strongly in 2022 due to Venture capital expenditures and Job-to-job mobility. For Ireland performance increased strongly due to improved performance on SMEs with business process innovations, Employment in innovative enterprises, and Sales of innovative products.

Performance declined over time from 2016 to 2023 for Luxembourg (-1.5%-points) and France (-1.6%-points). For Luxembourg peak annual performance was reached in 2019 followed by two years of performance declines, due to decreases in Upgrading ICT skills, Employment in innovative enterprises, and Environment-related technologies. For France performance was quite stable over time, with a recent increase in 2022 followed by a decline in 2023, due to decreases in SMEs with product innovations, Job-to-job mobility in Human Resources in S&T, and Sales of innovative products.

Figure 12: Performance Strong Innovators



Performance is relative to that of the EU in 2016. The graph on the left shows the average performance of the Strong Innovators, calculated as the unweighted average of the respective Member States. All vertical scales in Figures 11-14 span a range of 70%-points to allow an easy comparison of the results between the four performance groups.

³ Performance change for each of the performance groups is calculated as the unweighted average of the performance changes of the group members. In the text, for simplicity, all changes are shown as percentage changes, but these are percentage point changes.

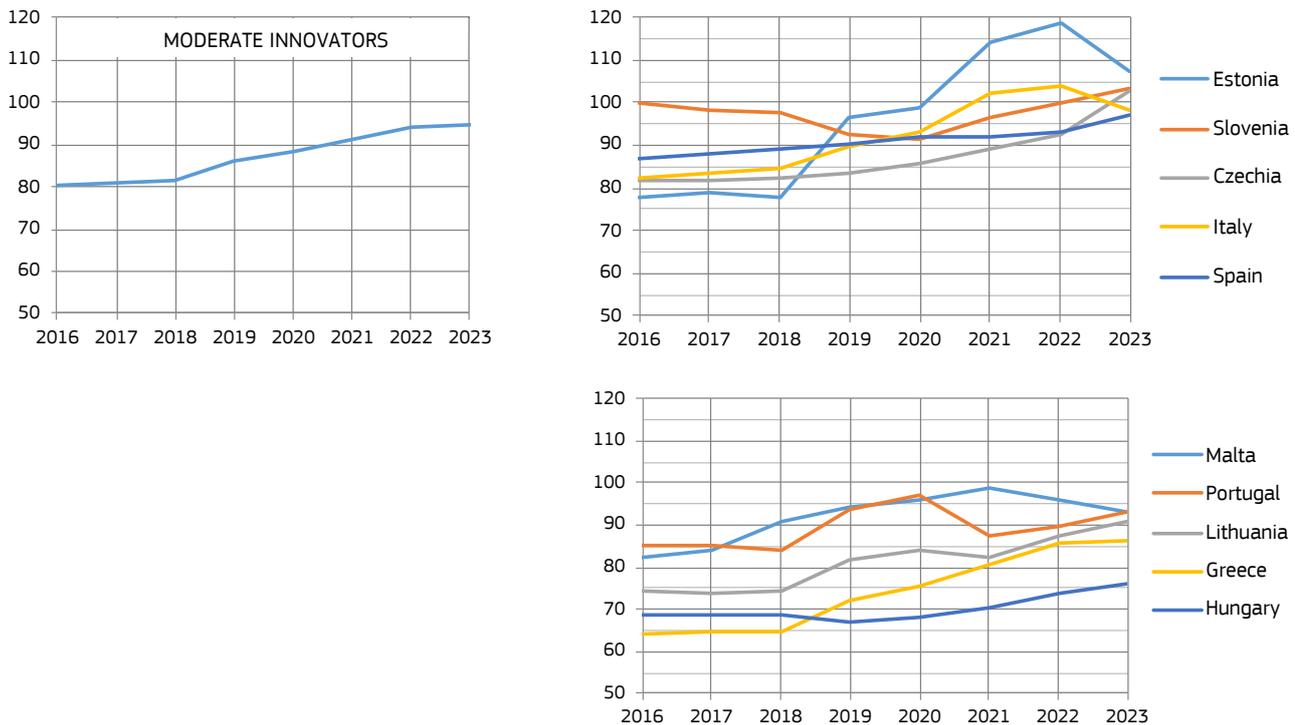
Moderate Innovators

For the Moderate Innovators, performance has been increasing continuously since 2016, and more substantially since 2018. Compared to 2016, average performance has improved by 14.4 percentage points, i.e. at a higher rate than the Strong Innovators and the Innovation Leaders. The performance gap to the Strong Innovators has become smaller over time, which is an indication of converging performance between the two groups. For all Moderate Innovators performance has increased between 2016 and 2023 and grew faster than the EU, except for Hungary, Portugal and Slovenia. Highest performance increases over time are observed for Estonia (29.3%-points), Greece (22.2%-points), Czechia (21.0%-points), Lithuania (16.7%-points), and Italy (15.6%-points). For Estonia performance declined in 2023 mostly due to worsened performance on all indicators using innovation survey data. For both Greece and Czechia performance has improved consistently with annual performance increases between 2017 and 2023. Czechia's highest annual performance increase is in 2023, due to increases in Innovation expenditures per employee, SMEs with business process innovations, and Employment in innovative enterprises. Greece's annual performance increase was highest in 2019, and relatively high more recently in 2021 and 2022 mostly due to increases in Government support for business R&D, Public R&D expenditures, Job-to-job mobility in Human Resources in S&T, and Resource productivity.

Other Moderate Innovators whose performance increase is above the rate of the EU include Malta (10.9%-points) and Spain (9.7%-points). For Malta performance increased from 2017 to 2021, but annual performance decreased in 2022 and 2023, due to reduced performance on Government support for business R&D, Job-to-job mobility in Human Resources in S&T, Employment in innovative enterprises, and Sales of innovative products. For Spain performance increased for all years except for 2021. Performance increased most in 2023 due to improved performance on SMEs with product innovations, SMEs with business process innovations, and Sales of innovative products.

Hungary's performance (7.7%-points) is just below that of the EU. For Hungary performance increased most in 2022 due to strong improvements for most indicators and most strongly for Most cited publications, Job-to-job mobility in Human Resources in S&T, and Resource productivity. Portugal's performance increase (7.7%-points) is marginally lower than that of Hungary. For Portugal, peak annual performance was reached in 2020. Performance declined strongly in 2021, due to worsened performance on all indicators using innovation survey data, followed by annual increases in 2022 and 2023 which did not make up for the decline in 2021. For Slovenia performance increased at a relatively low rate (2.9%-points) due to annual performance decreases in 2017 to 2020. More recently, performance improved strongly in 2021-2023, mostly due to improved performance on Foreign doctorate students and Venture capital expenditures.

Figure 13: Performance Moderate Innovators



Performance is relative to that of the EU in 2016. The graph on the left shows the average performance of the Moderate Innovators, calculated as the unweighted average of the respective Member States. All vertical scales in Figures 11-14 span a range of 70%-points to allow an easy comparison of the results between the four performance groups.

Emerging Innovators

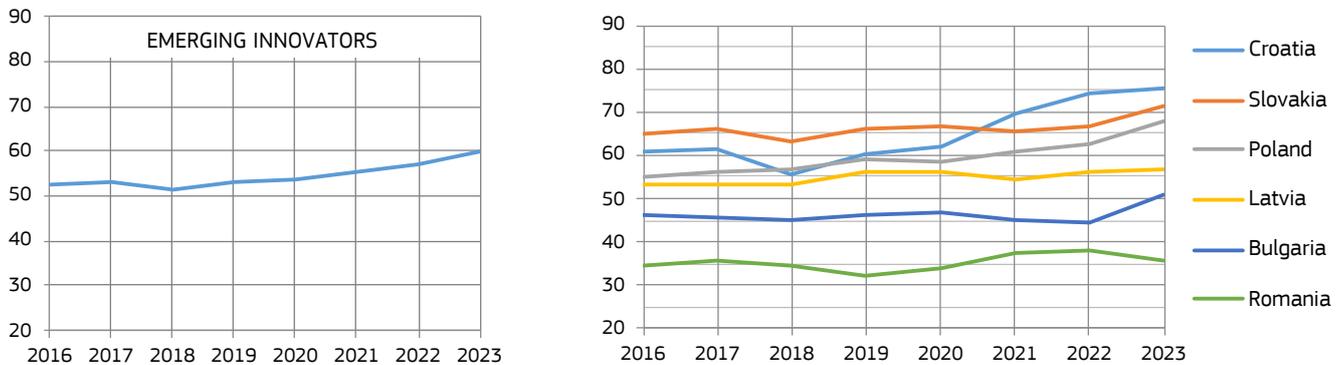
For all Emerging Innovators performance increased over time. Their average overall performance improved by 7.3 percentage points, which is below the average rate of increase for the EU and below that for the other performance groups. The performance gap to the Moderate Innovators widened. For Croatia (14.8%-points) performance has improved consistently with annual performance increases between 2019 and 2023. The highest annual increase was in 2021 due to much higher performance on Venture capital expenditures and SMEs with product innovations. Poland (13.3%-points) had a performance increase above that of the EU. For Poland performance increased in all years except for a small decline in 2020. In 2023 performance increased strongly, as a result of very strong increases in Foreign doctorate students, SMEs with business process innovations, and Employment in innovative enterprises.

For Slovakia (6.4%-points), Bulgaria (4.4%-points), Latvia (3.5%-points) and Romania (1.4%-points) performance increased at a rate below that of the EU. For Slovakia performance declined in both 2018 and 2021 and increased in all other years. In 2023 the performance

increase is relatively strong because of higher performance for Government support for business R&D, SMEs with business process innovations, and Employment in innovative enterprises. For Latvia performance increased in both 2022 and 2023. The increase in 2023 is due to much higher performance on Employed ICT specialists and Job-to-job mobility in Human Resources in S&T.

Bulgaria (4.4%-points) and Romania (1.4%-points) show the lowest performance levels. As a result of low performance increases compared to the EU average, their performance gap to the EU and most Member States has increased. For Bulgaria performance increased strongly in 2023 due to improved performance on Upgrading ICT skills, SMEs with business process innovations, and Innovative SMEs collaborating with others. For Romania performance increased in the period 2020 to 2022 but decreased in 2023. Performance declined in 2023 most strongly for SMEs with product innovations and Innovative SMEs collaborating with others. For Romania there was also a strong increase in Upgrading ICT skills in 2023.

Figure 14: Performance Emerging Innovators



Performance is relative to that of the EU in 2016. The graph on the left shows the average performance of the Emerging Innovators, calculated as the unweighted average of the respective Member States. All vertical scales in Figures 11-14 span a range of 70%-points to allow an easy comparison of the results between the four performance groups.

3. Performance by innovation dimension (EU Member States)

This chapter first provides a comparative analysis of the average performance of the four innovation performance groups across the 12 innovation dimensions. It is followed by a detailed discussion of the individual Member States' performance in the 12 innovation dimensions.



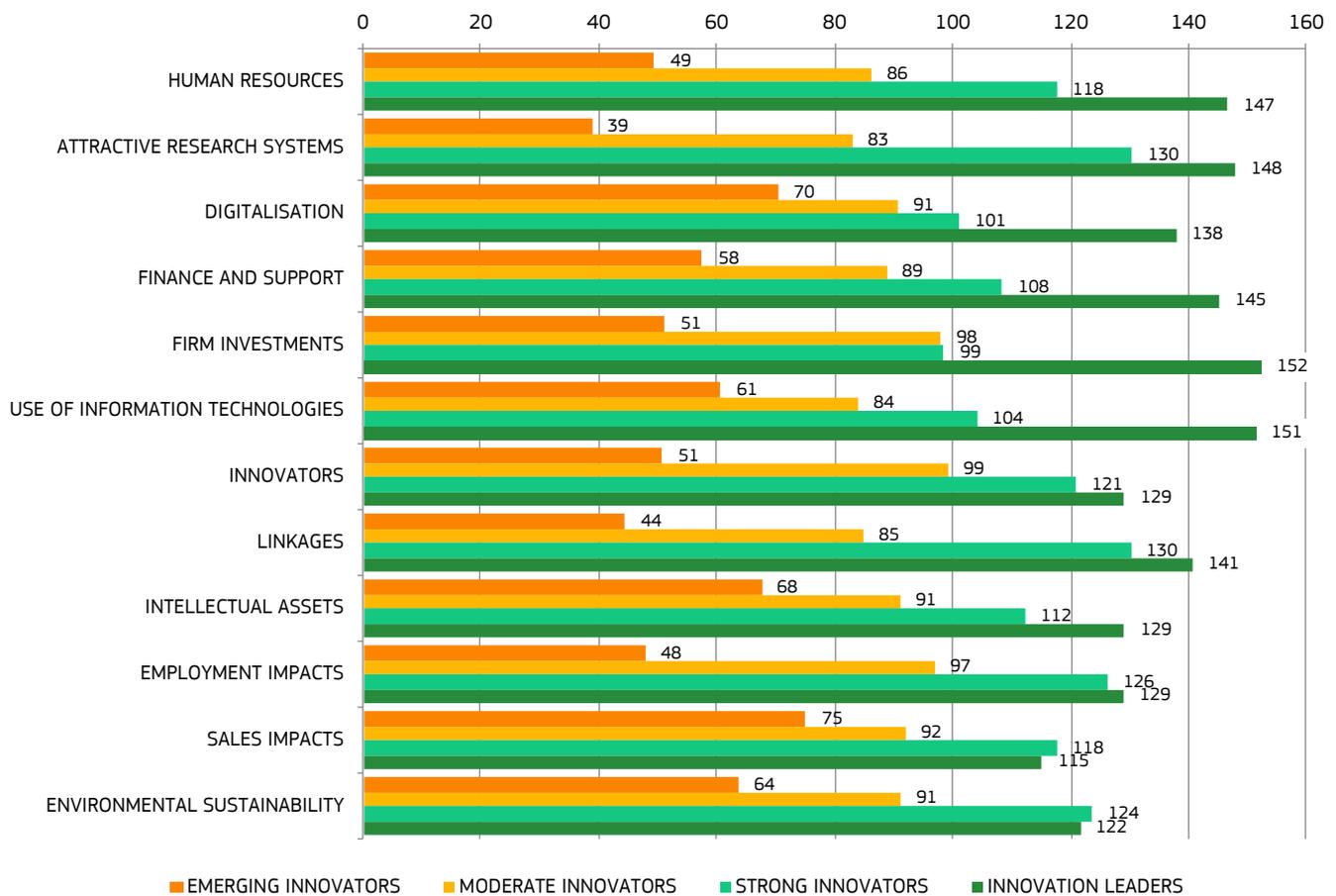
The average performance difference⁴ is 19%-points between the Innovation Leaders and Strong Innovators, 27%-points between the Strong and Moderate Innovators, and 33%-points between the Moderate and Emerging Innovators. The order of performance groups (Leaders – Strong – Moderate – Emerging Innovators) observed for average innovation performance also applies to almost all dimensions. Only in Sales impacts and Environmental sustainability, the Strong Innovators outperform the Innovation Leaders (Figure 15). Average performance for each dimension for each group has been calculated as the unweighted average of the innovation index scores for the Member States in that performance group.

In several innovation dimensions, performance differences are much higher between the performance groups. The performance difference between the Innovation Leaders and the Strong Innovators is highest

more than 30%-points) in Digitalisation, Finance and support, Firm investments and Use of information technologies. Between the Strong and Moderate Innovators, performance differences are highest (more than 30%-points) for Attractive research systems, Linkages, and Environmental sustainability. Between the Moderate and Emerging Innovators, performance differences are highest (more than 45%-points) for Firm investments, Innovators, and Employment impacts.

Performance differences between the Innovation Leaders and the Strong Innovators are smallest (below 5%-points or even negative) in Employment impacts, Sales impacts, and Environmental sustainability. Performance differences between the Strong and Moderate Innovators are smallest (below 15%-points in Digitalisation and Firm investments. Performance differences between the Moderate and Emerging Innovators are smallest (below 25%-points) in Digitalisation, Use of information technologies, Intellectual assets, and Sales impacts.

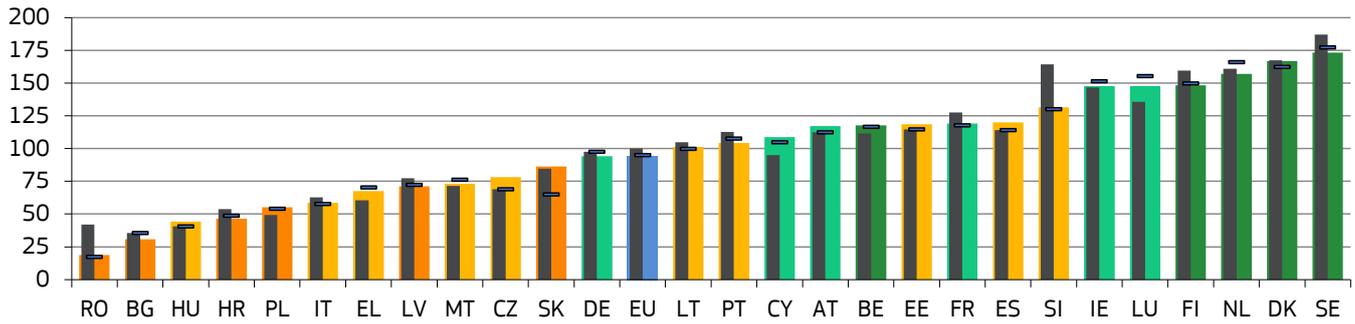
Figure 15: Performance groups: innovation performance per dimension



Average scores for each performance group are defined as the unweighted average of the relative-to-EU scores of the Member States within that group. As these unweighted averages do not consider differences in country size, results are not directly comparable. For this reason, average scores for the performance groups have been adjusted such that the unweighted average of the four groups for each dimension equals 100.

⁴ The average performance difference is defined as the difference between the unweighted average of the relative to EU innovation performance scores of all Member States in one performance group and that of all Member States in another performance group.

Human resources



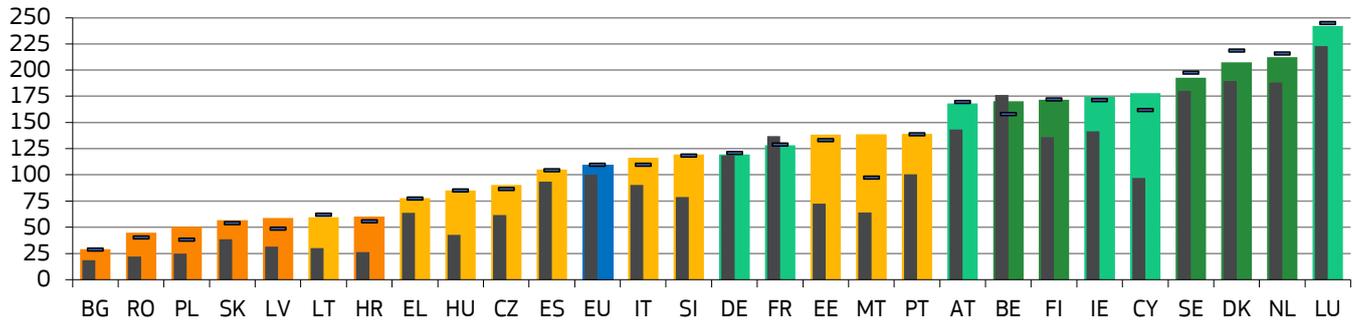
Coloured columns show Member States' performance in 2023, using the most recent data for the indicators in this dimension, relative to that of the EU in 2016. The horizontal hyphens show performance in 2022, using the next most recent data for the indicators in this dimension, relative to that of the EU in 2016. Black columns show performance in 2016 relative to that of the EU in 2016.

The top-5 best performing Member States in Human resources includes four Innovation Leaders and one Strong Innovator, with Sweden taking top position. The bottom-5 is composed of four Emerging Innovators and one Moderate Innovator, with lowest performance for Romania. All Innovation Leaders perform above the EU average. All Strong Innovators also perform above the EU average, except for Germany. Five Moderate Innovators perform above the EU average and five perform below the EU average. All Emerging Innovators perform below the EU average.

For 13 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Cyprus (13.8%-points), followed by Luxembourg and Czechia. For 14 Member States performance has declined, most strongly for Slovenia (-33.0%-points), followed by Romania. The EU average declined by 5.6%-points.

In comparison to 2022, performance has improved for 15 Member States. The highest performance increase is for Slovakia (21.3%-points), followed by Czechia. For 12 Member States performance has declined, most strongly for the Netherlands (-8.8%-points), followed by Luxembourg. The EU average declined by 0.7%-points.

Attractive research systems



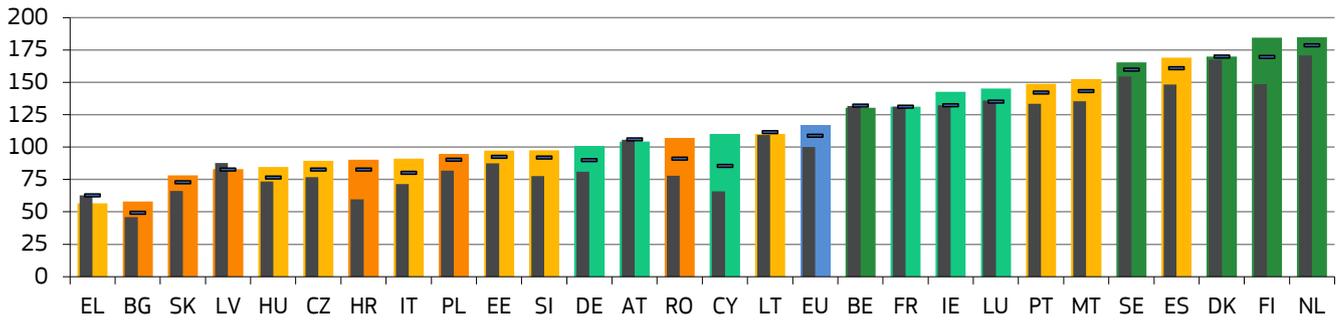
Coloured columns show Member States' performance in 2023, using the most recent data for the indicators in this dimension, relative to that of the EU in 2016. The horizontal hyphens show performance in 2022, using the next most recent data for the indicators in this dimension, relative to that of the EU in 2016. Black columns show performance in 2016 relative to that of the EU in 2016.

The top-5 best performing Member States in Attractive research systems includes three Innovation Leaders and two Strong Innovators, with Luxembourg taking top position. The bottom-5 is composed of five Emerging Innovators, with lowest performance for Bulgaria. All Innovation Leaders and all Strong Innovators perform above the EU average. Five Moderate Innovators perform above the EU average and five perform below the EU average. All Emerging Innovators perform below the EU average.

For 25 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Cyprus (80.7%-points), followed by Malta and Estonia. For only two Member States performance has declined, for France and Belgium. The EU average improved by 9.5%-points.

In comparison to 2022, performance has improved for 17 Member States. The highest performance increase is for Malta (41.5%-points), followed by Cyprus. For 10 Member States performance has declined, most strongly for Denmark (-11.2%-points), followed by Sweden. The EU average declined marginally by 0.2%-points

Digitalisation



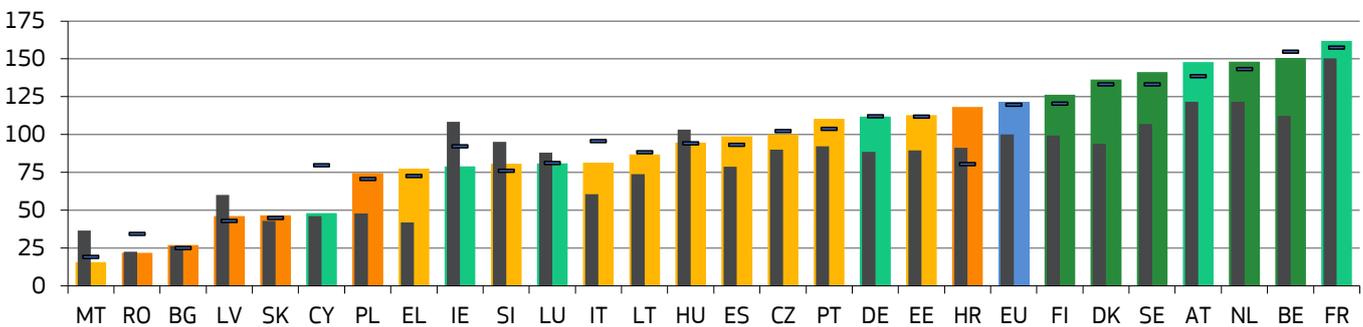
Coloured columns show Member States' performance in 2023, using the most recent data for the indicators in this dimension, relative to that of the EU in 2016. The horizontal hyphens show performance in 2022, using the next most recent data for the indicators in this dimension, relative to that of the EU in 2016. Black columns show performance in 2016 relative to that of the EU in 2016.

The top-5 best performing Member States in Digitalisation includes four Innovation Leaders and one Moderate Innovator, with the Netherlands taking top position. The bottom-5 is composed of three Emerging Innovators and two Moderate Innovators, with lowest performance for Greece. All Innovation Leaders perform above the EU average. Three Strong Innovators perform above the EU average and three perform below the EU average. Three Moderate Innovators perform above the EU average and seven perform below the EU average. All Emerging Innovators perform below the EU average.

For 22 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Cyprus (44.2%-points), followed by Finland, Croatia, and Romania. For four Member States performance has declined, most strongly for Greece (-6.1%-points), followed by Latvia. The EU average increased by 16.6%-points.

In comparison to 2022, performance has improved for 21 Member States. The highest performance increase is for Cyprus (24.6%-points), followed by Romania and Finland. For two Member States performance did not change. For four Member States performance has declined, most strongly for Greece (6.1%-points). The EU average increased by 7.9%-points.

Finance and support



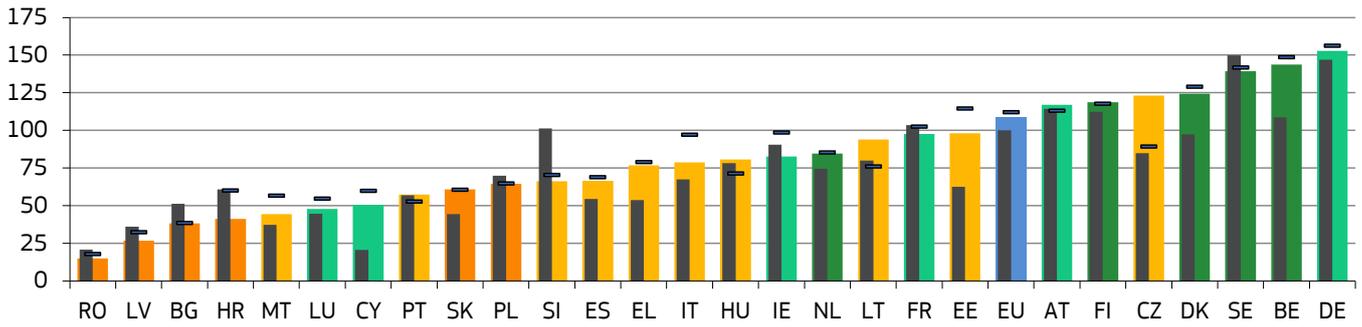
Coloured columns show Member States' performance in 2023, using the most recent data for the indicators in this dimension, relative to that of the EU in 2016. The horizontal hyphens show performance in 2022, using the next most recent data for the indicators in this dimension, relative to that of the EU in 2016. Black columns show performance in 2016 relative to that of the EU in 2016.

The top-5 best performing Member States in Finance and support includes three Innovation Leaders and two Strong Innovators, with France taking top position. The bottom-5 is composed of four Emerging Innovators and one Moderate Innovator, with lowest performance for Malta. All Innovation Leaders perform above the EU average. Two Strong Innovators perform above the EU average and four perform below the EU average. All Moderate Innovators and all Emerging Innovators perform below the EU average.

For 20 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Denmark (42.6%-points), followed by Belgium, Greece and Sweden. For seven Member States performance has declined, most strongly for Ireland (-29.4%-points), followed by Malta. The EU average increased by 21.9%-points.

In comparison to 2022, performance has improved for 17 Member States. The highest performance increase is for Croatia (37.8%-points). For 10 Member States performance has declined, most strongly for Cyprus (-31.6%-points). The EU average increased by 2.3%-points.

Firm investments



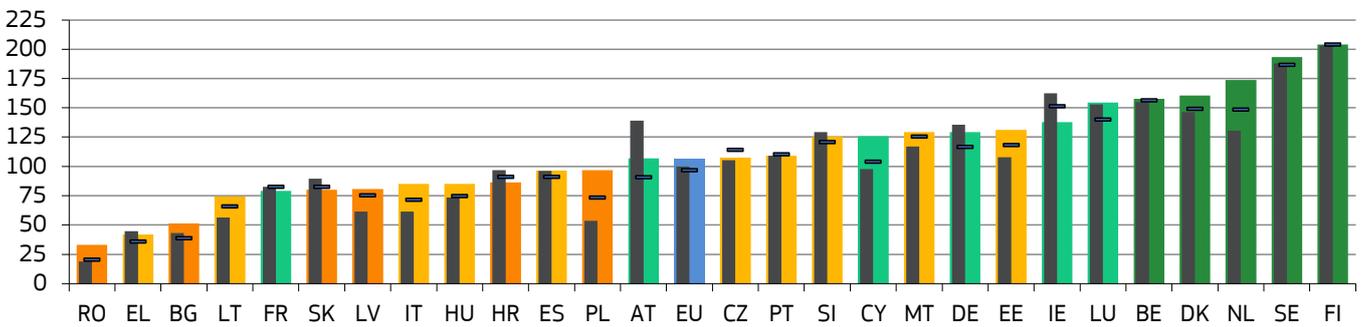
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The top-5 best performing Member States in Firm investments includes three Innovation Leaders, one Strong Innovator, and one Moderate Innovator, with Germany taking top position. The bottom-5 is composed of four Emerging Innovators and one Moderate Innovator, with lowest performance for Romania. All Innovation Leaders perform above the EU average, except for the Netherlands. Two Strong Innovators perform above the EU average and four perform below the EU average. One Moderate Innovator (Czechia) performs above the EU average and all other Moderate Innovators perform below the EU average. All Emerging Innovators perform below the EU average.

For 18 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Czechia (38.3%-points), followed by Estonia, Belgium, and Cyprus. For nine Member States performance has declined, most strongly for Slovenia (-35.0%-points), followed by Croatia. The EU average increased by 8.8%-points.

In comparison to 2022, performance has improved for seven Member States. The highest performance increase is for Czechia (34.0%-points), followed by Lithuania. For 20 Member States performance has declined, most strongly for Croatia (-18.9%-points), followed by Italy and Estonia. The EU average declined by 3.4%-points.

Use of information technologies



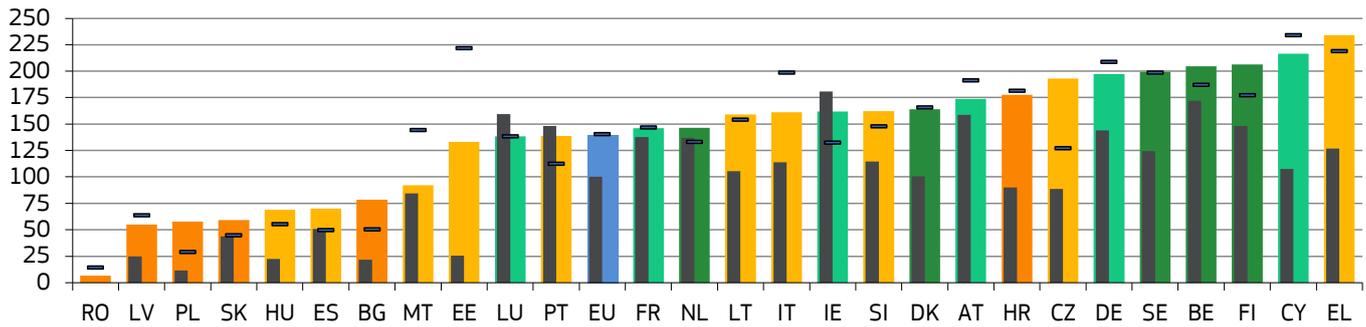
Coloured columns show Member States' performance in 2023, using the most recent data for the indicators in this dimension, relative to that of the EU in 2016. The horizontal hyphens show performance in 2022, using the next most recent data for the indicators in this dimension, relative to that of the EU in 2016. Black columns show performance in 2016 relative to that of the EU in 2016.

The top-5 best performing Member States in Use of information technologies includes all Innovation Leaders, with Finland taking top position. The bottom-5 is composed of two Emerging Innovators, two Moderate Innovators, and one Strong Innovators, with lowest performance for Romania. All Innovation Leaders perform above the EU average. Four Strong Innovators perform above the EU average and two perform below the EU average, with France showing the lowest performance. Five Moderate Innovators perform above the EU average and five perform below the EU average. All Emerging Innovators perform below the EU average.

For 18 Member States, performance has improved between 2016 and 2023. The highest performance increase is for the Netherlands (43.1%-points), followed by Poland. For nine Member States performance has declined, most strongly for Austria (-32.1%-points), followed by Ireland. The EU average increased by 7.1%-points.

In comparison to 2022, performance has improved for 20 Member States. The highest performance increase is for the Netherlands (25.3%-points), followed by Poland and Cyprus. For six Member States performance has declined, most strongly for Ireland (-13.6%-points), followed by Czechia. The EU average increased by 10.2%-points.

Innovators



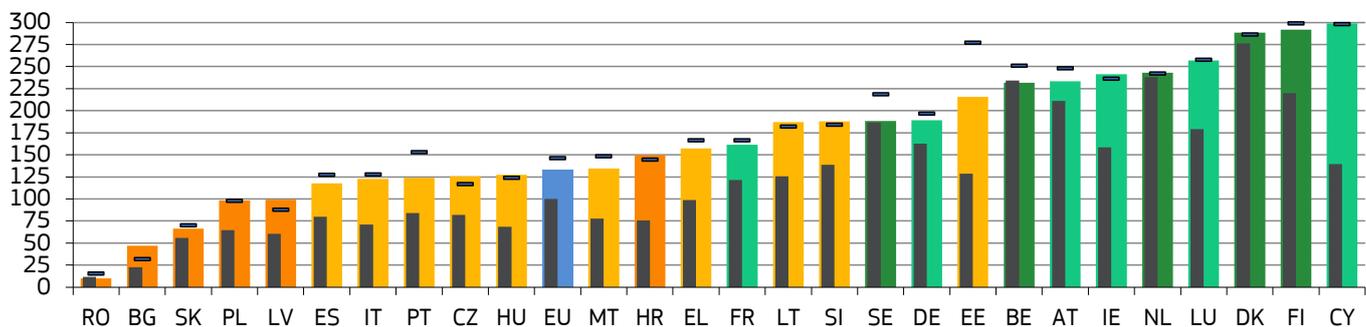
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The top-5 best performing Member States in Innovators includes three Innovation Leaders, one Strong Innovator, and one Moderate Innovator, Greece, which also takes top position. The bottom-5 is composed of four Emerging Innovators and one Moderate Innovator, with lowest performance for Romania. All Innovation Leaders perform above the EU average. All Strong Innovators also perform above the EU average, except for Luxembourg. Five Moderate Innovators perform above the EU average and five perform below the EU average. One Emerging Innovator, Croatia, performs above the EU average and all other Emerging Innovators perform below the EU average.

For 24 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Cyprus (109.0%-points), followed by Estonia, Greece, and Czechia. For three Member States performance has declined, most strongly for Luxembourg (-20.9%-points) and also for Ireland and Portugal. The EU average increased by 39.8%-points.

In comparison to 2022, performance has improved for 15 Member States. The highest performance increase is for Czechia (65.9%-points). For 11 Member States performance has declined, most strongly for Estonia (-88.4%-points), followed by Malta and Italy. The EU average declined marginally by 0.6%-points.

Linkages



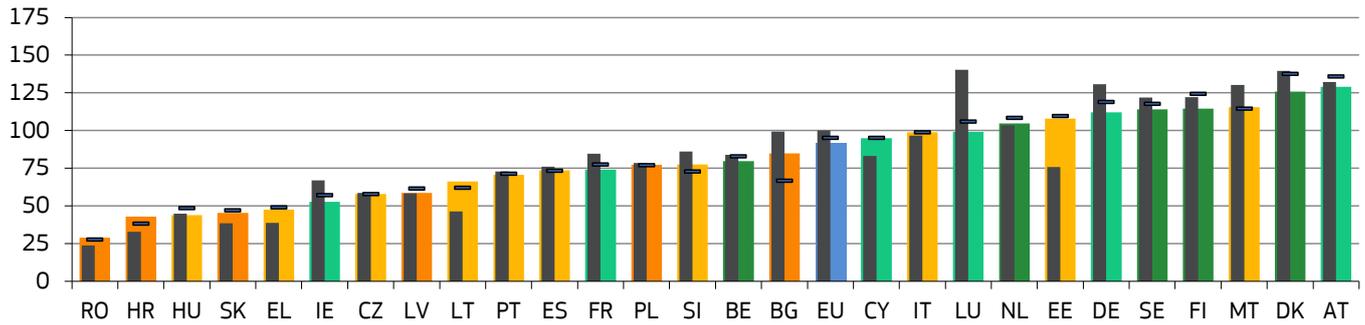
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The top-5 best performing Member States in Linkages includes three Innovation Leaders and two Strong Innovators, with Cyprus taking top position. The bottom-5 is composed of five Emerging Innovators, with lowest performance for Romania. All Innovation Leaders and all Strong Innovators perform above the EU average. Five Moderate Innovators perform above the EU average and five perform below the EU average. One Emerging Innovator, Croatia, performs above the EU average and all other Emerging Innovators perform below the EU average.

For 25 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Cyprus (159.2%-points), followed by Estonia and Ireland. For two Member States performance has declined, for Belgium and Romania. The EU average increased by 33.4%-points.

In comparison to 2022, performance has improved for 12 Member States. The highest performance increase is for Bulgaria (15.1%-points), followed by Latvia. For 15 Member States performance has declined, most strongly for Estonia (-61.5%-points), followed by Sweden and Portugal. The EU average declined by 13.1%-points.

Intellectual assets



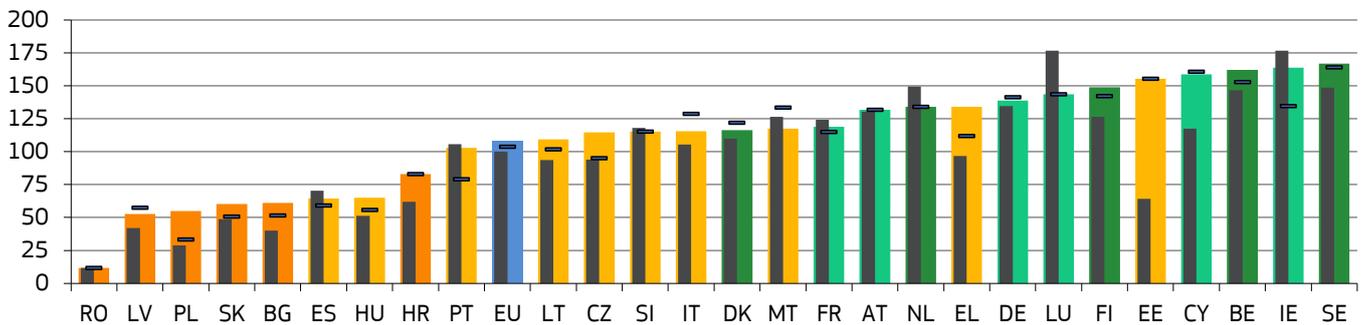
Coloured columns show Member States' performance in 2023, using the most recent data for the indicators in this dimension, relative to that of the EU in 2016. The horizontal hyphens show performance in 2022, using the next most recent data for the indicators in this dimension, relative to that of the EU in 2016. Black columns show performance in 2016 relative to that of the EU in 2016.

The top-5 best performing Member States in Intellectual assets includes three Innovation Leaders, one Strong Innovator, and one Moderate Innovator, with Austria taking top position. The bottom-5 is composed of three Emerging Innovators and two Moderate Innovators, with lowest performance for Romania. All Innovation Leaders perform above the EU average, except for Belgium. Four Strong Innovators perform above the EU average and two perform below the EU average. Three Moderate Innovators perform above the EU average and seven perform below the EU average. All Emerging Innovators perform below the EU average.

For 10 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Estonia (32.2%-points), followed by Lithuania. For 17 Member States performance has declined, most strongly for Luxembourg (-41.2%-points), followed by Germany. The EU average declined by 8.2%-points.

In comparison to 2022, performance has improved for 10 Member States. The highest performance increase is for Bulgaria (18.2%-points). For 17 Member States performance has declined, most strongly for Denmark (-11.9%-points). The EU average declined by 3.3%-points.

Employment impacts



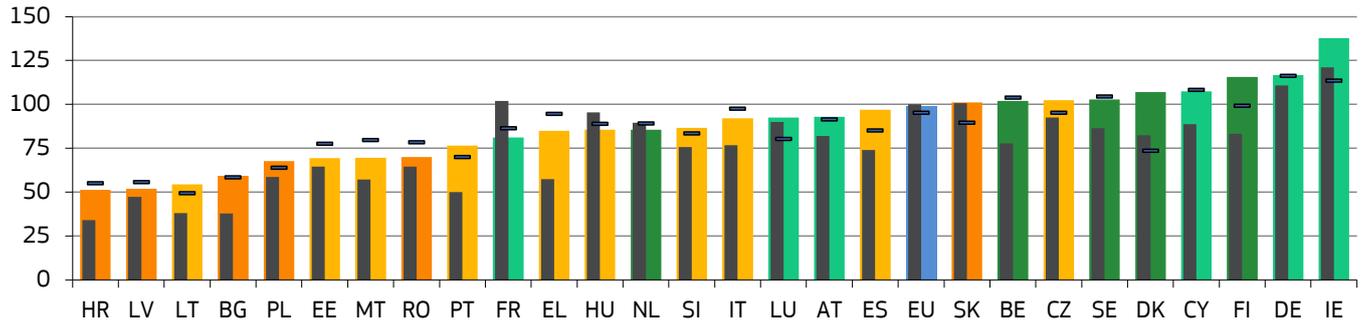
Coloured columns show Member States' performance in 2023, using the most recent data for the indicators in this dimension, relative to that of the EU in 2016. The horizontal hyphens show performance in 2022, using the next most recent data for the indicators in this dimension, relative to that of the EU in 2016. Black columns show performance in 2016 relative to that of the EU in 2016.

The top-5 best performing Member States in Employment impacts includes two Innovation Leaders, two Strong Innovators, and one Moderate Innovator, with Sweden taking top position. The bottom-5 is composed of five Emerging Innovators, with lowest performance for Romania. All Innovation Leaders and all Strong Innovators perform above the EU average. Seven Moderate Innovators perform above the EU average and three perform below the EU average. All Emerging Innovators perform below the EU average.

For 18 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Estonia (91.4%-points), followed by Cyprus and Greece. For eight Member States performance has declined, most strongly for Luxembourg (-33.1%-points). The EU average increased by 7.9%-points.

In comparison to 2022, performance has improved for 14 Member States. The highest performance increase is for Ireland (29.0%-points). For seven Member States performance did not change. For six Member States performance has declined, most strongly for Malta (-16.2%-points), followed by Italy. The EU average increased by 4.1%-points.

Sales impacts



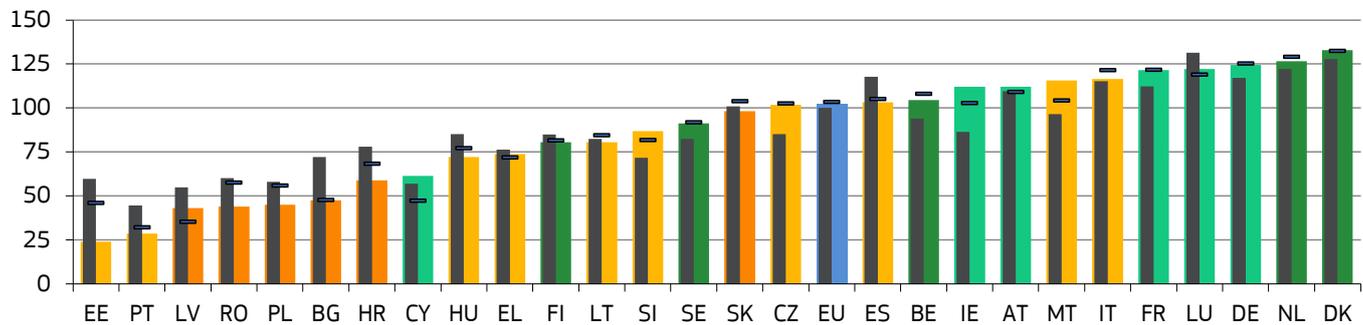
Coloured columns show Member States' performance in 2023, using the most recent data for the indicators in this dimension, relative to that of the EU in 2016. The horizontal hyphens show performance in 2022, using the next most recent data for the indicators in this dimension, relative to that of the EU in 2016. Black columns show performance in 2016 relative to that of the EU in 2016.

The top-5 best performing Member States in Sales impacts includes two Innovation Leaders and three Strong Innovators, with Ireland taking top position. The bottom-5 is composed of four Emerging Innovators and one Moderate Innovator, with lowest performance for Croatia. All Innovation Leaders perform above the EU average, except for the Netherlands. Three Strong Innovators perform above the EU average and three perform below the EU average. One Moderate Innovator, Czechia, performs above the EU average and all other Moderate Innovators perform below the EU average. One Emerging Innovator, Slovakia, performs above the EU average and all other Emerging Innovators perform below the EU average.

For 15 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Finland (32.3%-points). For 12 Member States performance has declined, most strongly for France (-20.7%-points), followed by Hungary. The EU average declined marginally by 0.7%-points.

In comparison to 2022, performance has improved for 14 Member States. The highest performance increase is for Denmark (33.5%-points), followed by Ireland. For 13 Member States performance has declined, most strongly for Malta (-10.2%-points). The EU average increased by 4.1%-points.

Environmental sustainability



Coloured columns show Member States' performance in 2023, using the most recent data for the indicators in this dimension, relative to that of the EU in 2016. The horizontal hyphens show performance in 2022, using the next most recent data for the indicators in this dimension, relative to that of the EU in 2016. Black columns show performance in 2016 relative to that of the EU in 2016.

The top-5 best performing Member States in Environmental sustainability includes two Innovation Leaders and three Strong Innovators, with Denmark taking top position. The bottom-5 is composed of three Emerging Innovators and two Moderate Innovators, with lowest performance for Estonia. Three Innovation Leaders perform above the EU average and two perform below the EU average. All Strong Innovators perform above the EU average, except for Cyprus. Three Moderate Innovators perform above the EU average and seven perform below the EU average. All Emerging Innovators perform below the EU average.

For 13 Member States, performance has improved between 2016 and 2023. The highest performance increase is for Ireland (25.68%-points). For 14 Member States performance has declined, most strongly for Estonia (-35.8%-points), followed by Bulgaria. The EU average increased by 2.7%-points.

In comparison to 2022, performance has improved for nine Member States. The highest performance increase is for Cyprus (13.9%-points), followed by Malta. For 18 Member States performance has declined, most strongly for Estonia (-22.2%-points), followed by Romania and Poland. The EU average declined marginally by 0.6%-points.

4. Innovation performance of other European countries

This chapter presents the position and analyses the results of 11 more European countries based on the same methodology used for the EU Member States.



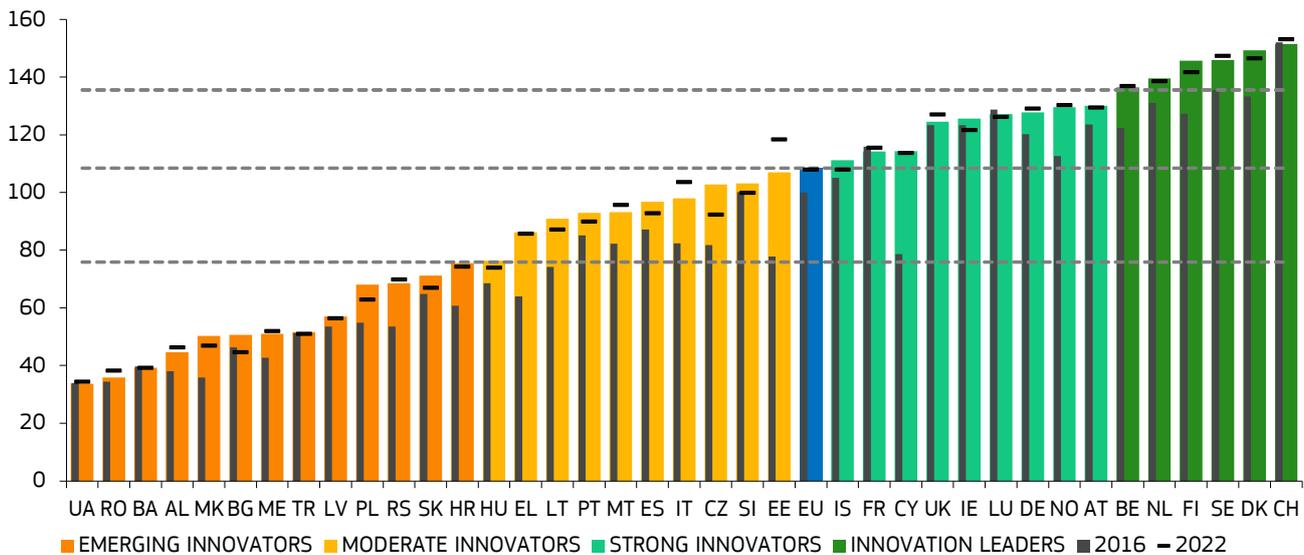
The innovation performance of 11⁵ European countries, which are not EU Member States, has been assessed using the same methodology⁶. The performance groups for all European countries are shown on a map in Figure 19. Switzerland (CH) is the overall best performing country in Europe, outperforming all EU Member States (Figure 16). Switzerland has the highest performance in six indicators: New doctorate graduates, International scientific co-publications, Foreign doctorate students, Public-private co-publications, Resource productivity, and Air emissions by fine particulates.

Iceland (IS), Norway (NO), and the United Kingdom (UK) are Strong Innovators. Iceland and Norway have the highest performance on Public-private co-publications, a position they share with Switzerland. Iceland also has highest performance on International scientific

co-publications, and Norway also has highest performance on Venture capital expenditures and Innovative SMEs collaborating with others. The United Kingdom has highest performance on four indicators, of which two are shared with Switzerland: Venture capital expenditures, Government support for business R&D, Job-to-job mobility of Human Resources in Science & Technology, and Resource productivity.

Albania (AL), Bosnia and Herzegovina (BA), Montenegro (ME), North Macedonia (MK), Serbia (RS), Türkiye (TR), and Ukraine (UA) are Emerging Innovators. Three countries show highest performance across all countries on at least one indicator: Albania on Sales of innovative products and Environment-related technologies, Bosnia and Herzegovina on Environment-related technologies, and Serbia on Non-R&D innovation expenditures.

Figure 16: Performance groups: innovation performance per dimension



All performance scores are relative to that of the EU in 2016. Coloured columns show countries' performance in 2023, using the most recent data for 32 indicators. The horizontal hyphens show performance in 2022, using the next most recent data. Grey columns show countries' performance in 2016. The dashed lines show the threshold values between the performance groups, where the threshold values of 70%, 100%, and 125%, when using the latest 2023 data, have been adjusted upward by multiplying with 1.085 to reflect the performance increase of the EU between 2016 and 2023 as the graph shows performance scores relative to the EU in 2016.

Compared to 2016, the performance of three countries has improved faster than the EU (8.5%-points) (Figure 17). For Norway, strong growth is due to high performance increases on (in decreasing order) International scientific co-publications, Public-private co-publications, Innovative SMEs collaborating with others, and Venture capital expenditures. For North Macedonia, strong growth is due to high performance increases on Foreign doctorate students, Job-to-job mobility of Human Resources in Science and Technology, and Environment-related technologies. For Serbia, strong growth is due to high performance increases on SMEs with product innovations, Broadband penetration, and Employment in innovative enterprises.

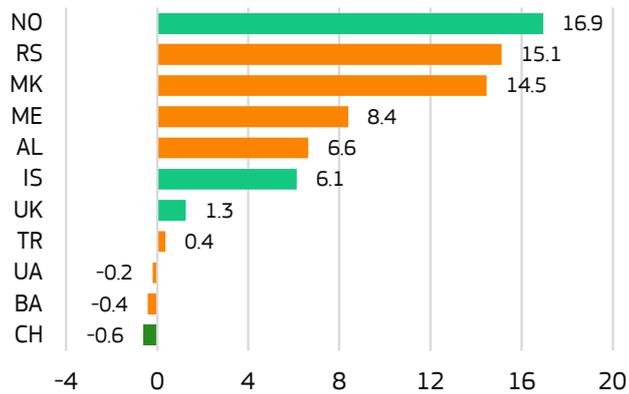
For five countries, performance between 2016 and 2023 has increased at a rate below that of the EU (8.5%) and for three countries performance has decreased. For Montenegro, performance has increased strongly on Broadband penetration, Population with tertiary education, and International scientific co-publications. For Albania, performance has increased strongly on Environment-related technologies, Population with tertiary education, and Most-cited publications. For Iceland, growth is due to high performance increases on Foreign doctorate students, Resource productivity, and R&D expenditures in the business sector. For the United Kingdom, performance has increased strongly on Government support for business R&D, Venture capital expenditures, and Public-private co-publications. For Türkiye, performance has increased strongly on Government support for business R&D and Population with tertiary education

For both Bosnia and Herzegovina, Switzerland, and Ukraine performance decreased. For Ukraine, relatively strong increases in Venture capital expenditures and Knowledge-intensive services exports, were offset by relatively strong decreases in Employment in knowledge-intensive activities and Medium and high-tech product exports. For Bosnia and Herzegovina, performance has increased relatively strongly on International scientific co-publications, Public-private co-publications, and Broadband penetration, but reduced strongly on Government support for business R&D. For Switzerland, strong increases in Venture capital expenditures, Job-to-job mobility of Human resources in Science & Technology, and Foreign doctorate students, have been matched by strong decrease in Sales of innovative products, SMEs with product innovations, and Design applications.

Compared to 2022, performance has increased most strongly for North Macedonia and Iceland. A smaller increase was observed for Türkiye and Bosnia and Herzegovina. Performance decreased for all other countries and most strongly for the United Kingdom (Figure 18). Performance declined between 2022 and 2023 for almost all 11 countries for the following indicators: Population with tertiary education, SMEs with business process innovations, Employment in innovative enterprises, Sales of innovative products, and Resource productivity.

⁵ Compared to previous EIS reports, Israel is no longer included as data for the eight years covered in the EIS 2023 are not available for too many indicators.

⁶ Data are available for 32 indicators for Norway and Serbia, 31 indicators for the United Kingdom, 30 indicators for Iceland, North Macedonia, and Türkiye, 29 indicators for Montenegro and Switzerland, and 25 indicators for Bosnia and Herzegovina. Data availability is relatively weak for Albania with data available for 23 indicators, and weak for Ukraine with data for 21 indicators.

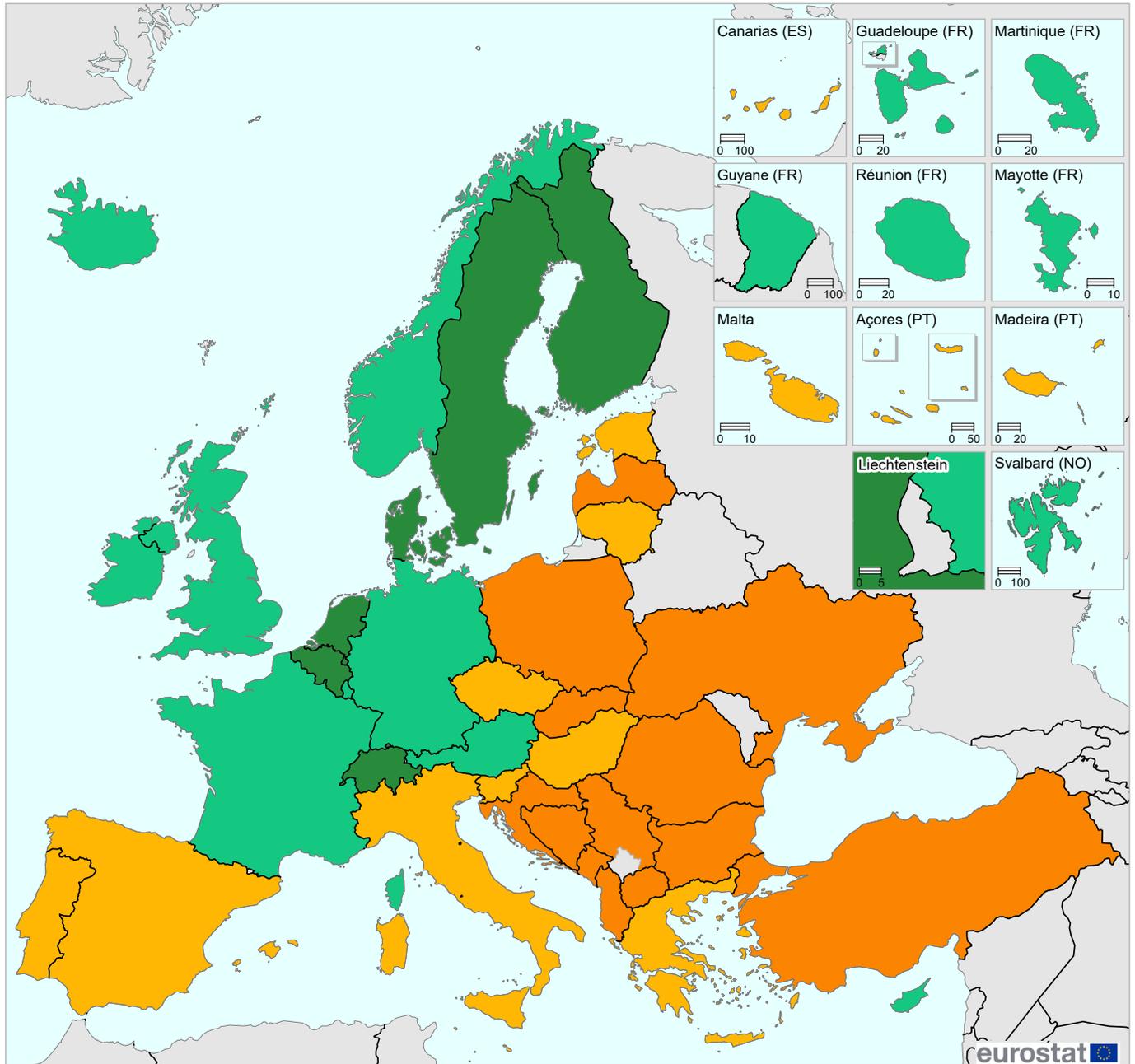
Figure 17: Performance change between 2016 and 2023

Performance change is measured as the difference between the 2023 and 2016 scores relative to that of the EU in 2016.

Figure 18: Performance change between 2022 and 2023

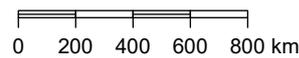
Performance change is measured as the difference between the 2023 and 2022 scores relative to that of the EU in 2016.

Figure 19: Map showing the performance of European countries' innovation systems



- Innovation Leader
- Strong Innovator
- Moderate Innovator
- Emerging Innovator

Administrative boundaries: © EuroGeographics © UN-FAO © Turkstat
 Cartography: Eurostat — GISCO, 06/2023

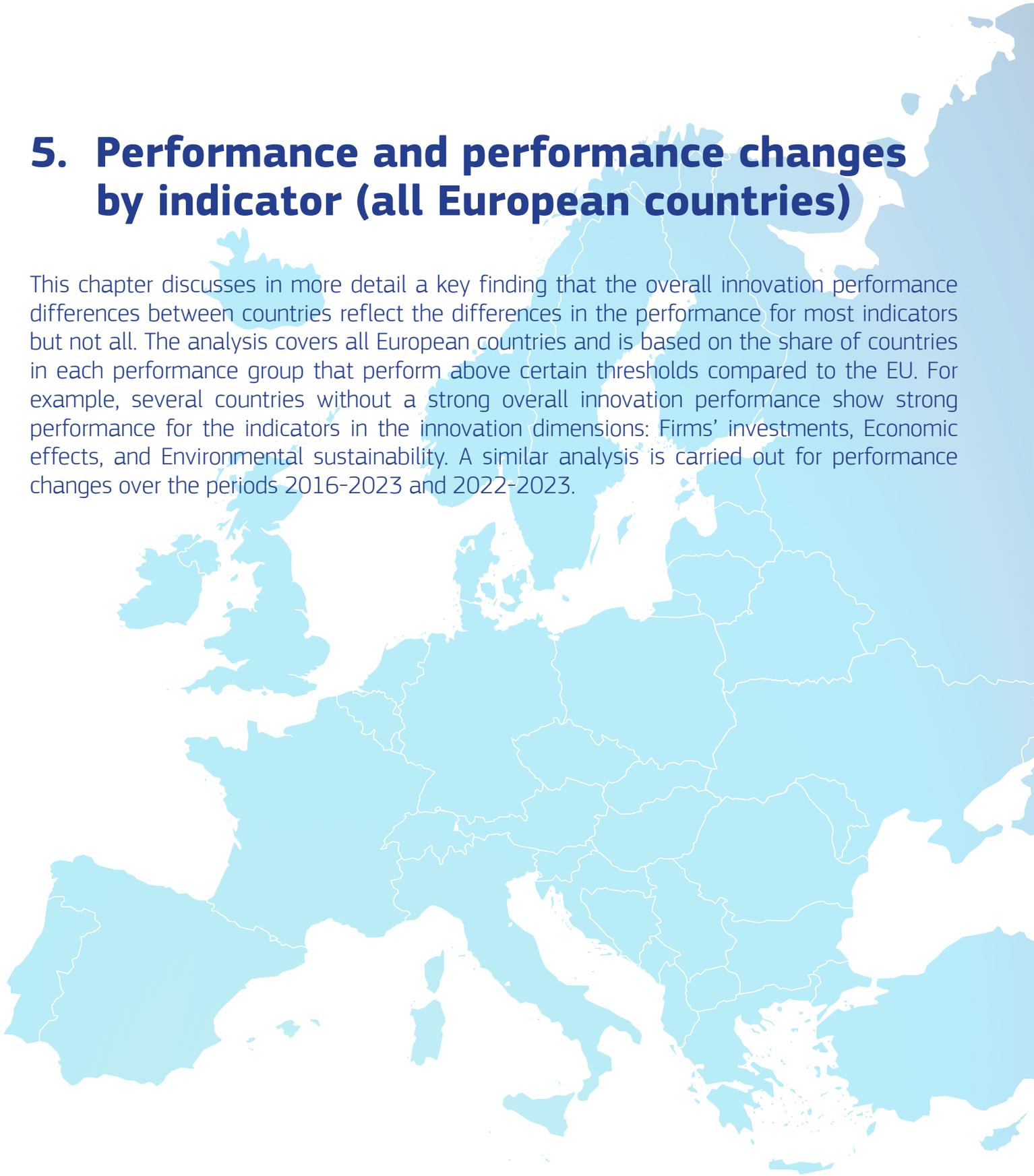


Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the European Union.

Source: European Commission – European Innovation Scoreboard 2023

5. Performance and performance changes by indicator (all European countries)

This chapter discusses in more detail a key finding that the overall innovation performance differences between countries reflect the differences in the performance for most indicators but not all. The analysis covers all European countries and is based on the share of countries in each performance group that perform above certain thresholds compared to the EU. For example, several countries without a strong overall innovation performance show strong performance for the indicators in the innovation dimensions: Firms' investments, Economic effects, and Environmental sustainability. A similar analysis is carried out for performance changes over the periods 2016-2023 and 2022-2023.



More innovative countries are expected to perform well on all indicators. As shown in Table 2, this holds for most indicators but not all. **Innovation Leaders** show highest performance (with countries performing above the EU average for at least 80% of the cases⁷) on the indicators in the dimensions Human resources, Attractive research systems, Digitalisation, Use of information technologies, Innovators, Linkages, and Employment impacts. The Innovation Leaders are performing less well (with countries performing above the EU average for less than 60% of the cases) on the indicators in the dimensions Economic effects and Environmental sustainability. Concerning individual indicators, weak performance⁸ has been found in Medium and high-tech product exports with all six Innovation Leaders performing below the EU average, Direct and indirect government funding for business R&D, Non-R&D innovation expenditures, and Development of environment-related technologies with four countries performing below average.

The **Strong Innovators** show highest performance (with countries performing above the EU average for at least 80% of the cases) on the indicators in the dimensions Attractive research systems, Linkages, and Employment impacts. The Strong Innovators are performing less well (with countries performing above the EU average for less than 50% of the cases) on the indicators in the dimensions Firm investments, Intellectual assets, and Economic effects. Concerning individual indicators, weak performing indicators include Non-R&D innovation expenditures and Medium and high-tech product exports with eight out of 9 Strong Innovators performing below the EU average, PCT patent applications with seven countries performing below average, and R&D expenditures in the business sector and Design applications with six countries performing below average.

The **Moderate Innovators** show highest performance (with countries performing above the EU average for at least 50% of the cases) on the indicators in the dimensions Innovators, Linkages, and Employment effects. The Moderate Innovators are performing less well (with countries performing above the EU average for less than 25% of the cases) on the indicators in the dimensions Finance and support, Firm investments, and Environmental sustainability. Concerning individual indicators, strong performing indicators include Public-private co-publications with nine out of 10 Moderate Innovators performing above the EU average, Population with tertiary education, Foreign doctorate students, and Trademark applications with seven countries performing above average. Weak performing indicators performance include Scientific international co-publications, PCT patent applications, and Development of environment-related technologies with all Moderate Innovators performing below the EU average, Most-cited scientific publications, R&D expenditures in the public sector, R&D expenditures in the business sector, and Innovation expenditures per person employed with 9 countries performing below average.

The **Emerging Innovators** show below average performance on most indicators and dimensions. Relatively good performance is seen for the indicators in the Innovators dimension (with countries performing above the EU average for almost 25% of the cases). Concerning individual indicators, relatively strong performing indicators include SMEs with product innovations with four out of 13 Emerging Innovators performing above the EU average, Development of environment-related technologies with three countries performing above average.

For **performance change between 2016 and 2023** (Table 3) there are no clear patterns. Increasing and decreasing performance is seen across all performance groups and indicators. Across all countries and indicators (with a maximum of 1,216 cases), performance increased for 711 cases (61%, average increase), remained the same for 138 cases (12%), and declined for 323 cases (28%, average decline). Both the Innovation Leaders (63%) and Strong Innovators (67%) show above average shares of increasing cases, the Strong Innovators (32%) show an above average share of decreasing cases. Only for International scientific co-publications performance increased for all countries. For Public-private scientific co-publications, Knowledge-intensive services exports, and Resource productivity performance increased for more than 90% of the countries. Indicators showing low shares of countries with increasing performance include New doctorate graduates, PCT patent applications, Employment in knowledge-intensive activities, and Development of environment-related technologies.

For **performance change between 2022 and 2023** (Table 4) there are no clear patterns either, but compared to the whole 2016-2023 period, performance change has worsened. Across all countries and indicators, performance is increasing for 468 cases (40%), remained the same for 288 cases (25%), and declined for 416 cases (35%). The Moderate Innovators (48%) show above average shares of increasing cases. The Innovation Leaders (39%) and also the Moderate Innovators (39%) show above average shares of decreasing cases. For no indicator, performance increased for all countries. The highest shares of countries (between 60% and 80%) with increasing performance are for Foreign doctorate students, Broadband penetration, Venture capital investments, Enterprises providing ICT training, Employed ICT specialists, and Resource productivity. The lowest share of countries (below 10%) with increasing performance is for New doctorate graduates. High shares of countries (at least 55% of countries) with declining performance are for R&D expenditures in the public sector, Job-to-job mobility of HRST, PCT patent applications, Design applications, and Development of environment-related technologies.

⁷ Calculated as the share of green coloured cells out of all cells, e.g. for the Innovation Leaders in Human resources 15 out of 18 cells are green and indicate performance above the average of the EU.

⁸ For both the Innovation Leaders and Strong Innovators only weak performing indicators will be identified as these countries are expected to perform above average on individual indicators given their above EU average innovation performance.

Table 2: Performance in 2023 by indicator (countries grouped in descending 2023 performance order)

	CH	DK	SE	FI	NL	BE	AT	NO	DE	LU	IE	UK	CY	FR	IS	EE	SI	CZ	IT	ES	MT	PT	LT	EL	HU	HR	SK	RS	PL	LV	TR	ME	BG	MK	AL	BA	RO	UA	
Human resources																																							
1.1.1 New doctorate graduates																																							
1.1.2 Population completed tertiary education																																							
1.1.3 Lifelong learning																																							
Attractive research systems																																							
1.2.1 International scientific co-publications																																							
1.2.2 Scientific publications among top 10% most cited																																							
1.2.3 Foreign doctorate students																																							
Digitalisation																																							
1.3.1 Broadband penetration																																							
1.3.2 Individuals with above basic overall digital skills																																							
Finance and support																																							
2.1.1 R&D expenditure in the public sector																																							
2.1.2 Venture capital investments																																							
2.1.3 Direct and indirect government support for business R&D																																							
Firm investments																																							
2.2.1 R&D expenditure in the business sector																																							
2.2.2 Non-R&D innovation expenditure																																							
2.2.3 Innovation expenditures per person employed																																							
Use of information technologies																																							
2.3.1 Enterprises providing ICT training																																							
2.3.2 Employed ICT specialists																																							
Innovators																																							
3.1.1 SMEs with product innovations																																							
3.1.2 SMEs with business process innovations																																							
Linkages																																							
3.2.1 Innovative SMEs collaborating with others																																							
3.2.2 Public-private co-publications																																							
3.2.3 Job-to-job mobility of Human Resources in S&T																																							
Intellectual assets																																							
3.3.1 PCT patent applications																																							
3.3.2 Trademark applications																																							
3.3.3 Design applications																																							
Employment impacts																																							
4.1.1 Employment in knowledge-intensive activities																																							
4.1.2 Employment in innovative enterprises																																							
Economic effects																																							
4.2.1 Medium & high-tech product exports																																							
4.2.2 Knowledge-intensive services exports																																							
4.2.3 Sales of new-to-market and new-to-enterprise innovations																																							
Environmental sustainability																																							
4.3.1 Resource productivity																																							
4.3.2 Air emissions in fine particulates (PM2.5) in Industry																																							
4.3.3 Development of environment-related technologies																																							

Dark green: performance above 125% of EU; light green: performance between 100% and 125%; light orange: performance between 70% and 100%; dark orange: performance below 70%, white no change.

Table 3: Performance change between 2016 and 2023 by indicator (countries grouped in descending 2023 performance order)

	EU	CH	DK	SE	FI	NL	BE	AT	NO	DE	LU	IE	UK	CY	FR	IS	EE	SI	CZ	IT	ES	MT	PT	LT	EL	HU	HR	SK	RS	PL	LV	TR	ME	BG	MK	AL	BA	RO	UA		
Human resources																																									
1.1.1 New doctorate graduates	Green																																								
1.1.2 Population completed tertiary education	Green																																								
1.1.3 Lifelong learning	Green																																								
Attractive research systems																																									
1.2.1 International scientific co-publications	Green																																								
1.2.2 Scientific publications among top 10% most cited	Green																																								
1.2.3 Foreign doctorate students	Green																																								
Digitalisation																																									
1.3.1 Broadband penetration	Green																																								
1.3.2 Individuals with above basic overall digital skills	Green																																								
Finance and support																																									
2.1.1 R&D expenditure in the public sector	Green																																								
2.1.2 Venture capital investments	Green																																								
2.1.3 Direct and indirect government support for business R&D	Green																																								
Firm investments																																									
2.2.1 R&D expenditure in the business sector	Green																																								
2.2.2 Non-R&D innovation expenditure	Green																																								
2.2.3 Innovation expenditures per person employed	Green																																								
Use of information technologies																																									
2.3.1 Enterprises providing ICT training	Green																																								
2.3.2 Employed ICT specialists	Green																																								
Innovators																																									
3.1.1 SMEs with product innovations	Green																																								
3.1.2 SMEs with business process innovations	Green																																								
Linkages																																									
3.2.1 Innovative SMEs collaborating with others	Green																																								
3.2.2 Public-private co-publications	Green																																								
3.2.3 Job-to-job mobility of Human Resources in S&T	Green																																								
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4.2.3 Sales of new-to-market and new-to-enterprise innovations	Green																																								
Environmental sustainability																																									
4.3.1 Resource productivity	Green																																								
4.3.2 Air emissions in fine particulates (PM2.5) in Industry	Green																																								
4.3.3 Development of environment-related technologies	Green																																								

Green: positive performance change; orange: negative performance change; white: no change; grey: no data.

Table 4: Performance change between 2022 and 2023 by indicator (countries grouped in descending 2023 performance order)

	EU	CH	DK	SE	FI	NL	BE	AT	NO	DE	LU	IE	UK	CY	FR	IS	EE	SI	CZ	IT	ES	MT	PT	LT	EL	HU	HR	SK	RS	PL	LV	TR	ME	BG	MK	AL	BA	RO	UA				
Human resources																																											
1.1.1 New doctorate graduates																																											
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1.2.2 Scientific publications among top 10% most cited																																											
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4.3.2 Air emissions in fine particulates (PM2.5) in Industry																																											
4.3.3 Development of environment-related technologies																																											

Green: positive performance change; orange: negative performance change; white: no change; grey: no data.

6. Benchmarking against global competitors

This section provides a comparison of the EU to some of its main global economic competitors including Australia (AU), Brazil (BR), Canada (CA), Chile (CL), China (CN), India (IN), Japan (JP), Mexico (MX), South Africa (ZA), South Korea (KR), and the United States (US).

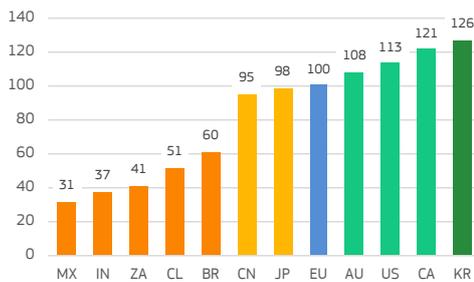


6.1 EU's innovation performance in an international comparison

South Korea is the most innovative country (Figure 20), performing well above the EU. Australia, Canada and the United States, also have a performance lead over the EU. The EU has a performance lead over Brazil, Chile, China, India, Japan, Mexico and South Africa.

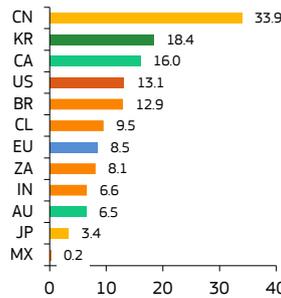
Based on relative-to-EU performance in 2023, South Korea would be an Innovation Leader, Australia, Canada, and the United States would be Strong Innovators, China and Japan would be Moderate Innovators, and Brazil, Chile, India, Mexico, and South Africa would be Emerging Innovators.

Figure 20: Performance global competitors



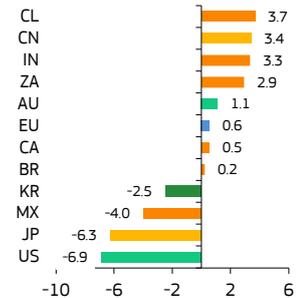
Coloured columns show performance in 2023 relative to that of the EU in 2023.

Figure 21: Performance change between 2016 and 2023



Performance change is measured as the difference between the 2023 and 2016 scores relative to that of the EU in 2016.

Figure 22: Performance change between 2022 and 2023



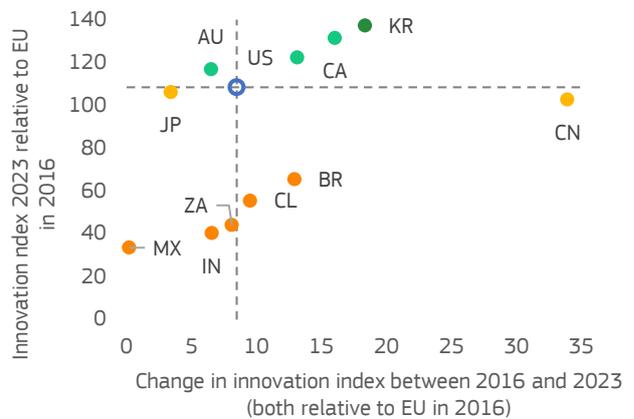
Performance change is measured as the difference between the 2023 and 2022 scores relative to that of the EU in 2016.

Performance between 2016 and 2023 has increased most in China, followed by South Korea and Canada (Figure 21). For five global competitors, performance grew but at a lower rate than that of the EU. For all global competitors, performance improved between 2016 and 2023.

More recently, between 2022 and 2023, performance has changed marginally for Brazil, Canada, and the EU (Figure 22). Performance has decreased strongly for Japan, Mexico, South Korea, and the United States. Performance improved most for Chile, China, India, and South Africa.

Combining current performance in 2023 and performance change between 2016 and 2023 shows that Canada, South Korea, and the United States have an increasing performance lead over the EU, and the performance lead of Australia is declining (Figure 23). The EU has an increasing performance lead over India, Japan, Mexico, and South Africa, but a declining performance lead over Brazil, China and Chile. China's performance level is almost at par with that of the EU, and with continued growth, China is expected to overtake the EU and have a performance lead in 2024.

Figure 23: EU is catching up compared to the most innovative global competitors



The vertical axis shows countries' performance in 2023 relative to that of the EU in 2016. The horizontal axis shows the change in performance between 2016 and 2023 relative to that of the EU in 2016. The intersection of the dashed lines shows the respective score for the EU (blue circle).

Methodology

The economic and population size of most global competitors outweighs that of many of the individual EU Member States. Thus, innovation performance is compared to the aggregate of the Member States, i.e. the EU. Data availability is more limited for global competitors than for European countries. Therefore, a more restricted set of 19 indicators (Annex H) has been used for the international comparison of the EU with its global competitors. For some indicators, different definitions or proxy indicators have been used as compared to the previous chapters⁹:

- For Employed ICT specialists, data are not available. The indicator Employment share in information and communication services (NACE J) is used as proxy. The same proxy indicator has also been used in the 2021 edition of the Regional Innovation Scoreboard.
- For Trademark applications, comparable data on resident and non-resident applications have been used from the World Development Indicators.
- For Design applications, comparable data on resident and non-resident applications have been used from the World Development Indicators.
- For Medium and high-tech product exports and Knowledge-intensive services exports, the data for the EU exclude trade between Member States ('intra-EU trade', and only include exports to non-Member States ('extra-EU trade').
- For Knowledge-intensive services exports, data have been used from the UN Comtrade database using the older EBOPS 2002 classification and not the latest EBOPS 2010 classification.
- For Air pollution in PM2.5 in Industry, data are not available. The indicator Exposure to air pollution (PM2.5) is used as a proxy. The same proxy indicator has also been used in the 2021 edition of the Regional Innovation Scoreboard.

For each of the global competitors, the following pages briefly discuss the performance of their innovation system compared to the EU, and relative strengths and weaknesses for the different indicators. The countries are ordered according to their performance rank order. For each country, a table with contextual data is also included, similar to those used for the European countries in Chapter 8. Data have been extracted from various sources including Eurostat, OECD (Main Science and Technology Indicators (MSTI), Education at a Glance, Green Growth Indicators), different UN data sources (including UNESCO Institute for Statistics, United Nations (Comtrade) and UNIDO), Scopus, World Bank (World Development Indicators), and National Statistical Offices for some of the countries included in the international comparison.

For the international benchmarking, a comparable list of contextual indicators has been used as those in Chapter 7. However, for most indicators measuring Performance and structure of the economy and Demography data have been retrieved from other data sources than Eurostat (cf. Annex I). For the international comparison, the number of Unicorns is included in the Business and Entrepreneurship category. Unicorns are start-ups with a value of more than US\$1 billion.

Differences in contextual setting

The results for the contextual indicators on the following pages show the following differences with the EU. Top R&D spending firms in **South Korea** spend almost three times as much on R&D compared to the EU. On the other hand, FDI net inflows as a percentage of GDP are much lower. **Canada's** economy shows a lower employment share for industry, and a higher employment share for services. Entrepreneurial activities are at a much higher level. For the **United States**, entrepreneurial activities are at a higher level, and top R&D spending firms spend twice as much on R&D. The number of Unicorns is more than six times that of the EU. The relative size of **Australia's** manufacturing industry is less than half that of the EU, but entrepreneurial activities are at a higher level.

China's agricultural sector is in relative terms almost six times bigger compared to the EU, while also the relative size of the manufacturing industry is close to twice that of the EU. There are less top R&D spending firms per million population in China, but they spend, on average, more on R&D. Entrepreneurial activities and the number of Unicorns in China are at a higher level. **Japan's** top R&D spending firms spend almost twice as much on R&D compared to EU top R&D spending firms. FDI net inflows as a percentage of GDP are lower, and Japan is also facing a declining population.

Brazil has a relatively high share of employment in agriculture. Furthermore, entrepreneurial activities are at a much higher level in Brazil, however top R&D spending firms spend less on R&D. **Chile** has a relatively high share of employment in agriculture and both FDI net inflows and entrepreneurial activities are also higher compared to the EU. **India's** agricultural sector accounts for more than 40% of total employment, and FDI net inflows and entrepreneurial activities are at a higher level. The structure of **South Africa's** economy as measured by employment shares is comparable to that of the EU. R&D spending from top R&D enterprises are relatively low but FDI net inflows as a percentage of GDP and entrepreneurial activity are relatively high. **Mexico's** agricultural sector is in relative terms close to 3 times bigger compared to the EU and FDI net inflows are also higher compared to the EU. Spending from top R&D enterprises is relatively low as well as the number of Unicorns.

⁹ For these indicators aggregate results for the EU are not comparable to those used in the European benchmarking analysis.

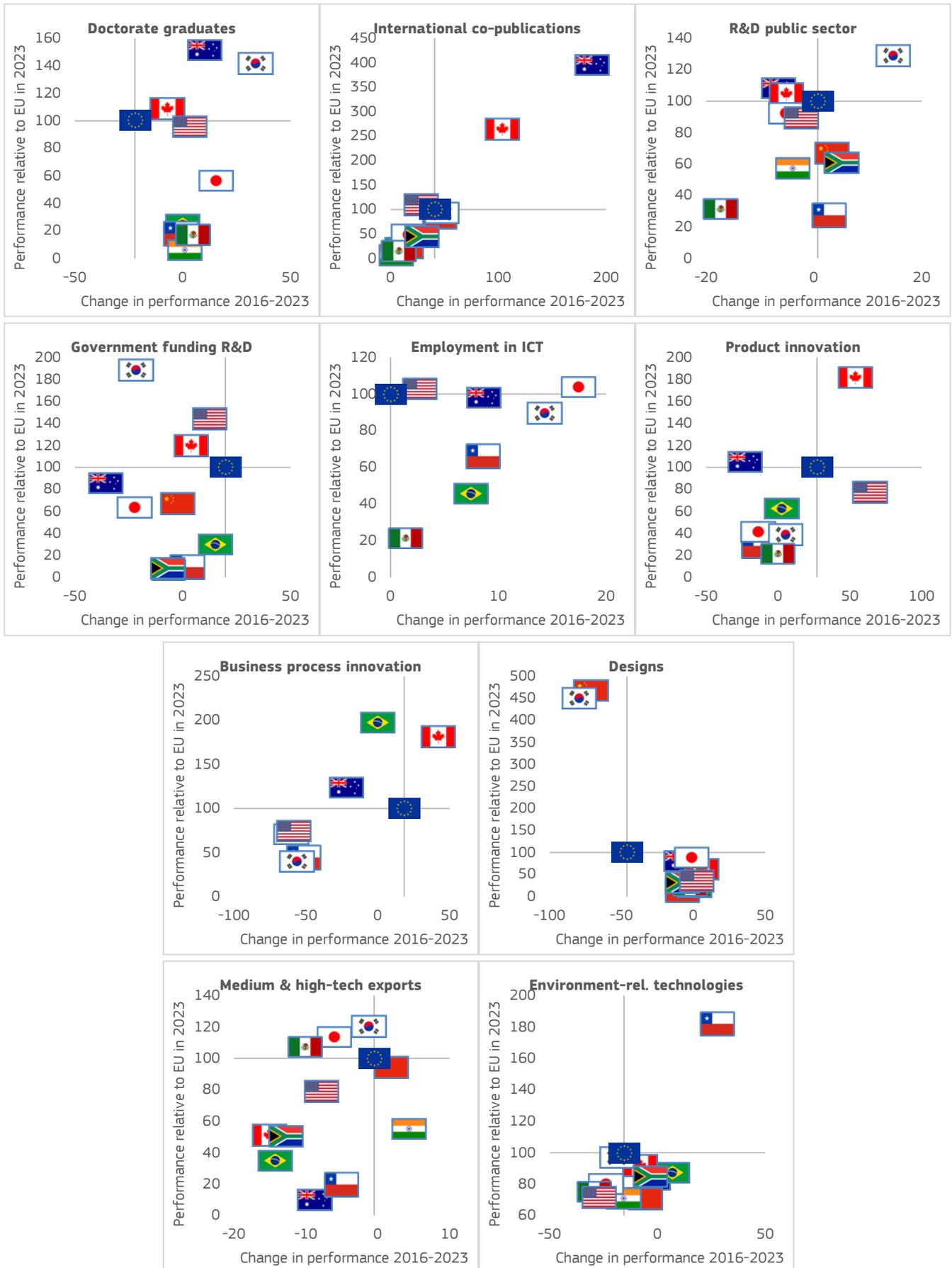
Differences in innovation performance

The performance of the EU compared to its global competitors can be assessed from the scatter plots in Figures 24 to 26. The vertical axis shows the more recent performance in 2023, the horizontal axis shows performance change between 2016 and 2023. The horizontal and vertical bold lines show the performance of the EU. Global competitors above and to the right of both lines, combine a stronger performance level with faster growth. Global competitors above and to the left of both lines, combine a stronger performance level with slower growth. Global competitors below and to the right of both lines, combine a weaker performance level with faster growth. Global competitors below and to the left of both lines, combine a weaker performance level with slower growth.

The EU is showing strong performance in the following indicators (Figure 24):

- + In Environment-related technologies the EU has overall 2nd performance. Data for this indicator have not been updated compared to the EIS 2022. Several countries performing below but relatively close to the level of the EU (among others Brazil, Canada, South Africa) have shown a faster rate of improvement and the high rank position of the EU is at risk.
- + In Employment in ICT the EU has overall 3rd performance. There is no performance change for the EU as there was a break in series in 2021 for data from Eurostat. For the global competitors there were no breaks in series in the data from the OECD and UNECE.
- + In SMEs with product innovations, using data from 2018 innovation surveys, the latest innovation survey data collected by the OECD, the EU has overall 3rd performance. The EU has improved its performance relative to most global competitors, except Canada.
- + In Design applications the EU has overall 3rd performance. The EU has improved its performance relative to China and South Korea but the gap to both countries is still very high. All other global competitors have improved their performance relative to the EU.
- + In New doctorate graduates the EU has overall 4th performance. However, all global competitors have improved at a faster rate and Canada has overtaken the EU.
- + In International scientific co-publications, the EU has overall 4th performance. The EU is facing an increasing performance gap to both Australia and China. The EU is closing its performance gap to both Canada and the United States.
- + In R&D expenditures in the public sector the EU has overall 4th performance. The EU has grown faster than six global competitors but has grown slower than 4 global competitors. The EU is at risk of being overtaken by Japan and the United States but at the same time might be able to overtake Australia and Canada.
- + In Direct and indirect government funding of business R&D the EU has overall 4th performance. The EU has improved its performance relative to all global competitors and there is no imminent threat of being overtaken by any global competitor. The gap to Canada has become smaller.
- + In SMEs with business process innovations, using data from 2018 innovation surveys, the EU has overall 4th performance. Only Canada has shown a faster rate of improvement than the EU. The gap to Australia seems to be too big to expect the EU to overtake Australia soon.
- + In Medium & high-tech product exports the EU has overall 4th performance. The EU is closing its gap with Japan, Mexico and South Korea, but is losing its lead over China.

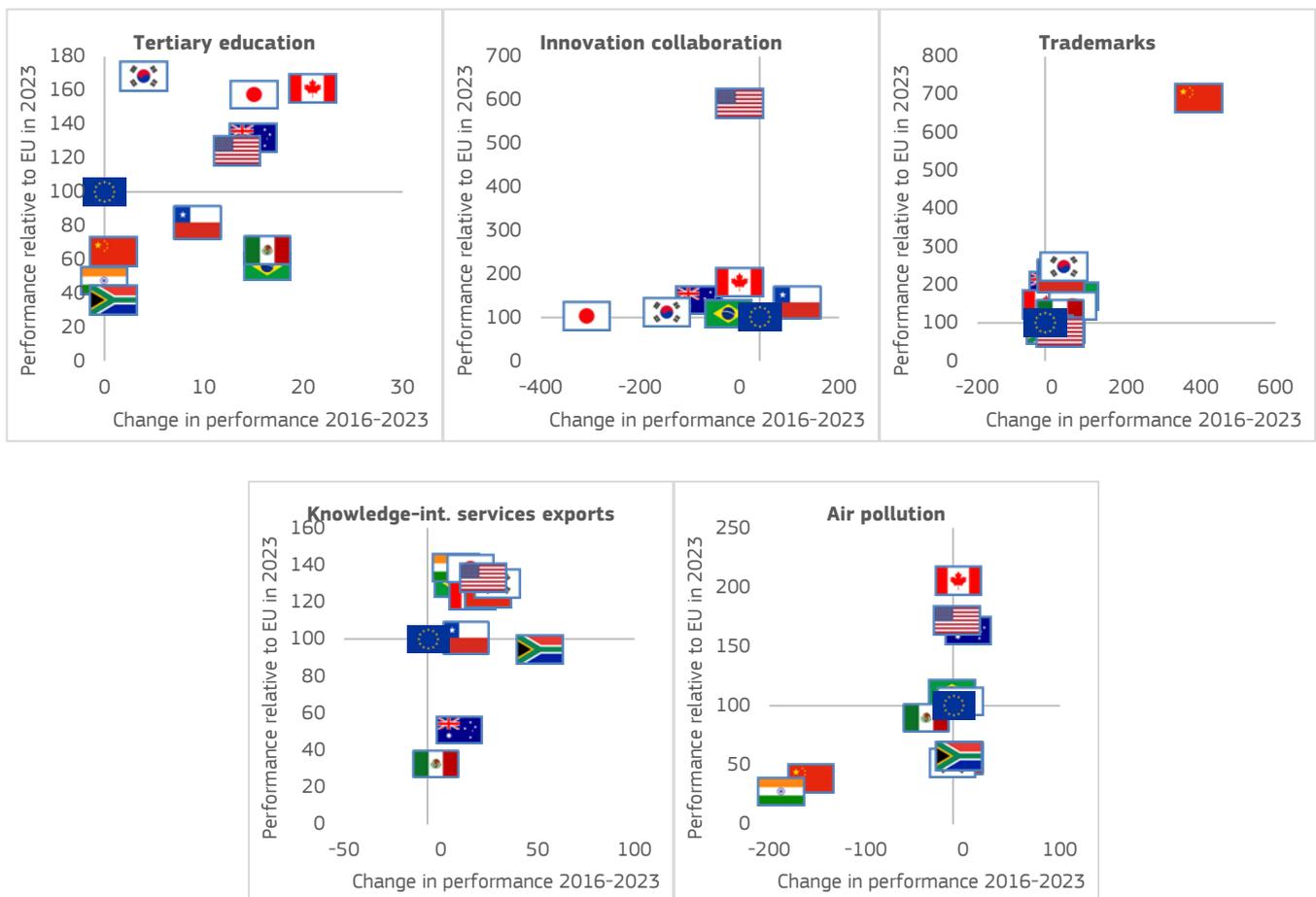
Figure 24: Indicators where the EU shows a strong performance against the global competitors



The EU is showing relatively weak performance in the following indicators (Figure 25):

- In Trademark applications the EU has overall 9th performance. The EU performance has worsened over time and all other global competitors have improved their position relative to the EU. Trademarks seems to be the weakest element in the research and innovation system of the EU.
- In Knowledge-intensive services exports the EU has overall 9th performance. The EU has shown the worst performance improvement compared to all global competitors performing with a declining performance over time. Chile has overtaken the EU and South Africa has almost closed its performance gap to the EU.
- In Innovative SMEs collaborating with others, using data from 2018 innovation surveys, the EU has overall 8th and lowest performance (data are not available for four global competitors). The EU has shown a faster improvement than most global competitors, only Chile has grown even faster. It seems likely that the EU might soon overtake Brazil, Japan and South Korea.
- In Population with completed tertiary education the EU has overall 6th performance. The EU performance has not improved due to a break in series in 2021 for data from Eurostat. For the global competitors there were no breaks in series in the data from the OECD.
- In Exposure to air pollution the EU has overall 6th performance. The EU has seen a decline of its performance and has also done worse than most of its global competitors. Japan has overtaken the EU.

Figure 25: Indicators where the EU shows a weak performance against the global competitors

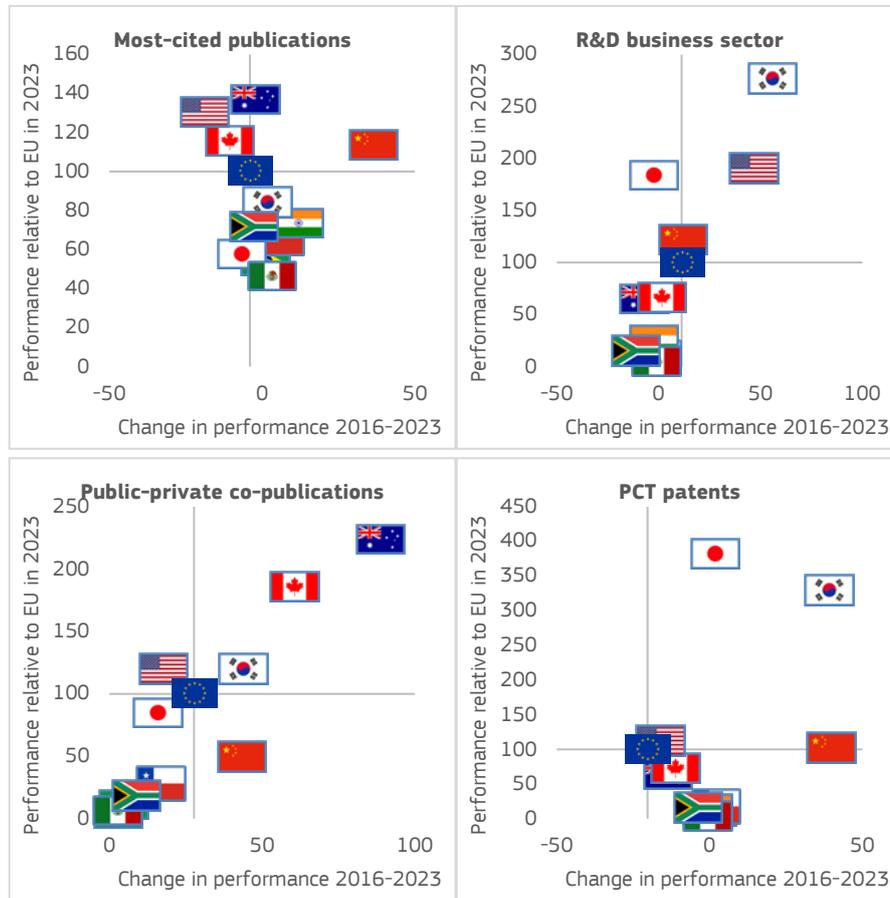


For the other indicators (Figure 26), the EU's performance is in between that of its global competitors as shown by the more central position of the EU in the scatter plots for Most-cited scientific publications, R&D expenditures in the business sector, Public-private scientific co-publications, and PCT patent applications.

South Korea, Canada, the United States and Australia perform better than the EU. These four countries all outperform the EU on Tertiary

education, R&D expenditures in the business sector, and Public-private co-publications. The EU has a substantial performance gap with South Korea and the United States on R&D expenditures in the business sector, and on Intellectual Property indicators with South Korea. The performance gap on Tertiary education is substantial vis-à-vis South Korea and Canada, and the performance gap on Public-private co-publications is substantial vis-a-vis Canada and Australia. There is not one indicator where the EU outperforms all the leading global innovators.

Figure 26: Indicators where the EU shows an average performance against the global competitors

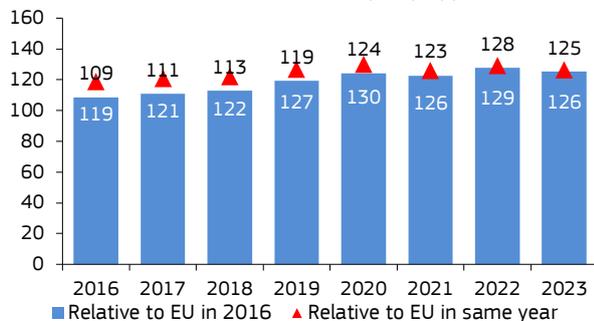


6.2 Country profiles global competitors

The country profiles for each of the global competitors show innovation performance relative to the EU over time, performance for each of the innovation indicators, and information for a set of structural indicators.



The performance of **South Korea** is well above that of the EU, and the country is an Innovation Leader. Performance has increased since 2016. In 2023 performance declined. South Korea's relative strengths are in Intellectual Property applications.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

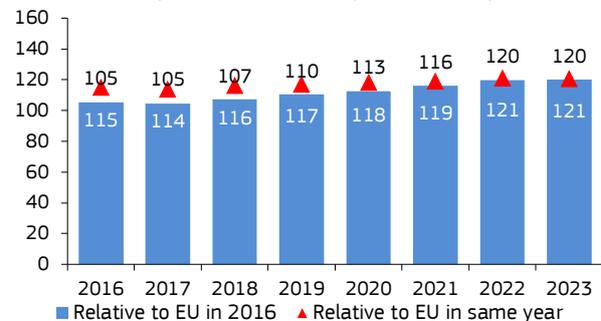
South Korea	2023	Change
Doctorate graduates	141.5	33.9
Tertiary education	168.2	3.9
International co-publications	92.9	47.6
Most cited publications	84.3	1.8
R&D expenditure public sector	128.9	14.7
Government funding business R&D	188.7	-21.5
R&D expenditure business sector	276.6	56.1
Employment in ICT	89.5	14.3
Product innovators	39.0	5.2
Business process innovators	40.1	-56.0
Innovation co-operation	111.3	-146.3
Public-private co-publications	120.4	43.9
PCT patent applications	329.9	39.3
Trademark applications	247.7	32.4
Design applications	449.7	-79.2
Medium & high-tech product exports	120.6	-1.2
Knowledge-intensive services exports	129.9	29.3
Exposure to air pollution	52.1	-10.4
Environment-related technologies	97.0	-18.8

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	KR	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	45,000	47,300
Change in GDP, %	1.7	-0.3
Employment share in Agriculture	5.0	4.5
Employment share in Industry	25.0	25.0
Employment share in Services	70.0	70.5
Manufacturing - share in total value added	25.2	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	8.7	6.8
FDI net inflows (% GDP)	0.68	2.07
Top R&D spending firms per mln population	11.1	20.3
- average R&D spending, mln Euros	585.1	216.6
Number of Unicorns (July 2021)	14	100
Buyer sophistication 1-7 (best)	5.26	3.73
Governance and policy framework		
Corruption Perceptions Index	62.0	64.0
Basic-school entrepreneurial education and training	3.19	3.27
Government procurement of advanced technology products	3.88	3.50
Rule of law (-2.5 to 2.5 best)	1.17	1.04
Demography		
Population size, mln	51.8	447.4
Change in population, %	0.0	0.0
Share of population aged 15-64	72.0	64.2
Population density (population / km2)	530.7	112.0



The performance of **Canada** is well above that of the EU, and the country is a Strong Innovator. Performance has increased since 2016. Canada's relative strengths are in International and Public-private co-publications and Exposure to air pollution.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

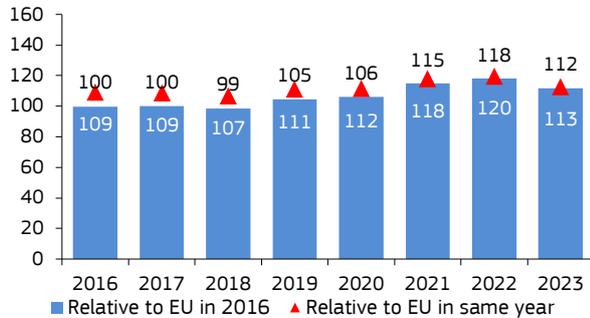
Canada	2023	Change
Doctorate graduates	109.0	-7.1
Tertiary education	161.1	21.0
International co-publications	264.8	104.1
Most cited publications	115.7	-10.5
R&D expenditure public sector	104.8	-5.1
Government funding business R&D	119.8	4.0
R&D expenditure business sector	66.2	1.7
Employment in ICT	N/A	N/A
Product innovators	181.9	54.2
Business process innovators	180.9	42.2
Innovation co-operation	181.4	0.0
Public-private co-publications	186.2	60.6
PCT patent applications	72.8	-11.0
Trademark applications	147.3	-14.4
Design applications	61.8	6.0
Medium & high-tech product exports	51.0	-15.1
Knowledge-intensive services exports	123.8	16.3
Exposure to air pollution	205.4	-4.7
Environment-related technologies	91.8	-8.0

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	CA	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	49,900	47,300
Change in GDP, %	-1.3	-0.3
Employment share in Agriculture	1.5	4.5
Employment share in Industry	19.5	25.0
Employment share in Services	79.0	70.5
Manufacturing - share in total value added	9.8	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	17.9	6.8
FDI net inflows (% GDP)	2.64	2.07
Top R&D spending firms per mln population	7.4	20.3
- average R&D spending, mln Euros	171.2	216.6
Number of Unicorns (July 2021)	20	100
Buyer sophistication 1-7 (best)	4.45	3.73
Governance and policy framework		
Corruption Perceptions Index	75.0	64.0
Basic-school entrepreneurial education and training	4.28	3.27
Government procurement of advanced technology products	3.45	3.50
Rule of law (-2.5 to 2.5 best)	1.68	1.04
Demography		
Population size, mln	38.0	447.4
Change in population, %	0.9	0.0
Share of population aged 15-64	66.1	64.2
Population density (population / km2)	4.2	112.0



The performance of the **United States** is above that of the EU, and the country is a Strong Innovator. Performance has increased up until 2022 and decreased in 2023 due to lower shares of enterprises that introduced innovations.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

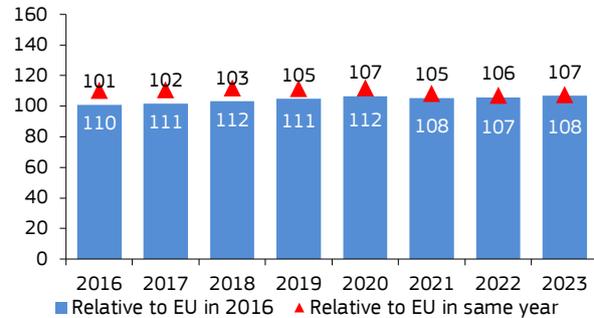
United States	2023	Change
Doctorate graduates	95.9	3.3
Tertiary education	124.2	13.4
International co-publications	110.3	28.4
Most cited publications	130.3	-18.8
R&D expenditure public sector	89.5	-2.3
Government funding business R&D	144.2	12.6
R&D expenditure business sector	190.3	47.0
Employment in ICT	103.1	2.7
Product innovators	77.5	64.4
Business process innovators	74.3	-58.5
Innovation co-operation	591.5	0.0
Public-private co-publications	120.3	17.8
PCT patent applications	113.0	-16.0
Trademark applications	74.7	22.6
Design applications	35.7	2.3
Medium & high-tech product exports	79.2	-7.8
Knowledge-intensive services exports	133.2	21.7
Exposure to air pollution	171.9	-6.2
Environment-related technologies	71.7	-27.0

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	US	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	65,800	47,300
Change in GDP, %	0.9	-0.3
Employment share in Agriculture	1.4	4.5
Employment share in Industry	19.8	25.0
Employment share in Services	78.8	70.5
Manufacturing - share in total value added	10.8	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	16.4	6.8
FDI net inflows (% GDP)	1.37	2.07
Top R&D spending firms per mln population - average R&D spending, mln Euros	24.0	20.3
Number of Unicorns (July 2021)	476.0	216.6
Buyer sophistication 1-7 (best)	653	100
Buyer sophistication 1-7 (best)	5.02	3.73
Governance and policy framework		
Corruption Perceptions Index	67.7	64.0
Basic-school entrepreneurial education and training	4.18	3.27
Government procurement of advanced technology products	4.52	3.50
Rule of law (-2.5 to 2.5 best)	1.41	1.04
Demography		
Population size, mln	330.6	447.4
Change in population, %	0.5	0.0
Share of population aged 15-64	65.3	64.2
Population density (population / km2)	36.1	112.0



The performance of **Australia** is above that of the EU, and the country is a Strong Innovator. Performance has increased since 2016. Australia's strengths are in International and Public-private co-publications, and Trademark applications.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

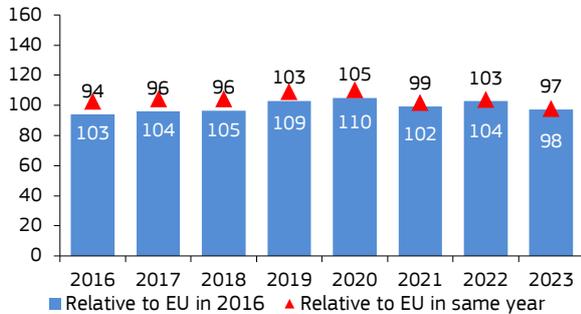
Australia	2023	Change
Doctorate graduates	151.2	10.2
Tertiary education	131.8	15.0
International co-publications	395.3	187.0
Most cited publications	136.7	-2.1
R&D expenditure public sector	108.3	-6.6
Government funding business R&D	85.9	-35.4
R&D expenditure business sector	65.1	-6.9
Employment in ICT	98.3	8.7
Product innovators	105.2	-22.8
Business process innovators	123.9	-21.6
Innovation co-operation	140.3	-80.5
Public-private co-publications	224.1	88.8
PCT patent applications	63.3	-13.6
Trademark applications	197.0	3.7
Design applications	79.5	-8.7
Medium & high-tech product exports	10.2	-8.7
Knowledge-intensive services exports	50.9	9.7
Exposure to air pollution	163.3	5.5
Environment-related technologies	83.2	-1.8

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	AU	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	53,600	47,300
Change in GDP, %	0.4	-0.3
Employment share in Agriculture	2.6	4.5
Employment share in Industry	19.5	25.0
Employment share in Services	77.9	70.5
Manufacturing - share in total value added	5.5	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	10.5	6.8
FDI net inflows (% GDP)	1.85	2.07
Top R&D spending firms per mln population - average R&D spending, mln Euros	4.2	20.3
Number of Unicorns (July 2021)	272.6	216.6
Buyer sophistication 1-7 (best)	8	100
Buyer sophistication 1-7 (best)	3.97	3.73
Governance and policy framework		
Corruption Perceptions Index	75.0	64.0
Basic-school entrepreneurial education and training	4.05	3.27
Government procurement of advanced technology products	3.34	3.50
Rule of law (-2.5 to 2.5 best)	1.68	1.04
Demography		
Population size, mln	25.6	447.4
Change in population, %	0.7	0.0
Share of population aged 15-64	65.2	64.2
Population density (population / km2)	3.3	112.0



The performance of **Japan** is below that of the EU, and the country is a Moderate Innovator. Performance has decreased since 2016. Relative strengths are in Tertiary education, Business R&D expenditures and Patent applications.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

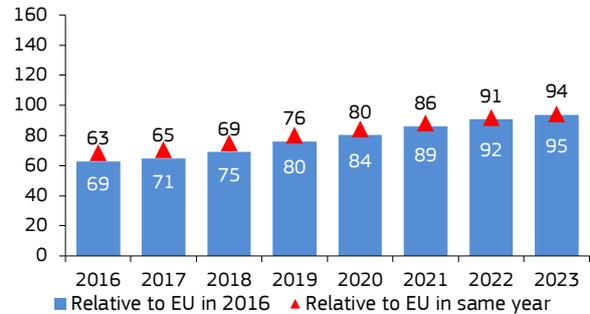
Japan	2023	Change
Doctorate graduates	56.4	15.8
Tertiary education	157.3	15.1
International co-publications	48.5	16.7
Most cited publications	57.6	-6.7
R&D expenditure public sector	92.2	-5.2
Government funding business R&D	63.7	-22.2
R&D expenditure business sector	183.6	-2.3
Employment in ICT	104.1	17.4
Product innovators	41.6	-13.4
Business process innovators	70.4	-60.0
Innovation co-operation	103.2	-307.0
Public-private co-publications	85.0	15.9
PCT patent applications	382.4	2.0
Trademark applications	144.1	57.7
Design applications	88.8	-1.3
Medium & high-tech product exports	113.7	-6.0
Knowledge-intensive services exports	138.1	15.3
Exposure to air pollution	104.1	-2.9
Environment-related technologies	80.1	-23.7

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	JP	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	42,000	47,300
Change in GDP, %	-1.1	-0.3
Employment share in Agriculture	3.4	4.5
Employment share in Industry	24.4	25.0
Employment share in Services	72.1	70.5
Manufacturing - share in total value added	20.0	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	5.8	6.8
FDI net inflows (% GDP)	0.88	2.07
Top R&D spending firms per mln population	22.1	20.3
- average R&D spending, mln Euros	406.9	216.6
Number of Unicorns (July 2021)	6	100
Buyer sophistication 1-7 (best)	4.91	3.73
Governance and policy framework		
Corruption Perceptions Index	73.3	64.0
Basic-school entrepreneurial education and training	2.80	3.47
Government procurement of advanced technology products	4.06	3.50
Rule of law (-2.5 to 2.5 best)	1.54	1.04
Demography		
Population size, mln	126.2	447.4
Change in population, %	-0.4	0.0
Share of population aged 15-64	58.5	64.2
Population density (population / km ²)	346.9	112.0



The performance of **China** is above that of the EU, and the country is a Moderate Innovator. Performance has increased strongly since 2016. Relative strengths are in Trademark applications and Design applications.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

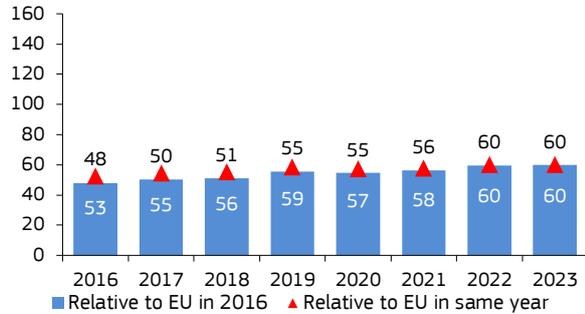
China	2023	Change
Doctorate graduates	N/A	N/A
Tertiary education	64.9	17.8
International co-publications	20.6	14.8
Most cited publications	113.6	36.6
R&D expenditure public sector	66.9	3.4
Government funding business R&D	67.2	-2.2
R&D expenditure business sector	121.7	12.0
Employment in ICT	N/A	N/A
Product innovators	N/A	N/A
Business process innovators	N/A	N/A
Innovation co-operation	N/A	N/A
Public-private co-publications	49.5	43.3
PCT patent applications	102.8	39.9
Trademark applications	691.2	392.7
Design applications	467.3	-71.2
Medium & high-tech product exports	94.1	1.9
Knowledge-intensive services exports	124.6	24.5
Exposure to air pollution	38.7	-157.3
Environment-related technologies	70.8	-5.5

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	CN	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	17,700	47,300
Change in GDP, %	5.0	-0.3
Employment share in Agriculture	26.1	4.5
Employment share in Industry	28.0	25.0
Employment share in Services	45.9	70.5
Manufacturing - share in total value added	26.8	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	8.7	6.8
FDI net inflows (% GDP)	1.64	2.07
Top R&D spending firms per mln population	4.3	20.3
- average R&D spending, mln Euros	251.6	216.6
Number of Unicorns (July 2021)	169	100
Buyer sophistication 1-7 (best)	4.43	3.73
Governance and policy framework		
Corruption Perceptions Index	44.0	64.0
Basic-school entrepreneurial education and training	4.27	3.27
Government procurement of advanced technology products	4.38	3.50
Rule of law (-2.5 to 2.5 best)	-0.11	1.04
Demography		
Population size, mln	1410.4	447.4
Change in population, %	0.2	0.0
Share of population aged 15-64	69.4	64.2
Population density (population / km ²)	149.5	112.0



The performance of **Brazil** is below that of the EU, and the country is an Emerging Innovator. Performance has increased since 2016. Relative strengths are in Business process innovation, Trademark applications and Exposure to air pollution.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

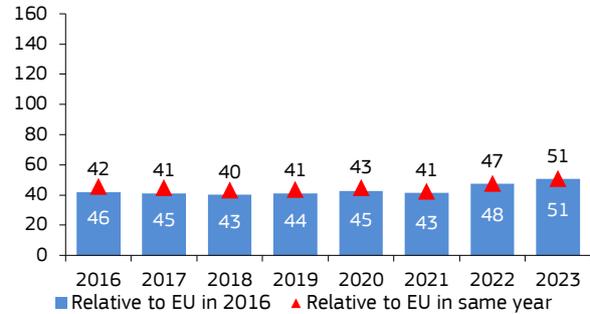
Brazil	2023	Change
Doctorate graduates	24.6	0.2
Tertiary education	55.9	16.4
International co-publications	21.9	11.0
Most cited publications	53.9	1.2
R&D expenditure public sector	N/A	N/A
Government funding business R&D	30.2	15.2
R&D expenditure business sector	N/A	N/A
Employment in ICT	45.6	7.5
Product innovators	62.7	2.7
Business process innovators	197.4	0.0
Innovation co-operation	108.4	-23.1
Public-private co-publications	11.6	4.8
PCT patent applications	10.5	0.7
Trademark applications	169.5	61.8
Design applications	29.2	-1.6
Medium & high-tech product exports	34.8	-14.2
Knowledge-intensive services exports	130.4	8.5
Exposure to air pollution	111.0	-11.4
Environment-related technologies	87.1	7.1

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	BR	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	15,400	47,300
Change in GDP, %	-0.3	-0.3
Employment share in Agriculture	9.3	4.5
Employment share in Industry	20.2	25.0
Employment share in Services	70.5	70.5
Manufacturing - share in total value added	10.6	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	22.6	6.8
FDI net inflows (% GDP)	3.06	2.07
Top R&D spending firms per mln population	0.2	20.3
- average R&D spending, mln Euros	104.7	216.6
Number of Unicorns (July 2021)	16	100
Buyer sophistication 1-7 (best)	3.51	3.73
Governance and policy framework		
Corruption Perceptions Index	38.0	64.0
Basic-school entrepreneurial education and training	2.58	3.27
Government procurement of advanced technology products	2.96	3.50
Rule of law (-2.5 to 2.5 best)	-0.22	1.04
Demography		
Population size, mln	213.1	447.4
Change in population, %	0.6	0.0
Share of population aged 15-64	69.9	64.2
Population density (population / km ²)	25.4	112.0



The performance of **Chile** is below that of the EU, and the country is an Emerging Innovator. Performance has increased since 2016. Relative strengths are in Trademark applications and Environment-related technologies.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

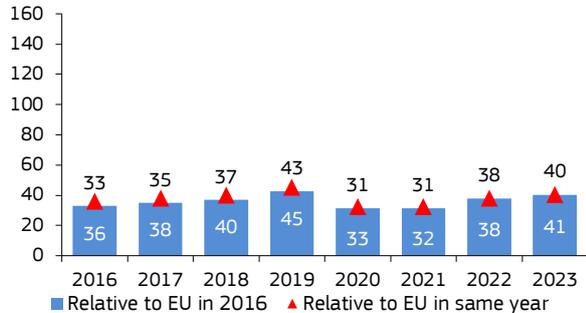
Chile	2023	Change
Doctorate graduates	18.0	-0.7
Tertiary education	81.9	9.3
International co-publications	85.0	45.9
Most cited publications	65.6	5.9
R&D expenditure public sector	27.3	2.8
Government funding business R&D	9.3	2.2
R&D expenditure business sector	8.5	-0.5
Employment in ICT	66.0	8.6
Product innovators	28.7	-13.1
Business process innovators	44.0	-51.5
Innovation co-operation	134.1	116.3
Public-private co-publications	28.0	16.8
PCT patent applications	18.6	2.3
Trademark applications	224.5	23.0
Design applications	14.1	-7.8
Medium & high-tech product exports	20.0	-5.1
Knowledge-intensive services exports	101.0	13.2
Exposure to air pollution	55.7	-2.9
Environment-related technologies	181.9	27.7

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	CL	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	26,300	47,300
Change in GDP, %	1.3	-0.3
Employment share in Agriculture	9.1	4.5
Employment share in Industry	22.4	25.0
Employment share in Services	68.4	70.5
Manufacturing - share in total value added	8.9	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	31.3	6.8
FDI net inflows (% GDP)	4.44	2.07
Top R&D spending firms per mln population	0.0	20.3
- average R&D spending, mln Euros	n/a	216.6
Number of Unicorns (July 2021)	2	100
Buyer sophistication 1-7 (best)	3.91	3.73
Governance and policy framework		
Corruption Perceptions Index	67.0	64.0
Basic-school entrepreneurial education and training	3.06	3.27
Government procurement of advanced technology products	3.10	3.50
Rule of law (-2.5 to 2.5 best)	0.98	1.04
Demography		
Population size, mln	19.3	447.4
Change in population, %	1.2	0.0
Share of population aged 15-64	69.0	64.2
Population density (population / km ²)	25.8	112.0



The performance of **South Africa** is well below that of the EU, and the country is an Emerging Innovator. Performance has increased since 2016. Relative strengths are in Knowledge-intensive services exports and Environment-related technologies.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

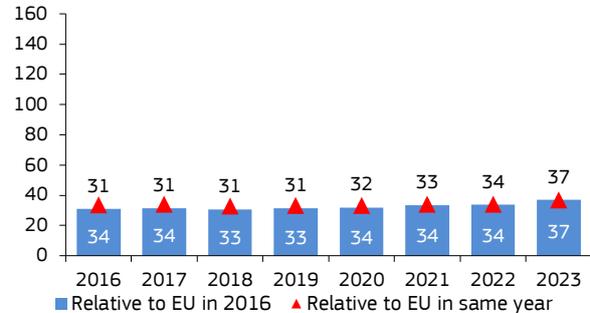
South Africa	2023	Change
Doctorate graduates	7.8	1.5
Tertiary education	36.1	0.9
International co-publications	44.1	28.9
Most cited publications	71.6	-2.6
R&D expenditure public sector	60.7	5.2
Government funding business R&D	8.4	-6.7
R&D expenditure business sector	15.0	-10.9
Employment in ICT	N/A	N/A
Product innovators	N/A	N/A
Business process innovators	N/A	N/A
Innovation co-operation	N/A	N/A
Public-private co-publications	18.5	8.8
PCT patent applications	16.2	-3.7
Trademark applications	82.0	-5.4
Design applications	31.6	-7.2
Medium & high-tech product exports	50.5	-12.7
Knowledge-intensive services exports	94.3	51.2
Exposure to air pollution	57.7	-4.1
Environment-related technologies	84.9	-3.2

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	ZA	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	14,200	47,300
Change in GDP, %	-2.0	-0.3
Employment share in Agriculture	5.2	4.5
Employment share in Industry	22.9	25.0
Employment share in Services	71.8	70.5
Manufacturing - share in total value added	11.9	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	14.1	6.8
FDI net inflows (% GDP)	4.04	2.07
Top R&D spending firms per mln population	0.1	20.3
- average R&D spending, mln Euros	49.3	216.6
Number of Unicorns (July 2021)	2	100
Buyer sophistication 1-7 (best)	3.96	3.73
Governance and policy framework		
Corruption Perceptions Index	40.0	64.0
Basic-school entrepreneurial education and training	2.76	3.27
Government procurement of advanced technology products	3.02	3.50
Rule of law (-2.5 to 2.5 best)	-0.04	1.04
Demography		
Population size, mln	58.8	447.4
Change in population, %	1.1	0.0
Share of population aged 15-64	65.3	64.2
Population density (population / km2)	48.2	112.0



The performance of **India** is well below that of the EU, and the country is an Emerging Innovator. Performance has increased marginally since 2016. Relative strengths are in Knowledge-intensive services exports and Trademark applications.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

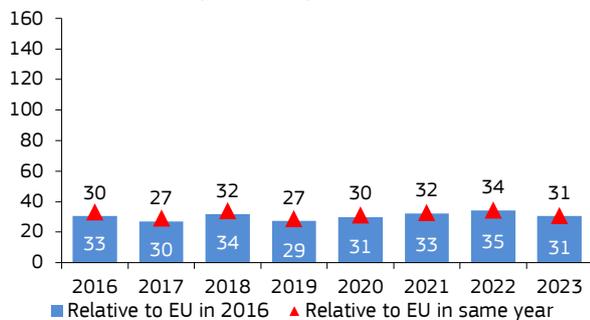
Mexico	2023	Change
Doctorate graduates	5.9	0.9
Tertiary education	47.3	0.0
International co-publications	6.3	5.6
Most cited publications	73.4	11.9
R&D expenditure public sector	57.1	-3.9
Government funding business R&D	N/A	N/A
R&D expenditure business sector	26.0	-2.4
Employment in ICT	5.9	0.9
Product innovators	47.3	0.0
Business process innovators	N/A	N/A
Innovation co-operation	N/A	N/A
Public-private co-publications	4.4	3.0
PCT patent applications	14.1	-0.7
Trademark applications	84.6	23.6
Design applications	20.9	0.9
Medium & high-tech product exports	55.4	4.4
Knowledge-intensive services exports	138.8	7.9
Exposure to air pollution	27.9	-187.9
Environment-related technologies	71.1	-15.5

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	IN	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	6,900	47,300
Change in GDP, %	-0.1	-0.3
Employment share in Agriculture	43.3	4.5
Employment share in Industry	25.0	25.0
Employment share in Services	31.7	70.5
Manufacturing - share in total value added	13.7	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	11.5	6.8
FDI net inflows (% GDP)	1.87	2.07
Top R&D spending firms per mln population	0.2	20.3
- average R&D spending, mln Euros	190.5	216.6
Number of Unicorns (July 2021)	70	100
Buyer sophistication 1-7 (best)	4.36	3.73
Governance and policy framework		
Corruption Perceptions Index	43.7	64.0
Basic-school entrepreneurial education and training	4.64	3.27
Government procurement of advanced technology products	4.14	3.50
Rule of law (-2.5 to 2.5 best)	-0.05	1.04
Demography		
Population size, mln	1395.7	447.4
Change in population, %	0.9	0.0
Share of population aged 15-64	67.2	64.2
Population density (population / km2)	467.4	112.0



The performance of **Mexico** is well below that of the EU, and the country is an Emerging Innovator. Performance has decreased since 2016, particularly in 2023. Relative strengths are in Medium and high-tech product exports and Trademarks.



Columns show performance relative to EU in 2016. The red triangle and white numbers show performance relative to EU in the same year.

Performance in 2023 relative to the EU in 2023 and change in performance between 2016 and 2023

	2023	Change
India		
Doctorate graduates	17.0	4.9
Tertiary education	65.7	16.4
International co-publications	15.1	7.8
Most cited publications	46.3	3.3
R&D expenditure public sector	31.6	-17.3
Government funding business R&D	7.0	-6.5
R&D expenditure business sector	4.5	-1.1
Employment in ICT	21.6	1.4
Product innovators	21.6	0.0
Business process innovators	N/A	N/A
Innovation co-operation	N/A	N/A
Public-private co-publications	6.5	2.8
PCT patent applications	4.2	-0.5
Trademark applications	124.9	22.9
Design applications	24.5	-2.2
Medium & high-tech product exports	107.3	-10.1
Knowledge-intensive services exports	32.7	-2.4
Exposure to air pollution	89.5	-38.3
Environment-related technologies	75.3	-29.3

Best three (green) and worst (orange) three indicators highlighted.

Structural differences	MX	EU
Performance and structure of the economy		
GDP per capita, PPP (international \$)	19,400	47,300
Change in GDP, %	-2.5	-0.3
Employment share in Agriculture	12.8	4.5
Employment share in Industry	25.9	25.0
Employment share in Services	61.3	70.5
Manufacturing - share in total value added	17.6	14.8
Business and entrepreneurship		
Total Entrepreneurial Activity (TEA)	13.0	6.8
FDI net inflows (% GDP)	2.62	2.07
Top R&D spending firms per mln population	0.1	20.3
- average R&D spending, mln Euros	110.0	216.6
Number of Unicorns (July 2021)	8	100
Buyer sophistication 1-7 (best)	3.52	3.73
Governance and policy framework		
Corruption Perceptions Index	31.0	64.0
Basic-school entrepreneurial education and training	3.44	3.27
Government procurement of advanced technology products	3.15	3.50
Rule of law (-2.5 to 2.5 best)	-0.70	1.04
Demography		
Population size, mln	125.9	447.4
Change in population, %	0.6	0.0
Share of population aged 15-64	66.6	64.2
Population density (population / km2)	64.6	112.0

7. Recent developments and policies with a potential impact on innovation

This chapter briefly discusses recent European and global phenomena and EU policy initiatives that might impact the EU innovation performance as captured by the EIS: Russia's war of aggression against Ukraine and the related energy crisis, high inflation and corresponding efforts to reduce dependencies, the impact of Covid-19 on individual innovation indicators and the New European Innovation Agenda that aims to position Europe at the forefront of the new wave of deep tech innovation and startups.

It is important to note that the analysis of the impacts of external factors on innovation performance in the EU is subject to some limitations and uncertainties. First, some of the indicators used in the European Innovation Scoreboard 2023 are based on data that are not collected on an annual basis. This means that the latest available data may not fully reflect the most recent developments and trends in these indicators. Second, it is difficult to attribute a specific change in an indicator to a specific event, as there may be other factors and confounding variables that also affect innovation performance. Therefore, some of the effects identified in this analysis may be tentative, partial, or hypothetical, rather than causal, comprehensive or direct.

7.1 Boosting resilience and innovation

Resilience is crucial for the EU to sustain innovation in a dynamic global economy, as it is at the basis of sustainable and adaptable innovative ecosystems in today's complex and interconnected economy. **Innovation serves as a cornerstone in building resilience in the face of diverse crises.** Preparedness and resilience hinge upon the capability to conceive and deploy innovative solutions at scale in crucial sectors. Therefore, maintaining a strong stance in innovation and technology is essential to enhance competitiveness and productivity, support Europe's green and digital transformation, and reinforce resilience.

A resilient EU growth model is anchored on sustainable competitiveness, economic security, open strategic autonomy and fair competition. It requires, among other elements, a well-functioning Single Market, access to private capital, de-risking of investments -including in R&D and innovation- in critical areas such as clean technologies-, the broad-based take-up of digital tools across the economy, and a strong push to foster a more circular economy in the EU.

The successive crises of recent years have put the EU economy under pressure, testing the limits of its resilience, and this is likely to be reflected in the performance of its innovation system.

The EU economy is operating in an increasingly complex context with numerous supply chain shocks, businesses facing high and volatile energy costs and rising geopolitical tensions. Moreover, the EU is dependent on third countries for the supply of certain strategic and critical inputs, products and technologies across different areas (green, digital, health, security/defence). Some of those have higher risks of experiencing single points of failure¹⁰.

These disturbances affect the performance of the economy with a disproportionate impact on young dynamic companies, which are the drivers of innovative efforts. They limit the availability of capital, both internal to the firm as well as from external sources, needed for innovative activities or disrupt the network of actors in innovation ecosystems. Similarly, skills of workers, including in knowledge intensive sectors, can be severely affected. As a result, the overall innovative capacity of the economy can suffer, and the negative impact can accumulate in time.

These recent crises have thus highlighted the need to strengthen the resilience of the EU's economy as a whole. This is particularly important for the supply chains and their ability to withstand shocks and recover quickly from them. **The updated Industry Strategy and the Green Deal Industrial Plan (2023)**¹¹ **support increased economic and industrial resilience.** Such an approach is anchored on three axes. First, curbing strategic dependencies including through international partnerships with like-minded countries to strengthen supply chains and diversify imports. Second, building a certain level of strategic capacity in cases where the opportunities of international trade to diversify and reduce risks are more limited. Finally, improving the understanding and capacity to anticipate strategic dependencies and risks, including stepping up efforts to map out strategic dependencies and supply chain risks by the European Commission, Member States and stakeholders.

The challenges related to resilience outlined above may have both direct and indirect effects on innovation performance and the EIS indicators. On the one hand, there may be a direct impact on certain indicators that reflect the linkages and co-operation among R&I actors, which may be enhanced. The impacts may extend to other indicators related to environmental sustainability, such as greenhouse gas emissions intensity of GDP, circular material use rate.

The policy measures implemented to enhance the resilience of the EU economy in response to the recent crises, particularly in relation to the green and digital transformation, are expected to have a significant positive impact on future innovation efforts. This may reflect in the EIS indicators. Although the immediate effects of these policies might not yet be observable in the currently available data, they are likely to shape and influence indicators under the following dimensions:

- Finance & support in the areas of green and digital transformation, can impact public investment in R&D;
- Use of information technologies, as policies focused on building resilience may influence the availability and skill set of human resources in science and technology;
- Linkages, as the emphasis on fostering resilience through cooperation and linkages among R&I actors may influence indicators related to collaboration in innovation activities, such as joint publications, joint patent applications, and co-publications with international partners.

The EIS has therefore the potential of informing about those policy developments, to the extent that they have an impact on the shape or on the performance of the EU innovation system.

¹⁰ https://single-market-economy.ec.europa.eu/publications/enhanced-methodology-monitor-eus-strategic-dependencies-and-vulnerabilities_en

¹¹ https://ec.europa.eu/commission/presscorner/detail/en/ip_23_510

7.2 Impact of the war in Ukraine and the increase of energy prices on innovation

The invasion of Ukraine by Russia had a profound impact on research infrastructure and human capital in Ukraine, as well as on the scientific collaboration and mobility between Ukraine and the EU. The war of aggression against Ukraine has also affected innovation in the EU through various channels, including an increase in energy prices. These effects are multiple and complex and can be partially captured by certain indicators, such as international scientific co-publications and highly cited publications. The EU has offered specific support for Ukrainian R&I actors, such as associating Ukraine to Horizon Europe and Euratom programmes, providing fellowships to displaced researchers, supporting deep tech start-ups, and facilitating access to research infrastructures. These measures could help preserve and enhance the scientific excellence and cooperation between Ukraine and the EU, as well as foster innovation spillovers across borders¹².

The disruption caused by the war and the resulting geopolitical tensions have implications for the EU's overall innovation landscape. The war in Ukraine has increased the demand for innovation in defence and security, resilience, and crisis management. This conflict has prompted the EU to invest in R&I projects aimed at addressing the challenges posed by hybrid threats, cyberattacks, disinformation, border security, and humanitarian assistance. The war's disruptive nature has created a pressing need for innovative solutions to effectively respond to these complex issues. Furthermore, the war's impact on innovation extends beyond Ukraine's borders. The EU, as a key partner, is deeply affected

7.3 Impact of high inflation on innovation growth

The impact of inflation on research and innovation is multifaceted, and its net effect on the innovation performance of the EU will depend on various factors, such as the severity and duration of inflation, the adaptability and resilience of businesses, and the effectiveness of policy responses. For example, the rise in costs due to inflation can directly impact R&D budgets, reducing the resources available for innovative activities. This can result in a reduction of investment in R&D projects, limiting the scope for experimentation, and potentially hindering the overall innovation process. Thereafter, high inflation can have significant implications for the indicators related to the finance and support dimension of innovation, particularly venture capital expenditures and public R&D expenditures. Inflation often leads to an increase in the cost of goods and services, including raw materials, equipment, and human

7.4 Impact of Covid-19

The EIS 2022 analysis showed that the Covid-19 pandemic negatively affected several of the indicators used for measuring overall innovation performance, such as Innovation expenditures, Innovative sales and Venture capital expenditures, all of which showed a decline in 2020. There was also an adverse effect on those indicators using GDP in the denominator as GDP fell in 2020 compared to 2019 for 22 Member States. Covid-19 also negatively impacted exports, but the impact was

by the conflict. The disruption caused by the war and the resulting geopolitical tensions have implications for the EU's overall innovation landscape. In summary, the war in Ukraine has not only driven the demand for innovation within the country itself but also has indirect consequences on the broader EU innovation ecosystem.

The energy crisis could affect the indicators related to firm investments dimension, such as R&D expenditure in the business sector and non-R&D innovation expenditures. High energy prices could reduce the profitability and availability of funds for R&D and innovation activities in energy-intensive sectors, such as manufacturing, transport, and agriculture. On the other hand, the energy crisis could also create incentives for firms to invest more in energy efficiency, renewable energy sources and digital solutions that can lower their energy costs and improve their competitiveness (see section above). For example, the EU has launched the REPowerEU Plan to boost investment, research, and innovation in clean energy. The plan aims to mobilise €500 billion of public and private investment over the next decade to support the development of hydrogen, offshore wind, and solar power¹³.

The impact of these factors on innovation performance in the EU depends on various economic conditions, policy responses and innovation capabilities. Future editions of the EIS may reflect better the impacts of the war in Ukraine and the increase of energy prices on innovation.

resources. As a result, organisations may face budget constraints and financial challenges that can hinder their ability to invest in research and development.

The complex nature of the impact of inflation on research and innovation should also be acknowledged. While inflation can pose challenges and constraints, it can also create certain incentives for innovation. The need to cope with rising costs may encourage firms to invest in new technologies, products, and processes that can improve efficiency, reduce expenses, and enhance competitiveness. Inflation can stimulate demand for innovative goods and services, as consumers seek more value for their limited budgets, promoting the adoption of novel solutions that offer improved quality, functionality, or durability.

less on both Medium- and high-tech product exports and Knowledge-intensive services exports than on total exports, creating an overall positive effect on the export shares of both. Available evidence did not allow to draw firm conclusions on the impact of the Covid-19 pandemic. This section provides a partial update of the analysis in the EIS 2022 for a limited number of indicators.

¹² EU research and innovation and the invasion of Ukraine: Main channels of impact (europa.eu)

¹³ EU action to address the energy crisis (europa.eu)

Table 5: Annual changes in R&D expenditures in the business and public sector in 2020 and 2021 for the EU and its main global competitors

	Business R&D (% GDP)	Business R&D (mln Euros)	Public R&D (% GDP)	Public R&D (mln Euros)	GDP (mln Euros)	Business R&D (% GDP)	Business R&D (mln Euros)	Public R&D (% GDP)	Public R&D (mln Euros)	GDP (mln Euros)
	Change	%-change	change	%-change	%-change	change	%-change	change	%-change	%-change
	2020	2020	2020	2020	2020	2021	2021	2021	2021	2021
EU	0.03	-1.9%	0.05	1.9%	-4.1%	-0.02	6.3%	-0.02	5.2%	7.7%
Canada	0.08	3.3%	0.06	3.0%	-4.5%	-0.09	3.5%	-0.11	-0.3%	13.6%
Japan	0.02	-2.5%	0.03	0.5%	-3.4%	0.02	2.6%	0.01	4.0%	1.9%
South Korea	0.08	2.9%	0.07	9.2%	0.8%	0.11	9.8%	0.02	8.7%	6.7%
United States	0.26	9.1%	0.03	3.2%	-1.5%	0.05	12.8%	-0.05	2.3%	10.7%

Data sources for R&D expenditures: Eurostat and OECD. There are no R&D data for 2020 and 2021 for Australia and China.

In 2020 there was an increase in the R&D intensity in the business sector for the EU (+0.03) (Table 5), but, not due to increasing R&D expenditures, as these dropped by 1.9% for the EU. Instead, as already reported in the EIS 2022, it was due to an even stronger decrease in GDP, with a decline of 4.1% for the EU.

The latest data for 2021 shows that R&D expenditures in the business sector increased for the EU (+6.3%), but also that GDP increased even more strongly than R&D, with 7.7% for the EU. The result is a decline in 2021 in the R&D intensity for the EU (-0.02).

Compared to its main global competitors, Japan, South Korea, and the United States all show an increase in their business R&D intensity in 2021. R&D expenditures in the business sector for South Korea and the United States grew at a faster rate than in the EU and at a faster rate than the GDP of both countries. For Japan, growth rates for both R&D and GDP are at a lower rate than for the EU, but R&D expenditures in Japan do increase at a faster rate than GDP, resulting in an increase in the R&D intensity.

In 2020 there was also an increase in the R&D intensity in the public sector for the EU (+0.05), due to the decreasing GDP and the resilience in the R&D expenditures in the public sector as they continued to grow in 2020. In 2021, the R&D intensity declined for the EU (-0.02), due to the stronger growth of GDP.

For Canada and the United States, the public R&D intensity declined in 2021 due to a faster growing GDP, for Japan and South Korea the public R&D intensity increased due to R&D expenditures growing at a faster rate than GDP.

The above analysis shows that in 2021 the EU economy and the R&I system have recovered, but the recovery of the R&I system was at a slower pace, most likely because the decline in R&D expenditures in 2020 was less strong than for GDP, hinting at the possibility that the R&D system is more resilient to shocks than the overall economy.

Table 6: Annual changes in Medium and high-tech product exports in 2020, 2021 and 2022

	Medium and high-tech product exports (change in %-share of total product exports)			Medium and high-tech product exports (volume, annual %-change)			Total product exports (volume, annual %-change)		
	2020	2021	2022	2020	2021	2022	2020	2021	2022
	EU	0.4	-1.3	0.3	-8.8%	10.5%	18.5%	-9.3%	12.8%
Australia	-0.3	-2.1	-0.9	-10.5%	8.0%	110.1%	-7.9%	39.7%	140.2%
Canada	-0.9	-5.0	-1.3	-14.7%	11.3%	129.8%	-12.7%	28.5%	139.4%
China	1.9	-1.0	-1.4	4.8%	30.4%	4.4%	1.6%	32.6%	7.0%
Japan	0.0	-1.7	-2.4	-9.1%	15.4%	-4.5%	-9.2%	18.1%	-1.3%
South Korea	3.4	-1.9	..	-0.9%	22.5%	..	-5.4%	25.7%	..
United States	4.9	-6.6	-3.5	-44.0%	88.6%	9.4%	-48.6%	112.6%	17.7%

Data sources: Eurostat and UN Comtrade. There are 2022 data for South Korea. For several global competitors, data on export volumes from UN Comtrade are different in 2021 and 2022 as compared to previous years creating suspiciously high annual changes, but indicator values are not affected as export shares using the latest data are comparable to those using data collected up until the EIS 2022.

Covid-19 most likely had a negative effect on the volume of product exports because of reduced economic activities in 2020. For the EU there was a stronger decline in the volume of Total product exports than in Medium and high-tech product exports, resulting in an increase in the share of Medium and high-tech product exports (Table 6). In 2021 the opposite took place, with a stronger increase in the volume of Total product exports than in Medium and high-tech product exports, resulting in a decrease in the share of Medium and high-tech product

exports. In 2022, both exports volumes increased at an even higher rate than in 2021, and also the share of Medium and high-tech product exports increased.

Compared to its main global competitors, the EU improved its relative performance in 2022 towards Australia, Canada, China, Japan, and the United States. Like the EU, the global competitors' exports increased in 2022, except for Japan. Results are too diverse to conclude whether the EU had a stronger recovery from the Covid-19 pandemic.

Table 7: Annual changes in Exports of knowledge-intensive services in 2020 and 2021

	Knowledge-intensive services exports (change in %-share of total services exports)		Knowledge-intensive services exports (volume, annual %-change)		Total services exports (volume, annual %-change)	
	2020	2021	2020	2021	2020	2021
EU	-4.1	0.4	-19.5%	16.9%	-14.3%	16.1%
Australia	8.2	-0.6	-5.8%	-19.1%	-29.3%	-17.7%
Canada	11.4	0.6	2.3%	5.3%	-12.7%	4.5%
China	8.5	4.4	11.8%	47.9%	-0.9%	39.8%
Japan	15.0	3.3	-6.7%	10.8%	-23.3%	6.6%
South Korea	9.7	6.3	-0.5%	47.5%	-13.2%	36.2%
United States	12.7	1.3	-3.8%	11.2%	-18.5%	9.5%

Data sources: Eurostat, OECD and UNCTAD

For Exports of knowledge-intensive services, the EIS 2022 suggested that in 2020 there appeared to be a negative impact of Covid-19 on export volumes, but a positive impact on the value of the indicator. The decline in Knowledge-intensive services exports was higher than that in Total services exports, resulting in a decrease in the share of Knowledge-intensive services exports in 2020 (Table 7).

There is no clear effect of Covid-19 on the indicator in 2021, but export volumes have recovered from the pandemic by showing substantial growth. Due to a stronger growth for Knowledge-intensive services exports, also the share of these exports in total services exports increased.

7.5 European Startup Scoreboard

The New European Innovation Agenda adopted on 5 July 2022, aims at fostering deep-tech innovation and startups capable of helping Europe tackle pressing societal issues, such as the green and digital transitions. The New European Innovation Agenda sets out 25 dedicated actions under five flagships, one of which points to the importance of robust and comparable data that can inform policies at all levels ensuring better policy coordination. In this context, the European Commission (EC) is particularly interested in improving existing and developing new tools for monitoring innovation ecosystems through high quality, comparable statistical evidence. The European Innovation Scoreboard was specifically mentioned as one of the tools to incorporate such evidence, followed by the development of a tailor-made European Startups Scoreboard based on key concepts of the startups' ecosystem.

In this context, an important first step was to understand the extent to which the same concepts of a startup ecosystem are defined and measured differently across the EU.

Compared to its main global competitors, the EU is doing worse in 2021 for the share of Knowledge-intensive services, except when compared to Australia. For most global competitors, recovery for Exports of knowledge-intensive services has been stronger than for Total services exports, similar to what has happened for the EU.

In response to this need, a feasibility study on a potential European Startup Scoreboard was conducted¹⁴ as part of the EIS 2022 and 2023 project. This study provides an extensive overview of how different categories of sources, such as laws and reports produced by distinct stakeholders, are defining and measuring concepts associated with the startup ecosystem, which indicators are being used to assess startup performance, and which types of data and data sources are used for this purpose. The overview encompasses not only the information available from the Member States but also third countries and international organisations. In addition, it provides a benchmarking exercise, where the European startup ecosystem is measured against some key competing countries in the rest of the world.

The feasibility study revealed that the key concepts analysed lack, to different degrees, definitional coherence. A European Startup Scoreboard would benefit from a widely accepted and consistent set of definitions and indicators for effective evidence-based policymaking and monitoring. Therefore, the findings of this study will guide the process of selecting fit-for-purpose operational concept definitions and indicators for possible future integration into the European Innovation Scoreboard and the development of a European Startup Scoreboard.

¹⁴ [European startup scoreboard - Publications Office of the EU \(europa.eu\)](https://europeanstartup.ec.europa.eu/european-startup-scoreboard)

8. Country profiles

This section provides individual profiles for the EU Member States and 11 other European countries (Albania, Bosnia and Herzegovina, Iceland, North Macedonia, Montenegro, Norway, Serbia, Switzerland, Türkiye, Ukraine, and United Kingdom). Each profile includes the following information:

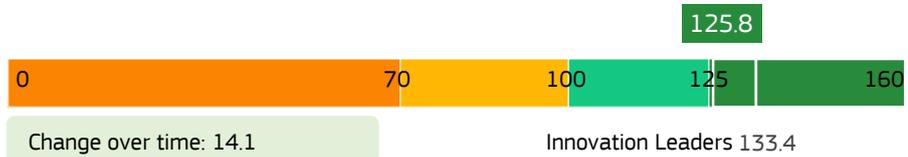
- The country's flag¹⁵.
- A graphical summary of the key performances.
- A table providing a comparison of the respective country's innovation performance in 2023 and performance change between both 2016 and 2023 and between 2022 and 2023, all relative to the EU score in 2016.
- A short listing of strengths and weaknesses.

Two-page country profiles are available on the EIS website. In addition to the one page included in this report, the second page in the two-page country profile includes the following information:

- A graph showing the development of the country's innovation index over time between 2016 and 2023 as compared to country's initial performance in 2016.
- Graphs for each of the innovation dimensions showing the development over time between 2016 and 2023 as compared to country's initial performance in 2016.
- A table providing data for the contextual indicators, which are used as proxies for structural differences between countries.
- Complementary text highlighting key observations.

The order of countries is first the Member States and then the other European countries. The order of the Member States and other European countries is based on the alphabetical order of the names in their national language.

¹⁵ <https://flagicons.lipis.dev/> for most countries and <https://flagpedia.net/organization/un> for Switzerland



Belgium

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	125.8	14.1	-0.5
Human resources	124.8	6.1	1.2
Doctorate graduates	129.7	11.4	0.0
Population with tertiary education	154.3	3.0	3.0
Lifelong learning	84.3	1.1	1.1
Attractive research systems	155.6	-5.9	12.2
International scientific co-publications	180.4	59.1	-4.5
Most cited publications	123.4	-20.1	-2.9
Foreign doctorate students	189.7	-34.1	62.3
Digitalisation	111.6	-1.5	-1.8
Broadband penetration	120.4	-2.9	-3.5
People with above basic overall digital skills	99.5	0.0	0.0
Finance and support	123.6	38.4	-4.1
R&D expenditures in the public sector	101.6	11.3	-12.9
Venture capital expenditures	103.4	46.6	3.4
Government support for business R&D	176.0	67.1	0.0
Firm investments	132.0	35.0	-5.0
R&D expenditure in the business sector	153.5	46.2	0.0
Non-R&D Innovation expenditures	86.6	5.4	-15.8
Innovation expenditures per employee	148.3	50.9	0.0
Use of information technologies	147.3	2.8	1.2
Enterprises providing ICT training	160.9	5.7	2.5
Employed ICT specialists	133.3	0.0	0.0
Innovators	146.5	32.7	17.8
Product innovators (SMEs)	134.5	22.0	34.5
Business process innovators (SMEs)	157.0	44.0	0.0
Linkages	173.7	-2.5	-19.2
Innovative SMEs collaborating with others	223.6	-25.5	-25.5
Public-private co-publications	265.2	62.5	-10.0
Job-to-job mobility of HRST	93.8	-11.8	-17.6
Intellectual assets	86.9	-4.0	-3.2
PCT patent applications	96.1	-6.4	-2.2
Trademark applications	92.4	4.1	-5.2
Design applications	67.6	-7.3	-2.7
Employment impacts	150.0	15.3	9.2
Employment in knowledge-intensive activities	136.1	0.0	0.0
Employment in innovative enterprises	161.4	29.7	18.0
Sales impacts	102.6	24.2	-2.0
Medium and high-tech goods exports	78.5	5.3	-3.3
Knowledge-intensive services exports	122.7	14.4	2.3
Sales of innovative products	115.5	65.5	-5.1
Environmental sustainability	101.7	10.6	-3.5
Resource productivity	129.9	31.4	3.8
Air emissions by fine particulate matter	103.6	5.8	-0.1
Environment-related technologies	70.8	2.2	-12.5

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

BELGIUM is an **Innovation Leader** with performance at 125.8% of the EU average. Performance is below the average of the Innovation Leaders. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance lead over the EU is becoming larger.

Relative strengths

Public-private co-publications
Innovative SMEs collaborating with others
Foreign doctorate students
International scientific co-publications
Government support for business R&D

Relative weaknesses

Design applications
Environment-related technologies
Medium and high-tech goods exports
Lifelong learning
Non-R&D Innovation expenditures

Strong increases since 2016

Government support for business R&D
Sales of innovative products
Public-private co-publications

Strong decreases since 2016

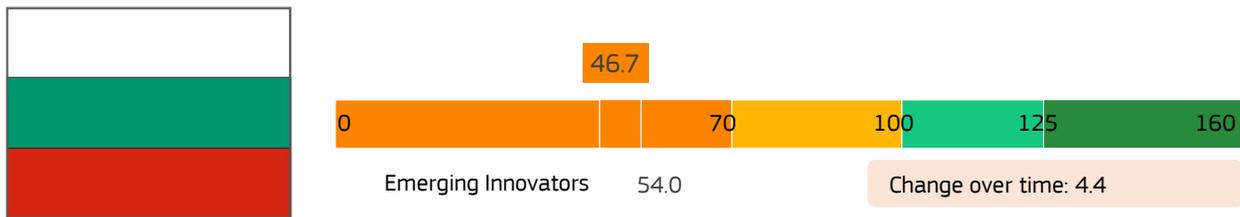
Foreign doctorate students
Innovative SMEs collaborating with others
Most cited publications

Strong increases since 2022

Foreign doctorate students
Product innovators
Employment in innovative enterprises

Strong decreases since 2022

Innovative SMEs collaborating with others
Job-to-job mobility of HRST
Non-R&D Innovation expenditures



Bulgaria

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	46.7	4.4	6.1
Human resources	32.7	-4.8	-4.8
Doctorate graduates	40.7	-11.4	-11.4
Population with tertiary education	52.6	1.2	1.2
Lifelong learning	0.0	-1.1	-1.1
Attractive research systems	26.6	10.8	0.5
International scientific co-publications	27.4	18.7	1.1
Most cited publications	17.4	-1.1	-2.8
Foreign doctorate students	44.0	30.6	7.4
Digitalisation	49.8	12.3	8.8
Broadband penetration	73.8	24.2	17.4
People with above basic overall digital skills	17.0	0.0	0.0
Finance and support	22.1	0.8	2.0
R&D expenditures in the public sector	21.9	-1.6	-1.6
Venture capital expenditures	36.8	5.3	9.6
Government support for business R&D	3.2	-0.7	-1.0
Firm investments	35.0	-13.2	-0.3
R&D expenditure in the business sector	31.9	-0.8	-4.6
Non-R&D Innovation expenditures	62.5	-34.2	1.1
Innovation expenditures per employee	15.6	-6.4	2.7
Use of information technologies	48.1	8.4	12.8
Enterprises providing ICT training	23.6	6.4	15.3
Employed ICT specialists	73.3	10.3	10.3
Innovators	56.0	56.7	27.8
Product innovators (SMEs)	78.8	67.4	25.4
Business process innovators (SMEs)	36.0	45.4	30.4
Linkages	35.4	24.6	15.1
Innovative SMEs collaborating with others	56.9	51.8	37.7
Public-private co-publications	37.6	24.1	3.3
Job-to-job mobility of HRST	16.7	0.0	0.0
Intellectual assets	92.5	-14.4	18.2
PCT patent applications	33.5	-4.9	1.3
Trademark applications	118.9	21.7	5.7
Design applications	149.2	-54.7	49.5
Employment impacts	56.7	21.0	9.5
Employment in knowledge-intensive activities	65.1	0.0	0.0
Employment in innovative enterprises	49.8	40.9	18.5
Sales impacts	59.7	21.4	0.9
Medium and high-tech goods exports	44.3	9.3	-3.0
Knowledge-intensive services exports	85.9	34.9	-1.4
Sales of innovative products	54.1	23.1	9.6
Environmental sustainability	46.2	-24.7	-0.2
Resource productivity	12.3	11.8	1.2
Air emissions by fine particulate matter	32.7	-25.4	0.5
Environment-related technologies	99.2	-48.3	-1.9

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

BULGARIA is an **Emerging Innovator** with performance at 46.7% of the EU average. Performance is below the average of the Emerging Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

Design applications
Trademark applications
Environment-related technologies
Knowledge-intensive services exports
Product innovators

Relative weaknesses

Lifelong learning
Government support for business R&D
Resource productivity
Innovation expenditures per employee
Job-to-job mobility of HRST

Strong increases since 2016

Product innovators
Innovative SMEs collaborating with others
Business process innovators

Strong decreases since 2016

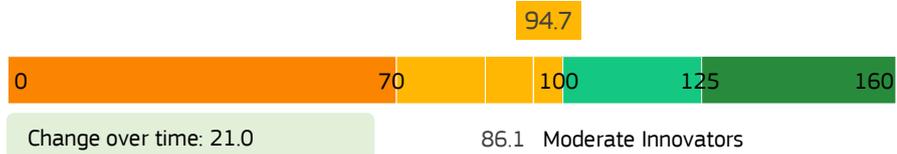
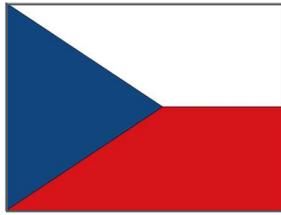
Design applications
Environment-related technologies
Non-R&D Innovation expenditures

Strong increases since 2022

Design applications
Innovative SMEs collaborating with others
Business process innovators

Strong decreases since 2022

Doctorate graduates
R&D expenditure in the business sector
Medium and high-tech goods exports



Czechia

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	94.7	21.0	10.5
Human resources	82.7	9.2	9.2
Doctorate graduates	114.8	0.0	0.0
Population with tertiary education	56.6	-2.4	-2.4
Lifelong learning	75.5	39.6	39.6
Attractive research systems	82.6	28.6	3.8
International scientific co-publications	103.1	52.2	-2.2
Most cited publications	47.7	4.0	1.9
Foreign doctorate students	126.9	63.0	13.8
Digitalisation	76.7	12.7	6.9
Broadband penetration	67.6	25.1	13.6
People with above basic overall digital skills	89.3	0.0	0.0
Finance and support	82.1	10.2	-2.1
R&D expenditures in the public sector	96.9	-21.0	-4.8
Venture capital expenditures	81.4	87.9	5.1
Government support for business R&D	65.7	-28.8	-5.9
Firm investments	113.2	38.3	34.0
R&D expenditure in the business sector	83.3	13.1	3.1
Non-R&D Innovation expenditures	158.8	49.8	45.0
Innovation expenditures per employee	104.8	52.7	54.5
Use of information technologies	100.4	2.3	-6.8
Enterprises providing ICT training	104.0	8.3	-10.2
Employed ICT specialists	96.7	-3.4	-3.4
Innovators	138.2	104.6	65.9
Product innovators (SMEs)	136.3	66.1	55.8
Business process innovators (SMEs)	139.8	145.7	76.8
Linkages	94.1	43.7	8.7
Innovative SMEs collaborating with others	127.8	55.6	34.5
Public-private co-publications	137.8	57.2	2.1
Job-to-job mobility of HRST	47.9	26.5	-11.8
Intellectual assets	63.1	-0.6	0.1
PCT patent applications	41.6	-7.2	0.3
Trademark applications	87.9	22.2	3.7
Design applications	67.3	-10.1	-2.8
Employment impacts	106.1	20.8	19.4
Employment in knowledge-intensive activities	96.4	0.0	0.0
Employment in innovative enterprises	114.1	40.5	37.8
Sales impacts	103.1	10.0	7.2
Medium and high-tech goods exports	114.2	8.1	4.7
Knowledge-intensive services exports	81.1	21.3	4.6
Sales of innovative products	110.4	-1.2	14.3
Environmental sustainability	99.0	16.6	-1.0
Resource productivity	77.1	28.9	0.8
Air emissions by fine particulate matter	117.8	18.5	-0.4
Environment-related technologies	93.7	6.0	-2.7

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

CZECHIA is a **Moderate Innovator** with performance at 94.7% of the EU average. Performance is above the average of the Moderate Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

- Non-R&D Innovation expenditures
- Business process innovators
- Public-private co-publications
- Product innovators
- Innovative SMEs collaborating with others

Relative weaknesses

- PCT patent applications
- Most cited publications
- Job-to-job mobility of HRST
- Population with tertiary education
- Government support for business R&D

Strong increases since 2016

- Business process innovators
- Venture capital expenditures
- Product innovators

Strong decreases since 2016

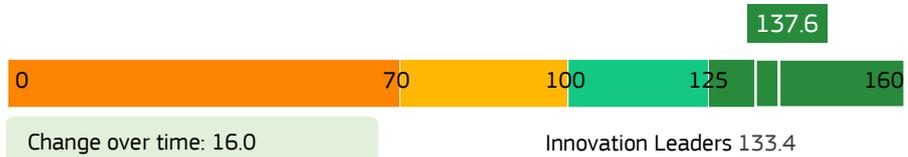
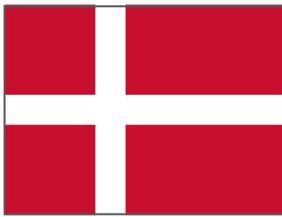
- Government support for business R&D
- R&D expenditures in the public sector
- Design applications

Strong increases since 2022

- Business process innovators
- Product innovators
- Innovation expenditures per employee

Strong decreases since 2022

- Job-to-job mobility of HRST
- Enterprises providing ICT training
- Government support for business R&D



Denmark

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	137.6	16.0	2.8
Human resources	176.7	-0.6	4.3
Doctorate graduates	144.5	-34.3	-22.9
Population with tertiary education	140.5	-4.2	-4.2
Lifelong learning	256.9	61.5	61.5
Attractive research systems	189.5	17.9	-11.2
International scientific co-publications	274.9	90.9	0.0
Most cited publications	127.0	-23.1	-17.4
Foreign doctorate students	210.8	44.1	-7.3
Digitalisation	145.6	2.4	0.0
Broadband penetration	143.3	4.7	0.0
People with above basic overall digital skills	148.6	0.0	0.0
Finance and support	111.9	42.6	3.1
R&D expenditures in the public sector	146.9	1.6	-1.6
Venture capital expenditures	130.1	111.2	6.2
Government support for business R&D	46.7	26.6	6.4
Firm investments	114.4	27.2	-4.5
R&D expenditure in the business sector	118.1	-8.5	-5.4
Non-R&D Innovation expenditures	101.6	47.6	25.3
Innovation expenditures per employee	121.2	43.8	-30.7
Use of information technologies	149.8	14.2	11.4
Enterprises providing ICT training	162.6	25.5	19.7
Employed ICT specialists	136.7	3.4	3.4
Innovators	117.2	63.4	-2.0
Product innovators (SMEs)	120.2	46.2	-0.1
Business process innovators (SMEs)	114.5	81.7	-4.0
Linkages	216.2	12.3	2.3
Innovative SMEs collaborating with others	127.6	15.7	5.9
Public-private co-publications	468.0	89.1	0.0
Job-to-job mobility of HRST	181.3	-26.5	0.0
Intellectual assets	136.9	-13.8	-11.9
PCT patent applications	141.0	-0.6	2.5
Trademark applications	112.3	4.2	-5.4
Design applications	157.7	-44.8	-35.3
Employment impacts	107.9	6.6	-5.5
Employment in knowledge-intensive activities	120.5	0.0	0.0
Employment in innovative enterprises	97.5	12.8	-10.6
Sales impacts	107.7	24.6	33.5
Medium and high-tech goods exports	78.0	5.8	0.4
Knowledge-intensive services exports	140.8	10.8	5.6
Sales of innovative products	115.0	70.5	119.0
Environmental sustainability	129.3	5.0	0.4
Resource productivity	65.0	12.1	3.4
Air emissions by fine particulate matter	131.0	5.1	-1.0
Environment-related technologies	190.8	0.0	0.0

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

DENMARK is an **Innovation Leader** with performance at 137.6% of the EU average. Performance is above the average of the Innovation Leaders. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance lead over the EU is becoming larger.

Relative strengths

Public-private co-publications
International scientific co-publications
Lifelong learning
Foreign doctorate students
Environment-related technologies

Relative weaknesses

Government support for business R&D
Resource productivity
Medium and high-tech goods exports
Employment in innovative enterprises
Non-R&D Innovation expenditures

Strong increases since 2016

Venture capital expenditures
International scientific co-publications
Public-private co-publications

Strong decreases since 2016

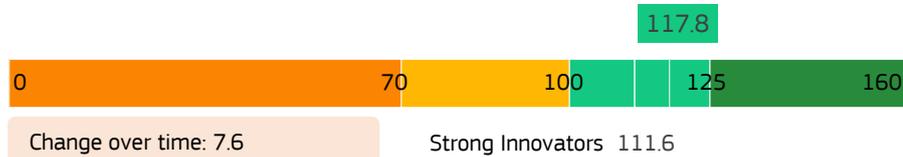
Design applications
Doctorate graduates
Job-to-job mobility of HRST

Strong increases since 2022

Sales of innovative products
Lifelong learning
Non-R&D Innovation expenditures

Strong decreases since 2022

Design applications
Innovation expenditures per employee
Doctorate graduates



Germany

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	117.8	7.6	-1.3
Human resources	99.8	-3.4	-3.4
Doctorate graduates	159.3	-11.4	-11.4
Population with tertiary education	71.7	1.2	1.2
Lifelong learning	62.7	4.4	4.4
Attractive research systems	109.0	1.0	-1.3
International scientific co-publications	94.1	29.3	-2.6
Most cited publications	106.5	-10.1	-1.4
Foreign doctorate students	131.9	0.0	0.0
Digitalisation	86.5	19.8	10.8
Broadband penetration	101.3	38.9	21.2
People with above basic overall digital skills	66.1	0.0	0.0
Finance and support	91.8	23.3	-0.2
R&D expenditures in the public sector	143.8	16.1	-1.6
Venture capital expenditures	87.0	53.1	3.3
Government support for business R&D	36.6	1.7	-2.0
Firm investments	140.4	5.9	-3.4
R&D expenditure in the business sector	141.7	10.8	0.0
Non-R&D Innovation expenditures	133.5	4.6	-6.3
Innovation expenditures per employee	144.7	2.2	-4.1
Use of information technologies	120.9	-6.0	12.7
Enterprises providing ICT training	128.2	-15.9	22.3
Employed ICT specialists	113.3	3.4	3.4
Innovators	141.1	53.4	-11.5
Product innovators (SMEs)	131.4	6.1	-25.9
Business process innovators (SMEs)	149.5	103.7	3.9
Linkages	141.9	26.6	-7.6
Innovative SMEs collaborating with others	117.8	42.1	-19.2
Public-private co-publications	188.6	53.1	-1.0
Job-to-job mobility of HRST	141.7	0.0	0.0
Intellectual assets	122.0	-18.6	-6.9
PCT patent applications	137.6	-11.5	-2.8
Trademark applications	105.7	7.4	-3.6
Design applications	117.1	-48.1	-14.8
Employment impacts	128.4	4.2	-2.6
Employment in knowledge-intensive activities	101.2	0.0	0.0
Employment in innovative enterprises	150.8	8.1	-5.0
Sales impacts	117.5	5.8	0.5
Medium and high-tech goods exports	112.8	0.2	2.4
Knowledge-intensive services exports	133.6	12.6	4.1
Sales of innovative products	107.3	6.2	-6.9
Environmental sustainability	121.2	7.5	-0.7
Resource productivity	126.2	45.3	5.5
Air emissions by fine particulate matter	124.0	2.4	-0.6
Environment-related technologies	112.2	-11.9	-5.2

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

GERMANY is a **Strong Innovator** with performance at 117.8% of the EU average. Performance is above the average of the Strong Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance lead over the EU is becoming smaller.

Relative strengths

- Public-private co-publications
- Doctorate graduates
- Employment in innovative enterprises
- Business process innovators
- Innovation expenditures per employee

Relative weaknesses

- Government support for business R&D
- Lifelong learning
- People with above basic overall digital skills
- Population with tertiary education
- Venture capital expenditures

Strong increases since 2016

- Business process innovators
- Public-private co-publications
- Venture capital expenditures

Strong decreases since 2016

- Design applications
- Enterprises providing ICT training
- Environment-related technologies

Strong increases since 2022

- Enterprises providing ICT training
- Broadband penetration
- Resource productivity

Strong decreases since 2022

- Product innovators
- Innovative SMEs collaborating with others
- Design applications



98.6



Change over time: 29.3

86.1 Moderate Innovators

Estonia

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	98.6	29.3	-11.4
Human resources	125.6	3.9	3.9
Doctorate graduates	85.2	-11.4	-11.4
Population with tertiary education	111.0	4.2	4.2
Lifelong learning	190.2	29.7	29.7
Attractive research systems	126.3	65.8	5.1
International scientific co-publications	171.2	112.9	-7.5
Most cited publications	88.5	21.5	0.6
Foreign doctorate students	147.2	123.4	27.2
Digitalisation	83.4	9.7	4.8
Broadband penetration	67.3	19.2	9.4
People with above basic overall digital skills	105.4	0.0	0.0
Finance and support	92.5	23.3	1.0
R&D expenditures in the public sector	98.4	-6.5	-1.6
Venture capital expenditures	134.9	102.1	0.0
Government support for business R&D	30.3	-19.0	5.6
Firm investments	90.1	35.5	-16.3
R&D expenditure in the business sector	64.6	27.7	1.5
Non-R&D Innovation expenditures	140.3	37.0	-42.0
Innovation expenditures per employee	73.8	41.9	-10.7
Use of information technologies	122.4	23.3	12.7
Enterprises providing ICT training	79.3	33.1	11.5
Employed ICT specialists	166.7	13.8	13.8
Innovators	95.3	107.8	-88.4
Product innovators (SMEs)	92.0	83.8	-110.2
Business process innovators (SMEs)	98.3	133.3	-65.2
Linkages	161.6	87.1	-61.5
Innovative SMEs collaborating with others	154.8	80.9	-112.7
Public-private co-publications	187.1	121.9	-23.3
Job-to-job mobility of HRST	156.3	76.5	-32.4
Intellectual assets	117.6	32.2	-1.6
PCT patent applications	59.9	17.5	-0.8
Trademark applications	194.0	63.9	6.1
Design applications	118.0	26.0	-8.6
Employment impacts	144.0	91.4	0.0
Employment in knowledge-intensive activities	112.0	0.0	0.0
Employment in innovative enterprises	170.2	177.9	0.0
Sales impacts	69.9	4.8	-8.3
Medium and high-tech goods exports	47.2	-9.5	-1.7
Knowledge-intensive services exports	103.7	37.0	6.5
Sales of innovative products	66.5	-13.3	-36.6
Environmental sustainability	23.3	-35.8	-22.2
Resource productivity	21.5	16.0	5.3
Air emissions by fine particulate matter	7.6	8.0	-14.1
Environment-related technologies	47.5	-121.8	-50.1

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

ESTONIA is a **Moderate Innovator** with performance at 98.6% of the EU average. Performance is above the average of the Moderate Innovators. Performance is increasing at a rate much higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

Trademark applications
Lifelong learning
Public-private co-publications
International scientific co-publications
Employment in innovative enterprises

Relative weaknesses

Air emissions by fine particulate matter
Resource productivity
Government support for business R&D
Medium and high-tech goods exports
Environment-related technologies

Strong increases since 2016

Employment in innovative enterprises
Business process innovators
Foreign doctorate students

Strong decreases since 2016

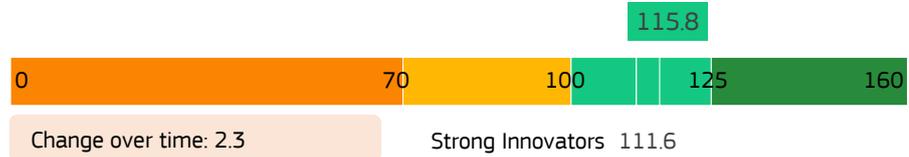
Environment-related technologies
Government support for business R&D
Sales of innovative products

Strong increases since 2022

Lifelong learning
Foreign doctorate students
Employed ICT specialists

Strong decreases since 2022

Innovative SMEs collaborating with others
Product innovators
Business process innovators



Ireland

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	115.8	2.3	3.9
Human resources	156.4	1.1	-3.8
Doctorate graduates	144.5	11.4	0.0
Population with tertiary education	217.3	3.6	3.6
Lifelong learning	99.0	-19.8	-19.8
Attractive research systems	159.3	32.9	3.2
International scientific co-publications	190.9	108.5	0.6
Most cited publications	116.0	-13.4	-0.9
Foreign doctorate students	207.2	68.4	15.1
Digitalisation	122.3	10.5	10.3
Broadband penetration	95.6	20.6	20.4
People with above basic overall digital skills	158.9	0.0	0.0
Finance and support	64.8	-29.4	-13.2
R&D expenditures in the public sector	14.1	-37.1	-17.7
Venture capital expenditures	72.7	11.5	-19.8
Government support for business R&D	114.8	-61.8	0.1
Firm investments	75.9	-7.9	-15.9
R&D expenditure in the business sector	54.9	-18.5	-5.4
Non-R&D Innovation expenditures	12.2	-62.9	-64.7
Innovation expenditures per employee	148.3	52.8	18.0
Use of information technologies	128.6	-24.5	-13.6
Enterprises providing ICT training	104.6	-46.5	-24.2
Employed ICT specialists	153.3	-3.4	-3.4
Innovators	115.8	-18.8	29.4
Product innovators (SMEs)	107.8	-30.9	4.2
Business process innovators (SMEs)	122.8	-5.9	56.2
Linkages	180.8	82.6	5.2
Innovative SMEs collaborating with others	201.4	100.5	6.8
Public-private co-publications	247.4	84.2	4.2
Job-to-job mobility of HRST	N/A	N/A	N/A
Intellectual assets	57.3	-14.4	-4.6
PCT patent applications	64.0	-17.5	1.8
Trademark applications	70.6	-16.9	-5.6
Design applications	33.0	-8.5	-12.0
Employment impacts	151.5	-13.1	29.0
Employment in knowledge-intensive activities	208.4	0.0	0.0
Employment in innovative enterprises	104.8	-25.4	56.5
Sales impacts	138.8	16.6	24.2
Medium and high-tech goods exports	99.9	18.1	-3.9
Knowledge-intensive services exports	161.9	2.2	-0.3
Sales of innovative products	169.2	32.2	98.1
Environmental sustainability	109.0	25.6	9.3
Resource productivity	151.8	99.8	32.0
Air emissions by fine particulate matter	129.4	15.0	2.3
Environment-related technologies	37.2	-11.8	2.3

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IRELAND is a **Strong Innovator** with performance at 115.8% of the EU average. Performance is above the average of the Strong Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance lead over the EU is becoming smaller.

Relative strengths

- Public-private co-publications
- Population with tertiary education
- Employment in knowledge-intensive activities
- Foreign doctorate students
- Innovative SMEs collaborating with others

Relative weaknesses

- Non-R&D Innovation expenditures
- R&D expenditures in the public sector
- Design applications
- Environment-related technologies
- R&D expenditure in the business sector

Strong increases since 2016

- International scientific co-publications
- Innovative SMEs collaborating with others
- Resource productivity

Strong decreases since 2016

- Non-R&D Innovation expenditures
- Government support for business R&D
- Enterprises providing ICT training

Strong increases since 2022

- Sales of innovative products
- Employment in innovative enterprises
- Business process innovators

Strong decreases since 2022

- Non-R&D Innovation expenditures
- Enterprises providing ICT training
- Lifelong learning



Greece

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	79.5	22.2	0.5
Human resources	71.5	6.8	-3.0
Doctorate graduates	70.3	11.4	-11.4
Population with tertiary education	118.5	6.0	6.0
Lifelong learning	17.6	0.0	0.0
Attractive research systems	71.0	14.1	0.3
International scientific co-publications	92.1	48.5	6.6
Most cited publications	93.3	7.1	3.9
Foreign doctorate students	1.4	-2.1	-13.9
Digitalisation	48.5	-6.1	-6.1
Broadband penetration	26.4	-12.1	-12.1
People with above basic overall digital skills	78.8	0.0	0.0
Finance and support	63.6	35.5	5.0
R&D expenditures in the public sector	100.0	35.5	-6.5
Venture capital expenditures	45.0	32.4	2.0
Government support for business R&D	44.5	38.7	24.0
Firm investments	70.5	23.1	-2.1
R&D expenditure in the business sector	44.4	31.5	-0.8
Non-R&D Innovation expenditures	106.2	9.0	-6.0
Innovation expenditures per employee	66.6	27.6	0.1
Use of information technologies	39.3	-2.6	6.1
Enterprises providing ICT training	48.3	-8.9	8.9
Employed ICT specialists	30.0	3.4	3.4
Innovators	167.3	106.9	15.1
Product innovators (SMEs)	179.0	123.7	16.6
Business process innovators (SMEs)	157.0	89.0	13.5
Linkages	117.7	58.1	-9.4
Innovative SMEs collaborating with others	174.8	56.6	-16.0
Public-private co-publications	146.9	84.6	14.8
Job-to-job mobility of HRST	58.3	47.1	-14.7
Intellectual assets	51.8	8.8	-1.5
PCT patent applications	37.2	1.2	-2.9
Trademark applications	95.1	31.8	2.5
Design applications	25.8	0.3	-2.7
Employment impacts	124.2	37.5	22.2
Employment in knowledge-intensive activities	81.9	0.0	0.0
Employment in innovative enterprises	158.9	73.0	43.3
Sales impacts	85.5	27.5	-9.7
Medium and high-tech goods exports	20.6	3.8	-2.2
Knowledge-intensive services exports	103.4	25.5	-17.0
Sales of innovative products	158.0	66.6	-12.2
Environmental sustainability	71.8	-2.5	1.8
Resource productivity	88.5	55.4	16.2
Air emissions by fine particulate matter	71.8	11.6	5.0
Environment-related technologies	55.2	-57.9	-11.7

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GREECE is a **Moderate Innovator** with performance at 79.5% of the EU average. Performance is below the average of the Moderate Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

- Product innovators
- Innovative SMEs collaborating with others
- Employment in innovative enterprises
- Sales of innovative products
- Business process innovators

Relative weaknesses

- Foreign doctorate students
- Lifelong learning
- Medium and high-tech goods exports
- Design applications
- Broadband penetration

Strong increases since 2016

- Product innovators
- Business process innovators
- Public-private co-publications

Strong decreases since 2016

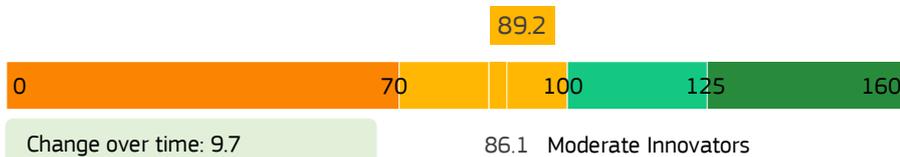
- Environment-related technologies
- Broadband penetration
- Enterprises providing ICT training

Strong increases since 2022

- Employment in innovative enterprises
- Government support for business R&D
- Product innovators

Strong decreases since 2022

- Knowledge-intensive services exports
- Innovative SMEs collaborating with others
- Job-to-job mobility of HRST



Spain

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	89.2	9.7	4.0
Human resources	127.2	5.9	5.9
Doctorate graduates	100.0	0.0	0.0
Population with tertiary education	149.1	10.8	10.8
Lifelong learning	133.3	9.9	9.9
Attractive research systems	96.1	11.6	0.9
International scientific co-publications	91.6	40.7	-1.0
Most cited publications	92.5	-4.1	-0.9
Foreign doctorate students	108.5	20.5	6.9
Digitalisation	144.9	20.8	8.2
Broadband penetration	140.0	41.0	16.2
People with above basic overall digital skills	151.7	0.0	0.0
Finance and support	81.1	20.1	5.7
R&D expenditures in the public sector	78.1	6.5	0.0
Venture capital expenditures	103.2	55.4	13.6
Government support for business R&D	55.9	1.7	5.1
Firm investments	61.0	11.9	-2.5
R&D expenditure in the business sector	52.1	10.8	1.5
Non-R&D Innovation expenditures	81.3	18.4	-2.6
Innovation expenditures per employee	53.0	7.1	-6.3
Use of information technologies	90.1	0.4	5.4
Enterprises providing ICT training	90.2	-6.4	3.8
Employed ICT specialists	90.0	6.9	6.9
Innovators	50.1	19.4	20.6
Product innovators (SMEs)	59.6	42.3	22.9
Business process innovators (SMEs)	41.8	-4.9	18.1
Linkages	88.2	37.9	-9.6
Innovative SMEs collaborating with others	57.0	7.5	3.6
Public-private co-publications	115.6	52.4	0.7
Job-to-job mobility of HRST	102.1	58.8	-26.5
Intellectual assets	80.1	-2.4	0.3
PCT patent applications	61.2	-5.0	-1.6
Trademark applications	112.6	7.7	0.1
Design applications	72.2	-6.8	3.0
Employment impacts	59.7	-5.8	5.5
Employment in knowledge-intensive activities	83.1	0.0	0.0
Employment in innovative enterprises	40.5	-11.3	10.7
Sales impacts	97.5	22.8	11.6
Medium and high-tech goods exports	67.9	-2.2	4.0
Knowledge-intensive services exports	68.7	31.4	-9.3
Sales of innovative products	169.2	50.8	49.3
Environmental sustainability	100.4	-14.5	-2.0
Resource productivity	139.1	7.8	13.5
Air emissions by fine particulate matter	85.5	-7.6	-2.2
Environment-related technologies	83.5	-37.6	-12.2

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SPAIN is a **Moderate Innovator** with performance at 89.2% of the EU average. Performance is above the average of the Moderate Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

Sales of innovative products
People with above basic overall digital skills
Population with tertiary education
Broadband penetration
Resource productivity

Relative weaknesses

Employment in innovative enterprises
Business process innovators
R&D expenditure in the business sector
Innovation expenditures per employee
Government support for business R&D

Strong increases since 2016

Job-to-job mobility of HRST
Venture capital expenditures
Public-private co-publications

Strong decreases since 2016

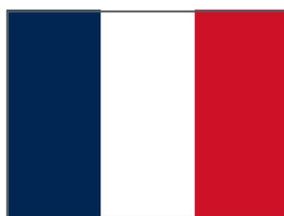
Environment-related technologies
Employment in innovative enterprises
Air emissions by fine particulate matter

Strong increases since 2022

Sales of innovative products
Product innovators
Business process innovators

Strong decreases since 2022

Job-to-job mobility of HRST
Environment-related technologies
Knowledge-intensive services exports



France

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	105.3	-1.6	-1.3
Human resources	126.3	-8.2	1.6
Doctorate graduates	114.8	-34.3	-11.4
Population with tertiary education	148.6	0.6	0.6
Lifelong learning	113.7	25.3	25.3
Attractive research systems	117.1	-8.9	-0.8
International scientific co-publications	76.3	13.2	-4.9
Most cited publications	89.3	-15.7	0.8
Foreign doctorate students	221.2	-13.9	-0.5
Digitalisation	112.3	0.0	0.0
Broadband penetration	105.8	0.0	0.0
People with above basic overall digital skills	121.3	0.0	0.0
Finance and support	132.7	11.3	4.3
R&D expenditures in the public sector	93.8	-4.8	-3.2
Venture capital expenditures	134.9	43.1	18.3
Government support for business R&D	176.0	0.0	0.0
Firm investments	89.7	-5.8	-4.8
R&D expenditure in the business sector	97.2	0.0	-5.4
Non-R&D Innovation expenditures	47.4	-29.7	-25.9
Innovation expenditures per employee	117.1	10.1	14.9
Use of information technologies	73.8	-3.5	-3.5
Enterprises providing ICT training	58.0	0.0	0.0
Employed ICT specialists	90.0	-6.9	-6.9
Innovators	104.5	8.4	-0.5
Product innovators (SMEs)	98.9	2.8	-28.5
Business process innovators (SMEs)	109.5	14.5	29.3
Linkages	120.9	39.8	-5.3
Innovative SMEs collaborating with others	137.2	28.2	25.2
Public-private co-publications	109.2	9.1	-6.9
Job-to-job mobility of HRST	112.5	64.7	-32.4
Intellectual assets	80.6	-10.7	-3.5
PCT patent applications	97.7	-15.7	-8.8
Trademark applications	69.7	0.2	0.0
Design applications	67.6	-12.8	0.3
Employment impacts	110.1	-5.3	3.8
Employment in knowledge-intensive activities	115.7	0.0	0.0
Employment in innovative enterprises	105.5	-10.3	7.5
Sales impacts	81.7	-20.7	-5.2
Medium and high-tech goods exports	87.3	-6.7	2.1
Knowledge-intensive services exports	112.5	9.5	2.2
Sales of innovative products	41.8	-79.9	-25.7
Environmental sustainability	118.3	9.2	-0.1
Resource productivity	149.5	50.8	4.2
Air emissions by fine particulate matter	109.3	4.8	-1.0
Environment-related technologies	100.1	-13.5	-2.1

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FRANCE is a **Strong Innovator** with performance at 105.3% of the EU average. Performance is below the average of the Strong Innovators. Performance is decreasing and is lower than the rate of increase of the EU (8.5%-points). The country's performance lead over the EU is becoming smaller.

Relative strengths

Foreign doctorate students
Government support for business R&D
Resource productivity
Population with tertiary education
Innovative SMEs collaborating with others

Relative weaknesses

Sales of innovative products
Non-R&D Innovation expenditures
Enterprises providing ICT training
Design applications
Trademark applications

Strong increases since 2016

Job-to-job mobility of HRST
Resource productivity
Venture capital expenditures

Strong decreases since 2016

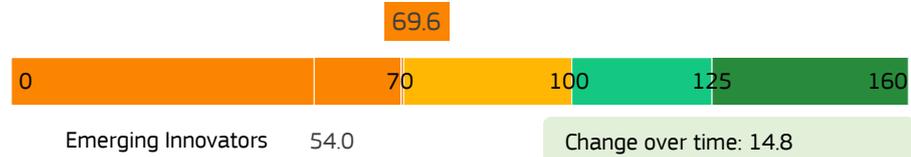
Sales of innovative products
Doctorate graduates
Non-R&D Innovation expenditures

Strong increases since 2022

Business process innovators
Lifelong learning
Innovative SMEs collaborating with others

Strong decreases since 2022

Job-to-job mobility of HRST
Product innovators
Non-R&D Innovation expenditures



Croatia

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	69.6	14.8	1.1
Human resources	49.3	-7.2	-2.3
Doctorate graduates	55.5	-11.4	0.0
Population with tertiary education	62.4	-1.2	-1.2
Lifelong learning	26.5	-7.7	-7.7
Attractive research systems	55.0	33.8	4.4
International scientific co-publications	84.4	62.7	9.6
Most cited publications	43.9	20.6	3.0
Foreign doctorate students	41.6	37.2	2.7
Digitalisation	77.3	30.6	7.5
Broadband penetration	45.3	60.2	14.7
People with above basic overall digital skills	121.0	0.0	0.0
Finance and support	97.0	27.1	37.8
R&D expenditures in the public sector	84.4	41.9	1.6
Venture capital expenditures	134.9	123.9	61.1
Government support for business R&D	62.6	-95.4	63.1
Firm investments	38.0	-19.5	-18.9
R&D expenditure in the business sector	36.8	16.2	-1.5
Non-R&D Innovation expenditures	62.7	-64.3	-50.6
Innovation expenditures per employee	18.9	-14.0	-7.1
Use of information technologies	80.5	-10.4	-4.8
Enterprises providing ICT training	90.8	-24.8	-13.4
Employed ICT specialists	70.0	3.4	3.4
Innovators	126.9	87.6	-4.0
Product innovators (SMEs)	133.8	94.7	-17.8
Business process innovators (SMEs)	120.9	79.9	10.7
Linkages	112.3	74.1	5.2
Innovative SMEs collaborating with others	106.3	68.8	-4.1
Public-private co-publications	147.4	98.4	2.9
Job-to-job mobility of HRST	102.1	67.6	14.7
Intellectual assets	46.7	10.0	4.6
PCT patent applications	35.9	-3.8	0.4
Trademark applications	72.0	33.9	8.0
Design applications	34.8	8.8	7.3
Employment impacts	76.9	21.1	0.0
Employment in knowledge-intensive activities	56.6	0.0	0.0
Employment in innovative enterprises	93.6	41.1	0.0
Sales impacts	51.7	17.3	-3.8
Medium and high-tech goods exports	41.3	-9.1	-7.8
Knowledge-intensive services exports	21.0	7.4	-12.4
Sales of innovative products	98.4	70.4	12.9
Environmental sustainability	57.2	-19.2	-9.5
Resource productivity	80.0	16.4	10.4
Air emissions by fine particulate matter	67.5	18.1	1.1
Environment-related technologies	19.7	-86.7	-35.4

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CROATIA is an **Emerging Innovator** with performance at 69.6% of the EU average. Performance is above the average of the Emerging Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

- Public-private co-publications
- Venture capital expenditures
- Product innovators
- People with above basic overall digital skills
- Business process innovators

Relative weaknesses

- Innovation expenditures per employee
- Environment-related technologies
- Knowledge-intensive services exports
- Lifelong learning
- Design applications

Strong increases since 2016

- Venture capital expenditures
- Public-private co-publications
- Product innovators

Strong decreases since 2016

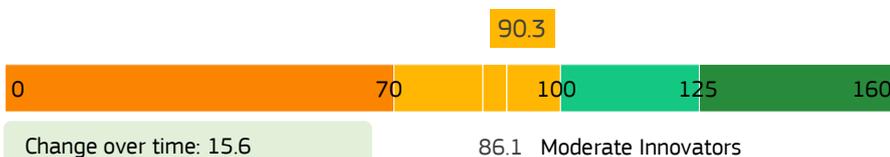
- Government support for business R&D
- Environment-related technologies
- Non-R&D Innovation expenditures

Strong increases since 2022

- Government support for business R&D
- Venture capital expenditures
- Broadband penetration

Strong decreases since 2022

- Non-R&D Innovation expenditures
- Environment-related technologies
- Product innovators



Italy

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	90.3	15.6	-5.6
Human resources	62.1	-4.0	0.9
Doctorate graduates	85.2	-11.4	0.0
Population with tertiary education	26.0	5.4	5.4
Lifelong learning	77.5	-3.3	-3.3
Attractive research systems	106.2	25.9	6.5
International scientific co-publications	88.2	46.7	0.8
Most cited publications	126.4	18.9	11.0
Foreign doctorate students	87.9	22.4	1.5
Digitalisation	77.9	19.5	10.8
Broadband penetration	74.7	38.3	21.2
People with above basic overall digital skills	82.4	0.0	0.0
Finance and support	66.8	20.9	-14.1
R&D expenditures in the public sector	67.2	1.6	0.0
Venture capital expenditures	56.6	5.9	-3.7
Government support for business R&D	79.8	63.2	-44.6
Firm investments	72.3	11.3	-18.5
R&D expenditure in the business sector	59.7	6.2	-1.5
Non-R&D Innovation expenditures	85.9	3.7	-27.0
Innovation expenditures per employee	73.3	23.4	-27.4
Use of information technologies	79.5	23.6	13.6
Enterprises providing ICT training	82.2	44.6	24.2
Employed ICT specialists	76.7	3.4	3.4
Innovators	115.2	47.2	-37.6
Product innovators (SMEs)	112.3	32.5	-35.0
Business process innovators (SMEs)	117.8	62.8	-40.4
Linkages	92.0	51.7	-5.1
Innovative SMEs collaborating with others	113.9	79.2	-16.2
Public-private co-publications	148.0	71.1	5.7
Job-to-job mobility of HRST	50.0	17.6	0.0
Intellectual assets	107.6	2.1	0.0
PCT patent applications	77.6	0.1	-1.2
Trademark applications	106.1	17.5	-2.8
Design applications	152.7	-7.4	3.7
Employment impacts	107.0	10.0	-13.1
Employment in knowledge-intensive activities	101.2	0.0	0.0
Employment in innovative enterprises	111.7	19.4	-25.6
Sales impacts	92.8	15.4	-5.4
Medium and high-tech goods exports	83.8	3.6	7.6
Knowledge-intensive services exports	95.2	18.4	-2.1
Sales of innovative products	102.8	30.0	-29.6
Environmental sustainability	113.4	1.2	-5.1
Resource productivity	170.2	23.6	-13.9
Air emissions by fine particulate matter	106.2	4.6	-0.8
Environment-related technologies	67.2	-17.9	-4.4

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

ITALY is a **Moderate Innovator** with performance at 90.3% of the EU average. Performance is above the average of the Moderate Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

Resource productivity
Design applications

Public-private co-publications
Most cited publications
Business process innovators

Relative weaknesses

Population with tertiary education
Job-to-job mobility of HRST
Venture capital expenditures
R&D expenditure in the business sector
Environment-related technologies

Strong increases since 2016

Innovative SMEs collaborating with others
Public-private co-publications
Government support for business R&D

Strong decreases since 2016

Environment-related technologies
Doctorate graduates
Design applications

Strong increases since 2022

Enterprises providing ICT training
Broadband penetration
Most cited publications

Strong decreases since 2022

Government support for business R&D
Business process innovators
Product innovators



Cyprus

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	105.4	35.6	0.6
Human resources	115.1	13.8	3.9
Doctorate graduates	55.5	22.9	0.0
Population with tertiary education	199.4	5.4	5.4
Lifelong learning	86.3	8.8	8.8
Attractive research systems	162.4	80.7	15.9
International scientific co-publications	274.9	227.8	0.0
Most cited publications	106.8	0.1	21.7
Foreign doctorate students	137.4	128.2	17.5
Digitalisation	94.4	44.2	24.6
Broadband penetration	108.2	87.0	48.4
People with above basic overall digital skills	75.5	0.0	0.0
Finance and support	39.4	2.0	-31.6
R&D expenditures in the public sector	34.4	3.2	-1.6
Venture capital expenditures	61.8	-9.8	-108.4
Government support for business R&D	16.2	12.8	8.1
Firm investments	46.4	29.9	-9.2
R&D expenditure in the business sector	25.0	23.1	3.1
Non-R&D Innovation expenditures	89.2	45.6	-25.7
Innovation expenditures per employee	32.1	22.3	-6.4
Use of information technologies	117.5	28.2	21.7
Enterprises providing ICT training	134.5	32.5	19.1
Employed ICT specialists	100.0	24.1	24.1
Innovators	154.8	109.0	-17.4
Product innovators (SMEs)	152.4	93.2	-33.7
Business process innovators (SMEs)	157.0	125.9	0.0
Linkages	223.9	159.2	0.8
Innovative SMEs collaborating with others	243.7	182.3	0.0
Public-private co-publications	295.5	240.9	-14.8
Job-to-job mobility of HRST	177.1	100.0	8.8
Intellectual assets	103.4	12.0	0.0
PCT patent applications	41.3	10.3	5.1
Trademark applications	201.0	0.0	0.0
Design applications	87.5	23.4	-6.7
Employment impacts	147.0	41.2	-1.8
Employment in knowledge-intensive activities	156.6	0.0	0.0
Employment in innovative enterprises	139.2	80.3	-3.4
Sales impacts	108.2	18.7	-1.0
Medium and high-tech goods exports	81.9	-32.2	-5.2
Knowledge-intensive services exports	146.3	31.1	-12.2
Sales of innovative products	105.4	81.6	19.6
Environmental sustainability	59.7	4.3	13.9
Resource productivity	55.9	0.8	8.4
Air emissions by fine particulate matter	61.6	-3.3	-6.3
Environment-related technologies	60.6	15.6	41.3

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

CYPRUS is a **Strong Innovator** with performance at 105.4% of the EU average. Performance is below the average of the Strong Innovators. Performance is increasing at a rate much higher than that of the EU (8.5%-points). The country's performance lead over the EU is becoming larger.

Relative strengths

- Public-private co-publications
- International scientific co-publications
- Innovative SMEs collaborating with others
- Trademark applications
- Population with tertiary education

Relative weaknesses

- Government support for business R&D
- R&D expenditure in the business sector
- Innovation expenditures per employee
- R&D expenditures in the public sector
- PCT patent applications

Strong increases since 2016

- Public-private co-publications
- International scientific co-publications
- Innovative SMEs collaborating with others

Strong decreases since 2016

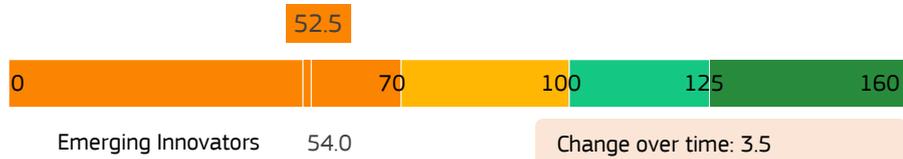
- Medium and high-tech goods exports
- Venture capital expenditures
- Air emissions by fine particulate matter

Strong increases since 2022

- Broadband penetration
- Environment-related technologies
- Employed ICT specialists

Strong decreases since 2022

- Venture capital expenditures
- Product innovators
- Non-R&D Innovation expenditures



Latvia

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	52.5	3.5	0.6
Human resources	75.4	-6.0	-1.1
Doctorate graduates	25.8	-22.9	-11.4
Population with tertiary education	122.5	2.4	2.4
Lifelong learning	78.4	12.1	12.1
Attractive research systems	53.7	27.4	10.1
International scientific co-publications	58.7	49.9	-4.1
Most cited publications	46.0	13.2	17.2
Foreign doctorate students	63.0	38.9	7.1
Digitalisation	71.2	-4.6	0.4
Broadband penetration	58.9	-9.1	0.9
People with above basic overall digital skills	88.1	0.0	0.0
Finance and support	37.9	-13.9	3.3
R&D expenditures in the public sector	54.7	3.2	-1.6
Venture capital expenditures	46.5	-55.7	8.7
Government support for business R&D	6.8	6.6	4.2
Firm investments	24.5	-9.4	-5.6
R&D expenditure in the business sector	12.5	-0.8	1.5
Non-R&D Innovation expenditures	57.3	-26.6	-16.0
Innovation expenditures per employee	9.2	-2.2	-3.3
Use of information technologies	75.4	19.3	5.6
Enterprises providing ICT training	58.0	17.8	-10.2
Employed ICT specialists	93.3	20.7	20.7
Innovators	39.3	30.0	-8.7
Product innovators (SMEs)	41.3	33.8	-16.2
Business process innovators (SMEs)	37.5	26.0	-0.7
Linkages	74.4	38.6	11.6
Innovative SMEs collaborating with others	45.8	41.6	-1.7
Public-private co-publications	98.9	71.5	-7.1
Job-to-job mobility of HRST	87.5	20.6	32.4
Intellectual assets	63.8	0.3	-3.0
PCT patent applications	41.8	-8.8	-3.2
Trademark applications	106.0	32.7	4.6
Design applications	49.8	-13.7	-8.6
Employment impacts	48.9	10.8	-4.7
Employment in knowledge-intensive activities	69.9	0.0	0.0
Employment in innovative enterprises	31.7	21.0	-9.2
Sales impacts	52.3	4.7	-3.8
Medium and high-tech goods exports	33.8	-7.1	-3.5
Knowledge-intensive services exports	83.8	15.7	7.0
Sales of innovative products	45.5	9.2	-17.6
Environmental sustainability	41.9	-11.8	7.6
Resource productivity	58.1	13.1	10.8
Air emissions by fine particulate matter	27.5	6.1	0.9
Environment-related technologies	46.5	-49.4	13.5

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LATVIA is an **Emerging Innovator** with performance at 52.5% of the EU average. Performance is below the average of the Emerging Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

- Population with tertiary education
- Trademark applications
- Public-private co-publications
- Employed ICT specialists
- People with above basic overall digital skills

Relative weaknesses

- Government support for business R&D
- Innovation expenditures per employee
- R&D expenditure in the business sector
- Doctorate graduates
- Air emissions by fine particulate matter

Strong increases since 2016

- Public-private co-publications
- International scientific co-publications
- Innovative SMEs collaborating with others

Strong decreases since 2016

- Venture capital expenditures
- Environment-related technologies
- Non-R&D Innovation expenditures

Strong increases since 2022

- Job-to-job mobility of HRST
- Employed ICT specialists
- Most cited publications

Strong decreases since 2022

- Sales of innovative products
- Product innovators
- Non-R&D Innovation expenditures



83.8



Change over time: 16.7

86.1 Moderate Innovators

Lithuania

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	83.8	16.7	3.7
Human resources	107.2	-3.6	1.3
Doctorate graduates	55.5	-11.4	0.0
Population with tertiary education	193.6	4.2	4.2
Lifelong learning	66.7	0.0	0.0
Attractive research systems	54.2	29.1	-2.7
International scientific co-publications	70.4	53.2	-5.7
Most cited publications	55.6	20.9	7.5
Foreign doctorate students	32.1	25.6	-23.3
Digitalisation	94.4	0.9	-1.3
Broadband penetration	101.6	1.8	-2.7
People with above basic overall digital skills	84.6	0.0	0.0
Finance and support	71.2	13.1	-1.5
R&D expenditures in the public sector	68.8	-25.8	-6.5
Venture capital expenditures	111.5	62.7	-1.2
Government support for business R&D	21.6	14.2	5.0
Firm investments	86.2	13.8	17.8
R&D expenditure in the business sector	34.0	16.9	0.8
Non-R&D Innovation expenditures	170.9	4.6	30.3
Innovation expenditures per employee	67.6	19.1	23.3
Use of information technologies	69.6	18.0	8.7
Enterprises providing ICT training	46.6	15.3	-3.8
Employed ICT specialists	93.3	20.7	20.7
Innovators	113.7	53.6	4.8
Product innovators (SMEs)	115.5	59.4	0.2
Business process innovators (SMEs)	112.1	47.3	9.7
Linkages	140.2	61.3	4.9
Innovative SMEs collaborating with others	126.3	-10.1	10.7
Public-private co-publications	66.0	36.4	-8.4
Job-to-job mobility of HRST	183.3	138.2	5.9
Intellectual assets	72.1	19.8	4.1
PCT patent applications	35.2	-9.3	2.9
Trademark applications	135.7	70.9	10.3
Design applications	56.3	16.8	0.8
Employment impacts	101.3	15.8	7.5
Employment in knowledge-intensive activities	84.3	0.0	0.0
Employment in innovative enterprises	115.2	30.8	14.5
Sales impacts	54.8	16.3	5.1
Medium and high-tech goods exports	45.8	3.7	-6.9
Knowledge-intensive services exports	35.9	24.1	9.6
Sales of innovative products	87.1	26.0	18.0
Environmental sustainability	78.3	-2.1	-4.0
Resource productivity	44.8	0.9	4.5
Air emissions by fine particulate matter	107.6	14.9	-0.2
Environment-related technologies	69.4	-23.9	-14.1

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

LITHUANIA is a **Moderate Innovator** with performance at 83.8% of the EU average. Performance is below the average of the Moderate Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

- Population with tertiary education
- Job-to-job mobility of HRST
- Non-R&D Innovation expenditures
- Trademark applications
- Innovative SMEs collaborating with others

Relative weaknesses

- Government support for business R&D
- Foreign doctorate students
- R&D expenditure in the business sector
- PCT patent applications
- Knowledge-intensive services exports

Strong increases since 2016

- Job-to-job mobility of HRST
- Trademark applications
- Venture capital expenditures

Strong decreases since 2016

- R&D expenditures in the public sector
- Environment-related technologies
- Doctorate graduates

Strong increases since 2022

- Non-R&D Innovation expenditures
- Innovation expenditures per employee
- Employed ICT specialists

Strong decreases since 2022

- Foreign doctorate students
- Environment-related technologies
- Public-private co-publications



Luxembourg

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	117.2	-1.5	1.0
Human resources	156.6	12.2	-7.4
Doctorate graduates	100.0	34.3	-11.4
Population with tertiary education	209.8	-9.6	-9.6
Lifelong learning	160.8	2.2	2.2
Attractive research systems	221.1	19.1	-2.9
International scientific co-publications	274.9	115.6	18.8
Most cited publications	133.1	-11.9	-13.0
Foreign doctorate students	330.5	0.0	0.0
Digitalisation	124.4	9.3	10.0
Broadband penetration	124.9	18.3	19.8
People with above basic overall digital skills	123.8	0.0	0.0
Finance and support	66.4	-7.1	-0.3
R&D expenditures in the public sector	67.2	-3.2	1.6
Venture capital expenditures	103.6	-10.0	0.4
Government support for business R&D	17.0	-9.5	-3.7
Firm investments	43.9	3.1	-7.0
R&D expenditure in the business sector	29.2	-13.1	-5.4
Non-R&D Innovation expenditures	51.2	18.4	0.0
Innovation expenditures per employee	52.1	5.2	-15.0
Use of information technologies	144.3	1.7	14.5
Enterprises providing ICT training	96.6	-21.7	4.5
Employed ICT specialists	193.3	24.1	24.1
Innovators	99.0	-20.9	0.0
Product innovators (SMEs)	107.8	7.4	0.0
Business process innovators (SMEs)	91.3	-51.1	0.0
Linkages	192.5	77.8	-0.8
Innovative SMEs collaborating with others	112.2	46.6	0.0
Public-private co-publications	436.3	274.9	33.8
Job-to-job mobility of HRST	154.2	14.7	-17.6
Intellectual assets	107.9	-41.2	-6.9
PCT patent applications	68.3	-3.0	2.3
Trademark applications	163.7	-40.9	-13.1
Design applications	104.7	-90.0	-13.8
Employment impacts	133.0	-33.1	0.0
Employment in knowledge-intensive activities	208.4	0.0	0.0
Employment in innovative enterprises	71.1	-64.5	0.0
Sales impacts	93.1	2.4	12.1
Medium and high-tech goods exports	89.6	11.7	30.4
Knowledge-intensive services exports	143.7	-5.7	-0.8
Sales of innovative products	45.3	-1.7	0.0
Environmental sustainability	118.9	-9.2	3.1
Resource productivity	171.7	2.7	-10.0
Air emissions by fine particulate matter	106.5	12.0	5.2
Environment-related technologies	84.1	-42.0	9.3

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LUXEMBOURG is a **Strong Innovator** with performance at 117.2% of the EU average. Performance is above the average of the Strong Innovators. Performance is decreasing and is lower than the rate of increase of the EU (8.5%-points). The country's performance lead over the EU is becoming smaller.

Relative strengths

Public-private co-publications
Foreign doctorate students
International scientific co-publications
Population with tertiary education
Employment in knowledge-intensive activities

Relative weaknesses

Government support for business R&D
R&D expenditure in the business sector
Sales of innovative products
Non-R&D Innovation expenditures
Innovation expenditures per employee

Strong increases since 2016

Public-private co-publications
International scientific co-publications
Innovative SMEs collaborating with others

Strong decreases since 2016

Design applications
Employment in innovative enterprises
Business process innovators

Strong increases since 2022

Public-private co-publications
Medium and high-tech goods exports
Employed ICT specialists

Strong decreases since 2022

Job-to-job mobility of HRST
Innovation expenditures per employee
Design applications



86.1 Moderate Innovators

Hungary

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	70.4	7.7	2.4
Human resources	47.0	3.6	3.6
Doctorate graduates	40.7	0.0	0.0
Population with tertiary education	41.6	-6.0	-6.0
Lifelong learning	60.8	22.0	22.0
Attractive research systems	77.8	42.3	-0.1
International scientific co-publications	56.7	29.5	1.7
Most cited publications	56.0	13.4	-7.5
Foreign doctorate students	146.3	120.4	15.2
Digitalisation	72.5	11.2	8.1
Broadband penetration	68.4	22.1	15.9
People with above basic overall digital skills	78.1	0.0	0.0
Finance and support	77.6	-8.7	0.5
R&D expenditures in the public sector	43.8	8.1	4.8
Venture capital expenditures	70.8	16.0	-1.8
Government support for business R&D	126.7	-58.0	-2.9
Firm investments	74.1	2.3	9.2
R&D expenditure in the business sector	82.6	7.7	1.5
Non-R&D Innovation expenditures	88.4	-8.0	14.1
Innovation expenditures per employee	54.1	6.3	12.3
Use of information technologies	79.5	11.6	10.4
Enterprises providing ICT training	75.9	16.6	14.0
Employed ICT specialists	83.3	6.9	6.9
Innovators	49.3	46.7	13.7
Product innovators (SMEs)	68.8	49.6	2.2
Business process innovators (SMEs)	32.2	43.5	25.9
Linkages	95.5	59.0	3.5
Innovative SMEs collaborating with others	82.9	46.5	-1.6
Public-private co-publications	114.1	58.8	-4.5
Job-to-job mobility of HRST	97.9	70.6	11.8
Intellectual assets	47.7	-1.0	-4.8
PCT patent applications	53.5	-7.6	-9.3
Trademark applications	66.2	12.0	-1.8
Design applications	19.1	-2.9	-1.3
Employment impacts	60.1	13.7	9.1
Employment in knowledge-intensive activities	92.8	0.0	0.0
Employment in innovative enterprises	33.3	26.8	17.8
Sales impacts	86.2	-9.8	-3.3
Medium and high-tech goods exports	109.2	-7.6	-2.3
Knowledge-intensive services exports	83.7	12.8	0.5
Sales of innovative products	56.6	-41.3	-9.5
Environmental sustainability	70.1	-13.0	-5.2
Resource productivity	57.9	11.9	2.4
Air emissions by fine particulate matter	94.6	-6.3	0.6
Environment-related technologies	46.9	-37.6	-17.2

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HUNGARY is a **Moderate Innovator** with performance at 70.4% of the EU average. Performance is below the average of the Moderate Innovators. Performance is increasing at a rate lower than that of the EU (856%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

- Foreign doctorate students
- Government support for business R&D
- Public-private co-publications
- Medium and high-tech goods exports
- Job-to-job mobility of HRST

Relative weaknesses

- Design applications
- Business process innovators
- Employment in innovative enterprises
- Doctorate graduates
- Population with tertiary education

Strong increases since 2016

- Foreign doctorate students
- Job-to-job mobility of HRST
- Public-private co-publications

Strong decreases since 2016

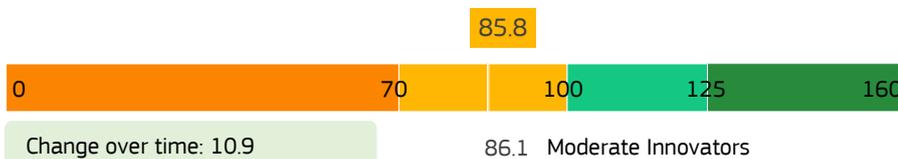
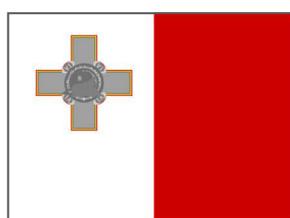
- Government support for business R&D
- Sales of innovative products
- Environment-related technologies

Strong increases since 2022

- Business process innovators
- Lifelong learning
- Employment in innovative enterprises

Strong decreases since 2022

- Environment-related technologies
- Sales of innovative products
- PCT patent applications



Malta

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	85.8	10.9	-2.6
Human resources	77.4	1.7	-3.2
Doctorate graduates	25.8	11.4	0.0
Population with tertiary education	102.3	-0.6	-0.6
Lifelong learning	108.8	-12.1	-12.1
Attractive research systems	126.9	74.9	41.5
International scientific co-publications	124.7	91.5	18.4
Most cited publications	88.2	20.1	36.7
Foreign doctorate students	206.0	184.9	73.9
Digitalisation	130.6	16.9	9.1
Broadband penetration	123.6	33.3	18.0
People with above basic overall digital skills	140.2	0.0	0.0
Finance and support	12.8	-20.8	-3.5
R&D expenditures in the public sector	18.8	-11.3	0.0
Venture capital expenditures	15.6	-8.1	4.7
Government support for business R&D	2.2	-47.3	-16.9
Firm investments	40.9	7.2	-12.2
R&D expenditure in the business sector	24.3	1.5	-1.5
Non-R&D Innovation expenditures	66.4	4.0	-34.0
Innovation expenditures per employee	36.0	15.7	-2.8
Use of information technologies	120.8	12.4	3.9
Enterprises providing ICT training	134.5	21.7	4.5
Employed ICT specialists	106.7	3.4	3.4
Innovators	66.0	7.9	-52.1
Product innovators (SMEs)	57.6	-5.9	-72.9
Business process innovators (SMEs)	73.3	22.7	-30.0
Linkages	100.7	56.7	-14.1
Innovative SMEs collaborating with others	65.0	48.6	-1.6
Public-private co-publications	131.9	106.0	19.3
Job-to-job mobility of HRST	116.7	41.2	-41.2
Intellectual assets	125.7	-14.9	1.0
PCT patent applications	60.1	13.7	4.9
Trademark applications	201.0	0.0	0.0
Design applications	139.0	-62.8	-3.3
Employment impacts	108.7	-8.9	-16.2
Employment in knowledge-intensive activities	165.1	0.0	0.0
Employment in innovative enterprises	62.4	-17.4	-31.5
Sales impacts	70.1	12.4	-10.2
Medium and high-tech goods exports	88.9	-3.5	-1.0
Knowledge-intensive services exports	70.5	28.4	-6.0
Sales of innovative products	43.1	17.1	-29.6
Environmental sustainability	112.5	19.2	11.3
Resource productivity	130.8	55.7	36.1
Air emissions by fine particulate matter	130.7	10.6	0.6
Environment-related technologies	68.2	4.8	7.2

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

MALTA is a **Moderate Innovator** with performance at 85.8% of the EU average. Performance is below the average of the Moderate Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

Foreign doctorate students
Trademark applications
Employment in knowledge-intensive activities
People with above basic overall digital skills
Design applications

Relative weaknesses

Government support for business R&D
Venture capital expenditures
R&D expenditures in the public sector
R&D expenditure in the business sector
Doctorate graduates

Strong increases since 2016

Foreign doctorate students
Public-private co-publications
International scientific co-publications

Strong decreases since 2016

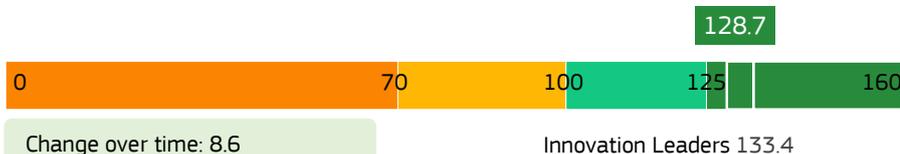
Design applications
Government support for business R&D
Employment in innovative enterprises

Strong increases since 2022

Foreign doctorate students
Most cited publications
Resource productivity

Strong decreases since 2022

Product innovators
Job-to-job mobility of HRST
Non-R&D Innovation expenditures



Netherlands

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	128.7	8.6	1.0
Human resources	166.4	-3.9	-8.8
Doctorate graduates	85.2	-11.4	-22.9
Population with tertiary education	183.2	4.8	4.8
Lifelong learning	242.2	-2.2	-2.2
Attractive research systems	193.8	24.0	-3.5
International scientific co-publications	199.3	74.0	-3.0
Most cited publications	146.1	-19.8	-10.9
Foreign doctorate students	281.7	77.6	13.2
Digitalisation	158.3	14.1	6.1
Broadband penetration	130.4	27.7	12.1
People with above basic overall digital skills	196.5	0.0	0.0
Finance and support	121.5	26.5	4.9
R&D expenditures in the public sector	96.9	-3.2	-4.8
Venture capital expenditures	127.9	80.5	7.5
Government support for business R&D	142.3	10.5	15.6
Firm investments	77.9	10.2	-0.5
R&D expenditure in the business sector	102.1	8.5	-1.5
Non-R&D Innovation expenditures	38.3	0.0	0.0
Innovation expenditures per employee	86.7	21.2	0.0
Use of information technologies	162.2	43.1	25.3
Enterprises providing ICT training	138.5	70.1	33.8
Employed ICT specialists	186.7	17.2	17.2
Innovators	104.7	9.3	13.1
Product innovators (SMEs)	103.4	-23.0	5.4
Business process innovators (SMEs)	105.8	43.7	21.3
Linkages	182.2	5.4	1.2
Innovative SMEs collaborating with others	161.9	6.8	44.0
Public-private co-publications	321.2	83.6	-11.0
Job-to-job mobility of HRST	139.6	-32.4	-32.4
Intellectual assets	114.1	1.4	-3.5
PCT patent applications	124.4	-12.9	-1.2
Trademark applications	106.5	7.8	-1.8
Design applications	107.5	14.4	-7.8
Employment impacts	124.1	-15.5	0.0
Employment in knowledge-intensive activities	165.1	0.0	0.0
Employment in innovative enterprises	90.4	-30.2	0.0
Sales impacts	86.3	-4.0	-3.5
Medium and high-tech goods exports	71.1	1.9	-6.6
Knowledge-intensive services exports	131.5	3.9	-2.7
Sales of innovative products	60.3	-22.8	0.0
Environmental sustainability	123.2	4.4	-2.6
Resource productivity	192.0	32.3	0.0
Air emissions by fine particulate matter	111.4	6.1	1.0
Environment-related technologies	71.9	-16.4	-8.5

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The **NETHERLANDS** is an **Innovation Leader** with performance at 128.7% of the EU average. Performance is below the average of the Innovation Leaders. Performance is increasing at a rate marginally higher than that of the EU (8.5%-points). The country's performance lead over the EU is becoming larger.

Relative strengths

Public-private co-publications
Foreign doctorate students
Lifelong learning
International scientific co-publications
People with above basic overall digital skills

Relative weaknesses

Non-R&D Innovation expenditures
Sales of innovative products
Medium and high-tech goods exports
Environment-related technologies
Doctorate graduates

Strong increases since 2016

Public-private co-publications
Venture capital expenditures
Foreign doctorate students

Strong decreases since 2016

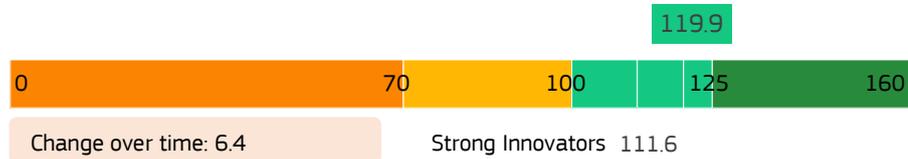
Job-to-job mobility of HRST
Employment in innovative enterprises
Product innovators

Strong increases since 2022

Innovative SMEs collaborating with others
Enterprises providing ICT training
Business process innovators

Strong decreases since 2022

Job-to-job mobility of HRST
Doctorate graduates
Public-private co-publications



Austria

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	119.9	6.4	0.6
Human resources	124.1	4.7	4.7
Doctorate graduates	129.7	0.0	0.0
Population with tertiary education	106.4	4.2	4.2
Lifelong learning	138.2	13.2	13.2
Attractive research systems	153.5	24.7	-1.3
International scientific co-publications	181.9	73.2	-4.4
Most cited publications	105.5	-11.1	-4.2
Foreign doctorate students	214.5	61.8	8.2
Digitalisation	89.4	-1.2	-1.6
Broadband penetration	59.6	-2.4	-3.2
People with above basic overall digital skills	130.4	0.0	0.0
Finance and support	121.3	26.3	9.4
R&D expenditures in the public sector	129.7	12.9	-1.6
Venture capital expenditures	71.7	32.2	3.6
Government support for business R&D	176.0	38.4	30.6
Firm investments	107.5	2.6	4.0
R&D expenditure in the business sector	150.7	1.5	-0.8
Non-R&D Innovation expenditures	64.5	-9.7	2.8
Innovation expenditures per employee	100.9	14.7	9.8
Use of information technologies	99.9	-32.1	16.3
Enterprises providing ICT training	86.8	-83.4	15.3
Employed ICT specialists	113.3	17.2	17.2
Innovators	124.2	14.8	-17.8
Product innovators (SMEs)	115.2	8.5	-14.4
Business process innovators (SMEs)	132.0	21.6	-21.4
Linkages	174.9	22.1	-14.8
Innovative SMEs collaborating with others	146.6	-50.0	5.4
Public-private co-publications	380.1	141.6	-16.8
Job-to-job mobility of HRST	110.4	32.4	-32.4
Intellectual assets	140.6	-3.1	-6.8
PCT patent applications	119.1	-4.4	-1.3
Trademark applications	133.7	17.1	-3.4
Design applications	178.9	-17.2	-16.5
Employment impacts	122.0	1.3	0.0
Employment in knowledge-intensive activities	109.6	0.0	0.0
Employment in innovative enterprises	132.1	2.4	0.0
Sales impacts	93.6	11.0	1.5
Medium and high-tech goods exports	98.0	5.8	8.7
Knowledge-intensive services exports	82.7	19.2	7.6
Sales of innovative products	98.8	8.9	-17.1
Environmental sustainability	109.0	2.4	2.8
Resource productivity	87.3	19.5	9.3
Air emissions by fine particulate matter	122.9	7.3	-0.5
Environment-related technologies	110.6	-14.9	2.5

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AUSTRIA is a **Strong Innovator** with performance at 119.9% of the EU average. Performance is above the average of the Strong Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance lead over the EU is becoming smaller.

Relative strengths

- Public-private co-publications
- Foreign doctorate students
- International scientific co-publications
- Design applications
- Government support for business R&D

Relative weaknesses

- Broadband penetration
- Non-R&D Innovation expenditures
- Venture capital expenditures
- Knowledge-intensive services exports
- Enterprises providing ICT training

Strong increases since 2016

- Public-private co-publications
- International scientific co-publications
- Foreign doctorate students

Strong decreases since 2016

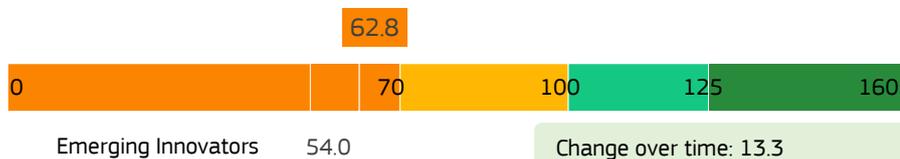
- Enterprises providing ICT training
- Innovative SMEs collaborating with others
- Design applications

Strong increases since 2022

- Government support for business R&D
- Employed ICT specialists
- Enterprises providing ICT training

Strong decreases since 2022

- Job-to-job mobility of HRST
- Business process innovators
- Sales of innovative products



Poland

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	62.8	13.3	5.2
Human resources	58.3	5.9	1.0
Doctorate graduates	25.8	0.0	-11.4
Population with tertiary education	91.3	-0.6	-0.6
Lifelong learning	57.8	24.2	24.2
Attractive research systems	46.2	25.6	12.3
International scientific co-publications	42.9	31.8	2.6
Most cited publications	51.2	15.7	6.7
Foreign doctorate students	40.3	42.4	34.2
Digitalisation	81.1	12.7	4.3
Broadband penetration	86.2	25.1	8.6
People with above basic overall digital skills	74.1	0.0	0.0
Finance and support	61.2	26.9	3.9
R&D expenditures in the public sector	64.1	3.2	3.2
Venture capital expenditures	43.5	15.2	1.7
Government support for business R&D	80.9	71.7	7.3
Firm investments	59.3	-5.3	-0.1
R&D expenditure in the business sector	59.7	36.2	3.1
Non-R&D Innovation expenditures	82.6	-45.9	-6.5
Innovation expenditures per employee	39.9	-9.4	2.5
Use of information technologies	90.3	42.9	23.3
Enterprises providing ICT training	113.2	84.1	43.9
Employed ICT specialists	66.7	3.4	3.4
Innovators	41.4	46.5	28.8
Product innovators (SMEs)	43.5	32.9	11.5
Business process innovators (SMEs)	39.6	60.9	47.3
Linkages	73.7	33.4	0.5
Innovative SMEs collaborating with others	51.1	39.5	29.6
Public-private co-publications	55.5	36.5	1.2
Job-to-job mobility of HRST	100.0	26.5	-26.5
Intellectual assets	84.2	-1.0	0.4
PCT patent applications	31.9	-3.0	-1.5
Trademark applications	92.8	15.7	2.9
Design applications	150.5	-11.6	0.9
Employment impacts	50.8	26.1	21.4
Employment in knowledge-intensive activities	59.0	0.0	0.0
Employment in innovative enterprises	44.0	50.8	41.6
Sales impacts	68.2	9.0	3.8
Medium and high-tech goods exports	75.9	1.0	2.3
Knowledge-intensive services exports	70.8	18.8	1.0
Sales of innovative products	54.6	9.2	9.4
Environmental sustainability	43.8	-13.1	-11.0
Resource productivity	46.4	22.1	3.0
Air emissions by fine particulate matter	48.4	14.9	-0.3
Environment-related technologies	34.3	-69.4	-32.9

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POLAND is an **Emerging Innovator** with performance at 62.8% of the EU average. Performance is above the average of the Emerging Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

Design applications
Enterprises providing ICT training
Job-to-job mobility of HRST
Trademark applications
Population with tertiary education

Relative weaknesses

Doctorate graduates
PCT patent applications
Environment-related technologies
Business process innovators
Innovation expenditures per employee

Strong increases since 2016

Enterprises providing ICT training
Government support for business R&D
Business process innovators

Strong decreases since 2016

Environment-related technologies
Non-R&D Innovation expenditures
Design applications

Strong increases since 2022

Business process innovators
Enterprises providing ICT training
Employment in innovative enterprises

Strong decreases since 2022

Environment-related technologies
Job-to-job mobility of HRST
Doctorate graduates



85.6



Change over time: 7.7

86.1 Moderate Innovators

Portugal

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	85.6	7.7	3.0
Human resources	110.4	-8.3	-3.4
Doctorate graduates	100.0	-11.4	0.0
Population with tertiary education	113.9	-18.6	-18.6
Lifelong learning	118.6	9.9	9.9
Attractive research systems	127.1	38.5	0.5
International scientific co-publications	137.4	76.8	3.3
Most cited publications	88.0	-12.6	-5.2
Foreign doctorate students	192.3	120.2	11.0
Digitalisation	127.7	15.6	6.9
Broadband penetration	141.1	30.7	13.6
People with above basic overall digital skills	109.3	0.0	0.0
Finance and support	90.6	18.2	6.7
R&D expenditures in the public sector	81.3	-4.8	-3.2
Venture capital expenditures	43.5	-27.6	-7.4
Government support for business R&D	163.1	98.3	35.2
Firm investments	52.7	0.5	4.7
R&D expenditure in the business sector	64.6	29.2	4.6
Non-R&D Innovation expenditures	64.3	-24.7	3.2
Innovation expenditures per employee	31.9	-5.0	6.2
Use of information technologies	101.9	-0.1	-1.3
Enterprises providing ICT training	106.9	7.0	4.5
Employed ICT specialists	96.7	-6.9	-6.9
Innovators	99.3	-9.2	26.2
Product innovators (SMEs)	90.6	-15.2	-13.0
Business process innovators (SMEs)	106.9	-2.8	67.9
Linkages	92.9	39.9	-29.0
Innovative SMEs collaborating with others	50.3	-14.3	-14.6
Public-private co-publications	148.3	93.1	13.1
Job-to-job mobility of HRST	104.2	64.7	-61.8
Intellectual assets	76.8	-2.2	-0.8
PCT patent applications	50.9	9.0	0.1
Trademark applications	107.2	19.0	-2.6
Design applications	81.5	-33.0	-0.5
Employment impacts	95.3	-2.8	23.8
Employment in knowledge-intensive activities	89.2	0.0	0.0
Employment in innovative enterprises	100.4	-5.5	46.4
Sales impacts	77.1	26.4	6.7
Medium and high-tech goods exports	59.9	11.8	3.0
Knowledge-intensive services exports	67.8	7.8	0.5
Sales of innovative products	111.0	72.2	19.9
Environmental sustainability	27.9	-16.0	-3.6
Resource productivity	48.7	8.4	2.6
Air emissions by fine particulate matter	0.0	0.0	0.0
Environment-related technologies	47.2	-51.2	-12.0

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PORTUGAL is a **Moderate Innovator** with performance at 85.6% of the EU average. Performance is below the average of the Moderate Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

Foreign doctorate students
Government support for business R&D
Public-private co-publications
Broadband penetration
International scientific co-publications

Relative weaknesses

Air emissions by fine particulate matter
Innovation expenditures per employee
Venture capital expenditures
Environment-related technologies
Resource productivity

Strong increases since 2016

Foreign doctorate students
Government support for business R&D
Public-private co-publications

Strong decreases since 2016

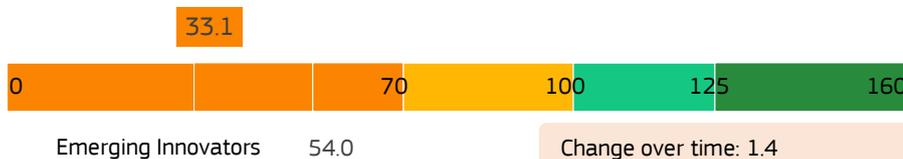
Environment-related technologies
Design applications
Venture capital expenditures

Strong increases since 2022

Business process innovators
Employment in innovative enterprises
Government support for business R&D

Strong decreases since 2022

Job-to-job mobility of HRST
Population with tertiary education
Innovative SMEs collaborating with others



Romania

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	33.1	1.4	-2.4
Human resources	19.9	-23.2	1.4
Doctorate graduates	25.8	-57.2	0.0
Population with tertiary education	0.0	0.0	0.0
Lifelong learning	36.3	5.5	5.5
Attractive research systems	41.0	22.8	4.7
International scientific co-publications	26.6	19.0	4.3
Most cited publications	60.3	31.1	7.8
Foreign doctorate students	20.0	7.3	-2.0
Digitalisation	91.8	29.2	16.0
Broadband penetration	143.3	57.5	31.6
People with above basic overall digital skills	21.0	0.0	0.0
Finance and support	18.0	-0.5	-12.4
R&D expenditures in the public sector	9.4	-6.5	-1.6
Venture capital expenditures	30.0	6.6	-40.3
Government support for business R&D	12.4	0.1	2.2
Firm investments	13.7	-6.0	-2.9
R&D expenditure in the business sector	16.7	10.0	1.5
Non-R&D Innovation expenditures	13.8	-34.6	-14.1
Innovation expenditures per employee	10.8	4.3	3.0
Use of information technologies	30.8	14.1	12.6
Enterprises providing ICT training	21.8	21.7	18.5
Employed ICT specialists	40.0	6.9	6.9
Innovators	4.6	6.5	-7.8
Product innovators (SMEs)	9.9	12.5	-15.1
Business process innovators (SMEs)	0.0	0.0	0.0
Linkages	7.7	-1.4	-5.4
Innovative SMEs collaborating with others	0.0	-4.0	-15.3
Public-private co-publications	40.4	26.2	2.4
Job-to-job mobility of HRST	0.0	-11.8	0.0
Intellectual assets	31.4	5.0	1.2
PCT patent applications	13.0	-5.4	-2.7
Trademark applications	62.5	20.4	5.8
Design applications	24.2	6.1	2.6
Employment impacts	10.9	0.0	0.0
Employment in knowledge-intensive activities	24.1	0.0	0.0
Employment in innovative enterprises	0.0	0.0	0.0
Sales impacts	70.5	5.6	-8.3
Medium and high-tech goods exports	88.9	8.3	1.7
Knowledge-intensive services exports	78.5	15.6	-2.5
Sales of innovative products	36.4	-11.1	-31.1
Environmental sustainability	42.7	-16.3	-13.7
Resource productivity	12.3	3.1	5.4
Air emissions by fine particulate matter	54.0	11.6	-2.9
Environment-related technologies	56.5	-62.0	-39.0

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ROMANIA is an **Emerging Innovator** with performance at 33.1% of the EU average. Performance is below the average of the Emerging Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

Broadband penetration
Medium and high-tech goods exports
Knowledge-intensive services exports
Trademark applications
Most cited publications

Relative weaknesses

Population with tertiary education
Business process innovators
Innovative SMEs collaborating with others
Job-to-job mobility of HRST
Employment in innovative enterprises

Strong increases since 2016

Broadband penetration
Most cited publications
Public-private co-publications

Strong decreases since 2016

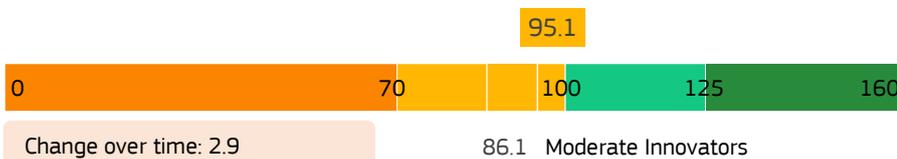
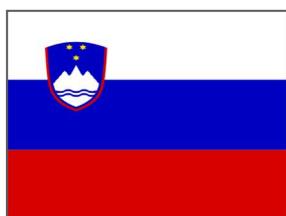
Environment-related technologies
Doctorate graduates
Non-R&D Innovation expenditures

Strong increases since 2022

Broadband penetration
Enterprises providing ICT training
Most cited publications

Strong decreases since 2022

Venture capital expenditures
Environment-related technologies
Sales of innovative products



Slovenia

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	95.1	2.9	3.3
Human resources	139.1	-33.0	1.4
Doctorate graduates	100.0	-91.5	-11.4
Population with tertiary education	130.6	-3.6	-3.6
Lifelong learning	195.1	29.7	29.7
Attractive research systems	109.0	40.5	1.0
International scientific co-publications	155.0	67.3	-9.4
Most cited publications	78.4	10.8	2.4
Foreign doctorate students	114.1	83.9	7.6
Digitalisation	83.5	19.8	5.4
Broadband penetration	93.3	38.9	10.6
People with above basic overall digital skills	70.0	0.0	0.0
Finance and support	66.1	-14.5	4.5
R&D expenditures in the public sector	67.2	1.6	0.0
Venture capital expenditures	33.7	28.8	27.4
Government support for business R&D	107.2	-82.5	-13.4
Firm investments	60.9	-35.0	-4.1
R&D expenditure in the business sector	105.6	-20.0	0.0
Non-R&D Innovation expenditures	26.9	-75.6	-6.9
Innovation expenditures per employee	45.5	-12.9	-5.7
Use of information technologies	117.3	-3.7	4.7
Enterprises providing ICT training	137.4	3.2	20.4
Employed ICT specialists	96.7	-10.3	-10.3
Innovators	116.1	47.9	14.4
Product innovators (SMEs)	134.6	62.4	-2.6
Business process innovators (SMEs)	99.9	32.4	32.4
Linkages	140.7	48.9	3.6
Innovative SMEs collaborating with others	114.1	-0.3	-4.9
Public-private co-publications	262.7	86.1	-16.1
Job-to-job mobility of HRST	110.4	76.5	20.6
Intellectual assets	84.4	-8.6	4.7
PCT patent applications	66.4	-23.7	-1.0
Trademark applications	118.1	22.1	3.5
Design applications	74.1	-13.4	13.0
Employment impacts	106.6	-2.8	0.0
Employment in knowledge-intensive activities	132.5	0.0	0.0
Employment in innovative enterprises	85.4	-5.5	0.0
Sales impacts	87.3	10.9	3.1
Medium and high-tech goods exports	105.1	16.1	5.7
Knowledge-intensive services exports	57.6	14.3	2.6
Sales of innovative products	93.2	-1.2	-0.1
Environmental sustainability	84.6	15.3	5.1
Resource productivity	99.3	45.2	18.2
Air emissions by fine particulate matter	91.1	10.6	1.0
Environment-related technologies	60.6	0.6	1.1

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

SLOVENIA is a **Moderate Innovator** with performance at 95.1% of the EU average. Performance is above the average of the Moderate Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

Public-private co-publications
Lifelong learning
International scientific co-publications
Enterprises providing ICT training
Product innovators

Relative weaknesses

Non-R&D Innovation expenditures
Venture capital expenditures
Innovation expenditures per employee
Knowledge-intensive services exports
Environment-related technologies

Strong increases since 2016

Public-private co-publications
Foreign doctorate students
Job-to-job mobility of HRST

Strong decreases since 2016

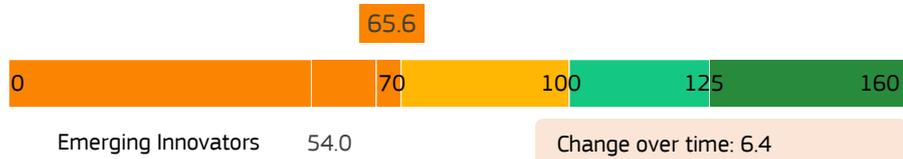
Doctorate graduates
Government support for business R&D
Non-R&D Innovation expenditures

Strong increases since 2022

Business process innovators
Lifelong learning
Venture capital expenditures

Strong decreases since 2022

Public-private co-publications
Government support for business R&D
Doctorate graduates



Slovakia

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	65.6	6.4	4.2
Human resources	91.6	1.7	21.3
Doctorate graduates	85.2	-45.8	0.0
Population with tertiary education	83.2	-2.4	-2.4
Lifelong learning	108.8	87.9	87.9
Attractive research systems	51.7	18.2	2.8
International scientific co-publications	62.5	32.3	-6.0
Most cited publications	39.8	11.8	3.8
Foreign doctorate students	62.3	19.6	8.5
Digitalisation	67.1	12.0	5.2
Broadband penetration	61.3	23.6	10.3
People with above basic overall digital skills	74.9	0.0	0.0
Finance and support	38.1	3.7	1.7
R&D expenditures in the public sector	45.3	-22.6	-1.6
Venture capital expenditures	35.5	16.0	-3.5
Government support for business R&D	33.0	26.9	11.6
Firm investments	56.0	16.5	0.3
R&D expenditure in the business sector	32.6	15.4	2.3
Non-R&D Innovation expenditures	99.6	16.7	-1.8
Innovation expenditures per employee	42.9	17.5	0.3
Use of information technologies	74.7	-9.7	-2.5
Enterprises providing ICT training	59.8	-19.7	-5.1
Employed ICT specialists	90.0	0.0	0.0
Innovators	42.3	15.6	14.2
Product innovators (SMEs)	42.9	16.0	0.5
Business process innovators (SMEs)	41.8	15.1	28.8
Linkages	49.8	10.7	-3.6
Innovative SMEs collaborating with others	59.1	-11.3	-8.8
Public-private co-publications	80.5	39.0	-7.2
Job-to-job mobility of HRST	29.2	17.6	2.9
Intellectual assets	49.4	7.0	-1.7
PCT patent applications	33.1	3.3	-0.7
Trademark applications	82.4	26.2	4.2
Design applications	37.2	-3.4	-7.5
Employment impacts	55.9	11.7	9.6
Employment in knowledge-intensive activities	68.7	0.0	0.0
Employment in innovative enterprises	45.4	22.8	18.6
Sales impacts	101.8	0.4	11.5
Medium and high-tech goods exports	119.9	8.5	6.4
Knowledge-intensive services exports	65.1	20.1	0.8
Sales of innovative products	114.5	-36.6	32.7
Environmental sustainability	95.5	-2.8	-5.7
Resource productivity	75.8	17.4	5.7
Air emissions by fine particulate matter	107.6	21.9	0.2
Environment-related technologies	97.6	-45.4	-20.3

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

SLOVAKIA is an **Emerging Innovator** with performance at 65.6% of the EU average. Performance is above the average of the Emerging Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

- Medium and high-tech goods exports
- Sales of innovative products
- Lifelong learning
- Air emissions by fine particulate matter
- Non-R&D Innovation expenditures

Relative weaknesses

- Job-to-job mobility of HRST
- R&D expenditure in the business sector
- Government support for business R&D
- PCT patent applications
- Venture capital expenditures

Strong increases since 2016

- Lifelong learning
- Public-private co-publications
- International scientific co-publications

Strong decreases since 2016

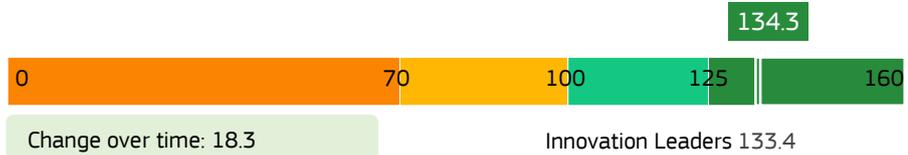
- Doctorate graduates
- Environment-related technologies
- Sales of innovative products

Strong increases since 2022

- Lifelong learning
- Sales of innovative products
- Business process innovators

Strong decreases since 2022

- Environment-related technologies
- Innovative SMEs collaborating with others
- Design applications



Finland

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	134.3	18.3	4.0
Human resources	157.1	-11.2	-1.4
Doctorate graduates	159.3	-11.4	11.4
Population with tertiary education	92.5	3.6	3.6
Lifelong learning	230.4	-29.7	-29.7
Attractive research systems	156.6	35.5	-0.6
International scientific co-publications	224.3	94.6	4.9
Most cited publications	122.1	3.0	-6.9
Foreign doctorate students	143.6	55.0	8.8
Digitalisation	158.2	36.0	14.8
Broadband penetration	130.2	70.8	29.2
People with above basic overall digital skills	196.5	0.0	0.0
Finance and support	103.6	26.9	6.0
R&D expenditures in the public sector	123.4	-12.9	-4.8
Venture capital expenditures	134.9	103.7	10.1
Government support for business R&D	39.3	0.8	16.6
Firm investments	109.1	6.5	0.9
R&D expenditure in the business sector	138.9	-6.2	7.7
Non-R&D Innovation expenditures	72.8	14.4	-9.1
Innovation expenditures per employee	110.1	11.7	3.4
Use of information technologies	190.6	0.9	0.0
Enterprises providing ICT training	187.9	1.9	0.0
Employed ICT specialists	193.3	0.0	0.0
Innovators	147.5	58.1	28.8
Product innovators (SMEs)	147.9	25.7	14.2
Business process innovators (SMEs)	147.0	92.7	44.2
Linkages	218.6	71.7	-7.1
Innovative SMEs collaborating with others	243.7	119.1	0.0
Public-private co-publications	369.8	57.1	-23.7
Job-to-job mobility of HRST	133.3	35.3	-5.9
Intellectual assets	124.6	-7.7	-9.9
PCT patent applications	150.1	-0.6	-0.6
Trademark applications	109.4	10.3	-7.2
Design applications	104.2	-30.8	-23.6
Employment impacts	138.0	22.6	7.0
Employment in knowledge-intensive activities	127.7	0.0	0.0
Employment in innovative enterprises	146.4	44.1	13.6
Sales impacts	116.4	32.3	16.4
Medium and high-tech goods exports	73.6	10.2	9.3
Knowledge-intensive services exports	142.0	14.8	2.8
Sales of innovative products	149.8	88.2	44.2
Environmental sustainability	78.3	-4.6	-1.0
Resource productivity	24.8	5.5	0.1
Air emissions by fine particulate matter	99.3	8.4	-0.3
Environment-related technologies	101.1	-26.5	-2.7

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FINLAND is an **Innovation Leader** with performance at 134.3% of the EU average. Performance is above the average of the Innovation Leaders. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance lead over the EU is becoming larger.

Relative strengths

Public-private co-publications
Innovative SMEs collaborating with others
Lifelong learning
International scientific co-publications
People with above basic overall digital skills

Relative weaknesses

Resource productivity
Government support for business R&D
Non-R&D Innovation expenditures
Medium and high-tech goods exports
Population with tertiary education

Strong increases since 2016

Innovative SMEs collaborating with others
Venture capital expenditures
International scientific co-publications

Strong decreases since 2016

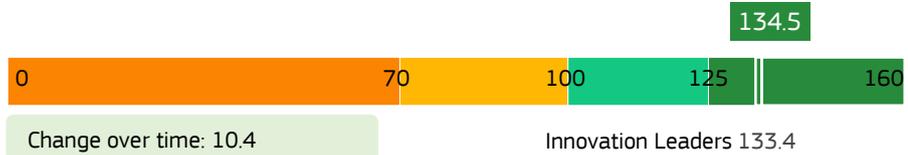
Design applications
Lifelong learning
Environment-related technologies

Strong increases since 2022

Business process innovators
Sales of innovative products
Broadband penetration

Strong decreases since 2022

Lifelong learning
Public-private co-publications
Design applications



Sweden

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	134.5	10.4	-1.4
Human resources	183.5	-13.7	-3.9
Doctorate graduates	144.5	-45.8	-22.9
Population with tertiary education	160.1	18.6	18.6
Lifelong learning	256.9	0.0	0.0
Attractive research systems	176.0	12.6	-4.8
International scientific co-publications	240.9	80.7	-1.1
Most cited publications	120.8	-21.3	-10.0
Foreign doctorate students	207.6	27.2	3.8
Digitalisation	141.7	10.8	5.5
Broadband penetration	142.2	21.2	10.9
People with above basic overall digital skills	141.1	0.0	0.0
Finance and support	115.9	34.3	8.0
R&D expenditures in the public sector	128.1	-1.6	-3.2
Venture capital expenditures	134.9	112.9	18.4
Government support for business R&D	76.5	0.7	12.5
Firm investments	128.0	-10.6	-2.4
R&D expenditure in the business sector	153.5	13.8	0.0
Non-R&D Innovation expenditures	73.1	-48.7	-7.5
Innovation expenditures per employee	148.3	0.0	0.0
Use of information technologies	180.4	5.3	6.6
Enterprises providing ICT training	167.8	10.8	13.4
Employed ICT specialists	193.3	0.0	0.0
Innovators	142.6	75.0	0.8
Product innovators (SMEs)	149.5	53.5	-20.5
Business process innovators (SMEs)	136.5	97.9	23.5
Linkages	141.1	1.4	-30.3
Innovative SMEs collaborating with others	133.7	20.0	-2.9
Public-private co-publications	387.7	100.5	2.4
Job-to-job mobility of HRST	41.7	-61.8	-70.6
Intellectual assets	124.2	-7.7	-3.5
PCT patent applications	150.8	0.0	0.0
Trademark applications	118.8	12.3	-3.8
Design applications	91.6	-33.1	-7.7
Employment impacts	154.6	18.5	2.9
Employment in knowledge-intensive activities	175.9	0.0	0.0
Employment in innovative enterprises	137.1	36.0	5.7
Sales impacts	103.4	16.4	-1.7
Medium and high-tech goods exports	87.1	0.6	4.1
Knowledge-intensive services exports	130.8	7.0	-4.8
Sales of innovative products	97.9	52.5	-7.0
Environmental sustainability	88.7	8.8	-0.6
Resource productivity	58.1	11.8	7.8
Air emissions by fine particulate matter	106.1	10.9	0.7
Environment-related technologies	94.3	4.4	-7.7

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SWEDEN is an **Innovation Leader** with performance at 134.5% of the EU average. Performance is above the average of the Innovation Leaders. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance lead over the EU is becoming larger.

Relative strengths

Public-private co-publications
Lifelong learning
International scientific co-publications
Foreign doctorate students
Employed ICT specialists

Relative weaknesses

Job-to-job mobility of HRST
Resource productivity
Non-R&D Innovation expenditures
Government support for business R&D
Medium and high-tech goods exports

Strong increases since 2016

Venture capital expenditures
Public-private co-publications
Business process innovators

Strong decreases since 2016

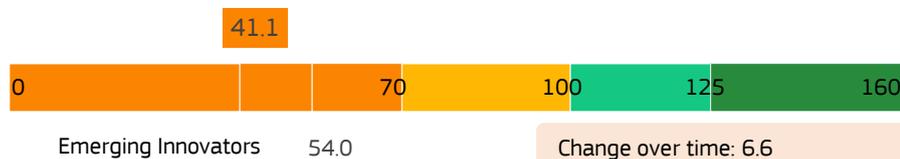
Job-to-job mobility of HRST
Non-R&D Innovation expenditures
Doctorate graduates

Strong increases since 2022

Business process innovators
Population with tertiary education
Venture capital expenditures

Strong decreases since 2022

Job-to-job mobility of HRST
Doctorate graduates
Product innovators



Albania *

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	41.1	6.6	-1.7
Human resources	53.6	17.8	0.0
Doctorate graduates	10.0	-0.5	0.0
Population with tertiary education	75.3	56.3	0.0
Lifelong learning	79.4	0.0	0.0
Attractive research systems	42.0	17.7	3.3
International scientific co-publications	6.1	8.7	0.0
Most cited publications	55.4	52.9	6.3
Foreign doctorate students	58.6	-54.8	-0.8
Digitalisation	4.1	0.0	0.0
Broadband penetration	7.1	0.0	0.0
People with above basic overall digital skills	0.0	0.0	0.0
Finance and support	0.0	0.0	0.0
R&D expenditures in the public sector**	0.0	0.0	0.0
Venture capital expenditures	N/A	N/A	N/A
Government support for business R&D	N/A	N/A	N/A
Firm investments	0.0	0.0	0.0
R&D expenditure in the business sector**	0.0	0.0	0.0
Non-R&D Innovation expenditures	N/A	N/A	N/A
Innovation expenditures per employee	N/A	N/A	N/A
Use of information technologies	N/A	N/A	N/A
Enterprises providing ICT training	N/A	N/A	N/A
Employed ICT specialists	N/A	N/A	N/A
Innovators	70.4	-8.6	-8.6
Product innovators (SMEs)	81.4	-9.4	-9.4
Business process innovators (SMEs)	60.7	-7.7	-7.7
Linkages	41.3	-14.4	-16.1
Innovative SMEs collaborating with others	73.1	-27.9	-27.9
Public-private co-publications	4.4	5.7	0.0
Job-to-job mobility of HRST	N/A	N/A	N/A
Intellectual assets	7.4	6.8	2.4
PCT patent applications	N/A	N/A	N/A
Trademark applications	4.5	4.9	-6.7
Design applications	12.7	10.1	10.1
Employment impacts	37.5	-5.8	-2.4
Employment in knowledge-intensive activities	30.9	-6.9	0.0
Employment in innovative enterprises	43.0	-4.8	-4.8
Sales impacts	53.2	1.8	-3.7
Medium and high-tech goods exports	0.0	0.0	0.0
Knowledge-intensive services exports	13.8	5.3	-11.3
Sales of innovative products	169.2	0.0	0.0
Environmental sustainability	98.6	35.6	0.0
Resource productivity	35.1	13.7	0.0
Air emissions by fine particulate matter	N/A	N/A	N/A
Environment-related technologies	190.8	58.2	0.0

ALBANIA is an **Emerging Innovator** with performance at 41.1% of the EU average. Performance is below the average of the Emerging Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

Environment-related technologies
Sales of innovative products
Product innovators
Lifelong learning
Population with tertiary education

Relative weaknesses

People with above basic overall digital skills
R&D expenditures in the public sector
R&D expenditure in the business sector
Medium and high-tech goods exports
Public-private co-publications

Strong increases since 2016

Environment-related technologies
Population with tertiary education
Most cited publications

Strong decreases since 2016

Foreign doctorate students
Innovative SMEs collaborating with others
Product innovators

Strong increases since 2022

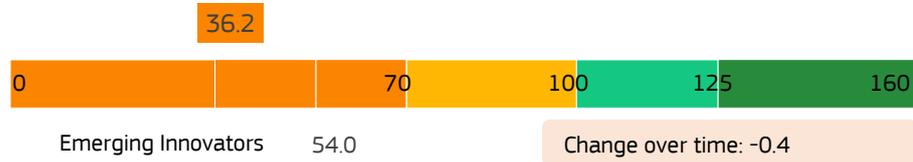
Design applications
Most cited publications

Strong decreases since 2022

Innovative SMEs collaborating with others
Knowledge-intensive services exports
Product innovators

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* Results for Albania are less reliable due to limited data availability. ** Data are not available, and it has been assumed that the normalised and relative to EU values equal 0, the same as the worst performing country. This assumption has been made to maximize data availability to allow to include Albania in the EIS and is in line with the latest known low R&D intensity of 0.15 in 2008.



Bosnia and Herzegovina

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	36.2	-0.4	0.1
Human resources	9.6	1.4	-2.2
Doctorate graduates	16.8	8.0	0.0
Population with tertiary education	9.8	-3.6	-4.2
Lifelong learning	1.0	-3.3	-3.3
Attractive research systems	37.3	20.5	7.0
International scientific co-publications	22.1	21.6	0.0
Most cited publications	39.1	16.4	8.6
Foreign doctorate students	N/A	N/A	N/A
Digitalisation	26.9	9.0	-1.8
Broadband penetration	42.2	17.7	-3.5
People with above basic overall digital skills	6.0	0.0	0.0
Finance and support	19.7	-39.6	2.9
R&D expenditures in the public sector	1.6	-12.9	0.0
Venture capital expenditures	N/A	N/A	N/A
Government support for business R&D	44.0	-72.7	6.6
Firm investments	0.7	0.8	0.0
R&D expenditure in the business sector	2.1	2.3	0.0
Non-R&D Innovation expenditures	0.0	0.0	0.0
Innovation expenditures per employee	0.0	0.0	0.0
Use of information technologies	63.5	1.9	5.6
Enterprises providing ICT training	62.6	1.9	5.7
Employed ICT specialists	N/A	N/A	N/A
Innovators	110.5	0.0	0.0
Product innovators (SMEs)	151.7	0.0	0.0
Business process innovators (SMEs)	74.5	0.0	0.0
Linkages	15.4	11.4	0.0
Innovative SMEs collaborating with others	N/A	N/A	N/A
Public-private co-publications	26.9	19.4	0.0
Job-to-job mobility of HRST	N/A	N/A	N/A
Intellectual assets	7.7	-2.0	2.2
PCT patent applications	14.5	-7.4	7.4
Trademark applications	4.9	3.6	-4.1
Design applications	1.1	0.5	0.5
Employment impacts	78.6	0.0	0.0
Employment in knowledge-intensive activities	N/A	N/A	N/A
Employment in innovative enterprises	71.5	0.0	0.0
Sales impacts	28.6	3.6	-4.4
Medium and high-tech goods exports	18.0	4.5	-3.6
Knowledge-intensive services exports	5.8	5.3	-9.0
Sales of innovative products	67.2	0.0	0.0
Environmental sustainability	89.7	1.0	0.0
Resource productivity	14.5	2.8	0.0
Air emissions by fine particulate matter	N/A	N/A	N/A
Environment-related technologies	190.8	0.0	0.0

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

BOSNIA AND HERZEGOVINA is an **Emerging Innovator** with performance at 36.2% of the EU average. Performance is below the average of the Emerging Innovators. Performance is decreasing and is lower than the rate of increase of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

- Environment-related technologies
- Product innovators
- Business process innovators
- Employment in innovative enterprises
- Sales of innovative products

Relative weaknesses

- Non-R&D Innovation expenditures
- Innovation expenditures per employee
- Lifelong learning
- Design applications
- R&D expenditures in the public sector

Strong increases since 2016

- International scientific co-publications
- Public-private co-publications
- Broadband penetration

Strong decreases since 2016

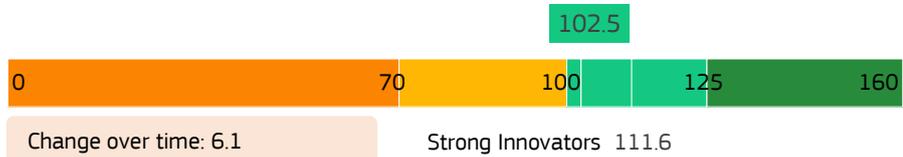
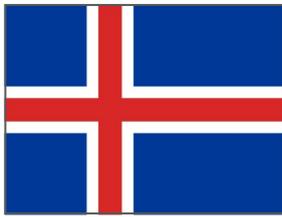
- Government support for business R&D
- R&D expenditures in the public sector
- PCT patent applications

Strong increases since 2022

- Most cited publications
- PCT patent applications
- Government support for business R&D

Strong decreases since 2022

- Knowledge-intensive services exports
- Population with tertiary education
- Trademark applications



Iceland

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	102.5	6.1	3.3
Human resources	135.7	11.3	6.4
Doctorate graduates	85.2	11.4	0.0
Population with tertiary education	89.6	-7.8	-7.8
Lifelong learning	249.0	35.2	35.2
Attractive research systems	189.5	31.3	21.4
International scientific co-publications	274.9	9.4	0.0
Most cited publications	109.8	-10.1	27.4
Foreign doctorate students	244.6	146.7	27.5
Digitalisation	153.1	0.0	0.0
Broadband penetration	N/A	N/A	N/A
People with above basic overall digital skills	181.6	0.0	0.0
Finance and support	78.5	7.0	0.0
R&D expenditures in the public sector	104.7	4.8	0.0
Venture capital expenditures	N/A	N/A	N/A
Government support for business R&D	58.4	9.5	0.0
Firm investments	87.6	21.0	7.9
R&D expenditure in the business sector	134.0	61.5	23.1
Non-R&D Innovation expenditures	81.5	0.0	0.0
Innovation expenditures per employee	47.6	0.0	0.0
Use of information technologies	88.7	10.6	10.6
Enterprises providing ICT training	N/A	N/A	N/A
Employed ICT specialists	90.0	10.3	10.3
Innovators	102.2	-18.0	0.0
Product innovators (SMEs)	103.5	-41.6	0.0
Business process innovators (SMEs)	101.1	7.1	0.0
Linkages	228.0	11.8	0.0
Innovative SMEs collaborating with others	205.6	23.2	0.0
Public-private co-publications	468.0	14.7	0.0
Job-to-job mobility of HRST	143.8	0.0	0.0
Intellectual assets	66.6	-19.0	7.4
PCT patent applications	92.9	-8.5	3.5
Trademark applications	72.4	-71.7	1.4
Design applications	22.3	8.9	16.9
Employment impacts	126.2	-8.9	0.0
Employment in knowledge-intensive activities	127.7	0.0	0.0
Employment in innovative enterprises	125.0	-17.3	0.0
Sales impacts	39.1	0.2	-7.4
Medium and high-tech goods exports	0.0	0.0	0.0
Knowledge-intensive services exports	91.9	0.7	-22.5
Sales of innovative products	39.0	0.0	0.0
Environmental sustainability	57.9	20.7	-1.2
Resource productivity	104.2	69.9	0.0
Air emissions by fine particulate matter	36.0	-3.3	-3.8
Environment-related technologies	43.4	15.8	0.9

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

ICELAND is a **Strong Innovator** with performance at 102.5% of the EU average. Performance is below the average of the Strong Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance lead over the EU is becoming smaller.

Relative strengths

- Public-private co-publications
- International scientific co-publications
- Lifelong learning
- Foreign doctorate students
- Innovative SMEs collaborating with others

Relative weaknesses

- Medium and high-tech goods exports
- Design applications
- Air emissions by fine particulate matter
- Sales of innovative products
- Environment-related technologies

Strong increases since 2016

- Foreign doctorate students
- Resource productivity
- R&D expenditure in the business sector

Strong decreases since 2016

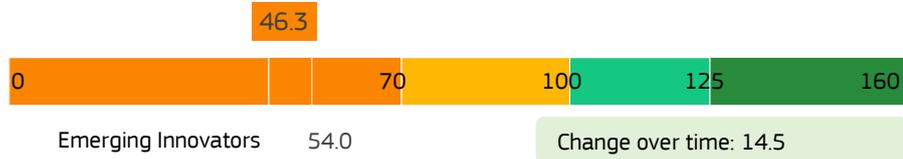
- Trademark applications
- Product innovators
- Employment in innovative enterprises

Strong increases since 2022

- Lifelong learning
- Foreign doctorate students
- Most cited publications

Strong decreases since 2022

- Knowledge-intensive services exports
- Population with tertiary education
- Air emissions by fine particulate matter



North Macedonia

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	46.3	14.5	3.4
Human resources	32.8	8.7	0.0
Doctorate graduates	11.0	-11.4	0.0
Population with tertiary education	75.1	42.5	0.0
Lifelong learning	8.8	0.0	0.0
Attractive research systems	84.8	76.4	19.2
International scientific co-publications	25.5	21.5	7.9
Most cited publications	48.2	29.6	21.6
Foreign doctorate students	228.7	234.8	24.3
Digitalisation	43.2	1.8	0.0
Broadband penetration	61.3	3.5	0.0
People with above basic overall digital skills	18.4	0.0	0.0
Finance and support	15.6	-4.3	0.1
R&D expenditures in the public sector	25.0	-12.9	0.0
Venture capital expenditures	N/A	N/A	N/A
Government support for business R&D	6.7	8.0	0.2
Firm investments	40.0	0.5	0.0
R&D expenditure in the business sector	3.5	1.5	0.0
Non-R&D Innovation expenditures	114.5	0.0	0.0
Innovation expenditures per employee	14.4	0.0	0.0
Use of information technologies	32.8	-5.6	0.0
Enterprises providing ICT training	42.0	-29.3	0.0
Employed ICT specialists	23.3	17.2	0.0
Innovators	60.0	5.3	0.0
Product innovators (SMEs)	49.2	-4.8	0.0
Business process innovators (SMEs)	69.5	16.0	0.0
Linkages	50.0	34.9	-16.5
Innovative SMEs collaborating with others	46.0	-11.4	0.0
Public-private co-publications	28.2	23.9	3.9
Job-to-job mobility of HRST	62.5	82.4	-41.2
Intellectual assets	14.4	9.0	-2.0
PCT patent applications	13.3	12.0	-9.7
Trademark applications	28.2	14.7	7.5
Design applications	1.0	0.8	0.4
Employment impacts	30.7	8.2	0.0
Employment in knowledge-intensive activities	18.1	16.9	0.0
Employment in innovative enterprises	41.0	0.0	0.0
Sales impacts	68.8	16.6	-2.1
Medium and high-tech goods exports	111.8	16.4	-8.7
Knowledge-intensive services exports	55.1	30.1	4.4
Sales of innovative products	22.6	0.0	0.0
Environmental sustainability	87.3	29.2	43.3
Resource productivity	38.2	15.7	0.0
Air emissions by fine particulate matter	N/A	N/A	N/A
Environment-related technologies	161.8	44.8	82.1

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NORTH MACEDONIA is an **Emerging Innovator** with performance at 46.3% of the EU average. Performance is below the average of the Emerging Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

Foreign doctorate students
Environment-related technologies
Non-R&D Innovation expenditures
Medium and high-tech goods exports
Population with tertiary education

Relative weaknesses

Design applications
R&D expenditure in the business sector
Government support for business R&D
Lifelong learning
Doctorate graduates

Strong increases since 2016

Foreign doctorate students
Job-to-job mobility of HRST
Environment-related technologies

Strong decreases since 2016

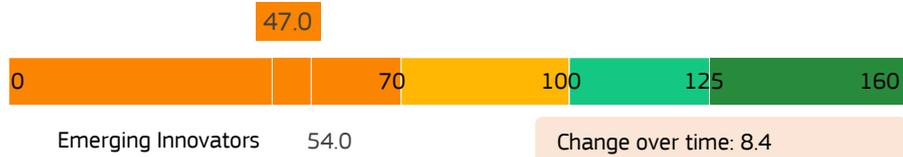
Enterprises providing ICT training
R&D expenditures in the public sector
Doctorate graduates

Strong increases since 2022

Environment-related technologies
Foreign doctorate students
Most cited publications

Strong decreases since 2022

Job-to-job mobility of HRST
PCT patent applications
Medium and high-tech goods exports



Montenegro

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	47.0	8.4	-0.9
Human resources	36.3	16.7	0.4
Doctorate graduates	4.4	3.0	0.9
Population with tertiary education	90.8	50.9	0.0
Lifelong learning	9.8	-3.3	0.0
Attractive research systems	48.1	-0.9	4.1
International scientific co-publications	55.0	46.5	-11.8
Most cited publications	37.4	1.7	12.4
Foreign doctorate students	60.9	-51.2	0.0
Digitalisation	47.7	26.8	13.6
Broadband penetration	65.8	52.8	26.8
People with above basic overall digital skills	22.9	0.0	0.0
Finance and support	14.5	7.7	0.0
R&D expenditures in the public sector	28.1	12.9	0.0
Venture capital expenditures	N/A	N/A	N/A
Government support for business R&D	0.3	-0.2	0.0
Firm investments	23.3	1.3	0.0
R&D expenditure in the business sector	9.7	3.8	0.0
Non-R&D Innovation expenditures	34.7	0.0	0.0
Innovation expenditures per employee	27.0	0.0	0.0
Use of information technologies	69.3	9.9	-6.6
Enterprises providing ICT training	107.5	16.6	-13.4
Employed ICT specialists	30.0	3.4	0.0
Innovators	132.5	0.0	0.0
Product innovators (SMEs)	170.6	0.0	0.0
Business process innovators (SMEs)	99.0	0.0	0.0
Linkages	48.3	-10.4	-3.7
Innovative SMEs collaborating with others	76.4	0.0	0.0
Public-private co-publications	39.0	41.6	-6.1
Job-to-job mobility of HRST	29.2	-44.1	-5.9
Intellectual assets	16.2	4.4	-2.6
PCT patent applications	37.0	18.0	0.0
Trademark applications	3.3	-11.8	-10.2
Design applications	0.0	0.0	0.0
Employment impacts	105.8	7.6	0.0
Employment in knowledge-intensive activities	69.9	15.7	0.0
Employment in innovative enterprises	135.3	0.0	0.0
Sales impacts	29.8	9.0	-9.2
Medium and high-tech goods exports	21.1	14.9	0.0
Knowledge-intensive services exports	20.4	9.0	-27.9
Sales of innovative products	51.9	0.0	0.0
Environmental sustainability	56.0	47.6	0.0
Resource productivity	N/A	N/A	N/A
Air emissions by fine particulate matter	N/A	N/A	N/A
Environment-related technologies	64.0	45.1	0.0

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MONTENEGRO is an **Emerging Innovator** with performance at 47.0% of the EU average. Performance is below the average of the Emerging Innovators. Performance is increasing at a rate just below that of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

Product innovators
Employment in innovative enterprises
Enterprises providing ICT training
Business process innovators
Population with tertiary education

Relative weaknesses

Design applications
Government support for business R&D
Trademark applications
Doctorate graduates
R&D expenditure in the business sector

Strong increases since 2016

Broadband penetration
Population with tertiary education
International scientific co-publications

Strong decreases since 2016

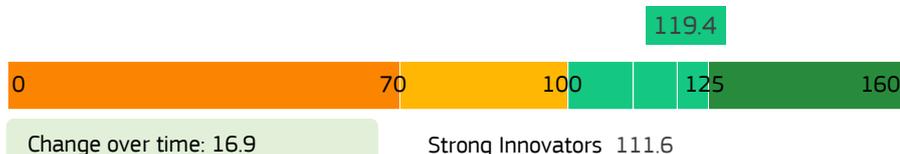
Foreign doctorate students
Job-to-job mobility of HRST
Trademark applications

Strong increases since 2022

Broadband penetration
Most cited publications
Doctorate graduates

Strong decreases since 2022

Knowledge-intensive services exports
Enterprises providing ICT training
International scientific co-publications



Norway

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	119.4	16.9	-0.7
Human resources	159.7	-4.3	0.7
Doctorate graduates	114.8	-22.9	-11.4
Population with tertiary education	178.6	3.6	3.6
Lifelong learning	190.2	17.6	17.6
Attractive research systems	162.4	27.2	0.6
International scientific co-publications	272.6	147.4	11.1
Most cited publications	112.0	-14.7	-6.6
Foreign doctorate students	129.8	11.1	7.3
Digitalisation	139.4	13.2	8.1
Broadband penetration	115.8	26.0	15.9
People with above basic overall digital skills	171.8	0.0	0.0
Finance and support	129.0	55.9	-2.7
R&D expenditures in the public sector	121.9	17.7	-21.0
Venture capital expenditures	134.9	93.2	13.3
Government support for business R&D	129.6	69.0	5.4
Firm investments	78.6	4.5	-2.6
R&D expenditure in the business sector	68.8	9.2	-13.8
Non-R&D Innovation expenditures	89.4	2.2	7.4
Innovation expenditures per employee	79.4	2.0	-0.5
Use of information technologies	142.9	-15.9	-1.5
Enterprises providing ICT training	168.4	-21.7	7.6
Employed ICT specialists	116.7	-10.3	-10.3
Innovators	155.6	73.7	-1.7
Product innovators (SMEs)	176.8	67.5	-2.7
Business process innovators (SMEs)	136.9	80.4	-0.5
Linkages	244.7	68.2	-6.2
Innovative SMEs collaborating with others	243.7	91.0	0.0
Public-private co-publications	468.0	144.7	0.0
Job-to-job mobility of HRST	150.0	11.8	-14.7
Intellectual assets	57.4	3.9	-3.1
PCT patent applications	92.0	-2.0	-4.1
Trademark applications	53.1	17.6	-1.5
Design applications	12.1	0.7	-3.1
Employment impacts	133.5	20.5	1.6
Employment in knowledge-intensive activities	120.5	0.0	0.0
Employment in innovative enterprises	144.2	39.9	3.1
Sales impacts	55.3	0.5	-3.9
Medium and high-tech goods exports	0.0	-5.0	0.0
Knowledge-intensive services exports	141.8	8.5	2.3
Sales of innovative products	42.8	-1.2	-17.7
Environmental sustainability	82.8	1.4	4.1
Resource productivity	70.2	-1.6	0.0
Air emissions by fine particulate matter	76.0	10.1	-1.1
Environment-related technologies	105.3	-6.7	13.1

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NORWAY is a **Strong Innovator** with performance at 119.4% of the EU average. Performance is well above the average of the Strong Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance lead over the EU is becoming larger.

Relative strengths

- Public-private co-publications
- International scientific co-publications
- Innovative SMEs collaborating with others
- Lifelong learning
- Population with tertiary education

Relative weaknesses

- Medium and high-tech goods exports
- Design applications
- Sales of innovative products
- Trademark applications
- R&D expenditure in the business sector

Strong increases since 2016

- International scientific co-publications
- Public-private co-publications
- Venture capital expenditures

Strong decreases since 2016

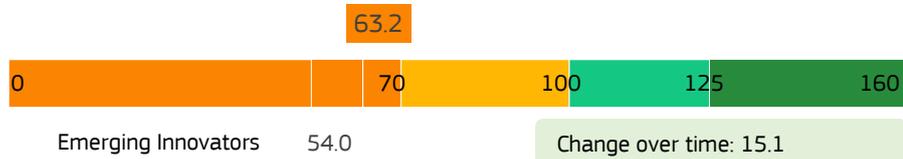
- Doctorate graduates
- Enterprises providing ICT training
- Most cited publications

Strong increases since 2022

- Lifelong learning
- Broadband penetration
- Venture capital expenditures

Strong decreases since 2022

- R&D expenditures in the public sector
- Sales of innovative products
- Job-to-job mobility of HRST



Serbia

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	63.2	15.1	-1.3
Human resources	47.3	5.1	-4.8
Doctorate graduates	55.5	11.4	-11.4
Population with tertiary education	50.3	-3.0	-3.0
Lifelong learning	34.3	4.4	4.4
Attractive research systems	46.7	19.7	3.1
International scientific co-publications	51.7	34.9	2.8
Most cited publications	49.0	15.2	5.5
Foreign doctorate students	36.3	15.7	-2.2
Digitalisation	59.2	37.5	17.7
Broadband penetration	75.3	73.7	34.8
People with above basic overall digital skills	37.0	0.0	0.0
Finance and support	39.2	20.6	0.6
R&D expenditures in the public sector	65.6	4.8	-3.2
Venture capital expenditures	35.7	52.9	8.6
Government support for business R&D	12.5	8.3	-2.5
Firm investments	101.9	14.3	2.6
R&D expenditure in the business sector	27.8	18.5	7.7
Non-R&D Innovation expenditures	181.5	25.6	0.0
Innovation expenditures per employee	108.5	0.0	0.0
Use of information technologies	79.7	-30.7	20.8
Enterprises providing ICT training	98.9	-66.2	38.9
Employed ICT specialists	60.0	3.4	3.4
Innovators	132.2	85.0	-2.3
Product innovators (SMEs)	157.2	101.1	-15.1
Business process innovators (SMEs)	110.2	67.8	11.3
Linkages	65.4	38.8	-27.0
Innovative SMEs collaborating with others	58.3	31.0	-55.8
Public-private co-publications	51.6	30.2	-3.1
Job-to-job mobility of HRST	77.1	50.0	-11.8
Intellectual assets	17.8	-0.2	-0.1
PCT patent applications	23.2	-4.7	0.0
Trademark applications	25.5	8.4	-1.0
Design applications	1.5	-1.3	0.6
Employment impacts	99.5	36.7	0.0
Employment in knowledge-intensive activities	55.4	0.0	0.0
Employment in innovative enterprises	135.8	71.6	0.0
Sales impacts	72.1	13.2	-4.2
Medium and high-tech goods exports	58.2	-6.6	-3.1
Knowledge-intensive services exports	74.2	20.9	-8.9
Sales of innovative products	89.5	34.1	0.0
Environmental sustainability	27.6	-11.8	-16.1
Resource productivity	3.1	-4.4	0.0
Air emissions by fine particulate matter	0.0	0.0	0.0
Environment-related technologies	91.6	-30.6	-45.7

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SERBIA is an **Emerging Innovator** with performance at 63.2% of the EU average. Performance is above the average of the Emerging Innovators. Performance is increasing at a rate higher than that of the EU (8.5%-points). The country's performance gap to the EU is becoming smaller.

Relative strengths

- Non-R&D Innovation expenditures
- Product innovators
- Employment in innovative enterprises
- Business process innovators
- Innovation expenditures per employee

Relative weaknesses

- Air emissions by fine particulate matter
- Design applications
- Resource productivity
- Government support for business R&D
- PCT patent applications

Strong increases since 2016

- Product innovators
- Broadband penetration
- Employment in innovative enterprises

Strong decreases since 2016

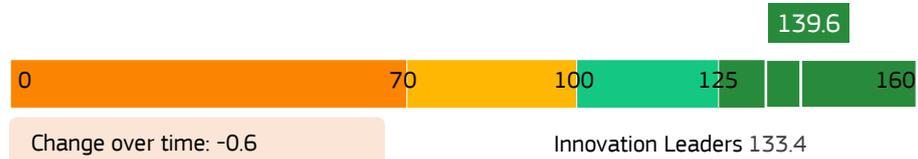
- Enterprises providing ICT training
- Environment-related technologies
- Medium and high-tech goods exports

Strong increases since 2022

- Enterprises providing ICT training
- Broadband penetration
- Business process innovators

Strong decreases since 2022

- Innovative SMEs collaborating with others
- Environment-related technologies
- Product innovators



Switzerland

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	139.6	-0.6	-1.8
Human resources	190.1	0.8	-4.1
Doctorate graduates	218.7	11.4	0.0
Population with tertiary education	153.8	-6.0	-6.0
Lifelong learning	199.0	-8.8	-8.8
Attractive research systems	224.5	-3.0	-5.5
International scientific co-publications	274.9	2.5	0.0
Most cited publications	140.4	-17.6	-10.1
Foreign doctorate students	330.5	25.4	0.0
Digitalisation	136.2	0.0	0.0
Broadband penetration	N/A	N/A	N/A
People with above basic overall digital skills	161.5	0.0	0.0
Finance and support	84.7	24.4	-0.1
R&D expenditures in the public sector	128.1	11.3	0.0
Venture capital expenditures	96.2	53.9	-0.3
Government support for business R&D	18.3	11.3	0.0
Firm investments	150.4	4.7	0.0
R&D expenditure in the business sector	144.4	4.6	0.0
Non-R&D Innovation expenditures	N/A	N/A	N/A
Innovation expenditures per employee	N/A	N/A	N/A
Use of information technologies	134.7	7.0	7.0
Enterprises providing ICT training	N/A	N/A	N/A
Employed ICT specialists	136.7	6.9	6.9
Innovators	131.3	-13.7	0.0
Product innovators (SMEs)	128.9	-40.6	0.0
Business process innovators (SMEs)	133.4	14.9	0.0
Linkages	194.3	15.5	2.5
Innovative SMEs collaborating with others	80.4	11.5	0.0
Public-private co-publications	468.0	0.0	0.0
Job-to-job mobility of HRST	170.8	26.5	5.9
Intellectual assets	133.2	-14.2	-11.7
PCT patent applications	147.4	-3.0	-3.0
Trademark applications	124.4	-4.1	-2.5
Design applications	122.0	-36.5	-29.7
Employment impacts	165.8	-5.2	0.0
Employment in knowledge-intensive activities	169.9	0.0	0.0
Employment in innovative enterprises	162.4	-10.1	0.0
Sales impacts	98.7	-9.9	0.6
Medium and high-tech goods exports	74.9	-2.7	0.9
Knowledge-intensive services exports	120.1	10.5	0.8
Sales of innovative products	109.6	-46.4	0.0
Environmental sustainability	125.0	-1.6	0.5
Resource productivity	192.0	11.5	0.0
Air emissions by fine particulate matter	132.6	4.2	0.0
Environment-related technologies	47.6	-17.3	1.4

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

SWITZERLAND is an **Innovation Leader** with performance at 139.6% of the EU average. Performance is above the average of the Innovation Leaders. Performance is decreasing and is lower than the rate of increase of the EU (8.5%-points). The country's performance lead over the EU is becoming smaller.

Relative strengths

Public-private co-publications
Foreign doctorate students
International scientific co-publications
Doctorate graduates
Lifelong learning

Relative weaknesses

Government support for business R&D
Environment-related technologies
Medium and high-tech goods exports
Innovative SMEs collaborating with others
Venture capital expenditures

Strong increases since 2016

Venture capital expenditures
Job-to-job mobility of HRST
Foreign doctorate students

Strong decreases since 2016

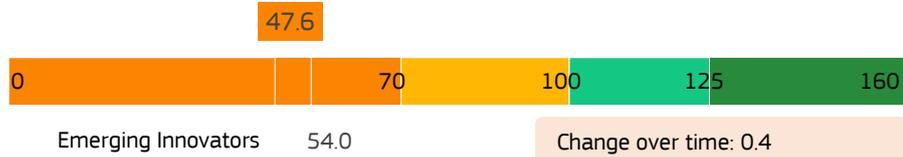
Sales of innovative products
Product innovators
Design applications

Strong increases since 2022

Employed ICT specialists
Job-to-job mobility of HRST
Environment-related technologies

Strong decreases since 2022

Design applications
Most cited publications
Lifelong learning



Türkiye

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	47.6	0.4	0.7
Human resources	48.5	35.2	0.0
Doctorate graduates	25.8	11.4	0.0
Population with tertiary education	66.5	58.1	0.0
Lifelong learning	N/A	N/A	N/A
Attractive research systems	45.6	21.1	6.9
International scientific co-publications	10.7	11.4	0.0
Most cited publications	73.2	27.8	11.8
Foreign doctorate students	33.0	15.0	2.2
Digitalisation	36.6	9.6	9.4
Broadband penetration	44.2	18.9	18.6
People with above basic overall digital skills	26.1	0.0	0.0
Finance and support	68.6	34.6	3.3
R&D expenditures in the public sector	40.6	-8.1	0.0
Venture capital expenditures	N/A	N/A	N/A
Government support for business R&D	111.5	90.3	7.6
Firm investments	46.8	-32.5	-1.5
R&D expenditure in the business sector	45.8	21.5	0.0
Non-R&D Innovation expenditures	61.5	-122.0	0.0
Innovation expenditures per employee	35.8	-4.4	-4.4
Use of information technologies	32.6	2.2	15.9
Enterprises providing ICT training	64.4	4.5	32.5
Employed ICT specialists	0.0	0.0	0.0
Innovators	58.4	-38.3	-1.9
Product innovators (SMEs)	64.1	-18.2	-8.2
Business process innovators (SMEs)	53.5	-59.6	4.8
Linkages	64.7	-18.3	-16.1
Innovative SMEs collaborating with others	42.1	-6.7	0.0
Public-private co-publications	10.9	8.2	0.0
Job-to-job mobility of HRST	106.3	-41.2	-38.2
Intellectual assets	27.1	6.4	0.7
PCT patent applications	49.7	12.3	-0.4
Trademark applications	20.4	9.1	4.2
Design applications	1.9	-3.1	-0.7
Employment impacts	23.1	-25.1	0.0
Employment in knowledge-intensive activities	7.2	7.2	0.0
Employment in innovative enterprises	36.1	-55.7	0.0
Sales impacts	65.9	5.7	-1.4
Medium and high-tech goods exports	55.1	-2.4	-2.5
Knowledge-intensive services exports	72.0	20.4	-1.2
Sales of innovative products	74.8	0.0	0.0
Environmental sustainability	44.1	4.1	-6.7
Resource productivity	66.5	23.0	0.0
Air emissions by fine particulate matter	N/A	N/A	N/A
Environment-related technologies	34.8	-7.7	-12.8

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

TÜRKİYE is an **Emerging Innovator** with performance at 47.6% of the EU average. Performance is below the average of the Emerging Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

Government support for business R&D
Job-to-job mobility of HRST
Sales of innovative products
Most cited publications
Knowledge-intensive services exports

Relative weaknesses

Employed ICT specialists
Design applications
Employment in knowledge-intensive activities
International scientific co-publications
Public-private co-publications

Strong increases since 2016

Government support for business R&D
Population with tertiary education
Most cited publications

Strong decreases since 2016

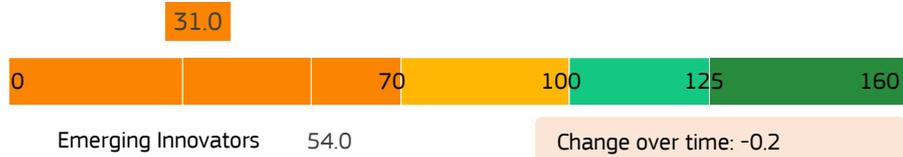
Non-R&D Innovation expenditures
Business process innovators
Employment in innovative enterprises

Strong increases since 2022

Enterprises providing ICT training
Broadband penetration
Most cited publications

Strong decreases since 2022

Job-to-job mobility of HRST
Environment-related technologies
Product innovators



Ukraine *

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	31.0	-0.2	-0.7
Human resources	34.9	-11.0	0.0
Doctorate graduates	33.1	-8.5	0.0
Population with tertiary education	N/A	N/A	N/A
Lifelong learning	N/A	N/A	N/A
Attractive research systems	17.5	4.2	1.7
International scientific co-publications	6.2	7.0	-0.7
Most cited publications	15.6	6.8	3.4
Foreign doctorate students	34.8	-4.6	0.0
Digitalisation	N/A	N/A	N/A
Broadband penetration	N/A	N/A	N/A
People with above basic overall digital skills	N/A	N/A	N/A
Finance and support	31.2	5.7	1.5
R&D expenditures in the public sector	11.8	-14.2	0.0
Venture capital expenditures	53.6	45.0	4.7
Government support for business R&D	24.9	-8.4	0.0
Firm investments	31.7	-3.5	0.1
R&D expenditure in the business sector	15.7	-7.0	0.0
Non-R&D Innovation expenditures	53.6	0.2	0.2
Innovation expenditures per employee	N/A	N/A	N/A
Use of information technologies	22.1	-3.7	0.0
Enterprises providing ICT training	21.8	-3.8	0.0
Employed ICT specialists	N/A	N/A	N/A
Innovators	0.0	-7.1	-7.1
Product innovators (SMEs)	0.0	-6.9	-6.9
Business process innovators (SMEs)	N/A	N/A	N/A
Linkages	21.0	4.5	-0.8
Innovative SMEs collaborating with others	31.3	0.0	0.0
Public-private co-publications	13.4	15.4	-2.8
Job-to-job mobility of HRST	N/A	N/A	N/A
Intellectual assets	17.3	1.5	-1.4
PCT patent applications	29.4	-4.8	-4.9
Trademark applications	16.5	15.1	3.0
Design applications	0.7	-1.3	-0.4
Employment impacts	72.8	-25.8	0.0
Employment in knowledge-intensive activities	80.7	-26.5	0.0
Employment in innovative enterprises	N/A	N/A	N/A
Sales impacts	38.3	5.6	-1.8
Medium and high-tech goods exports	13.4	-18.8	-14.4
Knowledge-intensive services exports	105.6	37.6	9.5
Sales of innovative products	3.1	3.4	3.4
Environmental sustainability	76.7	-10.5	-3.0
Resource productivity	N/A	N/A	N/A
Air emissions by fine particulate matter	N/A	N/A	N/A
Environment-related technologies	87.8	-10.0	-2.9

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

* Results for Ukraine are less reliable due to limited data availability.

UKRAINE is an **Emerging Innovator** with performance at 31.0% of the EU average. Performance is below the average of the Emerging Innovators. Performance is decreasing marginally and is lower than that of the EU (8.5%-points). The country's performance gap to the EU is becoming larger.

Relative strengths

- Knowledge-intensive services exports
- Environment-related technologies
- Employment in knowledge-intensive activities
- Venture capital expenditures
- Non-R&D Innovation expenditures

Relative weaknesses

- Product innovators
- Design applications
- Sales of innovative products
- International scientific co-publications
- R&D expenditures in the public sector

Strong increases since 2016

- Venture capital expenditures
- Knowledge-intensive services exports
- Public-private co-publications

Strong decreases since 2016

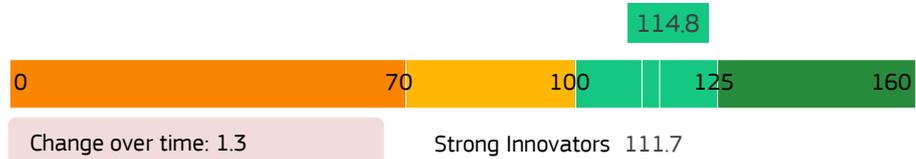
- Employment in knowledge-intensive activities
- Medium and high-tech goods exports
- R&D expenditures in the public sector

Strong increases since 2022

- Knowledge-intensive services exports
- Venture capital expenditures
- Most cited publications

Strong decreases since 2022

- Medium and high-tech goods exports
- Product innovators
- PCT patent applications



United Kingdom

	Performance relative to EU in 2023	Performance change 2016-2023	Performance change 2022-2023
SUMMARY INNOVATION INDEX	114.8	1.3	-2.6
Human resources	161.5	4.2	-3.4
Doctorate graduates	208.3	4.4	-8.0
Population with tertiary education	142.8	15.0	0.0
Lifelong learning	128.4	-9.9	0.0
Attractive research systems	170.6	13.4	-0.8
International scientific co-publications	158.9	70.5	0.0
Most cited publications	142.0	-3.4	-1.5
Foreign doctorate students	241.1	-1.4	0.0
Digitalisation	39.1	0.0	0.0
Broadband penetration	33.8	0.0	0.0
People with above basic overall digital skills	N/A	N/A	N/A
Finance and support	122.6	48.9	0.0
R&D expenditures in the public sector	64.1	-1.6	0.0
Venture capital expenditures	134.9	76.7	0.0
Government support for business R&D	176.0	89.1	0.0
Firm investments	76.2	-6.5	0.0
R&D expenditure in the business sector	83.5	0.0	0.0
Non-R&D Innovation expenditures	70.6	-20.7	0.0
Innovation expenditures per employee	73.6	0.0	0.0
Use of information technologies	120.2	-7.3	0.0
Enterprises providing ICT training	107.5	-29.3	0.0
Employed ICT specialists	133.3	13.8	0.0
Innovators	48.1	-58.2	0.0
Product innovators (SMEs)	91.0	-8.4	0.0
Business process innovators (SMEs)	10.5	-111.2	0.0
Linkages	206.5	19.3	0.0
Innovative SMEs collaborating with others	216.6	-13.6	0.0
Public-private co-publications	216.8	74.9	0.0
Job-to-job mobility of HRST	193.8	23.5	0.0
Intellectual assets	70.4	-20.0	-7.8
PCT patent applications	95.0	-3.3	-0.7
Trademark applications	71.2	-22.3	-8.0
Design applications	34.1	-39.3	-16.6
Employment impacts	147.3	15.2	0.0
Employment in knowledge-intensive activities	175.9	33.7	0.0
Employment in innovative enterprises	123.8	-2.3	0.0
Sales impacts	106.8	-9.9	-10.2
Medium and high-tech goods exports	67.6	-18.5	-24.0
Knowledge-intensive services exports	147.8	30.0	-1.3
Sales of innovative products	119.2	-46.3	0.0
Environmental sustainability	116.1	6.5	0.2
Resource productivity	192.0	45.1	0.0
Air emissions by fine particulate matter	84.7	2.5	0.0
Environment-related technologies	85.9	-14.6	0.5

The second column shows performance relative to that of the EU in 2023. Colours next to the column show matching colour codes: dark green: above 125% of the performance of the EU in 2023; light green: between 100% and 125%; light orange: between 70% and 100%; dark orange: below 70%. The next columns show performance change over time between 2016 and 2023 and between 2022 and 2023, with scores relative to those of the EU in 2016. Positive (negative) performance changes are shown in green (red).

The **UNITED KINGDOM** is a **Strong Innovator** with performance at 114.8% of the EU average. Performance is above the average of the Strong Innovators. Performance is increasing at a rate lower than that of the EU (8.5%-points). The country's performance lead over the EU is becoming smaller.

Relative strengths

Foreign doctorate students
Public-private co-publications
Innovative SMEs collaborating with others
Doctorate graduates
Job-to-job mobility of HRST

Relative weaknesses

Business process innovators
Broadband penetration
Design applications
R&D expenditures in the public sector
Medium and high-tech goods exports

Strong increases since 2016

Government support for business R&D
Venture capital expenditures
Design applications

Strong decreases since 2016

Business process innovators
Sales of innovative products
Enterprises providing ICT training

Strong increases since 2022

Environment-related technologies

Strong decreases since 2022

Medium and high-tech goods exports
Design applications
Trademark applications

9. European Innovation Scoreboard methodology

This chapter provides details on the methodology used in the EIS 2023, including a discussion of data sources for the innovation indicators, the methodology used for calculating the innovation index, and definitions and data sources for the contextual indicators.



9.1 Data sources, data availability and comparisons with the EIS 2022

The EIS uses the most recent statistics from Eurostat and other internationally recognised sources, such as the OECD and the United Nations, available at the time of analysis, with the cut-off date set at the end of April 2023. International sources have been used to improve comparability between countries. The data relates to the actual performance in 2022 for 11 indicators, 2021 for six indicators, 2020 for 13 indicators, and 2019 for two indicators (these are the most recent years for which data are available, cf. Annex E). Data availability is complete for 26 Member States. For Ireland, data is not available for Job-to-job mobility in Human Resources in Science & Technology.

For several indicators, among others, the two indicators on R&D expenditures, provisional data have been used. As in previous versions of the EIS report, provisional data are used to ensure the utilisation of the most recent data for calculating Member States' innovation performance. However, provisional data can be different from the final data, and these differences may have an impact on the results.

For two indicators, Eurostat has released more recent data but indicated a break in the series. These most recent data are not comparable with those from the years before the break was introduced. For several indicators there are major breaks in series (e.g. Population with tertiary education, Lifelong learning, Broadband penetration, Individuals with above basic overall digital skills, Employed ICT specialists, and Employment in knowledge-intensive activities). For two of these indicators, the new data series includes results for only one year, for three indicators for two years. To address the lack of comparability across years, performance changes over time for these indicators are based on these most recent data only. More details are provided in

the Methodology report 2023. Performance changes for the Summary Innovation Index, which measures Member States' average innovation performance, are, therefore, on average, smaller than what they would have been if there had been no breaks in series or new data series.

Finally, it must be stressed that comparisons with results from the EIS 2022 report are not possible, not even for the same years in both reports. Although the methodology in this year's report is the same as in the EIS 2022, results for the same year, e.g. 2022 in the EIS 2022 and 2022 in this year's report, are different due to several reasons:

- For two indicators, data for the most recent year have been used for all years due to breaks in series: 1.3.2 Individuals who have above basic overall digital skills and 4.1.1 Employment in knowledge-intensive activities.
- For two indicators timeliness has been updated with more than one year: Innovation expenditures per person employed in innovation-active enterprises and Enterprises providing training to develop or upgrade ICT skills of their personnel. Timeliness refers to the year for which the most recent data are available.
- By adding new data at the end of the time series for each indicator and removing data at the start of the time series, the highest and lowest data scores used for calculating normalised scores across all countries and all years for an indicator can change, directly impacting these normalised scores.

Consequently, one should only use the results for all years in this report to compare performance over time.

9.2 Methodology for calculating innovation indexes

The overall performance of each country's innovation system has been summarised in a composite indicator, the Summary Innovation Index. Full details on the EIS methodology are available in the EIS 2023 Methodology Report¹⁶. The methodology used for calculating the Summary Innovation Index is outlined below. "All countries" include all Member States and other European and countries.

European benchmark

Step 1: Setting reference years

For each indicator, a reference year is identified based on data availability for all countries for which data availability is at least 75%. For most indicators, this reference year will be lagging one or two years behind the year to which the EIS refers (cf. Annex E).

Step 2: Imputing for missing values

Reference year data are then used for "2023", etc. If data for a year-in-between are not available, missing values are replaced with the value for the previous year. If data are not available at the beginning of the time series, missing values are replaced with the next available year. The following examples clarify this step and show how 'missing' data are imputed. If data are missing for all years, no data will be imputed (the indicator will not contribute to the Summary Innovation Index).

Latest year missing	"2023"	"2022"	"2021"	"2020"	"2019"
Available data	N/A	45	40	35	30
Use most recent year	45	45	40	35	30
Year-in-between missing	"2022"	"2021"	"2020"	"2019"	"2018"
Available data	50	N/A	40	35	30
Substitute with previous year	50	40	40	35	30
Beginning-of-period missing	"2022"	"2021"	"2020"	"2019"	"2018"
Available data	50	45	40	35	N/A
Substitute with next available year	50	45	40	35	35

Step 3: Identifying and replacing outliers

Positive outliers are identified as those country scores which are higher than the mean across all countries plus twice the standard deviation. Negative outliers are identified as those country scores which are smaller than the mean across all countries minus twice the standard deviation. These outliers are replaced by the respective maximum and minimum values observed over all the years and all countries.

Step 4: Transforming data if data are highly skewed

Most of the indicators are fractional indicators with values between 0% and 100%. Some indicators are unbound indicators, where values are not limited to an upper threshold. These indicators can be highly volatile and can have skewed data distributions (where most countries show low performance levels, and a few countries show exceptionally high levels of performance). For these indicators where the degree of skewness across the full eight-year period is above one, data have been transformed using a square root transformation. For the following indicators data have been transformed: Air emissions in fine particulates in industry, Non-R&D innovation expenditures, PCT patent applications, Trademark applications, and Venture capital expenditures. A square root transformation uses the square root of the indicator value instead of the original value.

Step 5: Determining Maximum and Minimum scores

The Maximum score is the highest score found for the eight-year period within all countries excluding positive outliers. Similarly, the Minimum score is the lowest score found for the eight-year period within all countries excluding negative outliers.

Step 6: Calculating re-scaled scores

Re-scaled scores of the country scores (after correcting for outliers and a possible transformation of the data) for all years are calculated by first subtracting the Minimum score and then dividing by the difference between the Maximum and Minimum score. The maximum re-scaled score is thus equal to 1, and the minimum re-scaled score is equal to 0. For positive and negative outliers, the re-scaled score is equal to 1 or 0, respectively.

Step 7: Calculating composite innovation indexes

For each year, a composite Summary Innovation Index is calculated as the unweighted average of the re-scaled scores for all indicators where all indicators receive the same weight (1/32 if data are available for all 32 indicators).

Step 8: Calculating relative to EU performance scores

Performance scores relative to the EU are then calculated as the SII of the respective country divided by the SII of the EU multiplied by 100. Relative performance scores are calculated for the full eight-year period compared to the performance of the EU in 2016 and for the latest year also to that of the EU in 2023. For the definition of the performance groups, only the performance scores relative to the EU in 2023 have been used.

¹⁶ https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

International benchmark

The methodology for calculating average innovation performance for the EU and its major global competitors is comparable to that used for

calculating average innovation performance for the EU Member States but using a smaller set of countries and a smaller set of indicators.

Performance group membership

For determining performance group membership, the EIS uses the following classification scheme:

- Innovation Leaders are all countries with a relative performance in 2023 above 125% of the EU average in 2023.
- Strong Innovators are all countries with a relative performance in 2023 between 100% and 125% of the EU average in 2023.

- Moderate Innovators are all countries with a relative performance in 2023 between 70% and 100% of the EU average in 2023.
- Emerging Innovators are all countries with a relative performance in 2023 below 70% of the EU average in 2023.

9.3 Contextual analysis on the impact of structural differences between countries

In response to a need for contextual analyses to better understand performance differences between the innovation indicators used in the main measurement framework, a set of contextual indicators is included in the two-page country profiles available on the EIS website. As an introduction, the following sections discuss the relevance of these structural aspects to provide a better understanding of differences between countries in the performance of individual indicators. Full definitions of all performance indicators and contextual indicators are provided in the EIS 2023 Methodology Report. The list of contextual indicators, the years for which average performance has been calculated, and data sources used are shown in Table 8. The EIS does not include any indicators on gender as such data are not available for most of the indicators used to measure structural differences.

Performance and structure of the economy

GDP per capita in purchasing power standards (PPS)¹⁷ is a measure for interpreting real income differences between countries. Higher income can increase the demand for new innovative goods and services. Economic growth is captured by the average annual growth rate of GDP for 2020-2022. In economies that grow faster, increasing demand may provide more favourable conditions for enterprises to sell their goods and services.

Differences in economic structures are important. Differences in the

share of manufacturing industry in GDP, and in high-tech activities in manufacturing and services, are important factors that explain why countries can perform better or worse on indicators like business R&D expenditures, PCT patents, and innovative enterprises. Medium-high and high-tech industries have higher technological intensities than other industries. These industries, on average, will have higher R&D expenditures, more patent applications, and higher shares of innovative enterprises. Countries with above-average shares of these industries are expected to perform better on several EIS indicators. For example, for the EU on average, 85% of R&D expenditures in manufacturing are accounted for by medium-high and high-technology manufacturing industries^{18 19}. Also, the share of enterprises that introduced a product and/or business process innovation is higher in medium-high and high-technology manufacturing industries compared to all core industries covered in the Community Innovation Survey²⁰.

Foreign ownership, including ownership from both other EU Member States and non-Member States, is important as, on average, about 30% of business R&D expenditures in EU Member States is made by foreign affiliates, which is significantly higher compared to Japan and the United States and comparable to Australia and Canada²¹. The share of foreign-controlled enterprises in value-added serves as a proxy for differences in the impact of foreign ownership on the economy.

¹⁷ The purchasing power standard (PPS) is an artificial currency unit. Theoretically, one PPS can buy the same amount of goods and services in each country. However, price differences across borders mean that different amounts of national currency units are needed for the same goods and services depending on the country. PPS are derived by dividing any economic aggregate of a country in national currency by its respective purchasing power parities. PPS is the technical term used by Eurostat for the common currency in which national accounts aggregates are expressed when adjusted for price level differences using PPPs. Thus, PPPs can be interpreted as the exchange rate of the PPS against the Euro.

¹⁸ Based on NACE Rev. 2 three-digit level, manufacturing industries can be classified into high-technology, medium-high technology, medium-low-technology, and low-technology. The high-technology and medium-high technology industries include: Chemicals and chemical products (20); Basic pharmaceutical products and pharmaceutical preparations (21); Weapons and ammunition (25.4*); Computer, electronic and optical products (26); Electrical equipment (27); Machinery and equipment not elsewhere classified (28); Motor vehicles, trailers and semi-trailers (29); Other transport equipment (30) excluding Building of ships and boats (30.1); Air and spacecraft and related machinery (30.3); and Medical and dental instruments and supplies (32.5**). If data are only available at the NACE Rev. 2 two-digit level, industries identified with an * are classified as medium-low-technology, and industries identified with an ** are classified as low-technology, and thus excluded from the high-technology and medium-high technology industries (Source: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries).

¹⁹ Average results for 2015-2017 for 24 Member States for which data are available for at least one year. Data were extracted from Eurostat (Business enterprise R&D expenditure in high-tech sectors - NACE Rev. 2 [htec_sti_exp2]).

²⁰ In accordance with Commission Regulation No 995/2012, the following industries and services are included in the Core target population covered in the CIS: Core Industry (excluding construction): Mining and quarrying (B), Manufacturing (C) (10-12: Manufacture of food products, beverages and tobacco; 13-15: Manufacture of textiles, wearing apparel, leather and related products; 16-18: Manufacture of wood, paper, printing and reproduction; 20: Manufacture of chemicals and chemical products; 21: Manufacture of basic pharmaceutical products and pharmaceutical preparations; 19-22: Manufacture of petroleum, chemical, pharmaceutical, rubber and plastic products; 23: Manufacture of other non-metallic mineral products; 24: Manufacture of basic metals; 25: Manufacture of fabricated metal products, except machinery and equipment; 26: Manufacture of computer, electronic and optical products; 25-30: Manufacture of fabricated metal products (except machinery and equipment), computer, electronic and optical products, electrical equipment, motor vehicles and other transport equipment; 31-33: Manufacture of furniture; jewellery, musical instruments, toys; repair and installation of machinery and equipment, Electricity, gas, steam and air conditioning supply (D), Water supply, sewerage, waste management and remediation activities (E) (36: Water collection, treatment and supply; 37-39: Sewerage, waste management, remediation activities). Core Services: Wholesale trade, except of motor vehicles and motorcycles (46), Transport and storage (H) (49-51: Land transport and transport via pipelines, water transport and air transport; 52-53: Warehousing and support activities for transportation and postal and courier activities); Information and communication (J) (58: Publishing activities; 61: Telecommunications; 62: Computer programming, consultancy and related activities; 63: Information service activities), Financial and insurance activities (K) (64: Financial service activities, except insurance and pension funding; 65: Insurance, reinsurance and pension funding, except compulsory social security; 66: Activities auxiliary to financial services and insurance activities), Professional, scientific and technical activities (M) (71-73: Architectural and engineering activities; technical testing and analysis; Scientific research and development; Advertising and market research).

²¹ Average results for 2010-2016 for 14 Member States for which data were available (Austria, Belgium, Czechia, Finland, France, Germany, Hungary, Ireland, Italy, Netherlands, Poland, Slovenia Spain, and Sweden). Source of the data: OECD Main Science and Technology Indicators, Volume 2018 Issue 2.

Table 8: Contextual indicators in the European Innovation Scoreboard

	Period	Source
PERFORMANCE AND STRUCTURE OF THE ECONOMY		
GDP per capita (PPS)	Average 2020-2022	Eurostat
Average annual GDP growth (%)	Between 2020 and 2022	Eurostat
Employment share Manufacturing (NACE C) (%)	Average 2019-2021	Eurostat
of which High and Medium high-tech (%)	Average 2019-2021	Eurostat
Employment share Services (NACE G-N) (%)	Average 2019-2021	Eurostat
of which Knowledge-intensive services (%)	Average 2019-2021	Eurostat
Turnover share SMEs (%)	Average 2018-2020	Eurostat
Turnover share large enterprises (%)	Average 2018-2020	Eurostat
Foreign-controlled enterprises – share of value added (%)	Average 2018-2020	Eurostat
BUSINESS AND ENTREPRENEURSHIP		
Enterprise births (10+ employees) (%)	Average 2017-2019	Eurostat
Total early-stage Entrepreneurial Activity (TEA) (%)	Average 2019-2021	Global Entrepreneurship Monitor
FDI net inflows (% GDP)	Average 2019-2021	World Bank: World Development Indicators
Top R&D spending enterprises per 10 million population	Average 2019-2021	EU Industrial R&D Investment Scoreboard
Buyer sophistication (1 to 7 best)	Average 2017-2019	World Economic Forum
INNOVATION PROFILES		
In-house product innovators with market novelties	2018-2020	Eurostat, National Statistical Offices
In-house product innovators without market novelties	2018-2020	Eurostat, National Statistical Offices
In-house business process innovators	2018-2020	Eurostat, National Statistical Offices
Innovators that do not develop innovations themselves	2018-2020	Eurostat, National Statistical Offices
Innovation active non-innovators	2018-2020	Eurostat, National Statistical Offices
Non-innovators with potential to innovate	2018-2020	Eurostat, National Statistical Offices
Non-innovators without disposition to innovate	2018-2020	Eurostat, National Statistical Offices
GOVERNANCE AND POLICY FRAMEWORK		
Corruption Perceptions Index	Average 2020-2022	Transparency International
Basic-school entrepreneurial education and training (1 to 5 best)	Average 2019-2021	Global Entrepreneurship Monitor
Government procurement of advanced technology products (1 to 7 best)	Average 2017-2019	World Economic Forum
Rule of law (-2.5 to 2.5 best)	Average 2019-2021	World Bank: Worldwide Governance Indicators
CLIMATE CHANGE		
Circular material use rate	Average 2019-2021	Eurostat
Greenhouse gas emissions intensity of energy consumption	Average 2018-2020	European Environment Agency (EEA), Eurostat
Eco-Innovation Index	2022	EC, DG Environment
DEMOGRAPHY		
Population size	Average 2020-2022	Eurostat
Average annual population growth (%)	Between 2020 and 2022	Eurostat
Population density	Average 2017-2019	Eurostat

Business and entrepreneurship

Entrepreneurship is important for introducing new innovations on the market. The degree of entrepreneurship is measured by two contextual indicators measuring the share of new enterprise births in the economy and Total early-stage Entrepreneurial activity (TEA), which measures the share of the adult population aged 18–64 years who are in the process of starting a business (a nascent entrepreneur) or who started a business which is not older than 42 months at the time of the respective survey (owner-manager of a new business).

Inflows of new technologies are important as they add to a country's economic and technological capacities. Inward Foreign direct investment (FDI) can have a positive impact on innovation performance, although there are differences depending on the complexity of the receiving industry, political and economic framework conditions as well as the quality of the institutions of the receiving countries. Inward FDI flows are measured over a three-year period, as average net inflows of investments to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor.

Enterprise characteristics are important for explaining differences in R&D spending and innovation activities. Large enterprises, defined as enterprises with 250 or more employees, account for almost 80 percent of EU business R&D expenditures, whereas SMEs, defined as enterprises with 10 to 249 employees, account for only one-fifth. The presence of large R&D spending enterprises is captured by the EU Industrial R&D Investment Scoreboard, which provides economic and financial data and analysis of the top 1000 corporate R&D investors from the EU and top 2500 corporate R&D investors elsewhere in the world²².

Demand is an important driver of innovation. According to the Oslo Manual²³, demand factors shape innovation activity in two major ways: for the development of new products, as firms modify and differentiate products to increase sales and market share; and for the improvement of the production and supply processes to reduce costs and lower prices. A robust indicator measuring the demand for innovation is currently not available. The Executive Opinion Survey of the World Economic Forum includes an indicator that provides a measure of the preferences of individual consumers for innovative products. The degree of Buyer sophistication measures, on a scale from 1 (low) to 7 (high), whether buyers focus more on price or quality of products and services, with higher quality being the result of product innovations.

Innovation profiles

Innovation is a highly diverse activity. Enterprises can innovate through product or business process innovation, with the latter including process, marketing and organisational innovation. Enterprises can adopt new technologies developed by other enterprises or they engage in intensive in-house research and innovation activities. The capabilities needed by enterprises to innovate are very different in kind and size. Building on earlier work by academics and the OECD, Eurostat, UNU-MERIT (Maastricht University), ZEW – Leibniz Centre for European Economic Research, in collaboration with National Statistical Offices, developed a taxonomy of innovating and non-innovating enterprises based on CIS micro data. The following characteristics were used to identify seven mutually exclusive detailed innovation profiles: The degree of novelty of product innovations, own in-house capacities to innovate, and R&D activities. Of these, four innovation profiles capture different types of enterprises that have introduced an innovation (product or business process) and three innovation profiles capture non-innovators, of which one profile captures non-innovators with innovation activities, one profile captures non-innovators with an interest in innovation, while the other captures non-innovators without any innovation activities or interest:

- In-house product innovators with market novelties, including all enterprises that introduced a product innovation that was developed by the enterprise and that was not previously offered by competitors.
- In-house product innovators without market novelties, including all enterprises that introduced a product innovation that was developed by the enterprise but that is only new to the enterprise itself.
- In-house business process innovators, including all enterprises without a product innovation, but that did introduce a business process innovation that was developed by the enterprise.
- Innovators that do not develop innovations themselves, including all enterprises that introduced an innovation of any kind but did not develop it themselves (enterprises without significant own innovation capabilities).
- Innovation active non-innovators, including all enterprises that did not introduce any innovation but that either had ongoing or abandoned innovation activities.
- Non-innovators with potential to innovate, including all enterprises that did not introduce any innovation, and which had no ongoing or abandoned innovation activities but that did consider to innovate.
- Non-innovators without disposition to innovate, including all other enterprises, those that neither introduced an innovation nor had any ongoing or abandoned innovation activities nor considered to innovate.

Data on Innovation profiles should not be interpreted as “more is better”. Instead, the data should be used to better understand differences in the composition of different types of enterprises in a country, thereby helping policy makers to design policies that better target different enterprises.

²² <https://iri.jrc.ec.europa.eu/scoreboard>

²³ The Oslo Manual is the foremost international source of guidelines for the collection and use of data on innovation activities in industry. OECD/Eurostat (2018), Oslo Manual: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, OECD Publishing, Paris. DOI: <https://www.oecd.org/science/oslo-manual-2018-9789264304604-en.htm>

Governance and policy framework

Institutional and legal differences between countries may make it more difficult to engage in business activities. The Corruption Perceptions Index is a composite index based on a combination of surveys and assessments of corruption from 13 different sources and scores, and ranks countries based on how corrupt a country's public sector is perceived to be, with a score of 0 representing a very high level of corruption and a score of 100 representing a low level of corruption. The CPI is published by Transparency International, and the data are included in the EU Sustainable Development Goals indicator set to monitor progress on SDG Goal 16 on Peace, justice and strong institutions.

Entrepreneurial skills are important for successfully transforming ideas and inventions into innovations. These skills can be acquired on the job but also by formal schooling. Basic-school entrepreneurial education and training measures the extent to which training in creating or managing SMEs is incorporated within the education and training system at primary and secondary levels.

Governments play an important role in enhancing the innovation capacities of an economy. Government procurement of advanced technology products measures the extent to which government procurement decisions foster technological innovation – from 1 (not at all) to 7 (extremely effectively).

Trust is important for creating a business environment for undertaking risky innovative activities. Measures of the rule of law capture differences in the extent to which people have confidence in and abide by the rules of society. The Rule of law Index measures differences in the quality of contract enforcement, property rights, the police, the judicial system, as well as the prevalence of crime and violence.

Climate change

As the natural environment increasingly suffers from the loss of biodiversity, pollution and climate change, the relationship between innovation performance and environment sustainability grows in importance. EU level policy developments, such as the European Green Deal and the Recovery plan for Europe, underline the need to take account of the pivotal role of research and innovation in contributing to societal challenges. Three indicators are included in the Contextual indicators relevant for measuring climate change and the role of innovation.

The circular material use rate measures, in percentages, the share of material recovered and fed back into the economy – thus saving extraction of primary raw materials – in overall material use. It covers households, the private and the public sector. A higher circular material use rate indicates more secondary materials substituting for primary raw materials, thereby avoiding the environmental impacts of extracting primary material.

Greenhouse gas emissions intensity of energy consumption is an indicator that is part of the EU Sustainable Development Goals (SDG) indicator set. It is used to monitor progress towards Goal 13 on climate action and SDG 7 on affordable and clean energy. The indicator is calculated as the ratio between energy related GHG emissions and gross inland consumption of energy. It expresses how many tonnes CO₂ equivalents of energy related GHGs are being emitted in a certain economy per unit of energy that is being consumed. Lower scores on this indicator imply an improvement in environmental performance.

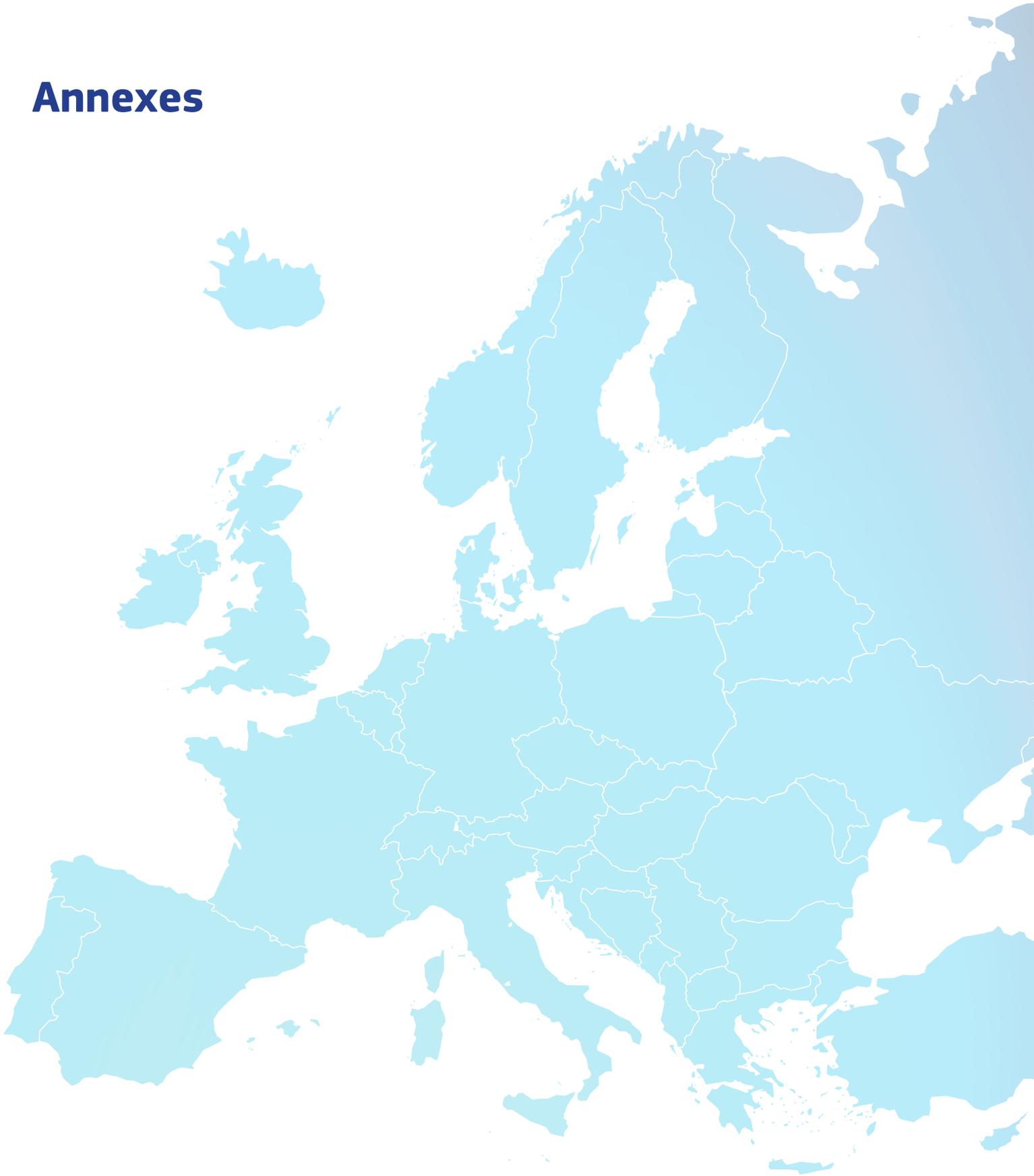
The Eco-Innovation index is a composite indicator based on 16 sub-indicators in five thematic areas: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency outcomes and socio-economic outcomes. The overall score of an EU Member State is calculated by the unweighted mean of the 16 sub-indicators. It shows how well individual Member States perform in eco-innovation compared to the EU average, which is equated with 100 (index EU=100). The index is part of the Eco-Innovation Scoreboard²⁴.

Demography

Structural data also includes population size and the average annual growth rate of population for 2020–2022. Increasing demand following an increasing population may provide more favourable conditions for enterprises to sell their goods and services. Densely populated areas are more likely to be more innovative for several reasons. Firstly, knowledge diffuses more easily when people and enterprises are located closer to each other. Secondly, in more densely populated areas there tends to be a concentration of government and educational services. Densely populated areas provide better training opportunities and employ above-average shares of highly educated people. Furthermore, the amount of natural assets per capita tends to decline with population density. This positively impacts on the share of Medium and high-tech product exports and the share of employment in knowledge intensive activities.

²⁴ https://green-business.ec.europa.eu/eco-innovation_en

Annexes



Annex A: Country abbreviations

AL	Albania	IT	Italy
AT	Austria	JP	Japan
AU	Australia	KR	South Korea
BA	Bosnia and Herzegovina	LT	Lithuania
BE	Belgium	LU	Luxembourg
BG	Bulgaria	LV	Latvia
BR	Brazil	ME	Montenegro
CA	Canada	MK	North Macedonia
CH	Switzerland	MT	Malta
CL	Chile	MX	Mexico
CN	China	NL	Netherlands
CY	Cyprus	NO	Norway
CZ	Czechia	PL	Poland
DE	Germany	PT	Portugal
DK	Denmark	RO	Romania
EL	Greece	RS	Serbia
EE	Estonia	SE	Sweden
ES	Spain	SI	Slovenia
FI	Finland	SK	Slovakia
FR	France	TR	Türkiye
HR	Croatia	UA	Ukraine
HU	Hungary	UK	United Kingdom
IE	Ireland	US	United States
IN	India	ZA	South Africa
IS	Iceland		

Annex B: Performance per indicator

Available on the EIS website: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

Annex C: Indicator values by European country in 2023

	EU	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL
FRAMEWORK CONDITIONS																				
Human resources																				
1.1.1 New doctorate graduates	0.7	0.9	0.3	0.8	1.0	1.1	0.6	1.0	0.5	0.7	0.8	0.4	0.6	0.4	0.2	0.4	0.7	0.3	0.2	0.6
1.1.2 Population completed tertiary education	42.0	51.4	33.8	34.5	49.0	37.1	43.9	62.3	45.2	50.5	50.4	35.5	29.2	59.2	45.9	58.2	61.0	31.9	42.4	56.4
1.1.3 Lifelong learning	11.9	10.3	1.7	9.4	27.9	8.1	21.1	11.8	3.5	15.3	13.3	4.4	9.6	10.5	9.7	8.5	18.1	7.9	12.8	26.4
Attractive research systems																				
1.2.1 International scientific co-publications	1279	2248	405	1317	3698	1208	2136	2374	1184	1178	993	1091	1137	3744	782	923	3496	757	1576	2476
1.2.2 Scientific publications among top 10% most cited	982.4	1190.9	244.4	515.2	1223.5	1040.5	880.1	1125.1	923.0	915.5	886.5	481.6	1217.7	1043.0	499.9	586.0	1278.3	589.4	877.2	1394.2
1.2.3 Foreign doctorate students	17.8	32.6	8.6	22.3	36.1	23.1	25.6	35.5	1.5	19.2	37.9	8.2	15.8	24.0	11.7	6.6	89.0	25.5	35.3	47.9
Digitalisation																				
1.3.1 Broadband penetration	57.5	66.7	45.7	42.9	85.1	58.1	42.8	55.5	24.4	75.5	60.1	32.9	46.1	61.2	39.0	58.2	68.7	43.3	68.1	71.2
1.3.2 Individuals with above basic overall digital skills	26.5	26.3	7.8	24.1	37.4	18.8	27.7	39.7	21.7	38.1	31.3	31.2	22.5	21.0	23.8	23.0	31.8	21.5	35.5	51.8
INVESTMENTS																				
Finance and support																				
2.1.1 R&D expenditure in the public sector	0.76	0.77	0.26	0.74	1.06	1.04	0.75	0.21	0.76	0.62	0.72	0.66	0.55	0.34	0.47	0.56	0.55	0.40	0.24	0.74
2.1.2 Venture capital investments	0.214	0.228	0.034	0.145	0.353	0.164	1.062	0.117	0.049	0.227	0.391	0.387	0.074	0.087	0.052	0.263	0.228	0.112	0.009	0.341
2.1.3 Direct and indirect government support for business R&D	0.18	0.32	0.01	0.12	0.08	0.07	0.06	0.21	0.08	0.10	0.42	0.11	0.14	0.03	0.01	0.04	0.03	0.23	0.00	0.26
Firm investments																				
2.2.1 R&D expenditure in the business sector	1.49	2.42	0.51	1.25	1.75	2.09	0.98	0.84	0.69	0.80	1.45	0.58	0.91	0.41	0.23	0.54	0.47	1.24	0.40	1.52
2.2.2 Non-R&D innovation expenditure	0.80	0.62	0.36	1.84	0.82	1.34	1.47	0.04	0.89	0.56	0.23	0.36	0.61	0.65	0.31	2.11	0.26	0.64	0.39	0.16
2.2.3 Innovation expenditures per person employed	7505	14635	1371	7852	9045	10752	5604	12292	5079	4086	8746	1608	5565	2568	909	5147	4023	4169	2856	6542
Use of information technologies																				
2.3.1 Enterprises providing ICT training	22.4	33.0	9.1	23.1	33.3	27.3	18.8	23.2	13.4	20.7	15.1	20.8	19.3	28.4	15.1	13.1	21.8	18.2	28.4	29.1
2.3.2 Employed ICT specialists	4.6	5.6	3.8	4.5	5.7	5.0	6.6	6.2	2.5	4.3	4.3	3.7	3.9	4.6	4.4	4.4	7.7	4.1	4.8	7.2
INNOVATION ACTIVITIES																				
Innovators																				
3.1.1 SMEs with product innovations	27.0	34.7	22.2	35.2	31.5	34.1	25.2	28.7	48.0	17.9	26.7	34.6	29.7	38.8	13.7	30.5	28.7	19.9	17.4	27.7
3.1.2 SMEs with business process innovations	41.6	63.4	24.5	52.2	45.5	54.8	41.1	47.7	66.3	26.1	44.1	47.2	46.4	64.9	24.9	44.8	39.3	23.5	34.5	43.1
Linkages																				
3.2.1 Innovative SMEs collaborating with others	11.7	24.3	7.3	14.5	14.5	13.5	17.3	22.0	19.3	7.3	15.5	12.3	13.1	27.8	6.1	14.4	12.9	9.9	8.1	18.0
3.2.2 Public-private co-publications	138.5	355.8	56.4	188.2	700.3	255.1	253.0	332.4	200.2	159.0	150.6	200.9	201.6	395.7	137.0	93.7	581.0	157.1	180.4	429.5
3.2.3 Job-to-job mobility of Human Resources in S&T	6.8	6.5	2.8	4.3	10.7	8.8	9.5	N/A	4.8	6.9	7.4	6.9	4.4	10.5	6.2	10.8	9.4	6.7	7.6	8.7
Intellectual assets																				
3.3.1 PCT patent applications	3.28	3.05	0.51	0.72	6.17	5.90	1.33	1.49	0.61	1.37	3.14	0.57	2.08	0.71	0.73	0.55	1.66	1.09	1.33	4.89
3.3.2 Trademark applications	7.19	6.30	9.64	5.80	8.75	7.89	22.93	4.08	6.61	8.78	4.00	4.21	7.94	39.21	7.93	12.12	16.89	3.69	49.84	7.99
3.3.3 Design applications	3.76	2.54	5.61	2.53	5.93	4.41	4.44	1.24	0.97	2.72	2.54	1.31	5.74	3.29	1.88	2.12	3.94	0.72	5.23	4.04
IMPACTS																				
Employment impacts																				
4.1.1 Employment in knowledge-intensive activities	14.5	17.5	11.6	14.2	16.2	14.6	15.5	23.5	13.0	13.1	15.8	10.9	14.6	19.2	12.0	13.2	26.4	13.9	19.9	19.9
4.1.2 Employment in innovative enterprises	59.0	77.3	44.1	63.2	58.3	74.1	79.9	60.4	76.5	41.3	60.6	57.1	62.5	70.7	38.7	63.5	50.4	39.2	47.8	56.1
Economic effects																				
4.2.1 Medium & high-tech product exports	61.2	51.1	35.1	67.9	50.9	67.2	36.5	61.2	24.0	46.2	55.3	33.7	53.6	52.7	30.2	35.8	56.4	65.5	56.0	47.7
4.2.2 Knowledge-intensive services exports	63.6	74.9	56.6	54.2	83.9	80.3	65.5	94.4	65.3	48.1	69.8	24.3	61.2	86.6	55.6	31.8	85.3	55.5	48.9	79.3
4.2.3 Sales of new-to-market and new-to-enterprise innovations	13.14	15.07	7.44	14.43	15.00	14.05	8.98	36.94	20.35	21.74	5.91	12.94	13.48	13.80	6.36	11.54	6.35	7.75	6.08	8.21
Environmental sustainability																				
4.3.1 Resource productivity	2.30	2.80	0.83	1.91	1.71	2.74	0.98	3.17	2.11	2.95	3.13	1.96	3.48	1.56	1.60	1.37	3.50	1.59	2.82	5.68
4.3.2 Air emissions in fine particulates (PM2.5) in Industry	0.073	0.063	0.369	0.033	0.013	0.022	0.538	0.015	0.169	0.118	0.050	0.187	0.057	0.214	0.402	0.054	0.056	0.088	0.013	0.045
4.3.3 Development of environment-related technologies	12.92	10.05	12.84	12.30	23.12	14.12	7.76	6.74	8.52	11.30	12.93	5.03	9.69	9.05	7.66	9.91	11.36	7.70	9.79	10.15

	AT	PL	PT	RO	SI	SK	FI	SE	AL*	BA	IS	MK	ME	NO	RS	CH	TR	UA*	UK
FRAMEWORK CONDITIONS																			
Human resources																			
1.1.1 New doctorate graduates	0.9	0.2	0.7	0.2	0.7	0.6	1.1	1.0	0.1	0.1	0.6	0.1	0.1	0.8	0.4	1.7	0.2	0.2	1.4
1.1.2 Population completed tertiary education	43.1	40.5	44.4	24.7	47.3	39.1	40.7	52.4	37.7	26.4	40.2	37.7	40.4	55.6	33.4	51.3	36.2	N/A	49.4
1.1.3 Lifelong learning	15.8	7.6	13.8	5.4	21.6	12.8	25.2	36.2	9.8	1.8	27.1	2.6	2.7	21.1	5.2	22.0	N/A	N/A	14.8
Attractive research systems																			
1.2.1 International scientific co-publications	2266	592	1729	395	1941	828	2777	2976	148	341	4348	382	737	3358	697	4291	203	149	1989
1.2.2 Scientific publications among top 10% most cited	1031.6	546.3	875.7	627.7	789.9	445.3	1179.8	1167.9	584.1	438.8	1070.3	519.9	423.6	1089.7	526.7	1343.1	742.8	228.8	1357.7
1.2.3 Foreign doctorate students	36.8	7.9	33.1	4.6	20.1	11.6	25.0	35.6	11.0	N/A	41.7	39.1	11.3	22.7	7.3	56.6	6.7	7.0	41.1
Digitalisation																			
1.3.1 Broadband penetration	39.3	51.3	76.0	77.0	54.5	40.1	71.1	76.5	15.7	31.5	N/A	40.1	42.1	64.6	46.4	N/A	32.4	N/A	27.7
1.3.2 Individuals with above basic overall digital skills	33.3	20.6	28.5	8.7	19.7	20.8	48.1	35.7	4.0	5.4	44.8	8.2	9.1	42.6	12.3	40.3	9.9	N/A	N/A
INVESTMENTS																			
Finance and support																			
2.1.1 R&D expenditure in the public sector	0.95	0.53	0.64	0.18	0.55	0.41	0.91	0.94	N/A	0.13	0.79	0.28	0.30	0.90	0.54	0.94	0.38	0.20	0.53
2.1.2 Venture capital investments	0.115	0.046	0.046	0.024	0.030	0.032	0.399	0.407	N/A	N/A	N/A	N/A	N/A	0.378	0.033	0.198	N/A	0.067	0.461
2.1.3 Direct and indirect government support for business R&D	0.36	0.15	0.30	0.02	0.19	0.06	0.07	0.14	N/A	0.08	0.11	0.01	0.00	0.24	0.02	0.03	0.20	0.05	0.46
Firm investments																			
2.2.1 R&D expenditure in the business sector	2.22	0.91	0.98	0.29	1.57	0.52	2.05	2.41	N/A	0.08	1.98	0.10	0.19	1.04	0.45	2.13	0.71	0.28	1.25
2.2.2 Non-R&D innovation expenditure	0.38	0.57	0.37	0.05	0.10	0.79	0.46	0.46	N/A	0.01	0.56	1.01	0.14	0.65	3.57	N/A	0.35	0.28	0.44
2.2.3 Innovation expenditures per person employed	7570	3134	2552	1022	3545	3356	8237	11650	N/A	237	3696	1282	2201	6005	8122	N/A	2841	N/A	5583
Use of information technologies																			
2.3.1 Enterprises providing ICT training	20.1	24.7	23.6	8.8	28.9	15.4	39.8	34.2	N/A	15.9	N/A	12.3	23.7	34.3	22.2	N/A	16.2	8.8	23.7
2.3.2 Employed ICT specialists	5.0	3.6	4.5	2.8	4.5	4.3	7.6	8.6	N/A	N/A	4.3	2.3	2.5	5.1	3.4	5.7	1.3	N/A	5.6
INNOVATION ACTIVITIES																			
Innovators																			
3.1.1 SMEs with product innovations	30.4	14.2	24.9	6.7	34.8	14.1	37.8	38.1	22.8	38.6	27.8	15.5	42.9	44.3	39.9	33.5	18.9	4.4	24.9
3.1.2 SMEs with business process innovations	50.2	25.5	43.4	5.3	41.6	26.1	54.2	51.4	31.1	34.8	41.9	33.5	41.3	51.5	44.3	50.5	29.2	N/A	17.7
Linkages																			
3.2.1 Innovative SMEs collaborating with others	16.4	6.7	6.6	1.5	13.1	7.5	27.6	15.1	8.9	N/A	22.5	6.2	9.3	37.4	7.4	9.7	5.8	4.7	23.6
3.2.2 Public-private co-publications	507.1	80.0	202.1	60.1	352.6	112.8	493.5	517.1	12.7	42.4	722.9	44.1	58.3	622.6	74.9	835.0	21.3	24.5	292.2
3.2.3 Job-to-job mobility of Human Resources in S&T	7.3	6.8	7.0	1.4	7.3	3.4	8.4	4.0	N/A	N/A	8.9	5.0	3.4	9.2	5.7	10.2	7.1	N/A	11.3
Intellectual assets																			
3.3.1 PCT patent applications	4.52	0.48	1.01	0.14	1.58	0.51	6.94	9.00	N/A	0.16	2.87	0.15	0.60	2.82	0.30	6.71	0.97	0.42	2.98
3.3.2 Trademark applications	11.82	6.35	8.07	3.38	9.52	5.23	8.36	9.63	0.29	0.30	4.25	1.14	0.26	2.65	1.02	10.42	0.80	0.65	4.14
3.3.3 Design applications	6.73	5.66	3.06	0.91	2.79	1.40	3.92	3.45	0.48	0.04	0.84	0.04	0.00	0.45	0.06	4.59	0.07	0.03	1.28
IMPACTS																			
Employment impacts																			
4.1.1 Employment in knowledge-intensive activities	15.3	11.1	13.6	8.2	17.2	11.9	16.8	20.8	8.8	N/A	16.8	7.7	12.0	16.2	10.8	20.3	6.8	12.9	20.8
4.1.2 Employment in innovative enterprises	68.6	42.3	59.1	12.3	54.7	42.8	72.8	70.0	42.0	50.5	66.5	41.5	69.5	72.2	69.6	77.6	40.0	N/A	66.1
Economic effects																			
4.2.1 Medium & high-tech product exports	60.3	49.9	42.4	56.0	63.6	70.5	48.8	55.1	11.5	22.8	12.8	66.7	24.2	5.4	41.6	49.5	40.2	20.6	46.0
4.2.2 Knowledge-intensive services exports	55.0	49.1	47.6	52.9	42.6	46.3	84.5	78.9	20.7	16.8	59.6	41.3	24.1	84.4	50.8	73.6	49.7	66.4	87.4
4.2.3 Sales of new-to-market and new-to-enterprise innovations	12.99	7.50	14.50	5.24	12.29	14.94	19.33	12.87	40.10	9.06	5.56	3.52	7.16	6.03	11.83	14.33	10.00	1.10	15.53
Environmental sustainability																			
4.3.1 Resource productivity	2.09	1.40	1.44	0.83	2.29	1.89	1.04	1.60	1.21	0.86	2.37	1.26	N/A	1.80	0.67	4.57	1.74	N/A	3.84
4.3.2 Air emissions in fine particulates (PM2.5) in Industry	0.024	0.280	0.886	0.251	0.099	0.054	0.075	0.057	N/A	N/A	0.349	N/A	N/A	0.152	0.795	0.011	N/A	N/A	0.120
4.3.3 Development of environment-related technologies	13.96	6.46	7.73	8.64	9.05	12.68	13.03	12.36	28.63	37.27	7.36	18.99	9.38	13.44	12.09	7.77	6.51	11.72	11.53

N/A = not available

Annex D: Performance change by European country and indicator in relative to EU scores between 2016 and 2023

Performance change is measured as the difference between performance in 2023 relative to the EU in 2016 and performance in 2016 relative to the EU in 2016

	EU	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL
FRAMEWORK CONDITIONS																				
Human resources																				
1.1.1 New doctorate graduates	-22.9	11.4	-11.4	0.0	-34.3	-11.4	-11.4	11.4	11.4	0.0	-34.3	-11.4	-11.4	22.9	-22.9	-11.4	34.3	0.0	11.4	-11.4
1.1.2 Population completed tertiary education	3.6	3.0	1.2	-2.4	-4.2	1.2	4.2	3.6	6.0	10.8	0.6	-1.2	5.4	5.4	2.4	4.2	-9.6	-6.0	-0.6	4.8
1.1.3 Lifelong learning	12.1	1.1	-1.1	39.6	61.5	4.4	29.7	-19.8	0.0	9.9	25.3	-7.7	-3.3	8.8	12.1	0.0	2.2	22.0	-12.1	-2.2
Attractive research systems																				
1.2.1 International scientific co-publications	42.6	59.1	18.7	52.2	90.9	29.3	112.9	108.5	48.5	40.7	13.2	62.7	46.7	227.8	49.9	53.2	115.6	29.5	91.5	74.0
1.2.2 Scientific publications among top 10% most cited	-4.5	-20.1	-1.1	4.0	-23.1	-10.1	21.5	-13.4	7.1	-4.1	-15.7	20.6	18.9	0.1	13.2	20.9	-11.9	13.4	20.1	-19.8
1.2.3 Foreign doctorate students	10.6	-34.1	30.6	63.0	44.1	0.0	123.4	68.4	-2.1	20.5	-13.9	37.2	22.4	128.2	38.9	25.6	0.0	120.4	184.9	77.6
Digitalisation																				
1.3.1 Broadband penetration	32.7	-2.9	24.2	25.1	4.7	38.9	19.2	20.6	-12.1	41.0	0.0	60.2	38.3	87.0	-9.1	1.8	18.3	22.1	33.3	27.7
1.3.2 Individuals with above basic overall digital skills	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INVESTMENTS																				
Finance and support																				
2.1.1 R&D expenditure in the public sector	3.2	11.3	-1.6	-21.0	1.6	16.1	-6.5	-37.1	35.5	6.5	-4.8	41.9	1.6	3.2	3.2	-25.8	-3.2	8.1	-11.3	-3.2
2.1.2 Venture capital investments	48.1	46.6	5.3	87.9	111.2	53.1	102.1	11.5	32.4	55.4	43.1	123.9	5.9	-9.8	-55.7	62.7	-10.0	16.0	-8.1	80.5
2.1.3 Direct and indirect government support for business R&D	19.8	67.1	-0.7	-28.8	26.6	1.7	-19.0	-61.8	38.7	1.7	0.0	-95.4	63.2	12.8	6.6	14.2	-9.5	-58.0	-47.3	10.5
Firm investments																				
2.2.1 R&D expenditure in the business sector	10.8	46.2	-0.8	13.1	-8.5	10.8	27.7	-18.5	31.5	10.8	0.0	16.2	6.2	23.1	-0.8	16.9	-13.1	7.7	1.5	8.5
2.2.2 Non-R&D innovation expenditure	1.7	5.4	-34.2	49.8	47.6	4.6	37.0	-62.9	9.0	18.4	-29.7	-64.3	3.7	45.6	-26.6	4.6	18.4	-8.0	4.0	0.0
2.2.3 Innovation expenditures per person employed	13.3	50.9	-6.4	52.7	43.8	2.2	41.9	52.8	27.6	7.1	10.1	-14.0	23.4	22.3	-2.2	19.1	5.2	6.3	15.7	21.2
Use of information technologies																				
2.3.1 Enterprises providing ICT training	10.8	5.7	6.4	8.3	25.5	-15.9	33.1	-46.5	-8.9	-6.4	0.0	-24.8	44.6	32.5	17.8	15.3	-21.7	16.6	21.7	70.1
2.3.2 Employed ICT specialists	3.4	0.0	10.3	-3.4	3.4	3.4	13.8	-3.4	3.4	6.9	-6.9	3.4	3.4	24.1	20.7	20.7	24.1	6.9	3.4	17.2
INNOVATION ACTIVITIES																				
Innovators																				
3.1.1 SMEs with product innovations	26.7	22.0	67.4	66.1	46.2	6.1	83.8	-30.9	123.7	42.3	2.8	94.7	32.5	93.2	33.8	59.4	7.4	49.6	-5.9	-23.0
3.1.2 SMEs with business process innovations	53.8	44.0	45.4	145.7	81.7	103.7	133.3	-5.9	89.0	-4.9	14.5	79.9	62.8	125.9	26.0	47.3	-51.1	43.5	22.7	43.7
Linkages																				
3.2.1 Innovative SMEs collaborating with others	26.8	-25.5	51.8	55.6	15.7	42.1	80.9	100.5	56.6	7.5	28.2	68.8	79.2	182.3	41.6	-10.1	46.6	46.5	48.6	6.8
3.2.2 Public-private co-publications	29.6	62.5	24.1	57.2	89.1	53.1	121.9	84.2	84.6	52.4	9.1	98.4	71.1	240.9	71.5	36.4	274.9	58.8	106.0	83.6
3.2.3 Job-to-job mobility of Human Resources in S&T	41.2	-11.8	0.0	26.5	-26.5	0.0	76.5	N/A	47.1	58.8	64.7	67.6	17.6	100.0	20.6	138.2	14.7	70.6	41.2	-32.4
Intellectual assets																				
3.3.1 PCT patent applications	-9.5	-6.4	-4.9	-7.2	-0.6	-11.5	17.5	-17.5	1.2	-5.0	-15.7	-3.8	0.1	10.3	-8.8	-9.3	-3.0	-7.6	13.7	-12.9
3.3.2 Trademark applications	9.9	4.1	21.7	22.2	4.2	7.4	63.9	-16.9	31.8	7.7	0.2	33.9	17.5	0.0	32.7	70.9	-40.9	12.0	0.0	7.8
3.3.3 Design applications	-20.7	-7.3	-54.7	-10.1	-44.8	-48.1	26.0	-8.5	0.3	-6.8	-12.8	8.8	-7.4	23.4	-13.7	16.8	-90.0	-2.9	-62.8	14.4
IMPACTS																				
Employment impacts																				
4.1.1 Employment in knowledge-intensive activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.1.2 Employment in innovative enterprises	15.5	29.7	40.9	40.5	12.8	8.1	177.9	-25.4	73.0	-11.3	-10.3	41.1	19.4	80.3	21.0	30.8	-64.5	26.8	-17.4	-30.2
Economic effects																				
4.2.1 Medium & high-tech product exports	-0.7	5.3	9.3	8.1	5.8	0.2	-9.5	18.1	3.8	-2.2	-6.7	-9.1	3.6	-32.2	-7.1	3.7	11.7	-7.6	-3.5	1.9
4.2.2 Knowledge-intensive services exports	-8.6	14.4	34.9	21.3	10.8	12.6	37.0	2.2	25.5	31.4	9.5	7.4	18.4	31.1	15.7	24.1	-5.7	12.8	28.4	3.9
4.2.3 Sales of new-to-market and new-to-enterprise innovations	8.9	65.5	23.1	-1.2	70.5	6.2	-13.3	32.2	66.6	50.8	-79.9	70.4	30.0	81.6	9.2	26.0	-1.7	-41.3	17.1	-22.8
Environmental sustainability																				
4.3.1 Resource productivity	26.1	31.4	11.8	28.9	12.1	45.3	16.0	99.8	55.4	7.8	50.8	16.4	23.6	0.8	13.1	0.9	2.7	11.9	55.7	32.3
4.3.2 Air emissions in fine particulates (PM2.5) in Industry	4.4	5.8	-25.4	18.5	5.1	2.4	8.0	15.0	11.6	-7.6	4.8	18.1	4.6	-3.3	6.1	14.9	12.0	-6.3	10.6	6.1
4.3.3 Development of environment-related technologies	-15.0	2.2	-48.3	6.0	0.0	-11.9	-121.8	-11.8	-57.9	-37.6	-13.5	-86.7	-17.9	15.6	-49.4	-23.9	-42.0	-37.6	4.8	-16.4

Performance change is measured as the difference between performance in 2023 relative to the EU in 2016 and performance in 2016 relative to the EU in 2016

	AT	PL	PT	RO	SI	SK	FI	SE	AL*	BA	IS	MK	ME	NO	RS	CH	TR	UA*	UK
FRAMEWORK CONDITIONS																			
Human resources																			
1.1.1 New doctorate graduates	0.0	0.0	-11.4	-57.2	-91.5	-45.8	-11.4	-45.8	-0.5	8.0	11.4	-11.4	3.0	-22.9	11.4	11.4	11.4	-8.5	4.4
1.1.2 Population completed tertiary education	4.2	-0.6	-18.6	0.0	-3.6	-2.4	3.6	18.6	56.3	-3.6	-7.8	42.5	50.9	3.6	-3.0	-6.0	58.1	N/A	15.0
1.1.3 Lifelong learning	13.2	24.2	9.9	5.5	29.7	87.9	-29.7	0.0	0.0	-3.3	35.2	0.0	-3.3	17.6	4.4	-8.8	N/A	N/A	-9.9
Attractive research systems																			
1.2.1 International scientific co-publications	73.2	31.8	76.8	19.0	67.3	32.3	94.6	80.7	8.7	21.6	9.4	21.5	46.5	147.4	34.9	2.5	11.4	7.0	70.5
1.2.2 Scientific publications among top 10% most cited	-11.1	15.7	-12.6	31.1	10.8	11.8	3.0	-21.3	52.9	16.4	-10.1	29.6	1.7	-14.7	15.2	-17.6	27.8	6.8	-3.4
1.2.3 Foreign doctorate students	61.8	42.4	120.2	7.3	83.9	19.6	55.0	27.2	-54.8	N/A	146.7	234.8	-51.2	11.1	15.7	25.4	15.0	-4.6	-1.4
Digitalisation																			
1.3.1 Broadband penetration	-2.4	25.1	30.7	57.5	38.9	23.6	70.8	21.2	0.0	17.7	N/A	3.5	52.8	26.0	73.7	N/A	18.9	N/A	0.0
1.3.2 Individuals with above basic overall digital skills	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A
INVESTMENTS																			
Finance and support																			
2.1.1 R&D expenditure in the public sector	12.9	3.2	-4.8	-6.5	1.6	-22.6	-12.9	-1.6	0.0	-12.9	4.8	-12.9	12.9	17.7	4.8	11.3	-8.1	-14.2	-1.6
2.1.2 Venture capital investments	32.2	15.2	-27.6	6.6	28.8	16.0	103.7	112.9	N/A	N/A	N/A	N/A	N/A	93.2	52.9	53.9	N/A	45.0	76.7
2.1.3 Direct and indirect government support for business R&D	38.4	71.7	98.3	0.1	-82.5	26.9	0.8	0.7	N/A	-72.7	9.5	8.0	-0.2	69.0	8.3	11.3	90.3	-8.4	89.1
Firm investments																			
2.2.1 R&D expenditure in the business sector	1.5	36.2	29.2	10.0	-20.0	15.4	-6.2	13.8	0.0	2.3	61.5	1.5	3.8	9.2	18.5	4.6	21.5	-7.0	0.0
2.2.2 Non-R&D innovation expenditure	-9.7	-45.9	-24.7	-34.6	-75.6	16.7	14.4	-48.7	N/A	0.0	0.0	0.0	0.0	2.2	25.6	N/A	-122.0	0.2	-20.7
2.2.3 Innovation expenditures per person employed	14.7	-9.4	-5.0	4.3	-12.9	17.5	11.7	0.0	N/A	0.0	0.0	0.0	0.0	2.0	0.0	N/A	-4.4	N/A	0.0
Use of information technologies																			
2.3.1 Enterprises providing ICT training	-83.4	84.1	7.0	21.7	3.2	-19.7	1.9	10.8	N/A	1.9	N/A	-29.3	16.6	-21.7	-66.2	N/A	4.5	-3.8	-29.3
2.3.2 Employed ICT specialists	17.2	3.4	-6.9	6.9	-10.3	0.0	0.0	0.0	N/A	N/A	10.3	17.2	3.4	-10.3	3.4	6.9	0.0	N/A	13.8
INNOVATION ACTIVITIES																			
Innovators																			
3.1.1 SMEs with product innovations	8.5	32.9	-15.2	12.5	62.4	16.0	25.7	53.5	-9.4	0.0	-41.6	-4.8	0.0	67.5	101.1	-40.6	-18.2	-6.9	-8.4
3.1.2 SMEs with business process innovations	21.6	60.9	-2.8	0.0	32.4	15.1	92.7	97.9	-7.7	0.0	7.1	16.0	0.0	80.4	67.8	14.9	-59.6	N/A	-111.2
Linkages																			
3.2.1 Innovative SMEs collaborating with others	-50.0	39.5	-14.3	-4.0	-0.3	-11.3	119.1	20.0	-27.9	N/A	23.2	-11.4	0.0	91.0	31.0	11.5	-6.7	0.0	-13.6
3.2.2 Public-private co-publications	141.6	36.5	93.1	26.2	86.1	39.0	57.1	100.5	5.7	19.4	14.7	23.9	41.6	144.7	30.2	0.0	8.2	15.4	74.9
3.2.3 Job-to-job mobility of Human Resources in S&T	32.4	26.5	64.7	-11.8	76.5	17.6	35.3	-61.8	N/A	N/A	0.0	82.4	-44.1	11.8	50.0	26.5	-41.2	N/A	23.5
Intellectual assets																			
3.3.1 PCT patent applications	-4.4	-3.0	9.0	-5.4	-23.7	3.3	-0.6	0.0	N/A	-7.4	-8.5	12.0	18.0	-2.0	-4.7	-3.0	12.3	-4.8	-3.3
3.3.2 Trademark applications	17.1	15.7	19.0	20.4	22.1	26.2	10.3	12.3	4.9	3.6	-71.7	14.7	-11.8	17.6	8.4	-4.1	9.1	15.1	-22.3
3.3.3 Design applications	-17.2	-11.6	-33.0	6.1	-13.4	-3.4	-30.8	-33.1	10.1	0.5	8.9	0.8	0.0	0.7	-1.3	-36.5	-3.1	-1.3	-39.3
IMPACTS																			
Employment impacts																			
4.1.1 Employment in knowledge-intensive activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-6.9	N/A	0.0	16.9	15.7	0.0	0.0	0.0	7.2	-26.5	33.7
4.1.2 Employment in innovative enterprises	2.4	50.8	-5.5	0.0	-5.5	22.8	44.1	36.0	-4.8	0.0	-17.3	0.0	0.0	39.9	71.6	-10.1	-55.7	N/A	-2.3
Economic effects																			
4.2.1 Medium & high-tech product exports	5.8	1.0	11.8	8.3	16.1	8.5	10.2	0.6	0.0	4.5	0.0	16.4	14.9	-5.0	-6.6	-2.7	-2.4	-18.8	-18.5
4.2.2 Knowledge-intensive services exports	19.2	18.8	7.8	15.6	14.3	20.1	14.8	7.0	5.3	5.3	0.7	30.1	9.0	8.5	20.9	10.5	20.4	37.6	30.0
4.2.3 Sales of new-to-market and new-to-enterprise innovations	8.9	9.2	72.2	-11.1	-1.2	-36.6	88.2	52.5	0.0	0.0	0.0	0.0	0.0	-1.2	34.1	-46.4	0.0	3.4	-46.3
Environmental sustainability																			
4.3.1 Resource productivity	19.5	22.1	8.4	3.1	45.2	17.4	5.5	11.8	13.7	2.8	69.9	15.7	N/A	-1.6	-4.4	11.5	23.0	N/A	45.1
4.3.2 Air emissions in fine particulates (PM2.5) in Industry	7.3	14.9	0.0	11.6	10.6	21.9	8.4	10.9	N/A	N/A	-3.3	N/A	N/A	10.1	0.0	4.2	N/A	N/A	2.5
4.3.3 Development of environment-related technologies	-14.9	-69.4	-51.2	-62.0	0.6	-45.4	-26.5	4.4	58.2	0.0	15.8	44.8	45.1	-6.7	-30.6	-17.3	-7.7	-10.0	-14.6

Annex E: Indicators: definitions, data sources and interpretation

More details including Eurostat series code are available in the Methodology Report.

INDICATOR	DEFINITION NUMERATOR SOURCE	DEFINITION DENOMINATOR SOURCE	MOST RECENT YEAR FOR WHICH DATA ARE AVAILABLE INTERPRETATION
1.1.1 New doctorate graduates in science, technology, engineering, and mathematics (STEM) per 1000 population aged 25-34	Number of doctorate graduates in science, technology, engineering, and mathematics (STEM) Eurostat	Population between and including 25 and 34 years Eurostat	2020 The indicator is a measure of the supply of new second-stage tertiary graduates in all fields of training (ISCED 8). For most countries, ISCED 8 captures PhD graduates. There is a complex relation between STEM-graduates and innovation in the private sector. STEM-graduates do well as employees within firms with many of them taking up managerial positions
1.1.2 Percentage population aged 25-34 having completed tertiary education	Number of persons in age class with some form of post-secondary education Eurostat	Population between and including 25 and 34 years Eurostat	2022 This is a general indicator of the supply of advanced skills. It is not limited to science and technical fields, because the adoption of innovations in many areas depends on a wide range of skills. The indicator focuses on a younger age cohort of the population, aged 25 to 34, and will therefore easily and quickly reflect changes in educational policies leading to more tertiary graduates
1.1.3. Lifelong learning	The target population for lifelong learning statistics refers to all persons in private households aged between 25 and 64 years. The information collected relates to all education or training, whether or not relevant to the respondent's current or possible future job. Data are collected through the EU Labour Force Survey Eurostat	Total population of the same age group, excluding those who did not answer the question concerning participation in (formal and non-formal) education and training Eurostat	2022 Lifelong learning encompasses all purposeful learning activity, whether formal, non-formal or informal, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence. The intention or aim to learn is the critical point that distinguishes these activities from non-learning activities, such as cultural or sporting activities
1.2.1 International scientific co-publications per million population	Number of scientific publications with at least one co-author based abroad (where abroad is non-EU for the EU) Scopus *	Total population Eurostat	2022 International scientific co-publications are a proxy for the quality of scientific research as collaboration increases scientific productivity For individual countries all publications with at least one co-author outside the country are included, For the EU only publications with at least one co-author in a non-EU Member State are included
1.2.2 Scientific publications among the top-10% most cited publications worldwide as percentage of total scientific publications of the country	Number of scientific publications among the top-10% most cited worldwide Scopus *	Total number of scientific publications Scopus *	2020 The indicator is a measure for the quality of the research system, as highly cited publications are assumed to be of higher quality. There could be a bias towards small or English-speaking countries given the coverage of Scopus' publication data
1.2.3 Foreign doctorate students as a percentage of all doctorate students	Number of doctorate students from foreign countries Eurostat	Total number of doctorate students Eurostat	2020 The share of foreign doctorate students reflects the mobility of students as an effective way of diffusing knowledge. Attracting high-skilled foreign doctorate students will secure a continuous supply of researchers

INDICATOR	DEFINITION NUMERATOR SOURCE	DEFINITION DENOMINATOR SOURCE	MOST RECENT YEAR FOR WHICH DATA ARE AVAILABLE	INTERPRETATION
1.3.1 Broadband penetration	Number of enterprises with a maximum contracted download speed of the fastest fixed internet connection of at least 100 Mb/s Eurostat, Community Survey of ICT Usage and E-commerce in Enterprises	All enterprises Eurostat, Community Survey of ICT Usage and E-commerce in Enterprises	2022	Realising Europe's full e-potential depends on creating the conditions for electronic commerce and the Internet to flourish. This indicator captures the relative use of this e-potential by the share of enterprises that have access to fast broadband Data on the speed of mobile connections is not available, the indicator on the speed of fixed internet access is the most suitable proxy
1.3.2 Individuals who have above basic overall digital skills (% share)	Number of individuals with above basic overall digital skills Eurostat: EU survey on the ICT usage in households and by individuals	Total number of individuals aged 16 to 74 Eurostat	2021	Above basic overall digital skills represent the highest level of the overall digital skills indicator, which is a composite indicator based on selected activities performed by individuals aged 16-74 on the internet in four specific areas (information, communication, problem solving, content creation) during the previous 3 months
2.1.1 R&D expenditure in the public sector (percentage of GDP)	All R&D expenditures in the government sector (GOVERD) and the higher education sector (HERD) Eurostat	Gross Domestic Product Eurostat	2021	Research and development (R&D) expenditure represents one of the major drivers of economic growth in a knowledge-based economy. As such, trends in the R&D expenditure indicator provide key indications of the future competitiveness and wealth of the EU. R&D spending is essential for making the transition to a knowledge-based economy as well as for improving production technologies and stimulating growth
2.1.2 Venture capital (percentage of GDP)	Venture capital expenditures is defined as private equity being raised for investment in companies. Management buyouts, management buy-ins, and venture purchase of quoted shares are excluded. Venture capital includes early stage (seed + start-up) and expansion and replacement capital Invest Europe Comment: Three-year averages have been used	Gross Domestic Product Eurostat	2022	The amount of venture capital is a proxy for the relative dynamism of new business creation. For enterprises using or developing new (risky) technologies, venture capital is often the only available means of financing their (expanding) business
2.1.3 Direct government funding and government tax support for business R&D (percentage of GDP)	Sum of GTARD as a percentage of GDO and Direct funding of BERD as a percentage of GDP OECD R&D Tax Incentive Database, http://oe.cd/rdtax, December 2020		2020	Public financing of R&D can take two forms: Direct funding for R&D through instruments such as grants and public procurement, and Indirect support through the tax system Direct funding is well captured in the official data on R&D expenditure by source of fund, differentiating between the following sources: Business enterprise sector, Government sector, Higher education sector, Private non-profit sector, and Abroad. Data on R&D funded by the Government sector are available from Eurostat (EU Member States and other European countries), OECD (OECD member states) and UIS (global coverage). Over time, more and more countries have introduced R&D tax incentives. The OECD has started to systematically collect data on R&D tax incentives since 2018 and with the support of the EC data are currently being collected on an annual basis and made available in the 'OECD R&D Tax Incentives database'. In the EU, 21 countries were offering R&D tax relief in 2019, a significant increase compared to only 12 countries offering R&D tax relief in 2000

INDICATOR	DEFINITION NUMERATOR SOURCE	DEFINITION DENOMINATOR SOURCE	MOST RECENT YEAR FOR WHICH DATA ARE AVAILABLE INTERPRETATION
2.2.1 R&D expenditure in the business sector (percentage of GDP)	All R&D expenditures in the business sector (BERD) Eurostat	Gross Domestic Product Eurostat	2021 The indicator captures the formal creation of new knowledge within firms. It is particularly important in the science-based sectors (pharmaceuticals, chemicals and some areas of electronics) where most new knowledge is created in or near R&D laboratories
2.2.2 Non-R&D innovation expenditures (percentage of turnover)	Sum of total innovation expenditure by enterprises in all size classes, excluding intramural and extramural R&D expenditures Eurostat (Community Innovation Survey)	Total turnover for all enterprises Eurostat (Community Innovation Survey)	2020 This indicator measures non-R&D innovation expenditure as a percentage of total turnover. Several of the components of innovation expenditure, such as investment in equipment and machinery and the acquisition of patents and licenses, measure the diffusion of new production technology and ideas
2.2.3 Innovation expenditures per person employed	Sum of total innovation expenditure by enterprises in all size classes in Purchasing Power Standard (PPS) Eurostat (Community Innovation Survey)	Total employment in innovative enterprises in all size classes Eurostat (Community Innovation Survey)	2020 The indicator measures the monetary input directly related to innovation activities
2.3.1 Enterprises providing training to develop or upgrade ICT skills of their personnel	Number of enterprises that provided any type of training to develop ICT related skills of their personnel Eurostat, Community Survey of ICT Usage and E-commerce in Enterprises	All enterprises Eurostat, Community Survey of ICT Usage and E-commerce in Enterprises	2022 ICT skills are particularly important for innovation in an increasingly digital economy. The share of enterprises providing training in that respect is a proxy for the overall skills development of employees
2.3.2 ICT specialists (as a percentage of total employment)	Number of employed ICT specialists Eurostat	Total employment Eurostat	2022 Eurostat defines ICT specialists as "workers who have the ability to develop, operate and maintain ICT systems, and for whom ICT constitute the main part of their job". Operationalised in terms of ISCO codes, this definition converts into a statistical definition of ICT specialists as follow: from 2011 onwards - corresponding to the application of the ISCO-08, Eurostat and OECD adopted a joint approach to define the occupations to be treated as ICT specialists (OECD, 2015 ²⁵)
3.1.1 SMEs introducing product innovations (percentage of SMEs)	Number of Small and medium-sized enterprises (SMEs) who introduced at least one product innovation. A product innovation is the market introduction of a new or significantly improved good or service with respect to its capabilities, user friendliness, components, or sub-systems Eurostat (Community Innovation Survey)	Total number of Small and medium-sized enterprises Eurostat (Community Innovation Survey)	2020 Product innovation is a key ingredient to innovation as they can create new markets and improve competitiveness. Higher shares of product innovators reflect a higher level of innovation activities
3.1.2 SMEs introducing business process innovations (percentage of SMEs)	Number of Small and medium-sized enterprises (SMEs) who introduced at least one business process innovation either new to the enterprise or new to their market Eurostat (Community Innovation Survey)	Total number of Small and medium-sized enterprises Eurostat (Community Innovation Survey)	2020 Many firms innovate not by improving new products but by improving their business processes. Business process innovations include process, marketing and organisational innovations

²⁵ https://ec.europa.eu/eurostat/cache/metadata/Annexes/isoc_sksif_esms_an1.pdf

INDICATOR	DEFINITION NUMERATOR SOURCE	DEFINITION DENOMINATOR SOURCE	MOST RECENT YEAR FOR WHICH DATA ARE AVAILABLE INTERPRETATION
3.2.1 Innovative SMEs collaborating with others (percentage of SMEs)	Number of Small and medium-sized enterprises with innovation co-operation activities, i.e. those firms that had any co-operation agreements on innovation activities with other enterprises or institutions in the three years of the survey period Eurostat (Community Innovation Survey)	Total number of Small and medium-sized enterprises Eurostat (Community Innovation Survey)	2020 This indicator measures the degree to which SMEs are involved in innovation co-operation. Complex innovations often depend on the ability to draw on diverse sources of information and knowledge, or to collaborate in the development of an innovation. This indicator measures the flow of knowledge between public research institutions and firms, and between firms and other firms. The indicator is limited to SMEs, because almost all large firms are involved in innovation co-operation
3.2.2 Public-private co-publications per million population	Number of public-private co-authored research publications. The definition of the "private sector" excludes the private medical and health sector. Publications are assigned to the country in which the business companies or other private sector organisations are located Scopus *	Total population Eurostat	2022 This indicator captures public-private research linkages and active collaboration activities between business sector researchers and public sector researchers resulting in academic publications
3.2.3 Job-to-job mobility of Human Resources in Science & Technology	Job-to-job mobility of Human Resources in Science & Technology Eurostat: Job-to-job mobility of HRST by sex [hrst_fl_mobsex]	Working age population aged 25-64 Eurostat	2020 Human Resources in Science & Technology (HRST) are people who fulfil one or other of the following conditions: 1) have successfully completed a tertiary level education; 2) not formally qualified as above but employed in a S&T occupation where the above qualifications are normally required. Job-to-job mobility in this context is defined as the movement of individuals between one job and another from one year to the next. It does not include inflows into the labour market from a situation of unemployment or inactivity
3.3.1 PCT patent applications per billion GDP (in PPS)	Number of patent applications filed under the PCT, at international phase, designating the European Patent Office (EPO). Patent counts are based on the priority date, the inventor's country of residence and fractional counts OECD	Gross Domestic Product in Purchasing Power Standard Eurostat	2019 The capacity of firms to develop new products will determine their competitive advantage. One measure of the rate of new product innovation is the number of patents. This indicator measures the number of PCT patent applications
3.3.2 Trademark applications per billion GDP (in PPS)	Number of trademark applications applied for at EUIPO European Union Intellectual Property Office (EUIPO) Comment: Two-year averages have been used	Gross Domestic Product in Purchasing Power Standard Eurostat	2022 Trademarks are an important innovation indicator, especially for the service sector. The Community trademark gives its proprietor a uniform right applicable in all Member States of the European Union through a single procedure which simplifies trademark policies at European level. It fulfils the three essential functions of a trademark: it identifies the origin of goods and services, guarantees consistent quality through evidence of the company's commitment vis-à-vis the consumer, and it is a form of communication, a basis for publicity and advertising
3.3.3 Design applications per billion GDP (in PPS)	Number of individual designs applied for at EUIPO European Union Intellectual Property Office (EUIPO) Comment: Two-year averages have been used	Gross Domestic Product in Purchasing Power Standard Eurostat	2022 A design is the outward appearance of a product or part of it resulting from the lines, contours, colours, shape, texture, materials and/or its ornamentation. A product can be any industrial or handicraft item including packaging, graphic symbols and typographic typefaces but excluding computer programmes. It also includes products that are composed of multiple components, which may be disassembled and reassembled. Community design protection is directly enforceable in each Member State, and it provides both the option of an unregistered and a registered Community design right for one area encompassing all Member States

INDICATOR	DEFINITION NUMERATOR SOURCE	DEFINITION DENOMINATOR SOURCE	MOST RECENT YEAR FOR WHICH DATA ARE AVAILABLE INTERPRETATION
4.1.1 Employment in knowledge-intensive activities (percentage of total employment)	Number of employed persons in knowledge-intensive activities in business industries. Knowledge-intensive activities are defined, based on EU Labour Force Survey data, as all NACE Rev.2 industries at 2-digit level where at least 33% of employment has a higher education degree (ISCED 5-8) Eurostat	Total employment Eurostat	2022 Knowledge-intensive activities provide services directly to consumers, such as telecommunications, and provide inputs to the innovative activities of other firms in all sectors of the economy
4.1.2 Employment in innovative enterprises	Number of employed persons in innovative enterprises ('Enterprises that have either introduced an innovation or have any kind of innovation activity (including enterprises with abandoned/suspended or on-going innovation activities) Eurostat (Community Innovation Survey)	Total employment for enterprises with 10 or more employees Eurostat (Community Innovation Survey)	2020 Innovation in enterprises has a profound impact on the employability of workers, but its effect in product- and process-innovation oriented firms varies across countries. Firm innovation proves to be specifically important during a time of economic recession. Although high-skilled employees are less affected by a recession than low-skilled employees, a notable positive effect is observed for low-skilled employees in innovative firms as well
4.2.1 Exports of medium and high technology products as a share of total product exports	Value of medium and high-tech exports, in national currency and current prices, including exports of the following SITC Rev.3 products: 266, 267, 512, 513, 525, 533, 54, 553, 554, 562, 57, 58, 591, 593, 597, 598, 629, 653, 671, 672, 679, 71, 72, 731, 733, 737, 74, 751, 752, 759, 76, 77, 78, 79, 812, 87, 88 and 891 Joint Research Centre: Innovation Output Indicator, Eurostat (ComExt) for Member States, UN ComTrade for non-EU countries	Value of total product exports Eurostat (ComExt) for Member States, UN ComTrade for non-EU countries	2022 The indicator measures the technological competitiveness of the EU, i.e. the ability to commercialise the results of research and development (R&D) and innovation in international markets. It also reflects product specialisation by country. Creating, exploiting and commercialising new technologies are vital for the competitiveness of a country in the modern economy. Medium and high technology products are key drivers for economic growth, productivity and welfare, and are generally a source of high value added and well-paid employment
4.2.2 Knowledge-intensive services exports as percentage of total services exports	Exports of knowledge-intensive services is defined as the sum of credits in EBOPS 2010 (Extended Balance of Payments Services Classification) items SC1, SC2, SC3A, SF, SG, SH, SI, SJ and SK1 ²⁶ Joint Research Centre: Innovation Output Indicator; complemented with data from Eurostat, OECD, UN Comtrade	Total value of services exports Joint Research Centre: Innovation Output Indicator; complemented with data from Eurostat, OECD, UN Comtrade	2022 The indicator measures the competitiveness of the knowledge-intensive services sector. Competitiveness-enhancing measures and innovation strategies can be mutually reinforcing for the growth of employment, export shares and turnover at the firm level. It reflects the ability of an economy, notably resulting from innovation, to export services with high levels of value added, and successfully take part in knowledge-intensive global value chains
4.2.3 Sales of new-to-market and new-to-firm innovations as percentage of turnover	Sum of total turnover of new or significantly improved products, either new-to-the-firm or new-to-the-market, for all enterprises Eurostat (Community Innovation Survey)	Total turnover for all enterprises Eurostat (Community Innovation Survey)	2021 This indicator measures the turnover of new or significantly improved products and includes both products which are only new to the firm and products which are also new to the market. The indicator thus captures both the creation of state-of-the-art technologies (new-to-market products) and the diffusion of these technologies (new-to-firm products)

²⁶ SC1 (Sea transport), SC2 (Air transport), SC3A (Space transport), SF (Insurance and pension services), SG (Financial services), SH (Charges for the use of intellectual property), SI (Telecommunications, computer, and information services), SJ (Other business services) and SK1 (Audio-visual and related services)

INDICATOR	DEFINITION NUMERATOR SOURCE	DEFINITION DENOMINATOR SOURCE	MOST RECENT YEAR FOR WHICH DATA ARE AVAILABLE INTERPRETATION
4.3.1 Resource productivity	Resource productivity is expressed by the amount of GDP generated per unit of direct material consumed, i.e. GDP / DMC in euros per kg Eurostat: Resource productivity [env_ac_rp]		2021 Resource productivity is a measure of the total amount of materials directly used by an economy (measured as domestic material consumption (DMC)) in relation to GDP. It provides insights into whether decoupling between the use of natural resources and economic growth is taking place. Resource productivity (GDP/DMC) is the EU sustainable development indicator for policy evaluation Domestic material consumption (DMC) measures the total amount of materials directly used by an economy and is defined as the annual quantity of raw materials extracted from the domestic territory, plus all physical imports minus all physical exports
4.3.2 Air emissions by fine particulate matter (PM2.5) in Industry	Air emissions by fine particulate matter (PM2.5) in the Manufacturing sector in Tonnes Eurostat, Air emissions accounts by NACE Rev. 2 activity [env_ac_ainah_r2]	Value added in the Manufacturing sector - Chain linked volumes (2010), million euro Eurostat	2021 Air pollution may be anthropogenic (human-induced) or of natural origin. Air pollution has the potential to harm both human health and the environment: particulate matter (PM), nitrogen dioxide and ground-level ozone are known to pose particular health risks. Long-term and peak exposures to these pollutants may be associated, among other impacts, with cardiovascular and respiratory diseases or an increased incidence of cancer. This indicator captures average concentration levels of fine particulate matter (PM2.5 — particles with a diameter of 2.5 micrometres or less) to which the population is exposed. The EU set an annual limit of 25 µg/m ³ for fine particulate matter in Directive 2008/50/EC ²⁷ on ambient air quality and cleaner air, while the World Health Organisation (WHO ²⁸) set a more stringent, but non-binding guideline value, whereby annual mean concentrations should not exceed 10 µg/m ³ in order to protect human health. PM2.5 is considered by the WHO as the pollutant with the highest impact on human health
4.3.3 Development of environment-related technologies, percentage of all technologies	Number of environment-related inventions OECD Green Growth database	Total number of patents	2019 The number of environment-related inventions is expressed as a percentage of all domestic inventions (in all technologies). Indicators of technology development are constructed by measuring inventive activity using patent data across a wide range of environment-related technological domains (ENVTECH ²⁹), including environmental management, water-related adaptation, and climate change mitigation technologies. The counts used include only higher-value inventions (with patent family size ≥ 2). Data are obtained from the Patents: Technology development dataset of the OECD Environment Database ³⁰

* Data provided by Science-Metrix as part of a contract to European Commission (DG Research and Innovation).

²⁷ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0050>

²⁸ <https://www.who.int/en/>

²⁹ [www.oecd.org/environment/consumption-innovation/ENV-tech%20search%20strategies,%20version%20for%20OECDstat%20\(2016\).pdf](http://www.oecd.org/environment/consumption-innovation/ENV-tech%20search%20strategies,%20version%20for%20OECDstat%20(2016).pdf)

³⁰ https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics_env-data-en

Annex F: Summary Innovation Index (SII) time series: normalised scores, relative to EU scores, and change over time

	SUMMARY INNOVATION INDEX									RELATIVE TO EU IN 2016							... IN 2023	CHANGE BETWEEN 2016 AND 2023	
	2016	2017	2018	2019	2020	2021	2022	2023		2016	2017	2018	2019	2020	2021	2022	2023	2023	
EU	0.505	0.507	0.509	0.520	0.526	0.537	0.545	0.548		100.0	100.4	100.8	103.0	104.1	106.3	107.9	108.5	100.0	8.5
BE	0.618	0.624	0.636	0.653	0.644	0.687	0.691	0.689		122.3	123.7	125.9	129.3	127.6	136.0	136.9	136.4	125.8	14.1
BG	0.234	0.232	0.226	0.234	0.237	0.228	0.225	0.256		46.3	45.9	44.8	46.3	46.9	45.1	44.6	50.6	46.7	4.4
CZ	0.413	0.413	0.415	0.420	0.433	0.450	0.466	0.519		81.7	81.7	82.1	83.2	85.7	89.1	92.3	102.7	94.7	21.0
DK	0.673	0.679	0.677	0.696	0.707	0.730	0.739	0.753		133.3	134.5	134.2	137.8	140.1	144.5	146.5	149.2	137.6	16.0
DE	0.607	0.608	0.611	0.614	0.616	0.641	0.651	0.645		120.2	120.4	121.1	121.6	122.1	127.1	129.0	127.8	117.8	7.6
EE	0.392	0.398	0.393	0.487	0.499	0.576	0.598	0.540		77.7	78.8	77.8	96.4	98.8	114.1	118.4	107.0	98.6	29.3
IE	0.623	0.625	0.632	0.622	0.610	0.598	0.614	0.634		123.3	123.9	125.1	123.2	120.8	118.4	121.7	125.6	115.8	2.3
EL	0.323	0.327	0.328	0.364	0.380	0.407	0.433	0.435		64.0	64.7	64.9	72.2	75.2	80.7	85.7	86.2	79.5	22.2
ES	0.440	0.445	0.449	0.457	0.464	0.463	0.469	0.489		87.1	88.2	89.0	90.5	91.9	91.8	92.8	96.8	89.2	9.7
FR	0.585	0.583	0.588	0.577	0.579	0.571	0.583	0.577		115.8	115.6	116.4	114.2	114.7	113.1	115.5	114.2	105.3	-1.6
HR	0.306	0.310	0.282	0.303	0.313	0.353	0.375	0.381		60.7	61.5	55.8	60.1	61.9	69.8	74.3	75.4	69.6	14.8
IT	0.416	0.422	0.426	0.454	0.469	0.515	0.523	0.495		82.4	83.6	84.4	89.9	92.9	102.0	103.6	98.0	90.3	15.6
CY	0.397	0.399	0.415	0.427	0.448	0.547	0.574	0.577		78.7	79.1	82.2	84.5	88.7	108.4	113.7	114.3	105.4	35.6
LV	0.270	0.267	0.269	0.284	0.282	0.276	0.285	0.288		53.4	53.0	53.3	56.3	56.0	54.7	56.4	57.0	52.5	3.5
LT	0.375	0.373	0.374	0.413	0.425	0.414	0.440	0.459		74.2	73.9	74.1	81.7	84.1	82.1	87.2	90.9	83.8	16.7
LU	0.650	0.650	0.649	0.655	0.648	0.635	0.637	0.642		128.7	128.8	128.5	129.7	128.4	125.9	126.2	127.1	117.2	-1.5
HU	0.346	0.346	0.346	0.338	0.343	0.356	0.373	0.385		68.6	68.5	68.5	66.9	68.0	70.4	73.9	76.3	70.4	7.7
MT	0.415	0.425	0.460	0.475	0.484	0.500	0.483	0.470		82.2	84.2	91.1	94.2	96.0	99.0	95.7	93.1	85.8	10.9
NL	0.661	0.668	0.675	0.693	0.696	0.684	0.699	0.705		131.0	132.3	133.7	137.2	137.8	135.4	138.5	139.6	128.7	8.6
AT	0.624	0.626	0.621	0.628	0.626	0.629	0.653	0.656		123.6	124.0	123.0	124.3	124.0	124.6	129.4	130.0	119.9	6.4
PL	0.277	0.285	0.285	0.297	0.295	0.308	0.317	0.344		54.8	56.4	56.5	58.9	58.3	61.0	62.9	68.1	62.8	13.3
PT	0.430	0.429	0.424	0.473	0.490	0.442	0.454	0.469		85.2	85.0	83.9	93.8	97.0	87.5	89.9	92.9	85.6	7.7
RO	0.174	0.179	0.174	0.161	0.171	0.189	0.193	0.181		34.4	35.4	34.5	31.9	33.8	37.4	38.3	35.9	33.1	1.4
SI	0.506	0.495	0.492	0.466	0.462	0.487	0.504	0.521		100.2	98.1	97.4	92.4	91.5	96.4	99.8	103.1	95.1	2.9
SK	0.327	0.334	0.319	0.333	0.337	0.331	0.338	0.359		64.8	66.1	63.2	66.0	66.7	65.6	67.0	71.2	65.6	6.4
FI	0.643	0.634	0.635	0.672	0.679	0.695	0.715	0.735		127.3	125.7	125.8	133.0	134.4	137.7	141.7	145.6	134.3	18.3
SE	0.684	0.695	0.698	0.698	0.698	0.733	0.744	0.737		135.5	137.7	138.3	138.2	138.2	145.2	147.3	145.9	134.5	10.4
AL*	0.192	0.205	0.193	0.205	0.238	0.230	0.234	0.225		38.0	40.6	38.3	40.6	47.1	45.6	46.3	44.6	41.1	6.6
BA	0.200	0.179	0.182	0.149	0.162	0.175	0.198	0.198		39.7	35.5	36.0	29.5	32.0	34.7	39.1	39.2	36.2	-0.4
IS	0.530	0.526	0.520	0.531	0.535	0.537	0.545	0.561		105.1	104.3	103.0	105.2	105.9	106.4	107.9	111.2	102.5	6.1
MK	0.181	0.185	0.193	0.200	0.206	0.209	0.237	0.254		35.8	36.6	38.2	39.5	40.9	41.4	46.9	50.2	46.3	14.5
ME	0.215	0.244	0.238	0.225	0.233	0.251	0.262	0.258		42.6	48.4	47.1	44.5	46.1	49.7	51.9	51.0	47.0	8.4
NO	0.569	0.570	0.578	0.612	0.620	0.627	0.658	0.654		112.6	113.0	114.6	121.3	122.8	124.2	130.3	129.5	119.4	16.9
RS	0.270	0.266	0.275	0.296	0.307	0.335	0.353	0.346		53.4	52.6	54.5	58.5	60.8	66.4	69.8	68.6	63.2	15.1
CH	0.767	0.770	0.776	0.768	0.774	0.778	0.773	0.764		152.0	152.5	153.6	152.1	153.3	154.1	153.2	151.4	139.6	-0.6
TR	0.259	0.264	0.275	0.305	0.311	0.258	0.257	0.260		51.2	52.4	54.5	60.5	61.5	51.0	50.9	51.6	47.6	0.4
UA*	0.171	0.153	0.147	0.146	0.144	0.156	0.173	0.170		33.9	30.4	29.1	28.8	28.4	30.9	34.3	33.7	31.0	-0.2
UK	0.622	0.641	0.647	0.649	0.658	0.630	0.642	0.629		123.3	126.9	128.2	128.5	130.3	124.7	127.1	124.5	114.8	1.3

* Results for Albania (AL) and Ukraine (UA) are less reliable due to limited data availability.

Annex G: Performance scores by country per dimension in 2023

Performance is measured relative to that of the EU in 2023.

	HUMAN RESOURCES	ATTRACTIVE RESEARCH SYSTEMS	DIGITALISATION	FINANCE AND SUPPORT	FIRM INVESTMENTS	INFORMATION TECHNOLOGIES	INNOVATORS	LINKAGES	INTELLECTUAL ASSETS	EMPLOYMENT IMPACTS	SALES IMPACTS	ENVIRONMENTAL SUSTAINABILITY
	2023	2023	2023	2023	2023	2023	2023	2023	2023	2023	2023	2023
EU	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
BE	124.8	155.6	111.6	123.6	132.0	147.3	146.5	173.7	86.9	150.0	102.6	101.7
BG	32.7	26.6	49.8	22.1	35.0	48.1	56.0	35.4	92.5	56.7	59.7	46.2
CZ	82.7	82.6	76.7	82.1	113.2	100.4	138.2	94.1	63.1	106.1	103.1	99.0
DK	176.7	189.5	145.6	111.9	114.4	149.8	117.2	216.2	136.9	107.9	107.7	129.3
DE	99.8	109.0	86.5	91.8	140.4	120.9	141.1	141.9	122.0	128.4	117.5	121.2
EE	125.6	126.3	83.4	92.5	90.1	122.4	95.3	161.6	117.6	144.0	69.9	23.3
IE	156.4	159.3	122.3	64.8	75.9	128.6	115.8	180.8	57.3	151.5	138.8	109.0
EL	71.5	71.0	48.5	63.6	70.5	39.3	167.3	117.7	51.8	124.2	85.5	71.8
ES	127.2	96.1	144.9	81.1	61.0	90.1	50.1	88.2	80.1	59.7	97.5	100.4
FR	126.3	117.1	112.3	132.7	89.7	73.8	104.5	120.9	80.6	110.1	81.7	118.3
HR	49.3	55.0	77.3	97.0	38.0	80.5	126.9	112.3	46.7	76.9	51.7	57.2
IT	62.1	106.2	77.9	66.8	72.3	79.5	115.2	92.0	107.6	107.0	92.8	113.4
CY	115.1	162.4	94.4	39.4	46.4	117.5	154.8	223.9	103.4	147.0	108.2	59.7
LV	75.4	53.7	71.2	37.9	24.5	75.4	39.3	74.4	63.8	48.9	52.3	41.9
LT	107.2	54.2	94.4	71.2	86.2	69.6	113.7	140.2	72.1	101.3	54.8	78.3
LU	156.6	221.1	124.4	66.4	43.9	144.3	99.0	192.5	107.9	133.0	93.1	118.9
HU	47.0	77.8	72.5	77.6	74.1	79.5	49.3	95.5	47.7	60.1	86.2	70.1
MT	77.4	126.9	130.6	12.8	40.9	120.8	66.0	100.7	125.7	108.7	70.1	112.5
NL	166.4	193.8	158.3	121.5	77.9	162.2	104.7	182.2	114.1	124.1	86.3	123.2
AT	124.1	153.5	89.4	121.3	107.5	99.9	124.2	174.9	140.6	122.0	93.6	109.0
PL	58.3	46.2	81.1	61.2	59.3	90.3	41.4	73.7	84.2	50.8	68.2	43.8
PT	110.4	127.1	127.7	90.6	52.7	101.9	99.3	92.9	76.8	95.3	77.1	27.9
RO	19.9	41.0	91.8	18.0	13.7	30.8	4.6	7.7	31.4	10.9	70.5	42.7
SI	139.1	109.0	83.5	66.1	60.9	117.3	116.1	140.7	84.4	106.6	87.3	84.6
SK	91.6	51.7	67.1	38.1	56.0	74.7	42.3	49.8	49.4	55.9	101.8	95.5
FI	157.1	156.6	158.2	103.6	109.1	190.6	147.5	218.6	124.6	138.0	116.4	78.3
SE	183.5	176.0	141.7	115.9	128.0	180.4	142.6	141.1	124.2	154.6	103.4	88.7
AL*	53.6	42.0	4.1	0.0	0.0	N/A	70.4	41.3	32.6	37.5	53.2	98.6
BA	9.6	37.3	26.9	19.7	0.7	63.5	110.5	15.4	7.7	78.6	28.6	89.7
IS	135.7	189.5	153.1	78.5	87.6	88.7	102.2	228.0	66.6	126.2	39.1	57.9
RS	32.8	84.8	43.2	15.6	40.0	32.8	60.0	50.0	14.4	30.7	68.8	87.3
NO	36.3	48.1	47.7	14.5	23.3	69.3	132.5	48.3	16.2	105.8	29.8	56.0
MK	159.7	162.4	139.4	129.0	78.6	142.9	155.6	244.7	57.4	133.5	55.3	82.8
ME	47.3	46.7	59.2	39.2	101.9	79.7	132.2	65.4	17.8	99.5	72.1	27.6
CH	190.1	224.5	136.2	84.7	150.4	134.7	131.3	194.3	133.2	165.8	98.7	125.0
TR	48.5	45.6	36.6	68.6	46.8	32.6	58.4	64.7	27.1	23.1	65.9	44.1
UA*	34.9	17.5	N/A	31.2	31.7	22.1	0.0	21.0	17.3	72.8	38.3	76.7
UK	161.5	170.6	39.1	122.6	76.2	120.2	48.1	206.5	70.4	147.3	106.8	116.1

* Results for Albania (AL) and Ukraine (UA) are less reliable due to limited data availability.

N/A = not available

Annex H: Indicators and data sources: comparison with global competitors

	Data source	Data not available for	Most recent year
FRAMEWORK CONDITIONS			
Human resources			
1.1.1 New doctorate graduates (STEM) (per 1000 population aged 25-34)	OECD	CN	2020
1.1.2 Population aged 25-64 having completed tertiary education	OECD		2021
Attractive research systems			
1.2.1 International scientific co-publications (per million population)	Scopus ¹	--	2022
1.2.2 Scientific publications among the top 10% most cited publications worldwide (share of total scientific publications of the country)	Scopus ¹	--	2020
Digitalisation <i>No indicator included in international comparison</i>			
INVESTMENTS			
Finance and support			
2.1.1 R&D expenditure in the public sector (percentage of GDP)	OECD, UIS	BR	2021
2.1.3 Direct government funding and government tax support for business R&D	OECD	IN	2020
Firm investments			
2.2.1 R&D expenditure in the business sector (percentage of GDP)	OECD, UIS	BR	2021
Use of information technologies			
2.3.2 Employment in information and communication services	OECD, UNECE	CA, CN, IN, ZA	2021
INNOVATION ACTIVITIES			
Innovators			
3.1.1 SMEs introducing product innovations (%-share)	OECD	CN, IN, ZA	2018
3.1.2 SMEs introducing business process innovations (%-share)	OECD	CN, IN, MX, ZA	2018
Linkages			
3.2.1 Innovative SMEs collaborating with others (%-share)	OECD	CA, CN, IN, MX, ZA	2018
3.2.2 Public-private co-publications (per million population)	Scopus ¹	--	2022
Intellectual assets			
3.3.1 PCT patent applications (per billion GDP)	Patents: OECD GDP: World Bank	--	2019
3.3.2 Trademark applications (per billion GDP)	World Bank	--	2020
3.3.3 Design applications (per billion GDP)	World Bank	--	2020
IMPACTS			
Employment impacts <i>No indicator included in international comparison</i>			
Sales effects			
4.2.1 Medium and high-tech product exports (share of total product exports)	UN Comtrade	--	2022
4.2.2 Knowledge-intensive services exports (share of total service exports)	UN Comtrade, OECD, JRC	--	2021
Environmental sustainability			
4.3.2 Exposure to air pollution (PM2.5)	OECD	--	2020
4.3.3 Development of environment-related technologies, % all technologies	OECD	--	2019

¹ Data provided by Science Metrix as part of a contract to the European Commission (DG Research and Innovation)

Annex I: Contextual indicators and data sources: comparison with global competitors

	Period	Source
PERFORMANCE AND STRUCTURE OF THE ECONOMY		
GDP per capita, PPP (international dollars)	Average 2019-2021	World Development Indicators
Average annual GDP growth (%)	2019-2021	World Development Indicators
Employment share in Agriculture (%)	Average 2017-2019	World Development Indicators
Employment share in Industry (%)	Average 2017-2019	World Development Indicators
Employment share in Services (%)	Average 2017-2019	World Development Indicators
Manufacturing – share in total value-added ¹	Average 2019-2021	UNIDO
BUSINESS AND ENTREPRENEURSHIP		
Total early-stage Entrepreneurial Activity (TEA) (%)	Average 2019-2021	Global Entrepreneurship Monitor
FDI net inflows (% GDP)	Average 2018-2020	World Development Indicators
Top R&D spending enterprises per 10 million population	Average 2019-2021	EU Industrial R&D Investment Scoreboard
Top R&D spending enterprises, average R&D spending, million Euros	Average 2019-2021	EU Industrial R&D Investment Scoreboard
Number of Unicorns	April 2023	CB Insights ²
Buyer sophistication (1 to 7 best)	Average 2017-2019	World Economic Forum
GOVERNANCE AND POLICY FRAMEWORK		
Ease of starting a business (0 to 100 best)	Average 2017-2019	Doing Business
Basic-school entrepreneurial education and training (1 to 5 best)	Average 2017-2019	Global Entrepreneurship Monitor
Government procurement of advanced technology products (1 to 7 best)	Average 2015-2017	World Economic Forum
Rule of law (-2.5 to 2.5 best)	Average 2016-2018	Worldwide Governance Indicators
DEMOGRAPHY		
Population size (millions)	Average 2019-2021	World Bank – WDI ¹
Average annual population growth (%)	2019-2021	World Bank – WDI ¹
Population density (inhabitants / km ²)	Average 2019-2021	World Bank – WDI ¹

¹ Value added data are used as employment data are not available.

² <https://www.cbinsights.com/research-unicorn-companies>

Annex J: Performance data global competitors

Performance in 2023 (relative to EU in 2023)

	AU	BR	CA	CL	CN	IN	JP	KR	MX	US	ZA
Summary Innovation Index	107.7	60.3	121.1	51.1	94.6	37.4	97.9	126.5	30.9	112.8	40.7
1.1.1 New doctorate graduates	151.2	24.6	109.0	18.0	N/A	5.9	56.4	141.5	17.0	95.9	7.8
1.1.2 Population completed tertiary education	131.8	55.9	161.1	81.9	64.9	47.3	157.3	168.2	65.7	124.2	36.1
1.2.1 International scientific co-publications	395.3	21.9	264.8	85.0	20.6	6.3	48.5	92.9	15.1	110.3	44.1
1.2.2 Scientific publications among top 10% most cited	136.7	53.9	115.7	65.6	113.6	73.4	57.6	84.3	46.3	130.3	71.6
2.1.1 R&D expenditure in the public sector	108.3	N/A	104.8	27.3	66.9	57.1	92.2	128.9	31.6	89.5	60.7
2.1.2 Direct & indirect government funding business R&D	85.9	30.2	119.8	9.3	67.2	N/A	63.7	188.7	7.0	144.2	8.4
2.2.1 R&D expenditure in the business sector	65.1	N/A	66.2	8.5	121.7	26.0	183.6	276.6	4.5	190.3	15.0
2.3.2 Employment in ICT	98.3	45.6	N/A	66.0	N/A	N/A	104.1	89.5	21.6	103.1	N/A
3.1.1 SMEs with product innovations	105.2	62.7	181.9	28.7	N/A	N/A	41.6	39.0	21.6	77.5	N/A
3.1.2 SMEs with business process innovations	123.9	197.4	180.9	44.0	N/A	N/A	70.4	40.1	N/A	74.3	N/A
3.2.1 Innovative SMEs collaborating with others	140.3	108.4	181.4	134.1	N/A	N/A	103.2	111.3	N/A	591.5	N/A
3.2.2 Public-private co-publications	224.1	11.6	186.2	28.0	49.5	4.4	85.0	120.4	6.5	120.3	18.5
3.3.1 PCT patent applications	63.3	10.5	72.8	18.6	102.8	14.1	382.4	329.9	4.2	113.0	16.2
3.3.2 Trademark applications	197.0	169.5	147.3	224.5	691.2	84.6	144.1	247.7	124.9	74.7	82.0
3.3.3 Design applications	79.5	29.2	61.8	14.1	467.3	20.9	88.8	449.7	24.5	35.7	31.6
4.2.1 Medium & high-tech product exports	10.2	34.8	51.0	20.0	94.1	55.4	113.7	120.6	107.3	79.2	50.5
4.2.2 Knowledge-intensive services exports	50.9	130.4	123.8	101.0	124.6	138.8	138.1	129.9	32.7	133.2	94.3
4.3.2 Air pollution in PM 2.5	163.3	111.0	205.4	55.7	38.7	27.9	104.1	52.1	89.5	171.9	57.7
4.3.3 Environment-related technologies	83.2	87.1	91.8	181.9	70.8	71.1	80.1	97.0	75.3	71.7	84.9

N/A = not available

Change in performance (2016-2023)

Performance change is measured as the difference between performance in 2023 relative to the EU in 2016 and performance in 2016 relative to the EU in 2016 (the results are the same as those shown in the final column in the performance tables in the country profiles in Chapter 6).

	AU	BR	CA	CL	CN	IN	JP	KR	MX	US	ZA
Summary Innovation Index	6.6	13.0	16.2	9.6	34.0	6.6	3.5	18.5	0.2	13.3	8.1
1.1.1 New doctorate graduates	10.2	0.2	-7.1	-0.7	n/a	0.9	15.8	33.9	4.9	3.3	1.5
1.1.2 Population completed tertiary education	15.0	16.4	21.0	9.3	17.8	0.0	15.1	3.9	16.4	13.4	0.9
1.2.1 International scientific co-publications	187.0	11.0	104.1	45.9	14.8	5.6	16.7	47.6	7.8	28.4	28.9
1.2.2 Scientific publications among top 10% most cited	-2.1	1.2	-10.5	5.9	36.6	11.9	-6.7	1.8	3.3	-18.8	-2.6
2.1.1 R&D expenditure in the public sector	-6.6	N/A	-5.1	2.8	3.4	-3.9	-5.2	14.7	-17.3	-2.3	5.2
2.1.2 Direct & indirect government funding business R&D	-35.4	15.2	4.0	2.2	-2.2	N/A	-22.2	-21.5	-6.5	12.6	-6.7
2.2.1 R&D expenditure in the business sector	-6.9	N/A	1.7	-0.5	12.0	-2.4	-2.3	56.1	-1.1	47.0	-10.9
2.3.2 Employment in ICT	8.7	7.5	N/A	8.6	N/A	N/A	17.4	14.3	1.4	2.7	N/A
3.1.1 SMEs with product innovations	-22.8	2.7	54.2	-13.1	N/A	N/A	-13.4	5.2	0.0	64.4	N/A
3.1.2 SMEs with business process innovations	-21.6	0.0	42.2	-51.5	N/A	N/A	-60.0	-56.0	N/A	-58.5	N/A
3.2.1 Innovative SMEs collaborating with others	-80.5	-23.1	0.0	116.3	N/A	N/A	-307.0	-146.3	N/A	0.0	N/A
3.2.2 Public-private co-publications	88.8	4.8	60.6	16.8	43.3	3.0	15.9	43.9	2.8	17.8	8.8
3.3.1 PCT patent applications	-13.6	0.7	-11.0	2.3	39.9	-0.7	2.0	39.3	-0.5	-16.0	-3.7
3.3.2 Trademark applications	3.7	61.8	-14.4	23.0	392.7	23.6	57.7	32.4	22.9	22.6	-5.4
3.3.3 Design applications	-8.7	-1.6	6.0	-7.8	-71.2	0.9	-1.3	-79.2	-2.2	2.3	-7.2
4.2.1 Medium & high-tech product exports	-8.7	-14.2	-15.1	-5.1	1.9	4.4	-6.0	-1.2	-10.1	-7.8	-12.7
4.2.2 Knowledge-intensive services exports	9.7	8.5	16.3	13.2	24.5	7.9	15.3	29.3	-2.4	21.7	51.2
4.3.2 Air pollution in PM 2.5	5.5	-11.4	-4.7	-2.9	-157.3	-187.9	-2.9	-10.4	-38.3	-6.2	-4.1
4.3.3 Environment-related technologies	-1.8	7.1	-8.0	27.7	-5.5	-15.5	-23.7	-18.8	-29.3	-27.0	-3.2

N/A = not available

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This study provides the results of the 2023 edition of the European Innovation Scoreboard.

Studies and reports

