CHAPTER 5.1

INVESTMENT IN R&D

KEY FIGURES

17 %
of world R&D expenditure attributed to the EU

1 %
annual increase of EU R&D intensity since 2000

24
Member States have increased their R&D intensity since 2000

2/3
of EU R&D expenditure performed by the business sector

7 %
of EU public funding comes from the European Commission

What can we learn?

- With only 6% of the world population, the **EU accounts for almost 20% of global R&D expenditure**.
- **With 2.19% of its GDP invested in R&D, the EU is still far from its 3% target**. It underinvests compared to its main competitors, especially in terms of private investments.
- **EU R&D expenditure is largely dominated by a limited number of big countries** (61% in Germany, France and Italy together).
- **R&D intensity increased over the 2000–2018 period in 24 Member States**, with national R&D intensity ranging from 0.5% in Romania to 3.3% in Sweden.
- Member States are slowly steering their national budgets towards societal and environmental challenges.

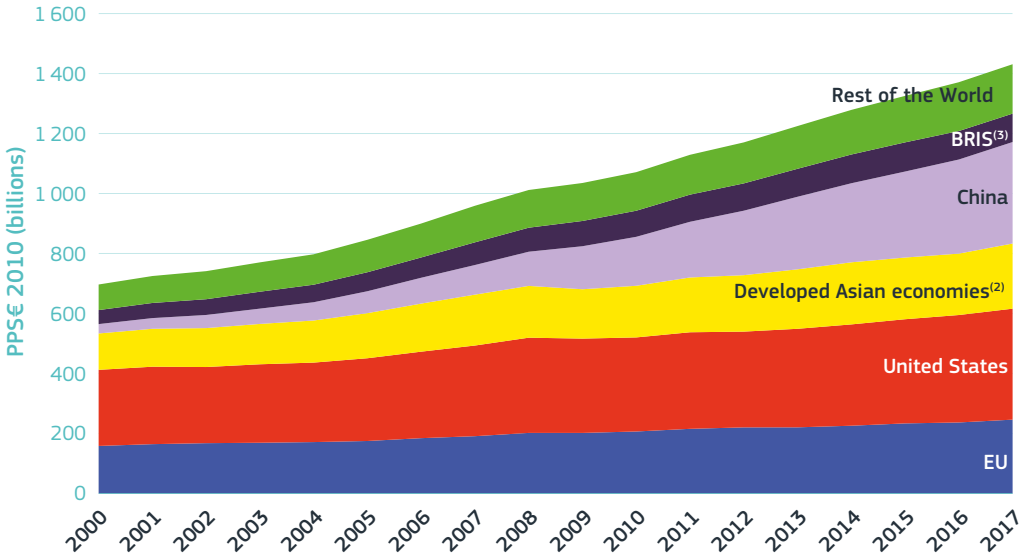
What does it mean for policy?

- R&I policy needs to **leverage further efforts in R&D investments**.
- Because of the scope, scale and urgency of the societal challenges facing Europe, policy is required to **pay more attention not just to the volume of R&D investments, but also to the overall direction of these investments**.
- Given the **significant increase in R&D tax incentives** over the last decade, there is a need to assess the use of this instrument in supporting transitions that require coordinated and strategic investment.

1. EU's share in world R&D expenditure is declining

World R&D expenditure is continuing to increase as all major regions have boosted their R&D spending. The EU's relative weight in this global R&D landscape is decreasing, although it still accounts for almost 20 % of global R&D expenditure. In 2017, the EU represented 17 % of total R&D expenditure in the world[1], down from 22 % in 2000 (Figure 5.1-1). The EU's continuously declining EU's share in world R&D expenditure is mainly due to the rapid rise of China whose share has increased almost fivefold from 5 % in 2000 to 24 % in 2017. The decline of the US share since 2000 has been even more pronounced than that of the EU, from 37 % in 2000 to 26 % in 2017. The share of the developed Asian economies shrank from 18 % in 2000 to 15 % in 2010, while the rest of the world's share has remained stable at around 12 %.

Figure 5.1-1 Evolution of world expenditure on R&D in real terms(1), 2000-2017



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat, OECD, UNESCO

Notes: (1)GERD in PPS€ at 2010 prices and exchange rates. (2)Japan+South Korea+Singapore+Chinese Taipei. (3)Brazil+Russian Federation+India+South Africa.

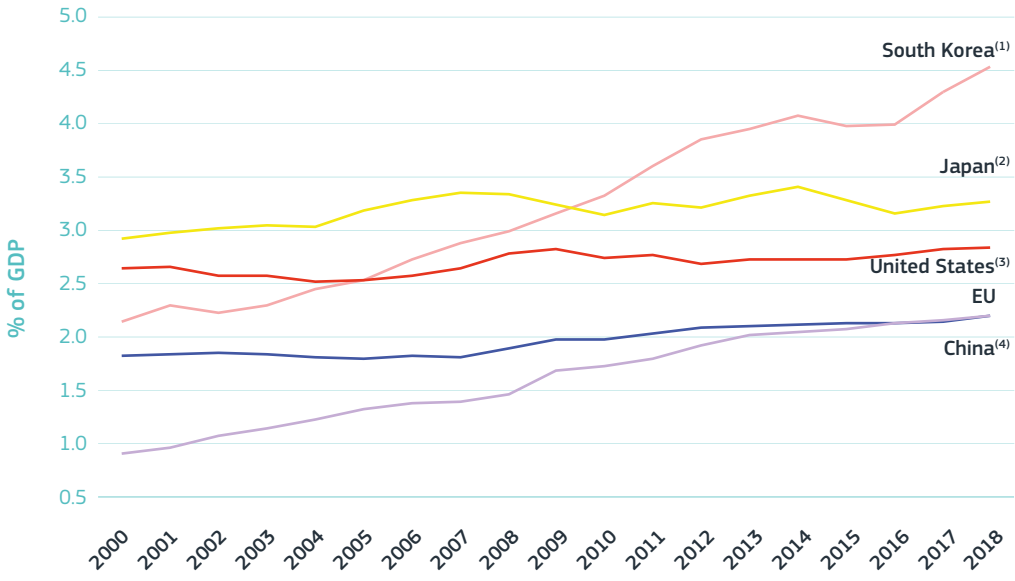
Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-1.xlsx

1 R&D expenditure is measured in PPS€ at 2010 prices and exchange rates.

The EU's relatively strong position in the world R&D landscape is partly due to R&D investment[2] being one of the five Europe 2020 headline targets[3]. The EU's target of devoting 3 % of its GDP to R&D activities and further national targets have mobilised increasing resources for R&D in the last two decades. In addition, R&D intensity targets have led to the portfolio of R&I support instruments becoming more complex, experimentation with new policies, and greater attention to impact assessment and evaluation (Box 5.1-1).

Although R&D expenditure in the EU has been increasing annually by 1% since 2000, it remains lower than the 3% Europe 2020 target, and visibly below the performance of most of its main competitors. At the EU level, R&D intensity increased from 1.81% in 2000 to 2.19% in 2018. However, to meet the 3% target by 2020, its R&D intensity would have to increase by more than 10% per year. R&D as a share of GDP in the EU is smaller than in South Korea (4.53%), Japan (3.26%) and the United States (2.83%). China has more than doubled its R&D intensity since 2000 and in 2018 its R&D-to-GDP ratio was equal to the EU's (Figure 5.1-2).

Figure 5.1-2 Evolution of R&D intensity, 2000-2018



Science, research and innovation performance of the EU 2020

Source: Eurostat (online data code: rd_e_gerdtot), OECD (Research and Development Statistics)

Notes: (1)South Korea: There is a break in series between 2007 and the previous years. (2)Japan: There is a break in series between 2008 and the previous years and between 2013 and the previous years. (3)United States: (i) R&D expenditure does not include most or all capital expenditure; (ii) There is a break in series between 2003 and the previous years. (4)China: There is a break in series between 2009 and the previous years.

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2 The R&D objective set at the EU level is expressed in terms of R&D intensity which measures the share of GDP invested in R&D.

3 At the 2002 Barcelona Summit, the European Council agreed that the EU should set the objective of devoting 3 % of its GDP to R&D activities by 2010. In 2010, this target became one of five headline targets in the Europe 2020 Strategy to be achieved by 2020 (European Commission, 2010).

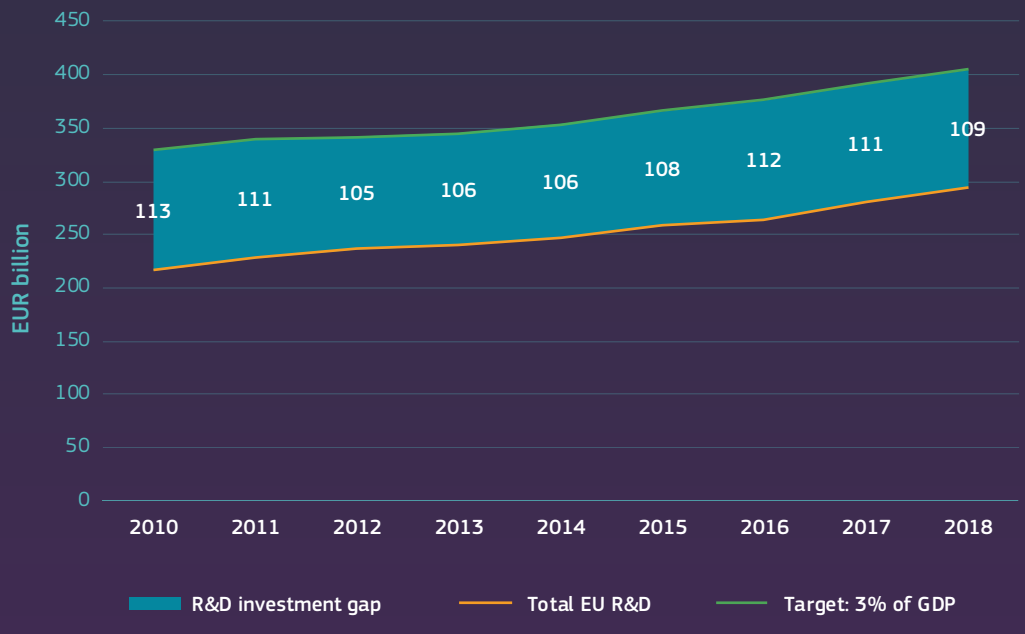
BOX 5.1-1 The 3% target

As the Europe 2020 Strategy has come to an end, the 3% investment target ceases to have a legal basis. The objective of investing 3% of GDP in R&D was first set in the Lisbon Strategy with the aim of turning the EU into the most competitive and dynamic knowledge-based economy in the world by 2010. The ambition was reset in the Europe 2020 Strategy with a focus to 'increase combined public and private investment in R&D to 3% of GDP' by 2020.

The Commission has monitored Member States' progress through the yearly European Semester cycle. At the beginning of 2020, the EU is still a long way from meeting its target. Although it has made progress over the past decade, the United States and key competitors in Asia invest in R&D at a higher rate than the EU. In order to reach an investment in R&D corresponding to 3% of its GDP, the EU would need to invest an additional EUR 110 billion per year (Figure 5.1-3).

Although the EU has not fulfilled its R&D investment ambition, the 3% target has proven to have had a clear mobilising effect as all Member States have set their own national targets. It has also stimulated reflections across Member States on their economic model and policy mix. It is a strong indicator within the European Semester that has provided a stimulus to the EU's R&I, growth and competitiveness policy. It is also an essential compass that can help accelerate the transition towards an environmentally, socially and economically sustainable Europe.

Figure 5.1-3 R&D investment gap in EU



Science, research and innovation performance of the EU 2020

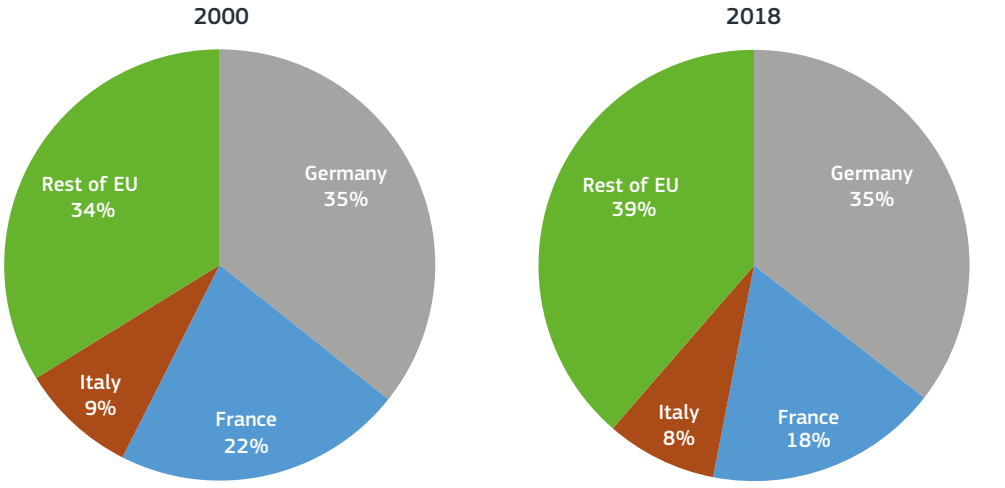
Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat (online data code: rd_e_gerdtot)

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-3.xlsx

EU R&D intensity is largely influenced by a limited number of big countries[4]: namely, 61% of the EU's R&D expenditure in 2018 was performed in Germany, France and Italy. R&D expenditure in the other EU countries together has increased by 5% since 2000 (Figure 5.1-4). However, Germany alone still accounts for almost the same amount of R&D spending as other 24 Member States combined. Hence, to a large extent, the overall EU R&D intensity is determined by its value in these three countries. If they do not set more ambitious targets and move forward, EU R&D intensity will not change drastically.

R&D intensity increased over the 2000-2018 period in 24 Member States. Despite this obvious progress, most Member States remained far from their national 2020 targets. The intensity of R&D spending across EU Member States varies considerably, with national R&D intensity ranging from 0.5% in Romania to 3.3% in Sweden. To a large extent, these big differences can be explained by their industrial specialisations, quality of academic research environment, and access to a large integrated technology market[5]. Three countries have already reached their 2020 target: Germany (3.13%, with a target of 3%), Denmark (3.03%, with a target of 3%) and Cyprus (0.55%, with a target 0.5%). Many of the countries with the lowest initial level of R&D intensity made the greatest progress. R&D intensity in Czechia, Cyprus, Greece, Estonia, Hungary and Poland[6] increased by more than 2.5% annually from 2000 to 2018, while Sweden and Finland, with the highest initial R&D intensity[7], faced declining intensity growth.

Figure 5.1-4 Distribution of Gross Domestic Expenditure in R&D (GERD) within the EU, 2000 and 2018



Source: Eurostat (online data code: rd_e_gerdtot)

Note: (1)France: break in series between 2010 and the previous years.

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4 The levels of R&D expenditure in Germany, France and Italy play an important part in aggregate EU R&D intensity.

5 van Pottelsberghe, 2008.

6 In 2000, the R&D intensity in Cyprus was 0.23%, Greece 0.56%, Estonia 0.6%, Hungary 0.79% and Poland 0.64%.

7 In 2000, the R&D intensity in Sweden was 3.91% and Finland 3.25%.

Figure 5.1-5 Situation of each Member State with regard to its R&D intensity target[6][8]

	R&D intensity 2018	R&D intensity target 2020	R&D intensity compound annual growth (%) 2000-2018[1]	R&D intensity compound annual growth (%) 2010-2018	R&D intensity compound annual growth (%) required to meet the 2020 target 2018-2020
Belgium	*2.76*	*3.00*	2.0	3.7	4.2
Bulgaria	*0.75*	*1.50*	2.4	3.6	41.0
Czechia[7]	*1.93*	*:*[2]	3.1	4.7	:
Denmark	*3.03*	*3.00*	1.7	*0.5*	*Target reached*
Germany[7]	*3.13*	*3.00*	1.5	*1.7*	*Target reached*
Estonia	*1.40*	*3.00*	4.8	-1.4	46.2
Ireland	*1.15*	*2.00*[3]	0.3	-4.0	32.1
Greece	*1.18*	*1.30*	4.6	8.8	5.1
Spain	*1.24*	*2.00*	1.9	-1.1	26.8
France	*2.20*	*3.00*	0.5	0.1	16.8
Croatia	*0.97*	*1.40*	0.1	3.4	20.0
Italy	*1.39*	*1.53*	1.8	1.6	4.8
Cyprus	*0.55*	*0.50*	5.0	*2.7*	*Target reached*
Latvia	*0.64*	*1.50*	2.1	0.6	53.2
Lithuania	*0.88*	*1.90*	2.3	1.4	47.2
Luxembourg	*1.21*	*2.30 - 2.60*[4]	-1.1	-1.1	42.2
Hungary	*1.53*	*1.80*	4.4	3.8	8.3
Malta	*0.55*	*2.00*	0.8	-1.2	90.6
Netherlands	*2.16*	*2.50*	0.5	2.0	7.5
Austria	*3.17*	*3.76*	2.9	1.9	8.8
Poland	*1.21*	*1.70*	3.6	6.7	18.4
Portugal	*1.35*	*2.70 - 3.30*[5]	2.2	-1.6	49.1
Romania	*0.51*	*2.00*	1.4	0.2	99.0
Slovenia	*1.95*	*3.00*	0.4	-3.0	24.0
Slovakia	*0.84*	*1.20*	1.5	4.0	19.7
Finland	*2.75*	*4.00*	-0.9	-3.7	20.7
Sweden	*3.31*	*4.00*	-0.6	0.5	9.9
EU	*2.19*	*3.00*	1.1	1.3	17.1

Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat (online data code: rd_e_gerdtot and t2020_20)

Notes: [1]HR: 2002-2017; EL, LU, SE: 2003-2017; MT: 2004-2017. [2]CZ: A target (of 1.0%) is available only for the public sector. [3]IE: The national target of 2.5% of GNP has been estimated to equal 2.0% of GDP. [4]LU: A 2020 target of 2.45% was assumed. [5]PT: A 2020 target of 3.0% was assumed. [6]DK, EL, FR, IT, LU, HU, NL, PT, RO, SI, SE: Breaks in series occur between 2000 and 2018; when there is a break in series the growth calculation takes into account annual growth before the break in series and annual growth after the break in series. [7]DE: new 2025 target of 3.5%. CZ: new 2030 target of 3.0%. [8]Values in italics are estimated or provisional.

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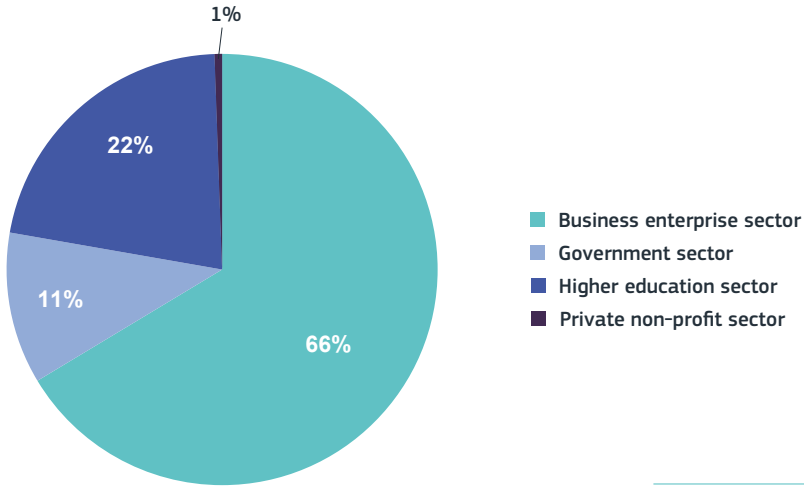
Public R&D expenditure accounts for one third of the total R&D performed in the EU, while the business enterprise sector continues to be the EU's strongest R&D performer, accounting for 66% of total R&D expenditure in 2018. Research, development and innovation are performed by four main institutional sectors: business enterprise, government, higher education and the private non-profit sector[8] (Eurostat, 2018). Figure 5.1-6 shows the shares of R&D expenditure in Europe, performed by these sectors in 2018. Public R&D expenditure is an aggregate of R&D expenditure performed by government and higher education sectors, while private R&D expenditure represents the sum of the business enterprise and private non-profit sector[9].

Figure 5.1-6 R&D expenditure by sectors of performance (%), EU, 2018



Source: Eurostat (online data code: rd_e_gerdtot)

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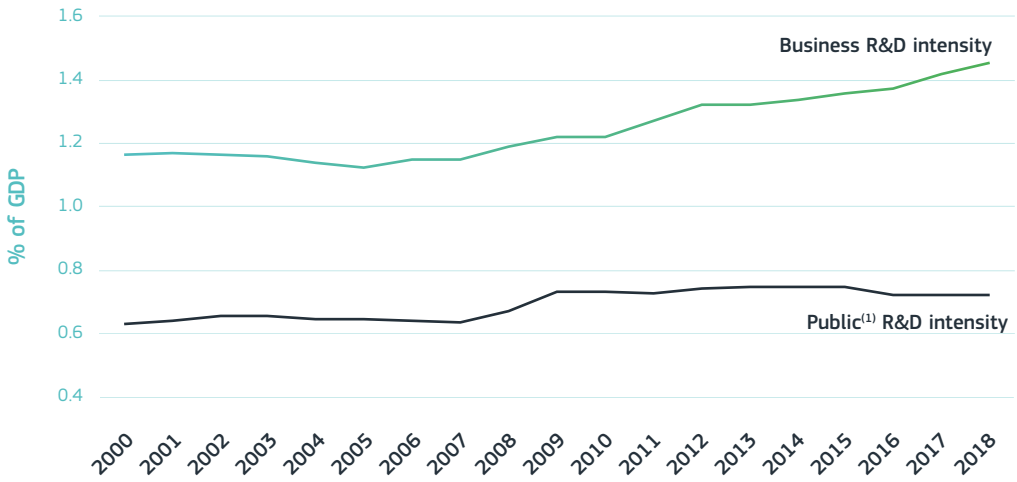
Over the last two decades, EU business R&D intensity has been steadily growing, while public R&D intensity has remained close to 0.7% of GDP (Figure 5.1-7). Despite this obvious progress, EU business R&D intensity is still significantly lower when compared to other main economies: China, United States, Japan and South Korea. On the other hand, among those four countries, only South Korea has a higher public R&D intensity than the EU.

Despite a fall of 4 percentage points from 2000 to 2017, the EU is maintaining its strong position in publicly performed R&D, accounting for slightly more than one fifth of the world's public R&D expenditure. China's increasingly strong presence in the R&D landscape is also evident in the public sector, as its share of world public R&D expenditure increased from 6% in 2000 to 19% in 2017. Over the same period, the United States' share declined, from 26% to 20% (Figure 5.1-8).

8 Expenditures by these four sectors are measured by BERD, GOVERD, HERD and PNPRD respectively.

9 In Europe, the private non-profit sector as an R&D performer is quite small (0.9% of GERD); consequently, when analysing private R&D expenditure, we usually only take business enterprise R&D expenditure into consideration.

Figure 5.1-7 Evolution of Business R&D and Public R&D as % of GDP in the EU, 2000-2018



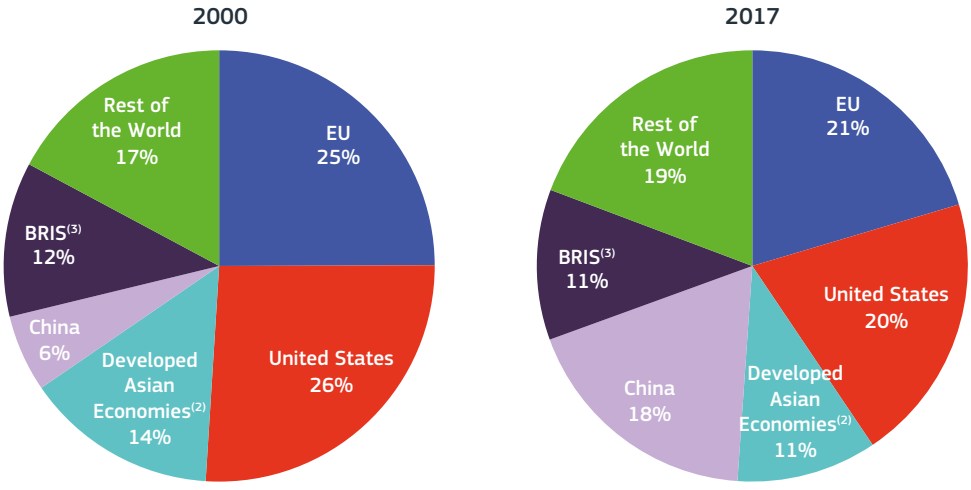
Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat (online data code: rd_e_gerdtot)

Note: (1)Public equals to GOVERD plus HERD.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-7.xlsx

Figure 5.1-8 World public expenditure on R&D -% distribution(1), 2000 and 2017



Science, research and innovation performance of the EU 2020

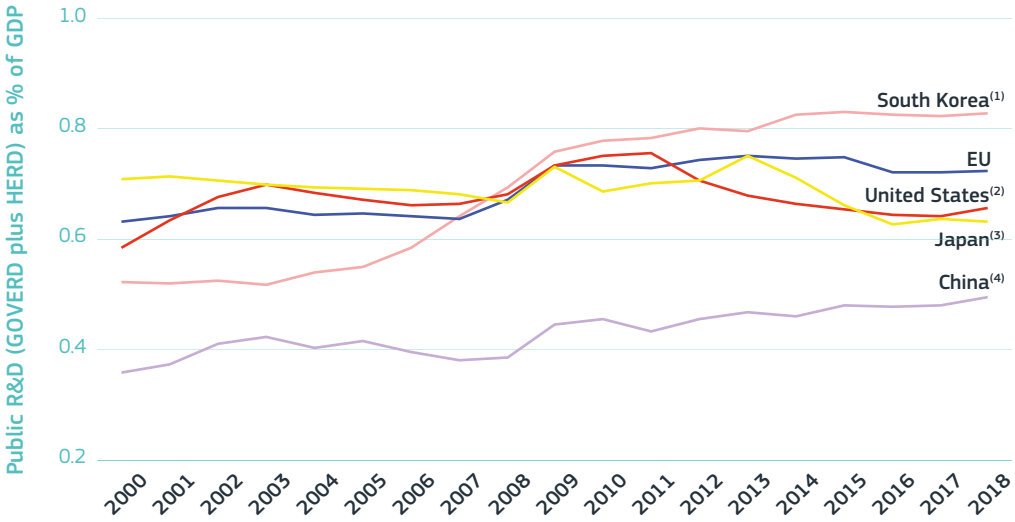
Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat, OECD, UNESCO

Notes: (1)The % shares were calculated from estimated values for total GERD in current PPS€. Public equals to GOVERD plus HERD.
(2)Japan+South Korea+Singapore+Chinese Taipei. (3)Brazil+Russian Federation+India+South Africa.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-8.xlsx

With a value of 0.72% of GDP in 2018, the EU has one of the highest public R&D intensities worldwide. Public R&D intensity is higher in the EU than in the United States, Japan and China. In 2018, the public R&D intensity in the US was 0.66%, in Japan 0.63% and China 0.49%. The only main economy with a higher public R&D intensity than the EU is South Korea with 0.83% of its GDP (Figure 5.1-9).

Figure 5.1-9 Evolution of public R&D intensity, 2000-2018



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat (online data code: rd_e_gerdtot) and OECD (Research and Development Statistics)

Notes: (1)South Korea: There is a break in series between 2007 and the previous years. (2)United States: (i) R&D expenditure does not include most or all capital expenditure; (ii) There is a break in series between 2003 and the previous years. (3)Japan: There is a break on series between 2008 and the previous years and between 2013 and the previous years. (4)China: There is a break in series between 2009 and the previous years.

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Trends in public R&D intensity are very diverse between Member States. Many Member States which already had a relatively strong public R&D system have kept increasing their investments, notably Denmark, Belgium, Germany and Austria (Figure 5.1-10). Estonia and Czechia boosted their public R&D intensities and are now above the EU average. Since 2007, Luxembourg, Slovakia, Greece, Latvia and Malta have also displayed strong growth rates in public R&D intensity, although they remained below the EU average in 2018. Some Member States which already had public R&D intensity well below the EU average, such as Bulgaria, Romania, Ireland and Hungary, have experienced budget cuts in their public R&D in recent years rather than building R&I capacities through more investments.

Focusing on business R&D, a strong business sector reflects the effectiveness of policies aimed at attracting and fostering business R&D investments and the development and growth of knowledge-intensive firms. Business R&D expenditure is determined to a large extent by a country's industrial structure and how its R&I systems function.

Figure 5.1-10 Public R&D intensity, 2018 and compound annual growth (%), 2007-2018

Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat, OECD and UNESCO

Notes: (1)US, JP, CH, KR, CN, TR, IL: 2017; BA, MD, UA: 2016. (2)MD, UA: 2007-2016; CH, JP: 2008-2017; MK: 2015-2018; EL, PT: 2008-2018; RS: 2009-2018; ME: 2011-2018; BA: 2012-2016; (3)US: R&D expenditure does not include most or all capital expenditure. (4)JP, CN, BE, DE, FR, LU, NL, PT, RO, SI, IS, RS: Breaks in series occur between 2007 and 2018; when there is a break in series the growth calculation takes into account annual growth before the break in series and annual growth after the break in series.

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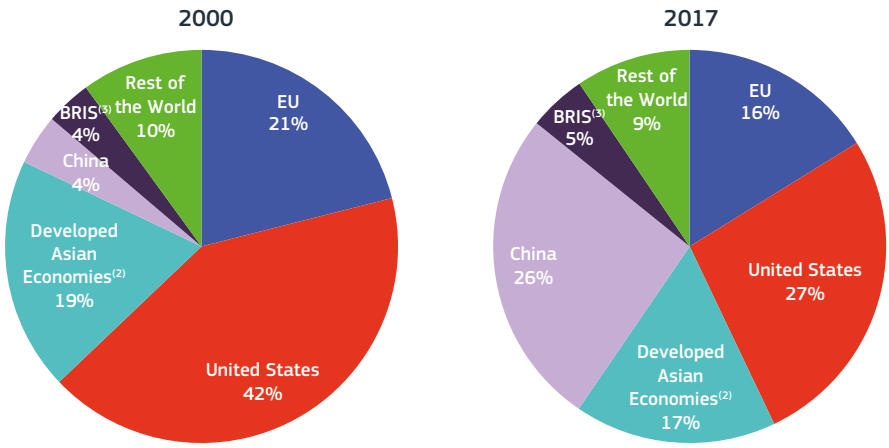
In the world's business R&D landscape, China now accounts for more than one quarter of global business R&D expenditure while the EU's share continues to decline. In 2000, together with the United States, the EU accounted for two thirds of global business R&D expenditure, while in 2017, their joint share was less than half. Since 2000, the EU's share of global business R&D expenditure has shrunk by 5 percentage points while, in parallel, the US share in world business R&D expenditure fell by a record 15%. At the same time, China's stake rose from 4% to 26% (Figure 5.1-11).

Contrary to public R&D intensity, the EU's business R&D intensity is significantly lower compared to other main economies: China, United States, Japan and South Korea. China and South Korea have had continuous and very rapid growth in business R&D intensity since 2007, with annual increases of 4% and 4.7%, respectively. In 2018, business R&D intensity in South Korea was 3.64%, in

Japan 2.59%, in the United States 2.05%, and in China 1.69% (Figure 5.1-12).

Figure 5.1-11 World business enterprise expenditure on R&D – % distribution[1], 2000 and 2017



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat, OECD and UNESCO

Notes: [1]The % shares were calculated from estimated values for total GERD in current PPS€. [2]Japan+South Korea+Singapore+Chinese Taipei. [3]Brazil+Russian Federation+India+South Africa.

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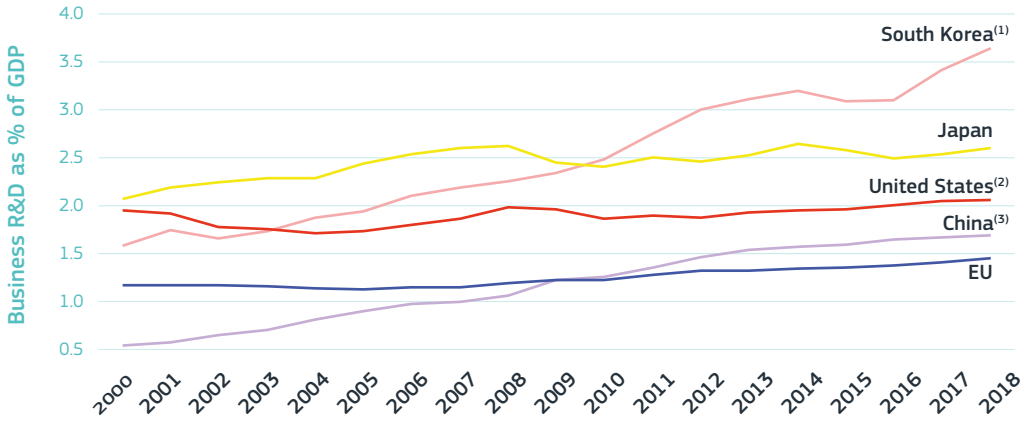
Figure 5.1-12 Evolution of business R&D intensity, 2000-2018



Science, research and innovation performance of the EU 2020

Source: Eurostat (online data code: rd_e_gerdtot), OECD (Research and Development Statistics)

Notes: [1]South Korea: There is a break in series between 2007 and the previous years. [2]United States: Business enterprise expenditure on R&D (BERD) does not include most or all capital expenditure. [3]China: There is a break in series between 2009 and the previous years.

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Only a few EU Member States with the best R&D systems (in particular, Austria, Germany, Denmark, Sweden and Belgium) resemble the private R&D intensity achievements of the main world economies, such as the United States, Japan, Switzerland and China (Figure 5.1-13). On the other hand, business R&D intensity increased most in Poland, Bulgaria, Greece and Slovakia between 2007 and 2018. However, their business R&D intensities remained below 1 % of the national GDP in 2018 and well below the EU average.

Figure 5.1-13 Business R&D intensity, 2018 and compound annual growth (%), 2007-2018

Science, research and innovation performance of the EU 2020

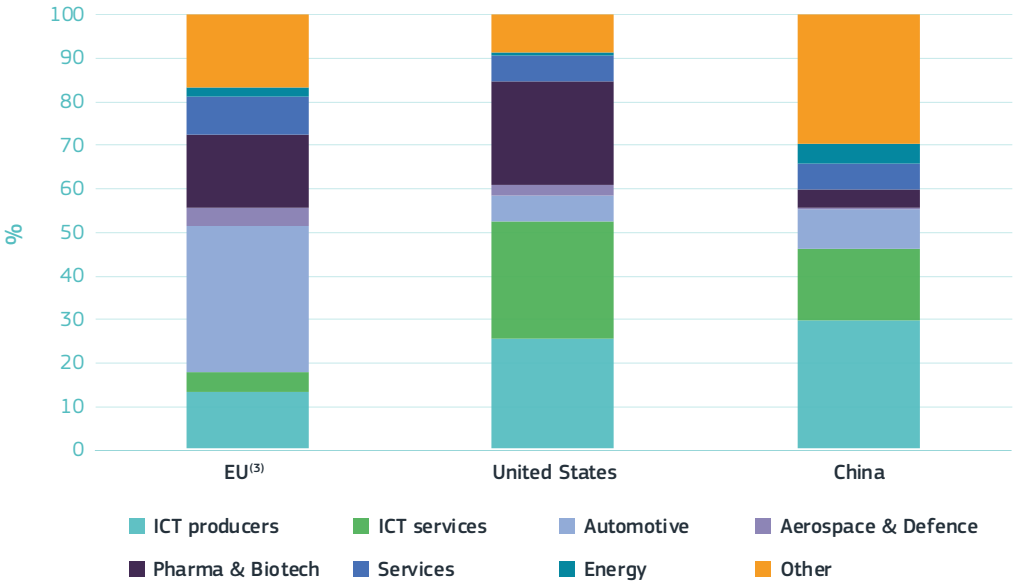
Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat, OECD and UNESCO

Notes: (1)US, JP, KR, CN, CH, TR, IL: 2017; BA, MD, UA: 2016. (2)MD, UA: 2007-2016; CH: 2008-2017; EL, ES, SI: 2008-2018; RS: 2009-2018; ME: 2011-2018; BA: 2012-2016; MK: 2015-2018. (3)US: R&D expenditure does not include most or all capital expenditure. (4)CN, IT, LU, NL, RO, SI, UK, IS, RS: Breaks in series occur between 2007 and 2018; when there is a break in series the growth calculation takes into account annual growth before the break in series and annual growth after the break in series.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-13.xlsx

To some extent, lower business R&D intensity in the EU compared to its main competitors can be explained by the sectoral composition of the economy. Less than 50% of the EU's industry[10] is in the high R&D-intensity sectors (e.g. ICT producers, ICT services, health industries) and around 40% in the medium-high R&D-intensity sectors (such as automobiles and other transport). Conversely, 80% of R&D investment by US companies, as well as over half of Chinese business R&D investment, is in the high R&D-intensity sectors (Figure 5.1-14).

Figure 5.1-14 Economic sectorial distribution(1)(2) of R&D spending by country/region, 2018



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on the 2019 EU Industrial R&D Investment Scoreboard

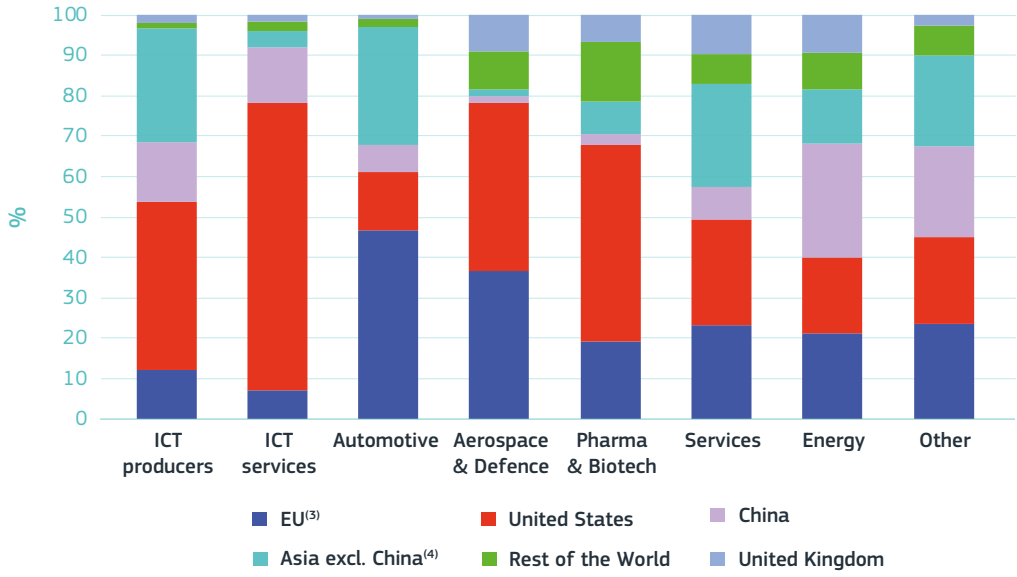
Notes: (1)R&D spending corresponding to the top global 2 500 companies. (2)ICT producers: electronic and electrical equipment, technology hardware and equipment. ICT services: software and computer services. Automotive: automobiles and parts. Services: leisure goods, personal goods, banks, life insurance, non-life insurance, financial services, real estate investment and services, media, general retailers, food and drugs retailers, healthcare equipment and services, support services, travel and leisure. Energy: alternative energy, oil and gas producers, oil equipment, services and distribution, electricity. Other: chemicals, general industrials, industrial engineering, household goods and home construction, construction and materials, industrial transportation, mining, industrial metals and mining, food producers, tobacco, forestry and paper, beverages, fixed line telecommunications, gas, water and multi utilities, mobile telecommunications. (3)EU corresponds to the EU Member States shown in the dataset.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-14.xlsx

10 Based on the 2019 EU Industrial R&D Investment Scoreboard (Hernández et al., 2019) which covers more than 90% of business spending on R&D (BERD) worldwide.

In terms of global positioning, the EU largely dominates R&D investments in the automotive sector and shows strong performance in aerospace and defence and in industrial engineering. US companies account for 71 % of the global R&D share of ICT services, 41 % in ICT producers and 48 % in pharmaceuticals and biotechnology – all three are high R&D-intensity sectors. While EU sectors with the largest global weight are automobiles (47 %) and aerospace and defence (37 %), China leads in terms of R&D investments in energy with 28 % of global R&D (Figure 5.1-15).

Figure 5.1-15 Geographical distribution of R&D[(1)] spending by economic sector[(2)], 2018



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on the 2019 EU Industrial R&D Investment Scoreboard and EIB Investment report 2019-2020

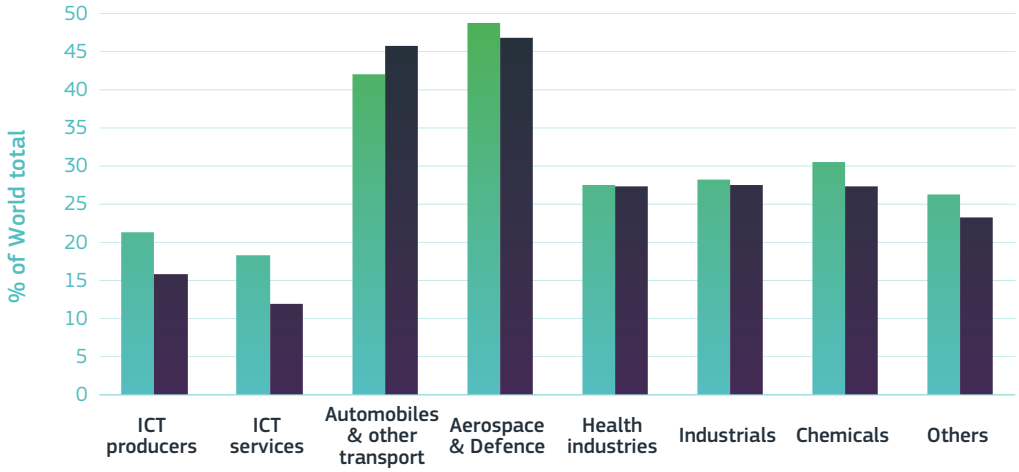
Notes: [(1)]R&D spending corresponding to the top global 2 500 companies. [(2)]ICT producers: electronic and electrical equipment, technology hardware and equipment. ICT services: software and computer services. Automotive: automobiles and parts. Services: leisure goods, personal goods, banks, life insurance, non-life insurance, financial services, real estate investment and services, media, general retailers, food and drugs retailers, healthcare equipment and services, support services, travel and leisure. Energy: alternative energy, oil and gas producers, oil equipment, services and distribution, electricity. Other: chemicals, general industrials, industrial engineering, household goods and home construction, construction and materials, industrial transportation, mining, industrial metals and mining, food producers, tobacco, forestry and paper, beverages, fixed line telecommunications, gas, water and multi utilities, mobile telecommunications. [(3)]EU corresponds to the EU Member States shown in the dataset. [(4)]Asia excl. China includes Japan, South Korea, Singapore, Twain and Malasya.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-15.xlsx

According to the latest EU R&D Industrial Scoreboard, **EU companies have reinforced their R&D specialisation in automobiles over the last decade**. On the other hand, they have reduced their global R&D share in ICT industries, aerospace and defence and chemicals (Figure 5.1-16). The decline in EU companies' share of global R&D in ICT sectors is taking place

in a context where an important sector shift towards these industries has occurred worldwide. Between 2009 and 2018, the share of the global R&D investment in ICT services increased from 10.7% to 15%, and to a lesser extent in ICT producers, from 22.9% to 23.6%. Hence, this shift has not been driven by EU companies but rather by US and Chinese companies.

Figure 5.1-16 Global R&D share of EU28 companies by economic sectors, 2009 and 2018



Science, research and innovation performance of the EU 2020

Source: European Commission, Joint Research Centre and DG Research and Innovation, The 2019 EU Industrial R&D Investment Scoreboard

Note: Shares computed for 386 EU28 and 1 264 non EU28 companies for witch R&D, Net Sales and Operating profits data are available for the all period 2009-2018.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-16.xlsx

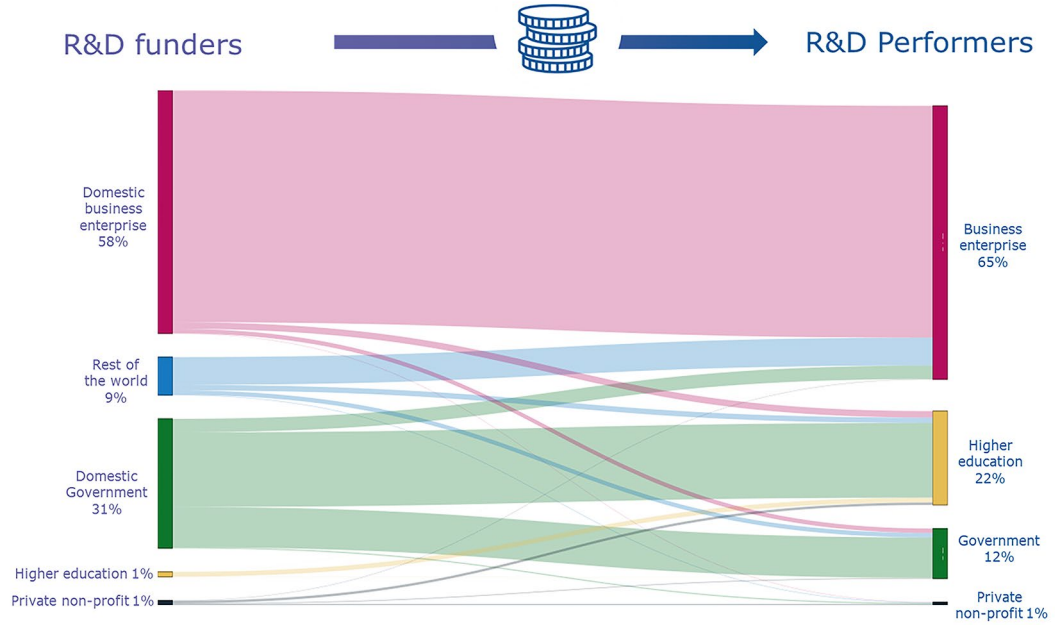
2 EU lags behind its main competitors in business R&D funding

There are five main sources of R&D funding: business enterprise, domestic government, higher education, the private non-profit sector, and the rest of the world. Figure 5.1-17 shows the shares of R&D funding in the EU and where those investments were performed in 2018. Altogether, the public sector finances slightly more than one third of R&D expenditure in the EU and the private sector slightly less than two thirds.

When assessing total public R&D support in Europe, besides domestic government investments, government support to business R&D through tax incentives[11] **and funding from the EU budget should also be included**. In many Member States, a substantial part of government support to business R&D is now made indirectly through R&D tax incentives. On the other hand, for most Member States, the main source of financing from the rest of the

11 Government-financed R&D includes only direct funding of R&D through grants, loans and procurements that governments give to private firms. Indirect government funding through R&D tax incentives is not recorded in government-financed R&D.

Figure 5.1-17 R&D funding in the EU



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat (online data code: rd_e_gerdfund)

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-17.xlsx

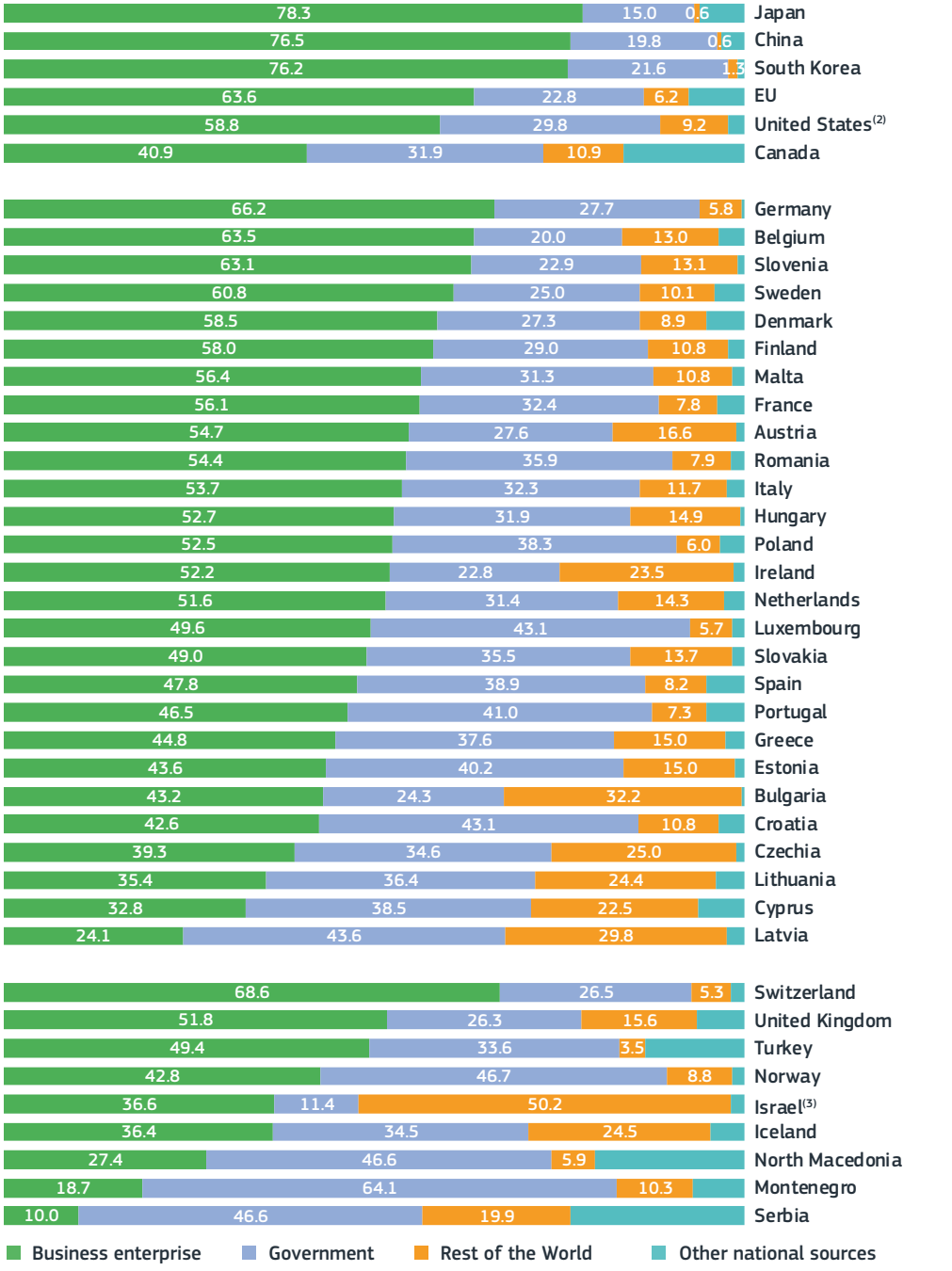
world is the European Commission, through its Horizon 2020 programme and the European Structural and Investment Funds.

The public sector is a main source of funding in less-research-intensive countries, where conditions for business R&D investment are still insufficiently attractive. Conversely, in the most-research-intensive countries, the business sector is the predominant source of funds. Businesses will invest where public policies are best, and where there are sufficient human resources and good research capacities. Hence, how much the private sector invests in a particular country relies largely on the return it can expect and therefore to the framework conditions in place.

Figure 5.1-18 shows the sources of R&D funding broken down into business enterprise, domestic government, rest of the world, and other national sources, while Figure 5.1-19 presents the European Commission's share of R&D funding from the rest of the world. Adding up investments from domestic governments and the EC, we find exceptionally high shares of publicly funded R&D in Latvia, Cyprus and Lithuania. The public sector is also the predominant investor in Greece, Luxembourg, Romania, Portugal, Slovakia and Spain.

In the most-research-intensive Member States (Germany, Sweden, Belgium, Denmark, Finland and Slovenia), the business sector is the predominant source of funds. In those countries, the R&I funding from the business sector is comparable to that in the United States (62 %), although significantly lower than in South Korea, China and Japan, where businesses finance more than 75 % of R&D.

Figure 5.1-18 Gross domestic expenditure on R&D (GERD) financed by sector (%), 2017[1]



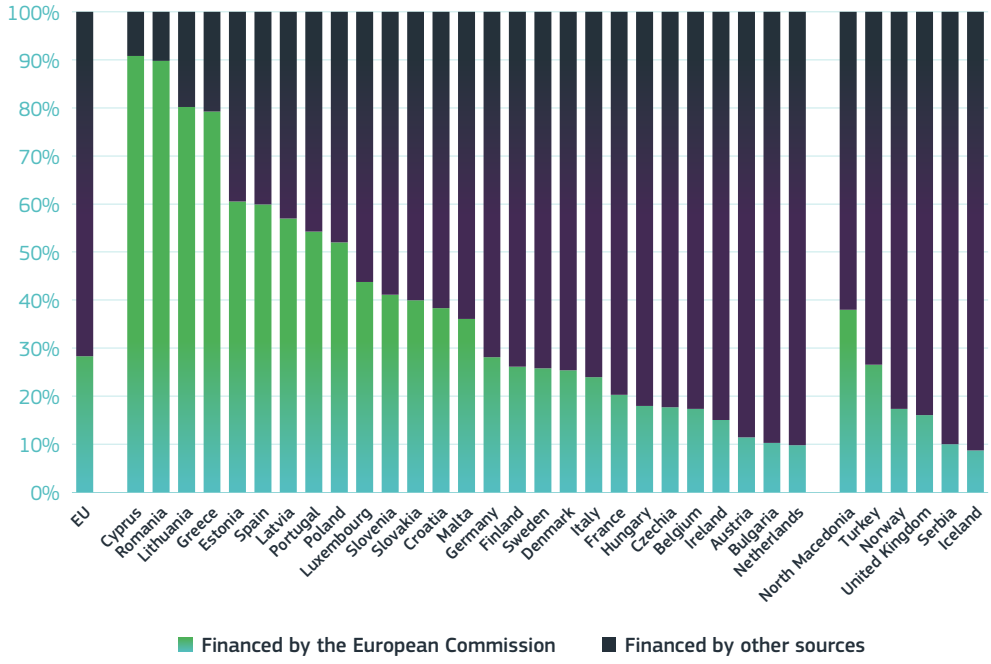
Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat (online data code: rd_e_gerdfund) and OECD

Notes: [1]UK, IL : 2016. [2]US: R&D expenditure does not include most or all capital expenditure. [3]IL: Defence (all or mostly) is not included.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-18.xlsx

Figure 5.1-19 R&D expenditure financed by the Rest of the World, 2017(1)



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat (online data code: rd_e_gerdfund)

Note: (1)TR: 2015; UK: 2016.

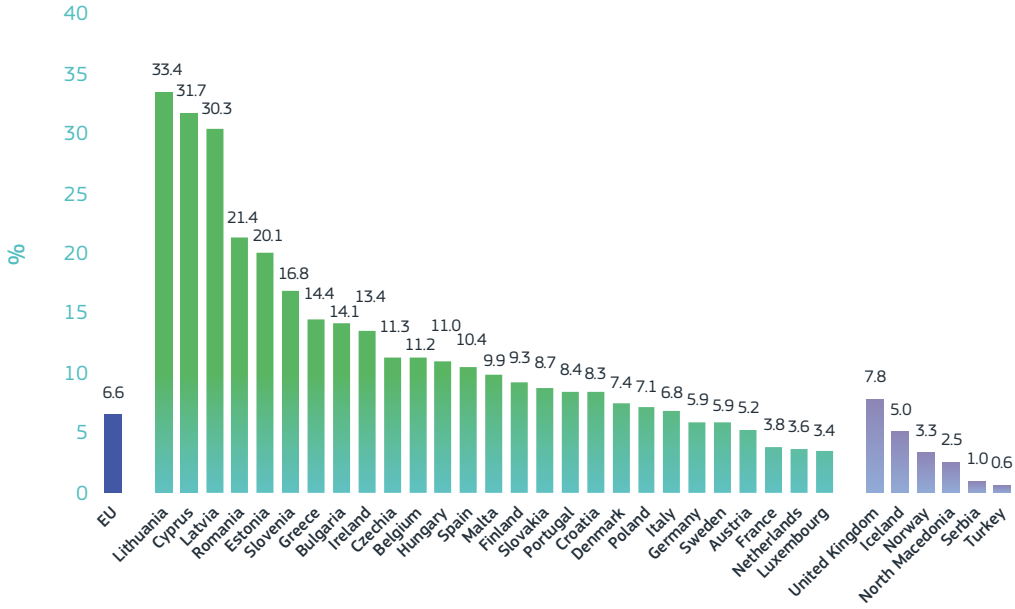
Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-19.xlsx

The European Commission's R&I funding programmes are now responsible for 6.6% of public funding for R&I in Europe and a significantly higher percentage when looking only at competitive funding. Budgets have increased massively over the last programming periods. The budget of almost EUR 100 billion proposed for the next Framework Programme, Horizon Europe, also represents a very strong increase compared to the current programme. Together with the European Structural and Investment Funds, the EC is an important source of R&I funding in many Member States (Figure 5.1-20).

Member States are slowly steering their national budget allocations for R&D towards societal and environmental challenges. Figure 5.1-21 shows an increase in energy-related government budget allocations for R&D (GBARD)[12] at the European level. Growth in the budget allocation for total civil, health and environmental-related R&D is more modest. In contrast, the R&D budget for defence has decreased significantly in recent years.

12 As GBARD measures only direct budget provisions, it does not account for the R&D performed.

Figure 5.1-20 R&D expenditure financed by the European Commission as % of total R&D expenditure financed by the public sector, 2017(1)



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat (online data code: rd_e_gerdfund)

Note: (1)TR: 2015; UK: 2016.

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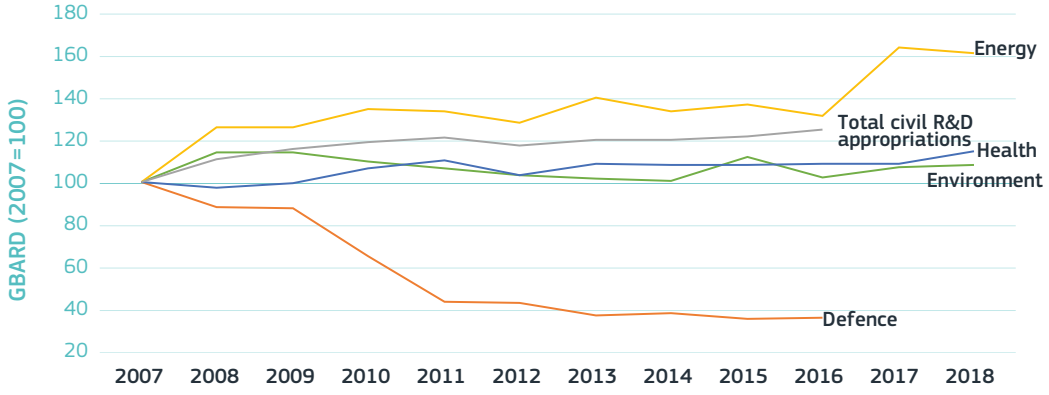
Figure 5.1-21 Evolution of government budget allocations to R&D in the EU, 2007-2018



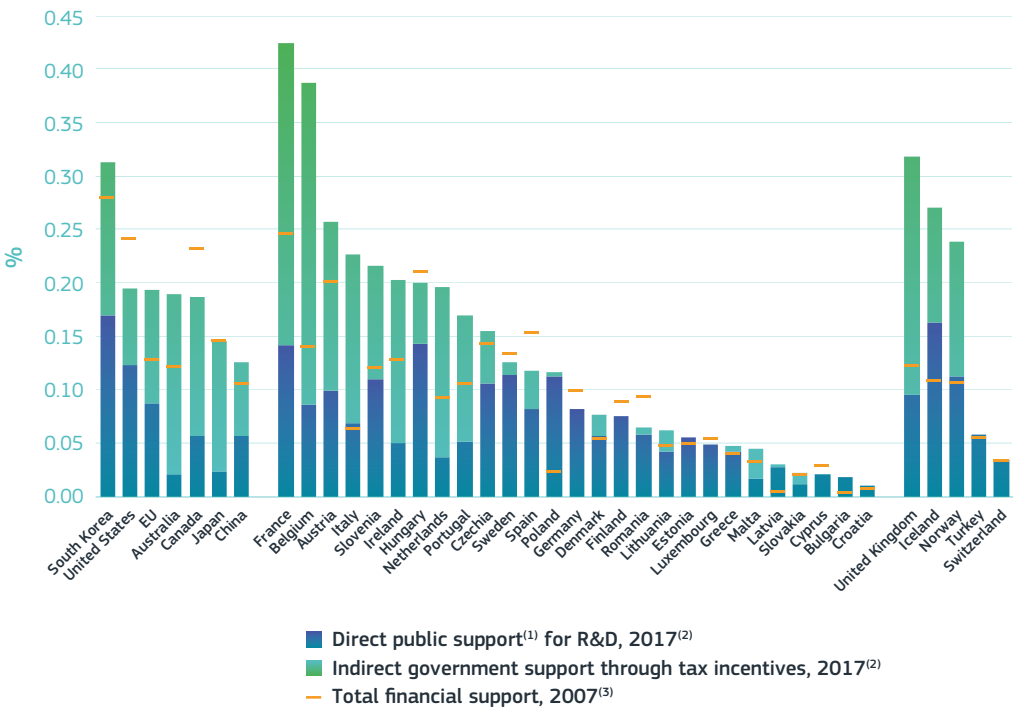
Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat (online data code: gba_nabsfin07)

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-21.xlsx

Business R&D intensity is significantly lower when compared to other main economies: China, United States, Japan and South Korea. **One important driver of business R&D expenditure is the expected return on investment. To improve the expected return, apart from direct support, governments are increasingly using R&D tax incentives**. Total public support for business R&D, comprising direct funding (e.g. grants, loans, procurement) and indirect support (R&D tax incentives[13]) increased substantially in the EU, from 0.13% of GDP in 2007 to 0.2% of GDP in 2017. Figure 5.1-22 shows that the level of public support for business R&D grew in most Member States between 2007 and 2017, particularly through the greater use of R&D tax incentives. Particularly strong increases in total public support for business R&D are evident in Belgium, Italy, France, the Netherlands, Slovenia, Poland, Latvia and Bulgaria.

Figure 5.1-22 Public support for business R&D as % of GDP, 2007 and 2017



Science, research and innovation performance of the EU 2020

Source: DG Research and Innovation, Chief Economist - R&I Strategy & Foresight Unit based on Eurostat (online data code: rd_e_gerdfund) and OECD (R&D tax expenditure and direct government funding of BERD)

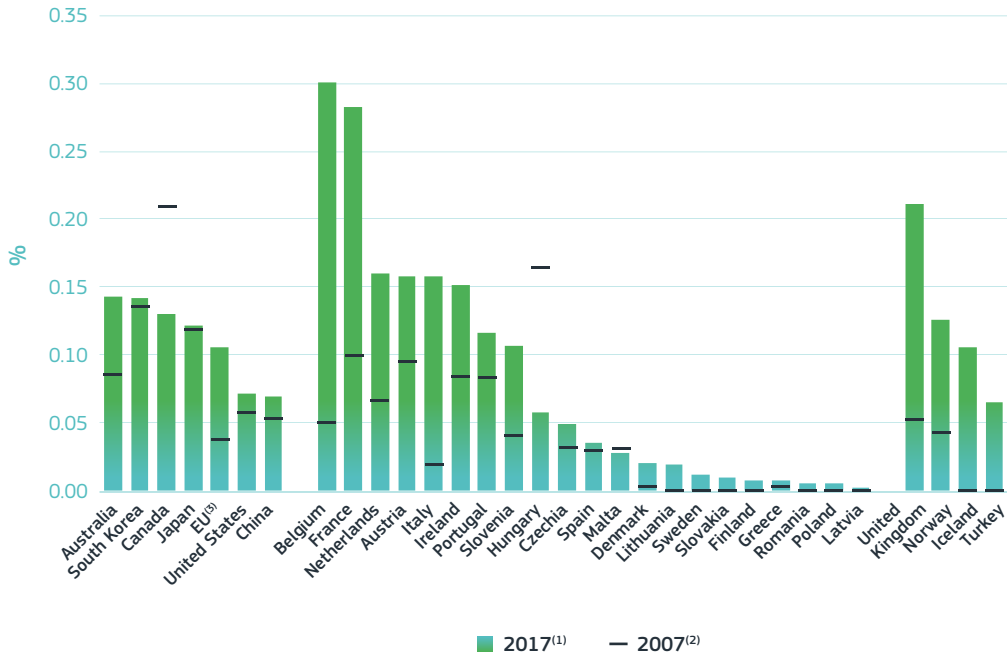
Notes: (1)Estimated direct public support for business R&D includes direct government funding, funding by higher education and public sector funding from abroad. (2)US: 2014 for tax incentives only; AU: 2015; FR: 2016 for tax incentives only; RO, UK: 2016; EL: 2015. (3)CH, TR: 2008; CN, MT: 2009; DE, EL: 2011. (4)The following countries have no tax incenitves for R&D: BG, DE, EE, HR, CY, LU, CH. (5)Elements of estimation were involved in the compilation of the data.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-22.xlsx

13 Following the Frascati manual (OECD, 2015), we only focus on expenditure based tax relief, such as: R&D tax credits, R&D allowances, reduction in R&D workers' salary taxes and social security and accelerated depreciation of R&D capital.

In 2017, tax incentives for R&D in the EU accounted for 55 % of all public support for business R&D. The level of the forgone tax revenues in EU almost tripled since 2007, from 0.04 % of GDP in 2007 to 0.11 % in 2017 (Figure 5.1-23). In comparison to the EU, the use of tax incentives is traditionally high and rather stable in South Korea and Japan. China has slightly increased indirect support to business R&D but it is still below the EU level. In the EU, the number of countries offering R&D tax relief increased from 12 in 2000 to 21 in 2018 (Appelt et al., 2019). Trends in forgone tax revenues are very diverse among the Member States. There is an exceptionally high share of tax incentives in total public support for business R&D in the Netherlands, Belgium, Ireland and Italy.

Figure 5.1-23 Tax incentives for R&D as % of GDP, 2007 and 2017



Source: OECD (R&D tax expenditure and direct government funding of BERD)

Notes: (1)US: 2014; FI: 2014; EL, FR: 2016. (2)CN: 2009; EL: 2011. (3)EU was estimated by DG Research and Innovation. (4)BG, DE, EE, HR, CY, LU, CH have no tax incentives for R&D.

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-23.xlsx

Given that coordinated transformation needs coordinated and strategic investment, the question arises as to whether the above-mentioned increased use of R&D tax incentives among the Member States provides the right tools to achieve this goal. Direct measures, such as grants and loans, are effective in provoking certain desired R&D outcomes (Appelt et al., 2019; Ognyanova, 2017) such as innovation that supports a sustainable transition. The downside, however, is the higher administrative burden put on companies. Some countries are considering the possibility to use tax incentives to incentivise private actors' behaviour towards SDGs. This is the case for instance in Belgium[14], where a tax credit granted for environmentally friendly R&D investments was introduced. However, more generally speaking, the tax incentives regime – exactly because of its lack of directionality – may make it difficult for governments to have enough impact on steering private investment towards sustainability and systemic change[15]. Therefore, in order to establish consistency among national reforms and EU policies, a discussion is needed on the best policy mix to provide public support to business R&D expenditure.

Because of the scope, scale and urgency of the societal challenges facing Europe, policy is required to pay more attention not just to the rate (quantity and quality) of R&I investments but also to the overall direction of such investments. This can support the coordinated transformation of a broad range of interconnected systems that are crucial to our economy and society. Systems such as energy, agro-food, health, mobility, production and consumption all include a number of actors that must act together.

14 https://www.oecd.org/sti/rd-tax-stats-belgium.pdf

15 Moreover, while its effect of increasing R&D efforts is undeniable, recent analysis of existing evidence on the impact of tax incentives points to its limited impact on innovation (Mitchell et al. 2020).

3. Conclusions

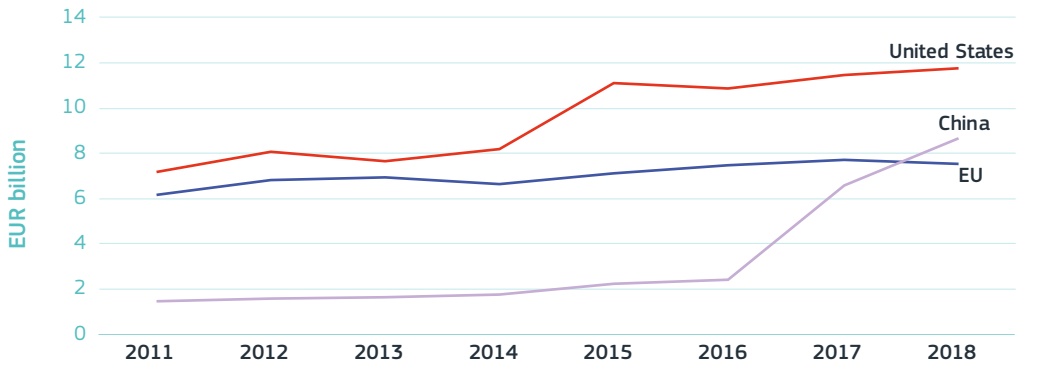
With just over 2% of its GDP in R&D, the EU is still a long way from its 3% target. It is underinvesting in R&D compared to its main competitors, especially in terms of private investments, while Asian countries, in particular China and South Korea, are investing at a rate that is eclipsing both the EU and the United States. If this continues, Europe risks being outpaced irreversibly.

The Commission is committed to focusing R&I investments on delivering the 'European Green Deal', its new strategy for growth (European Commission, 2019). R&I are called upon to play a strong role to support this initiative. Given the size of the challenge and its costly nature, with EUR 1 trillion mobilised for the Green Deal over the next decade, this demands investing record amounts in R&D if Europe is to become the world's first climate-neutral continent and can achieve the Sustainable Development Goals.

For R&I to deliver on Europe's ambitions, including becoming the world's first climate-neutral continent, R&I must also be given a clear sense of directionality[16]. Public investments in R&D can play an essential role in this. Bloomberg data show that, while the United States leads in climate-related R&D spending, China has recently quadrupled its spending, slightly overtaking the EU (Figure 5.1-24). Member States should reinforce their performance in climate-related R&D in order to boost their competitiveness in the novel technologies which are required for transition.

One of the main public investment instruments in Europe is the EU's R&I Framework Programme. The next one, Horizon Europe, will cover 2021-2027 and will continue to create new knowledge and solutions to attain the SDGs. It will provide even greater directionality through its mission-oriented approach (on, for example, climate change, healthy oceans, climate-neutral and smart cities, and soil health and food) and European partnerships. In addition, it has set a 35% spending target for the climate.

Figure 5.1-24 Investment in climate-related R&D, 2011-2018



Science, research and innovation performance of the EU 2020

Source: European Investment Bank based on data from Bloomberg New Energy Finance (BNEF)

Stat. link: https://ec.europa.eu/info/sites/info/files/srip/2020/parti/chapter51/figure-51-24.xlsx

16 In the same vein, the 2018 update of the Bioeconomy Strategy aims to accelerate the deployment of a sustainable European bioeconomy in order to maximise its contribution towards the 2030 Agenda and its SDGs, as well as the Paris Agreement (see European Commission, 2018).

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