Gross domestic expenditure on R&D, EU-28, 2002–2016 (% of GDP) Source: Eurostat online data code (t202020)

This article is part of a set of statistical articles on the Europe 2020 strategy. It provides recent findings on research and development (R&D) and innovation in the European Union (EU).

General overview

The Europe 2020 strategy is the EU’s agenda for growth and jobs for the current decade. It emphasises smart, sustainable and inclusive growth as a way to strengthen the EU economy and prepare its structure for the challenges of the next decade. R&D and innovation are key policy components of the Europe 2020 strategy. Innovative products and services not only contribute to the strategy’s smart growth goal but also to its inclusiveness and sustainability objectives. Introducing new ideas to the market promotes industrial competitiveness, job creation, labour productivity and the efficient use of resources. R&D and innovation are also essential for finding solutions to societal challenges such as climate change and clean energy, security and active and healthy ageing.
Europe 2020 strategy target on R&D

The Europe 2020 strategy sets the target of 'improving the conditions for innovation, research and development'\(^a\), in particular with the aim of 'increasing combined public and private investment in R&D to 3 % of GDP' by 2020\(^b\).

\(^a\) European Council conclusions 17 June 2010, EUCO 13/10, Brussels, 2010.


Key messages

- After a period of slow but rising growth, gross domestic expenditure on R&D as a percentage of GDP ('R&D intensity') in the EU stagnated at around 2.03 % between 2014 and 2016. As a result, the 3 % target is still some distance away.

- The business enterprise sector continues to be the biggest investor in R&D in the EU, accounting for 64.9 % of total R&D expenditure in 2016. It has also recorded the highest increase since 2004. Although the higher education sector (for example, universities) and the government sector have lower R&D shares and have been growing at a slower pace, they also play an important role in the long-term stability of R&D expenditure.

- R&D expenditure is highest in northern and western European countries, which are also characterised by predominantly business-financed R&D.

- Regions with the highest R&D intensity in the EU are found in Germany, Austria, the United Kingdom, Belgium, France and the Nordic countries. The Braunschweig region in Germany recorded the highest R&D intensity in the EU in 2015 at 9.5 %.

- The EU increased its output of tertiary graduates in science and technology by 59 % between 2003 and 2015. Despite this progress, women still remain underrepresented in this field of study.

- More than one-third of the EU labour force is employed in knowledge-intensive activities and this share has increased from 34.2 % in 2008 to 36.1 % in 2017.

- Since 2002, the share of R&D personnel in the labour force has been slowly but continuously increasing, reaching 1.2 % of the active population in 2016. The business sector employs more than half of this workforce.

- High-tech exports to outside the EU increased by almost 66 % in nominal terms between 2008 and 2017. This growth was mainly driven by exports in the pharmacy and aerospace sectors.
The headline indicator ‘gross domestic expenditure on R&D’, also referred to as R&D intensity, shows the proportion of gross domestic product (GDP) dedicated to research and development. For three consecutive years R&D expenditure in the EU has stagnated around 2.03% of GDP, further decreasing the chances that the EU will reach its 3% target. At the global level, the EU accounts for one-fifth of the world’s R&D investment.

Nevertheless, the EU’s R&D intensity is still lagging behind other advanced economies, such as the United States, Japan and South Korea, with only the best performing Member States surpassing the United States (see Figure 2). The EU’s relative position in the global R&D landscape has also weakened because of the rapid rise of R&D expenditure in China. In 2015, China overtook the EU by spending 2.07% of its GDP on R&D.

R&D spending up in two thirds of Member States since 2008

Considerable differences across countries underlie the overall EU trend, with R&D intensity ranging from 0.44% to 3.25% in 2016 (see Figure 2). Differences in R&D investment, in particular business R&D spending,

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Table 1: Indicators presented in this article

<table>
<thead>
<tr>
<th>Topic</th>
<th>Indicator</th>
<th>Unit</th>
<th>2008</th>
<th>2016</th>
<th>Target</th>
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</thead>
<tbody>
<tr>
<td>Resources allocated to research and development in the EU</td>
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<tr>
<td>Gross domestic expenditure on R&amp;D, EU-28</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(Euros)</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>EU-28, % of GDP</td>
<td></td>
<td></td>
<td>1.84</td>
<td>2.03</td>
<td>3.00</td>
</tr>
<tr>
<td>Business Enterprise R&amp;D as percentage of GDP</td>
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<td></td>
<td>1.16</td>
<td>1.32</td>
<td>1.94</td>
</tr>
<tr>
<td>Government R&amp;D as percentage of GDP</td>
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<td></td>
<td>0.24</td>
<td>0.26</td>
<td>0.33</td>
</tr>
<tr>
<td>Tertiary graduates in science and technology</td>
<td>Tertiary graduates in science and technology aged 20-29 years</td>
<td></td>
<td>14.5</td>
<td>19.1</td>
<td>(*)</td>
</tr>
<tr>
<td>EU-28, per 1 000 inhabitants</td>
<td>Employment in knowledge-intensive activities</td>
<td></td>
<td>34.2</td>
<td>36.1</td>
<td></td>
</tr>
<tr>
<td>Total R&amp;D personnel and researchers</td>
<td>Bilateral agreements, EU-28, % of total population</td>
<td></td>
<td>1.06 (*)</td>
<td>1.22 (*)</td>
<td></td>
</tr>
<tr>
<td>Innovative enterprises</td>
<td>Total innovative enterprises</td>
<td></td>
<td>48.1 (*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU-28, % of total number of enterprise</td>
<td>Innovative enterprises engaged in any type of co-operation</td>
<td></td>
<td>33.1 (*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU-28, % of product and/or process innovative enterprises</td>
<td>High-tech enterprises outside the EU</td>
<td></td>
<td>0.2</td>
<td>0.3</td>
<td>(*)</td>
</tr>
<tr>
<td>EU-28, billion euro</td>
<td></td>
<td></td>
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</table>

(*) Data are provisional or estimated.
(1) 2015 data instead of 2016.
(2) 2014 data instead of 2016.
(3) 2015 data instead of 2016.

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Figure 1: Gross domestic expenditure on R&D, EU-28, 2002–2016 (% of GDP) Source: Eurostat online data code (t202020)

The headline indicator ‘gross domestic expenditure on R&D’, also referred to as R&D intensity, shows the proportion of gross domestic product (GDP) dedicated to research and development. For three consecutive years R&D expenditure in the EU has stagnated around 2.03% of GDP, further decreasing the chances that the EU will reach its 3% target. At the global level, the EU accounts for one-fifth of the world’s R&D investment. Nevertheless, the EU’s R&D intensity is still lagging behind other advanced economies, such as the United States, Japan and South Korea, with only the best performing Member States surpassing the United States (see Figure 2). The EU’s relative position in the global R&D landscape has also weakened because of the rapid rise of R&D expenditure in China. In 2015, China overtook the EU by spending 2.07% of its GDP on R&D.

R&D spending up in two thirds of Member States since 2008

Considerable differences across countries underlie the overall EU trend, with R&D intensity ranging from 0.44% to 3.25% in 2016 (see Figure 2). Differences in R&D investment, in particular business R&D spending,

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1Research and experimental development (R&D) comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications (Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development, 6th edition, p. 63).


3Data refer to China excluding Hong Kong.
between countries generally reflect differences in their industrial structure, knowledge intensity of sectors and research capabilities\textsuperscript{4}.  

Figure 2: Gross domestic expenditure on R&D, by country, 2008 and 2016 (% of GDP) Source: Eurostat online data code (t202020)

R&D intensity increased in most Member States between 2008 and 2016. It is to be noted that Finland was a leader in R&D intensity in 2008, but its spending contracted to below 3.00 % of GDP in 2016. The negative trends experienced in both Finland and Sweden could be partly attributed to difficulties in their information and communication technology (ICT) sectors\textsuperscript{5}.

Almost two-thirds of R&D spending took place in the business sector

R&D activities are performed by four main institutional sectors: business enterprise, government, higher education and the private non-profit sector. Figure 3 illustrates the distribution of R&D expenditure between these four sectors in 2016. The business enterprise sector, which accounted for 64.9 % of total R&D expenditure in the EU (EUR 196.6 billion), continues to be the biggest investor in R&D.


\textsuperscript{5}European Commission, Science, Research and Innovation Performance of the EU , Brussels 2016 (p. 34).
Figure 3: R&D expenditure, by sectors of performance, EU-28, 2016 (%) Source: Eurostat online data code (rdegerdtot)

Although it contributes a more modest share of 11.2% (EUR 33.9 billion), the government sector also plays an important role, especially in terms of the long-term stability of R&D expenditure. This includes performing ‘far from the market’ research and research that is of social or environmental importance (for example, health, quality of life, environment and defence). It also establishes the basis for R&D activities and compensates for reduced business R&D expenditure during economic downturns to help avoid a decline in the build-up of capital stocks and harm to long-term productivity growth.

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6The market does not provide sufficient incentives for this type of research due to the non-appropriable, public good, intangible character of knowledge and the risky nature of research. For more information see: OECD Science, Technology and Industry Outlook 2012, p.177.

7OECD, Public investment in R&D in reaction to economic crises — A longitudinal study for OECD countries, 2016.
Between 2004 and 2016 R&D expenditure as a percentage of GDP increased for the two major R&D sectors: business enterprise and higher education (see Figure 4).

Considering the sectoral distribution of R&D spending, it is not surprising that annual trends in gross domestic expenditure on R&D follow the R&D expenditure patterns of the business enterprise sector. Business R&D expenditure typically reflects the cyclical behaviour of growth in gross domestic product (GDP). Indeed, the most significant drop in gross business R&D spending coincided with the slump in GDP growth in 2009, whereas it increased considerably in 2006 and 2011, during or after economic upturns. In comparison, public sector R&D expenditure (higher education and government) has been less cyclical and has grown more slowly over the same period.

Increasingly, governments complement direct R&D funding with indirect support in the form of tax incentives to promote business R&D and stimulate innovation and economic growth. According to 2015 OECD data, the amounts disbursed through tax incentives exceeded direct government funding for business R&D in 11 Member States. These amounts of foregone State revenues are not included in the Government Budget Allocations to Research and Development (GBARD), and therefore, for these countries, the latter indicator understates public investments in R&D. This is especially the case with Ireland, France, Belgium, Portugal and the Netherlands, where foregone tax revenue considerably exceeded public R&D funding allocated to companies in 2015. (European Commission, 2018, p.96). Currently in the EU only Germany, Estonia and Finland do not have any tax policy aimed at stimulating business R&D.

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8OECD, Measuring Tax Support for R&D and Innovation.

9European Commission, R&D tax incentives: How to make them most effective? Brussels 2017 (p.4).
Figure 5 illustrates country differences in gross domestic expenditure on R&D by sector of performance. The business enterprise sector remains the biggest spender on R&D in the most research-intensive countries. However, in the least research-intensive countries, such as the Baltic countries and some southern and eastern Member States, the public sector tends to account for the most R&D expenditure. Although the public R&D system drives the generation of knowledge and talent needed by innovative enterprises, it is only through business investment that the full impacts of R&D can be realised. Business R&D integrates and transforms available knowledge into commercially viable technologies and innovation such as greener products, processes and services that enable higher labour productivity, industrial competitiveness, resource efficiency and reduced environmental impacts.

**R&D intensity concentrated in a limited number of regions in Germany, Austria, the United Kingdom, Belgium, France and the Nordic countries**

When looking at the regional distribution of R&D intensity, there are 31 NUTS 2 regions that reported R&D intensity above 3.0 % in 2015 (see Map 1). These regions are located mostly in Germany (11 regions), Austria and the United Kingdom (five regions each), Sweden (four regions), Belgium (three regions), Denmark, France and Finland (one region each). Some research-intensive 'clusters' also become apparent: in particular, a band of research-intensive regions running from Finland through southern Sweden into Denmark and another band from the United Kingdom, through Belgium into southern Germany and Austria. This geographical concentration of R&D activities is a common phenomenon. R&D clusters often develop around academic institutions or specific high-technology industrial activities and knowledge-based services, where they could benefit from a favourable environment and knowledge sharing. Due to clusters many regions attract new start-ups and highly qualified personnel and develop a competitive advantage in specialised activities.

Three regions in the EU appear to have particularly high R&D intensities. In 2015, the German Braunschweig region spent 9.5 % of its GDP on R&D, almost five times higher than the EU average. In Belgium’s Brabant Wallon province and in Germany’s Stuttgart region, R&D spending peaked at 6.54 % and 6.24 % of GDP, respectively. In the case of Germany, this could be mainly attributed to the automobile industry concentrated in those regions, and in the case of Belgium to the pharmaceutical industry.

Capital regions recorded the highest levels of R&D intensity in 10 multi-regional Member States. In addition, in 19 countries, the capital region’s R&D intensity exceeded the national average but was not necessarily the highest in the country. Only Belgium and the Netherlands went against this trend, with capital regions’ R&D intensity below the national average. In Belgium this might be explained by the relatively narrow administrative borders, and in Netherlands by the large rural areas, which are part of the capital region. Regional disparities in R&D intensity within countries, measured as the difference in R&D intensity between the best and worst performing regions, were largest in countries with a high number of regions (Spain and France), and smallest in countries with fewer regions (Ireland, Slovenia and Slovakia).
Map 1: Gross domestic expenditure on R&D, by NUTS 2 regions, 2015(% of GDP) Source: Eurostat online data code (rdegerdreg)
Map 2: Change in gross domestic expenditure on R&D, by NUTS 2 regions, 2007–2015 (percentage points difference between 2015 and 2007, % of GDP) Source: Eurostat online data code (rdegerdreg)

Changes in R&D intensity over time are presented in Map 2. Of the 269 regions for which data are available, 54 experienced a decline in R&D intensity over the considered time frame. In the remaining regions, the increase in R&D intensity ranged between 0.01 percentage points and 3.14 percentage points (Braunschweig).

**Fostering talents, knowledge and skills for innovation**

Knowledge and skills are crucial for gaining new scientific and technological expertise and for building an economy’s capacity to absorb and use this knowledge. R&D expenditure is a vital enabling factor for human capital because it supports knowledge creation and skills development. Highly skilled human resources in turn are necessary for the EU’s research and innovation capacity and competitiveness. The advent of technological advances, such as machine learning, big data analytics, the internet of things and advanced robotics, together with the restructuring in the global value chains, are expected to change the world of work as we know it. To meet this demand for a highly qualified workforce and avoid a potential skills gap, the EU would need a high number of tertiary graduates (also see the articles on ‘Employment’ and ‘Education’). The European skills forecasting model of the Center for the Development of Vocational Training (Cedefop), for instance, projects that by 2025 about 48% of all job opportunities in Europe will need to be filled by individuals with tertiary-level
The number of science and technology graduates in the EU is increasing, but women remain underrepresented

A well-functioning research and innovation system is important for promoting excellence in education and skills development and ensuring a sufficient supply of graduates and postgraduates in science, technology, engineering and mathematics. Increasing the number of science graduates and jobs in knowledge-intensive activities would help to create a solid base for the EU knowledge economy and contribute to Europe 2020’s objectives by fostering the EU’s innovation capacity, economic strength and employment.

Figure 6: Tertiary graduates in science and technology, EU-28, 2003–2015 (Graduates per 1 000 inhabitants aged 20 to 29 years) Source: Eurostat online data codes (tps00188) and (educuoe-grad04)

The number of EU students per 1 000 inhabitants aged 20 to 29 that graduate from tertiary education in science and technology grew by 59 % between 2003 and 2015. Despite the growth of female tertiary graduates in science and technology over the same period (by 70 %), women still remain underrepresented in these fields. In 2015, their number was only around half that of male graduates. The share of women in science and technology fields declines further at the postgraduate level and even more so after they transition to the workplace: in 2012 women accounted for 47 % of PhD graduates (ISCED 6: post-graduate programmes above master’s level), but made up only 33 % of researchers and 21 % of top-level researchers (grade A) (see ‘She Figures’, 2015, p. 5-6). Among other factors, occupational segregation — understood as under or overrepresentation of a given group in occupations or sectors — might be explained by differences in the educational pathways of women and men. For instance, according to the latest ‘She Figures’ publication by the European Commission, men are more than two times more likely than women to choose a degree in engineering, manufacturing and construction, while women are twice as likely to pursue an education degree.

Knowledge-intensive activities employ more than one-third of the EU labour force

Turning knowledge into economic and societal innovation drives productivity, supports long-term growth and generates high-quality jobs. Innovation can also shift a country’s economic structure towards more knowledge-intensive activities with higher added value. This structural change has important implications for employment

10Center for the Development of Vocational Training (Cedefop), Insights into Skill Shortages and Skill Mismatch, 2018, p.5.

11ISCED 1997 classifications used.

12European Commission, She Figures 2015 (p. 5).

13Knowledge-intensive activities are defined based on the level of tertiary educated people within sectors. An activity is classified as knowledge-intensive if more than 33 % of people employed in that activity are tertiary educated (according to ISCED97, levels
as it helps accommodate and stimulate the development of a highly skilled labour force. Therefore, the indicator on employment in knowledge-intensive activities as a percentage of total employment shows how the supply of highly skilled labour feeds into a country’s economic structure.

Employment in knowledge-intensive activities accounts for more than one-third of total employment in the EU. Between 2008 and 2017 this share increased slightly, from 34.2% to 36.1%. Of all women employed in the EU, 44.4% were working in knowledge-intensive activities, compared to only 28.9% of men. While half of all men employed in knowledge-intensive activities were working in the business sector, this was the case for only 30.6% of women.

![Figure 7: Employment in knowledge-intensive activities, EU-28, 2008–2017 (% of total employment)](source)

At the EU level, R&D personnel — researchers and other staff employed directly in R&D — accounted for 1.2% of the labour force in 2016, most of them in the business enterprise sector. Like the evolution of R&D intensity, the share of R&D personnel in the labour force increased marginally between 2002 and 2016 (0.28 percentage points). This was mainly driven by the business enterprise sector, where the share of R&D personnel grew by 0.18 percentage points. With more than 1.8 million researchers, the EU has the world’s most researchers, ahead of China and the United States.

5+6).

\[14\] 2016 data is provisional. Source: Eurostat online data code: (rdpperslf).

Turning knowledge assets into innovation

A dynamic business environment is essential for the promotion and diffusion of innovation. The challenge is to make use of R&D by fostering entrepreneurship and creativity to trigger innovation and economic competitiveness. Therefore, measures targeting knowledge diffusion and absorption of ideas and innovations, for example, through the creation of technology markets and licensing schemes, are just as important as investment in knowledge generation. The higher the uptake and use of ideas from R&D, the more likely innovative players are to invest in future knowledge generation through increased private R&D expenditure. Innovators also help to create a more dynamic innovation system. In many cases they contribute to the structural and technological changes needed to adapt to new circumstances and challenges. An example is the depletion of fossil fuels and the resulting transition towards more renewable energy sources.

Progress in achieving knowledge diffusion and absorption can be measured through data on the number of innovative companies, patent applications and exports of high-tech products, among others. Other attempts to measure innovation include composite indices such as the European Innovation Scoreboard and the Eco-Innovation Index.

Patents provide a valuable measure of how research is being exploited and the inventiveness of countries, regions and enterprises. In 2014, the total number of patent applications to the European Patent Office (EPO) was 10 % higher compared to the level in 2002. Patent applications had been steadily increasing until 2007 but have since stabilised at around 57 000 per year. Further information on patent applications in the EU can be found in the Eurostat publication 'Sustainable Development in the European Union — Monitoring report on progress towards the SDGs in an EU context'.

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16Source: Eurostat online data code (sdg0940).

The European Innovation Scoreboard is a policy instrument used by the European Commission to compare Member States’ research and innovation performance. The Eco-Innovation Scoreboard is a policy tool that helps measure eco-innovation performance and assess whether the EU and its Member States are moving towards smart and sustainable growth, as requested by the Europe 2020 strategy.

Eco-innovation is any innovation that reduces the use of natural resources and decreases the release of harmful substances across a product’s whole life cycle, bringing both economic and environmental benefits. Environmental benefits include lower greenhouse gas (GHG) emissions, reduced waste generation and improved resource productivity, in particular better material and energy efficiency.

Almost half of EU enterprises carry out innovation activities

Almost half (49.1%) of EU enterprises reported innovation activity between 2012 and 2014. The share remained relatively stable since the previous biennial Community Innovation Survey (CIS) in 2012 (48.9%) (see Figure 9). The share of innovative enterprises is broadly linked with GDP per capita levels. Germany had by far the highest share of innovative enterprises at 67.0%, but other countries with high GDP per capita and productivity levels such as France, and the Benelux and northern European countries also seemed to provide a favourable environment for innovative business activities, with 55% or more of enterprises reporting innovation activities. These countries also share a high proportion of medium-high and high-tech manufacturing companies or a high proportion of knowledge-intensive services (for example, ICT and finance). The share of innovative enterprises therefore seems to be also linked to economic structures.

Innovative companies can be distinguished by the type of innovation they pursue. Figure 9 shows how different business strategies lead to different innovation types such as product, process, organisational or marketing innovation. More than a quarter (27.3%) of EU enterprises reported an organisational innovation that involved implementing a new method in the enterprise’s business practices, workplace organisation or external relations.

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18 The European Innovation Scoreboard analyses the innovation system of EU Member States through a set of 27 indicators broken down into eight dimensions looking at human resources, research systems, finance and support, firm investments, linkages and entrepreneurship, intellectual assets, innovators and economic effects. (See European Commission, European Innovation Scoreboard 2018, 2018 Brussels).

19 The Eco-IS shows how well individual countries perform in different dimensions of eco-innovation compared with the EU average. It is based on 16 indicators grouped in to five thematic areas: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency and socio-economic outcomes. In the index, Member States are ranked in relation to the EU average of 100.

20 Eco-innovation Observatory. Introducing eco-innovation: from incremental changes to systemic transformations, 2011.

21 The Community Innovation Survey (CIS) is a survey of innovation activities of enterprises in EU Member States. The survey collects information about product and process innovation as well as organisational and marketing innovation and other key variables. Most questions cover new or significantly improved goods or services or the implementation of new or significantly improved processes, logistics or distribution methods. It produces a broad set of indicators on innovation activities, innovation expenditure, public funding, sources of information for innovation, innovation co-operation, organisational and marketing innovation and on strategies and obstacles for reaching the enterprises’ goals. For further information, see Statistics Explained article on innovation statistics available on the Eurostat website.

22 Eurostat online data code: (inncis9type).
Complex innovations with the highest potential for boosting productivity and growth often depend on the ability to draw on diverse sources of information and knowledge, or to collaborate on the development of an innovation. **Innovation co-operation**, which measures among other things the flow of knowledge between public research institutions and enterprises and between enterprises and other enterprises, provides an important indication of enterprises’ innovation activity. A third (33.1 %) of EU enterprises that conducted product and process innovation activities were also engaged in innovation co-operation arrangements from 2012 to 2014.

**High-tech exports to non-EU countries have increased significantly since 2007**

Beyond turning research results into tangible applications, innovative businesses compete globally to sell their high-tech products on the world market. The volume of **high-tech trade** provides an indication of EU enterprises’ ability to commercialise their R&D and innovation outputs globally. It also reflects how specialised a country is in producing medium- and high-tech products that result from innovation and contribute to its balance of trade and international competitiveness. The creation, exploitation and commercialisation of high-tech products is associated with high value added for the economy and knowledge-intensive and remunerative jobs.

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main drivers behind the development of the EU’s high-tech exports since 2008 were the pharmacy and aerospace sectors, which increased by 196 % and 107 %, respectively. In terms of destination, the United States was the main importer of EU high-tech products in 2017 (EUR 84 billion), followed by China (EUR 39 billion)\textsuperscript{24}.

**Data sources**

**Indicators presented in the article:**

- Gross domestic expenditure on R&D (R202020)
- Gross domestic expenditure on R&D by sectors of performance (rdgerdtot)
- Gross domestic expenditure on R&D by NUTS 2 regions (rdgerdreg)
- Tertiary graduates in science and technology (tps00188 and educueograd04)
- Employment in knowledge-intensive activities by sex (htekiaemp2)
- R&D personnel by sectors of performance (rdpperslf)
- Enterprises by types of innovation (inncis9type)
- Innovative enterprises engaged in any type of co-operation (inncis9coop)
- High-tech trade by group of products in EUR million (htectrdgroup4)

**Context**

R&D and innovation contribute to a well-functioning knowledge-based economy. Most importantly, they are central to providing the scientific and technical solutions needed to meet global societal challenges such as climate change and clean energy, security, and active and healthy\textsuperscript{2} ageing. The three main goals for EU research and innovation policy can be summarised as Open Innovation, Open Science and Open to the World. The development of new technologies alone will not be enough to solve many of the ‘grand’ societal challenges. Fundamental transformations in businesses and manufacturing processes, provision of services, the way society organises itself and other non-technological innovations will be equally important.

The challenges facing society also threaten the well-being of the population and can have dire social, economic and environmental implications inside and outside the EU. Research and innovation can not only help to address these challenges, but also to exploit the new market opportunities they offer.

A number of important EU policy strategies and initiatives address such win-win situations. Horizon 2020 — the EU’s research and innovation programme for the period 2014–2020 — is helping to bring ideas from the lab to the market by providing nearly EUR 75 billion\textsuperscript{25} of funding for research projects aimed at tackling societal challenges, generating excellence in science and fostering industrial leadership\textsuperscript{26}. The Investment Plan for Europe through the European Fund for Strategic Investments invests heavily in innovation related projects and small and medium-sized enterprises (SMEs).

The importance of R&D and innovation for fulfilling the Europe 2020 strategy’s ambitions is evident in their close interlinkages with the strategy’s other objectives. The R&D target is closely related to the strategy’s tertiary educational attainment and employment targets (see the articles on Employment and Education).


\textsuperscript{25}Set in current prices.

Public investment in R&D generates the knowledge base and talent that higher educational organisations and innovative companies need. Higher public investment in R&D also leverages private investment in research and innovation, providing new jobs in business and academia and ultimately increasing demand for scientists and researchers in the labour market. R&D investment spurs innovation, which contributes to industrial competitiveness and job creation.

The Europe 2020 target on R&D is also linked to the strategy’s climate change and energy targets (see the article on ‘Climate change and energy’). In particular, the transition to a green and low-carbon economy and adaptation to climate change will require significant innovation, from small incremental changes to major technological breakthroughs.

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