



**BRIEFING PAPER**

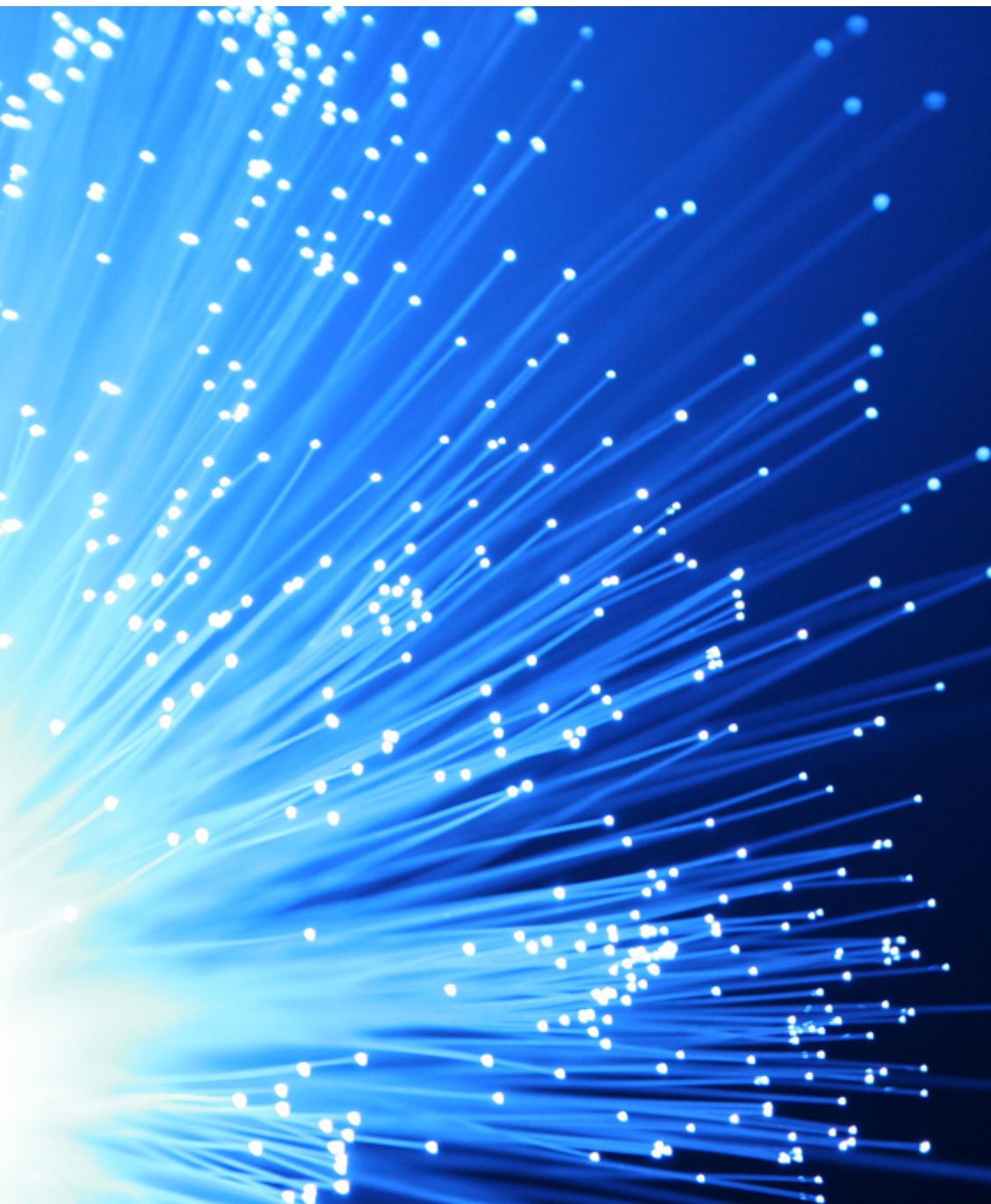
Number SN04223, 16 March 2021

# Research & Development spending

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## Summary

Research and development (R&D) refers to creative and systematic work undertaken to increase the stock of knowledge.

### **Total R&D**

In the UK in 2018, total expenditure on R&D was £37.1 billion, £558 per head, or the equivalent of 1.7% of GDP.

R&D investment has risen steadily over the past few decades, from £20.0 billion in 1986 to the current total of £37.1 billion (in 2018 prices). This is a real terms increase of 94%.

But as a proportion of GDP, R&D expenditure has fallen over this period (it was the equivalent of 19% of GDP in 1986).

The Government has a target for total R&D investment to reach 2.4% of GDP by 2027.

### **Sectors funding R&D**

The business sector is the largest funder of R&D performed in the UK. In 2018, it funded £20.3 billion (55%) of R&D.

Public funding for R&D (government, research councils and the devolved higher education funding councils) was £9.6 billion in 2018, 26% of the total.

### **Sectors performing R&D**

The business sector performed R&D worth £25.0 billion in 2018, 68% of the total.

The public sector (including research councils and devolved higher education) performed £11.2 billion of R&D, 30% of the total.

### **R&D by region**

In 2018, R&D performed in the South East of England was worth £7.0 billion, 19% of the total. R&D performed in the South East, the East of England and London accounted for 53% of all UK R&D. Per head, R&D expenditure in the East of England is the highest: £1064 per head. The figure for the whole UK was £558 per head. In Wales, R&D expenditure is £250 per head.

### **R&D by sector**

In 2019, the pharmaceutical industry performed the most R&D in the UK – worth £4.8 billion. The automotive manufacturing industry performed the second most R&D, worth £3.4 billion.

In 2018, the pharmaceuticals sector employed the most the most people in R&D related roles: 29,000.

### **International comparisons**

The UK R&D expenditure of 1.7% of GDP is below the OECD average of 2.4%.

R&D expenditure in Germany is the equivalent of 3.1% of GDP, in the US it is 2.8% and in France it is 2.2%.

### **Top R&D performing companies**

The world's top three R&D performing companies are Alphabet (from the USA), which performed €23.2 billion of R&D in 2019, Microsoft (from the USA), which performed €17.2 billion, followed by Huawei (from China), which performed €16.7 billion and, which performed £12.9 billion.

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In the UK, the top company performing R&D was GlaxoSmithKlein, a pharmaceuticals company, which performed R&D worth £5.1 billion.

# 1. Introduction

## 1.1 Defining Research & Development

Research and Development (R&D) spending is analysed according to the internationally agreed “Frascati method” for collecting and reporting on research and experimental development, named after the town in Italy where the original Organisation for Economic Cooperation and Development (OECD) guidelines were first proposed in 1963.<sup>1</sup>

The Frascati Manual uses the following definition of R&D:<sup>2</sup>

...creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge.

For an activity to count as an R&D activity under the Frascati definition, it must be “novel, creative, uncertain [about what the final outcome will be], systematic and transferable/reproducible.”<sup>3</sup>

## 1.2 Key concepts in R&D spending

R&D is measured by the amount spent **performing** R&D by an organisation, or the **funding** provided to perform R&D. These are not always the same – for example, the higher education sector in the UK *performs* R&D worth around £8.7 billion, but the sector only provides direct *funding* for R&D worth £211 million.

These two ways of measuring R&D spending are different ways of analysing the same overall total expenditure for R&D, known as Gross Expenditure on R&D (GERD). GERD is the preferred way of measuring R&D spending in the UK, and for comparing R&D spending in different countries.

R&D is performed and funded by the following sectors: business, higher education, government (including the research councils in the UK) and private non-profit. Some funding for UK R&D also comes from overseas sources.

### Box 1: Sources for statistics on R&D spending

The key source for information of GERD is **ONS**, [Gross domestic expenditure on R&D](#). This is published each year in March.

R&D performed by businesses is further analysed in **ONS**, [Business enterprise research and development](#) which is published in November each year.

The best source for international comparisons of R&D spending is **OECD**, [Main science and technology indicators](#).

A useful source for company level R&D investment is **European Commission**, [EU Industrial R&D Investment Scoreboard](#).

<sup>1</sup> OECD, [Frascati Manual](#), 2015

<sup>2</sup> *Ibid*, p44

<sup>3</sup> *Ibid*, p45

## 2. Total R&D funding

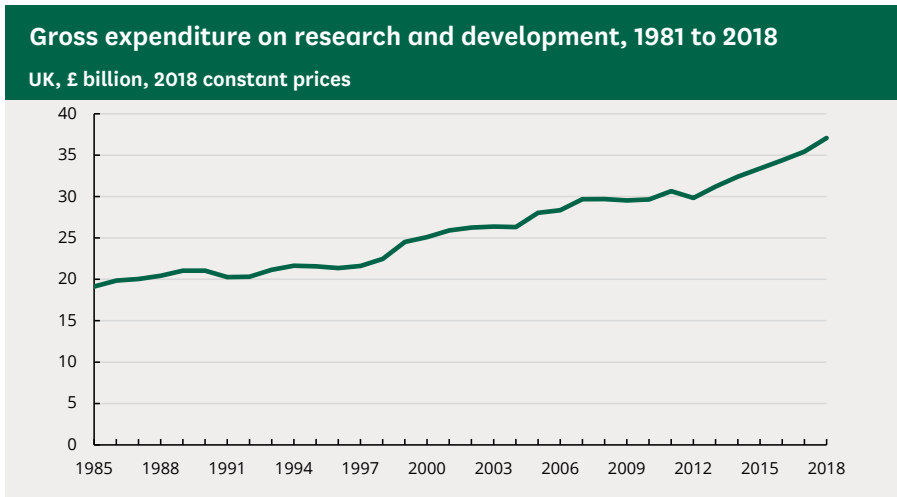
In the UK in 2018, total R&D (gross expenditure on research and development) was £37.1 billion, the equivalent of 1.7% of GDP. This was £558 per head.<sup>4</sup>

Total Research & Development spending in the UK				
	£ billion (current)	£ billion (2018 prices)	% of GDP	£ per head
2000	17.6	25.1	1.6%	298.6
2001	18.4	25.9	1.6%	310.8
2002	19.0	26.3	1.6%	320.9
2003	19.5	26.4	1.5%	327.4
2004	20.0	26.3	1.5%	334.1
2005	21.9	28.0	1.5%	361.9
2006	22.7	28.4	1.5%	373.7
2007	24.4	29.7	1.6%	398.5
2008	25.1	29.7	1.6%	405.5
2009	25.3	29.5	1.6%	407.0
2010	25.9	29.7	1.6%	412.4
2011	27.2	30.7	1.6%	429.2
2012	27.0	29.8	1.6%	423.5
2013	28.8	31.2	1.6%	448.8
2014	30.3	32.4	1.6%	468.8
2015	31.5	33.4	1.6%	483.4
2016	33.2	34.4	1.6%	505.4
2017	34.8	35.4	1.7%	526.6
2018	37.1	37.1	1.7%	558.0

Source: ONS, GERD statistics, 2019; Series [GLBA](#), [GLBD](#), [GLBH](#). Gross expenditure on research and development per head data uses ONS population estimates and current price data

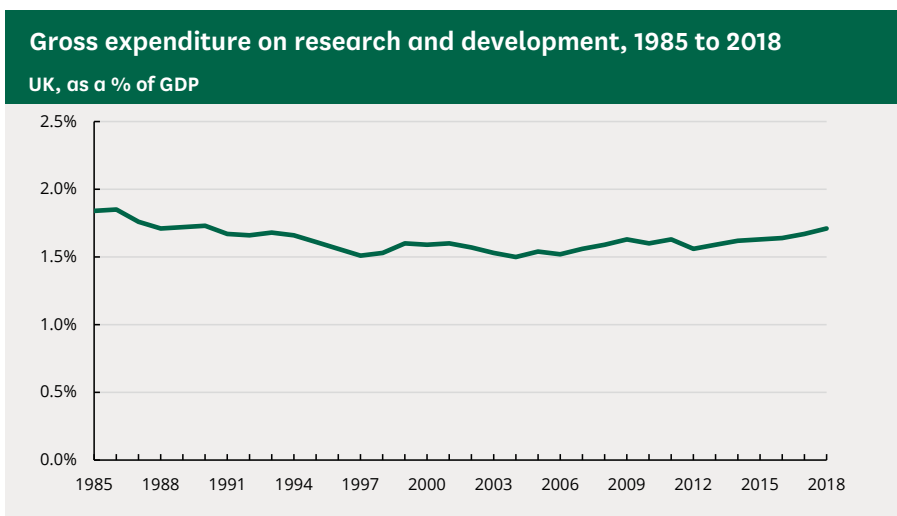
R&D investment in the UK has risen steadily over the past thirty years, from £19.1 billion in 1985 to the current total of £37.1 billion (in 2018 prices). This is a real-terms increase of 94% over the period.

<sup>4</sup> Unless otherwise stated, the data in this briefing paper is from ONS, [Gross expenditure on Research and Development](#), 2019



Source: ONS, [GLBD](#)

However, over the same period, R&D expenditure has fallen slightly as a proportion of GDP. R&D expenditure was the equivalent of 1.9% of GDP in 1986, compared to the 2018 figure of 1.8% of GDP. R&D expenditure as a % of GDP has risen slightly in each year since 2012.

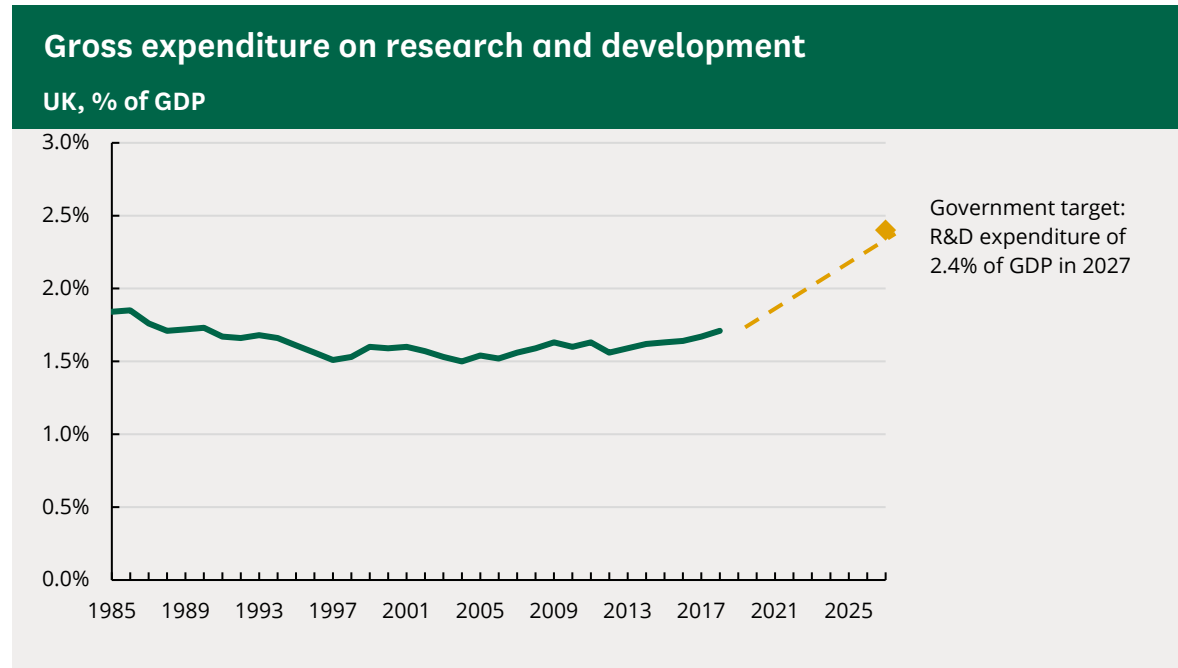


Source: ONS, [GLBH](#)

**Box 2: Government target for R&D expenditure to be 2.4% of GDP by 2027**

In its [Industrial Strategy](#) (published in November 2017), the government set a target to “...raise total R&D investment to 2.4% of GDP by 2027” (page 11).

In 2018, R&D expenditure was the equivalent of 1.7% of GDP.



Source: ONS, [GLBH](#) and Commons Library calculations

Increasing expenditure on R&D to the equivalent of 2.4% of GDP would lead to a record level of R&D investment in the UK. At 2.4% of GDP, R&D expenditure in the UK match the current OECD average.



### 3. R&D performance and funding

The following table shows the sectors funding and performing R&D in 2018.

For example, the government funded £3.1 billion of R&D in 2018 (not including research and higher education funding councils). Of this, £1.3 billion was performed by the government itself, with £1.2 billion performed by the business/enterprise sector. Total public funding of R&D, including research councils and devolved higher education funding councils, was £9.6 billion.

The business/enterprise sector performed £25.0 billion of R&D in 2018. £19.8 billion of this was funded by the business/enterprise sector, whilst £6.0 billion was funded by overseas sources, and £1.2 billion was funded by the government.

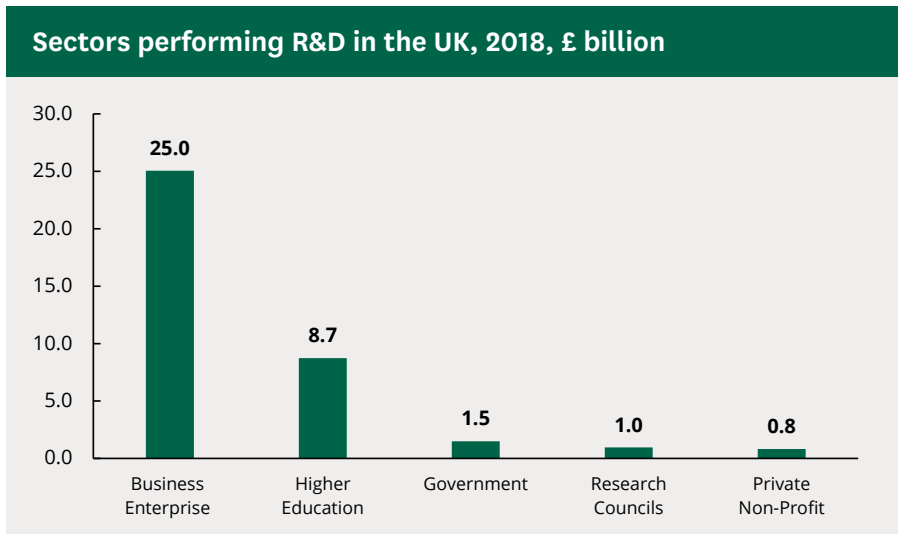
Total expenditure on R&D, by performing and funding sectors							
£ million, 2018, UK							
	Sector performing R&D					Total	Overseas
	Government	UK Research & Innovation	Higher Education	Business Enterprise	Private Non-Profit		
<i>Sector funding R&amp;D</i>							
Government	1,296	150	380	1,190	113	<b>3,129</b>	649
Research Councils	51	626	2,600	530	189	<b>3,996</b>	84
HE Funding Councils	-	-	2,492	-	-	<b>2,492</b>	0
Higher Education	4	18	-	179	10	<b>211</b>	0
Business Enterprise	16	54	389	19,832	25	<b>20,315</b>	5,955
Private Non-Profit	34	38	1,318	67	402	<b>1,860</b>	0
Overseas	97	75	1,562	3,250	84	<b>5,069</b>	0
<b>Total</b>	<b>1,498</b>	<b>962</b>	<b>8,740</b>	<b>25,048</b>	<b>823</b>	<b>37,072</b>	-
of which:							
Civil	1,331	962	8,693	23,363	810	<b>35,159</b>	-
Defence	168	-	47	1,685	14	<b>1,913</b>	-

Source: ONS, [Gross domestic expenditure on research and development](#)

### 3.1 Sectors performing R&D

The biggest R&D performing sector in 2018 was the business sector which performed R&D worth £25.0 billion, 68% of all R&D performed in 2018. The higher education sector performed R&D worth £8.7 billion, 24% of the total.

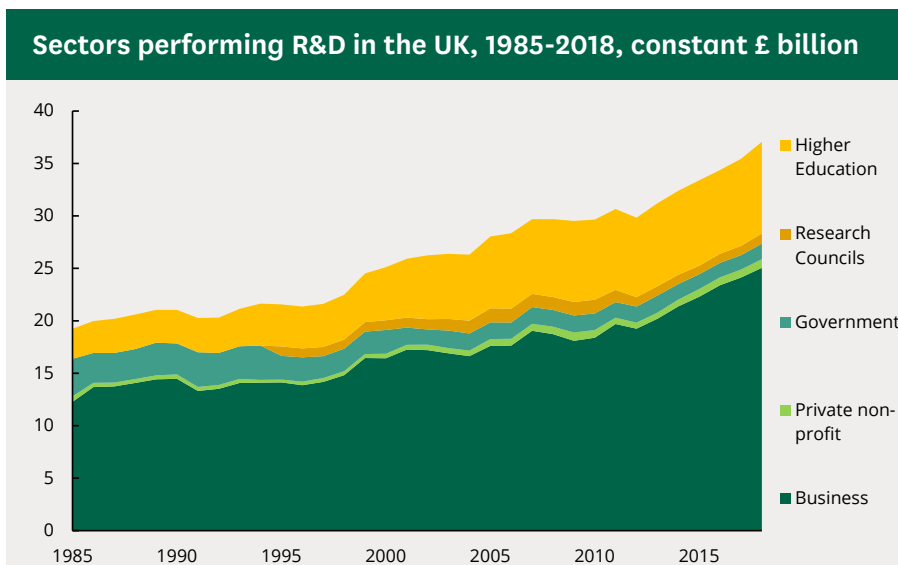
The government sector, including the research councils, performed £2.5 billion of R&D, 7% of the total. The following chart illustrates the amount of R&D expenditure performed by different sectors.



Source: ONS, [Gross domestic expenditure on research and development](#)

The chart below shows R&D performed by sector since 1985. In that year, R&D performed by the business sector was worth £12.3 billion (in 2018 prices), 64% of the total (compared to 68% in 2018).

Government and research councils performed 19% of the total in 1985 (and 7% in 2018). The higher education sector performed 15% of R&D in 1985 and 24% in 2018.

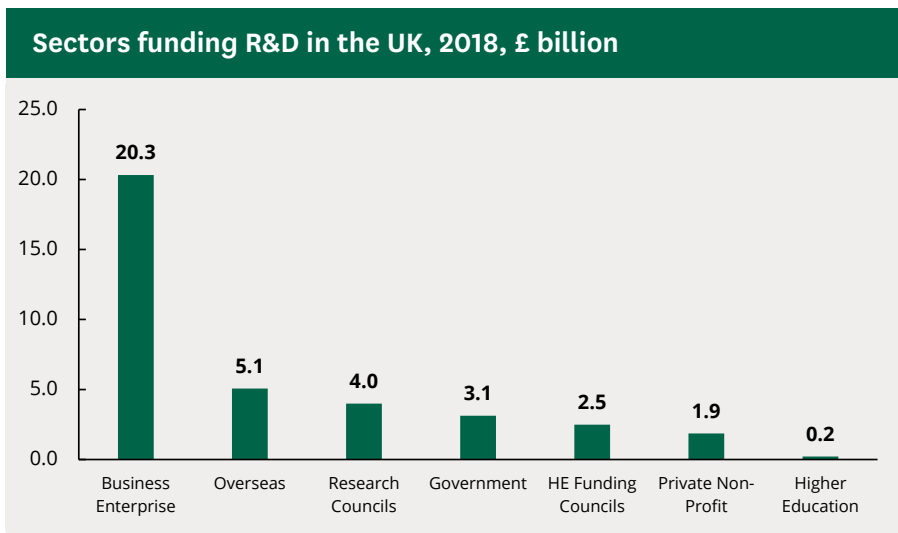


Source: ONS, [Gross domestic expenditure on research and development](#)

### 3.2 Sectors funding R&D

The business sector is also the largest sector funding R&D: £20.3 billion, 55% of the total in 2018.

The government (including the research councils and the HE funding councils, which were created in the mid-1990s, a change clearly visible in the chart), funded £9.6 billion R&D, 26% of the total.

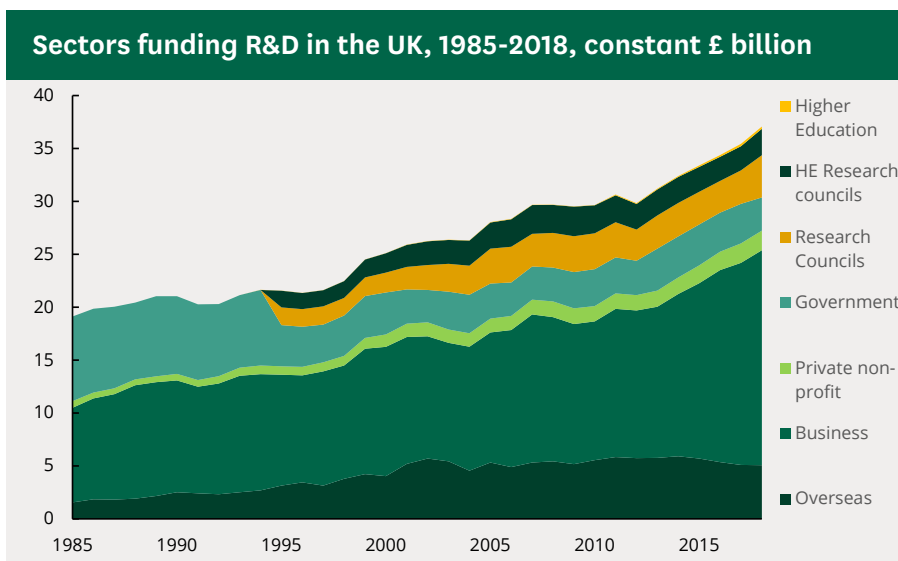


Source: ONS, [Gross domestic expenditure on research and development](#)

The proportion of R&D funded by government has fallen from 42% in 1985 to 26% in 2018 (including the research councils and the HE funding councils).

The proportion of R&D funded by business has increased from 47% in 1985 to the 2018 total of 55%.

Overseas funding of R&D has also increased over this period, from £1.6 billion (8%) in 1985, to £5.1 billion (14%) in 2017.



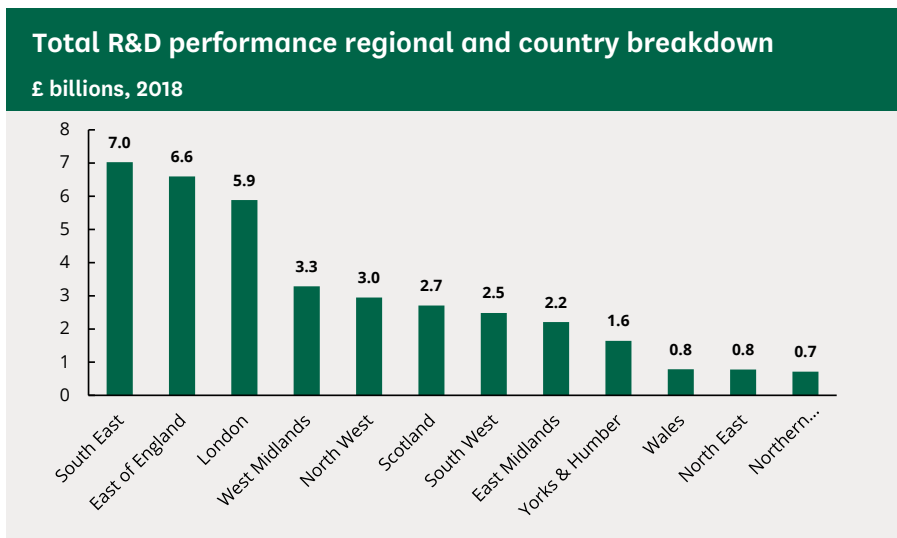
Source: ONS, [Gross domestic expenditure on research and development](#)

## 4. R&D by region

Total R&D expenditure is available broken down by the region and country of the UK in which it is performed.

In 2018, R&D expenditure performed in the South East totalled £7.0 billion, 19% of the total. R&D investment performed in the South East, the East of England and London was worth £19.5 billion, 53% of the UK total.

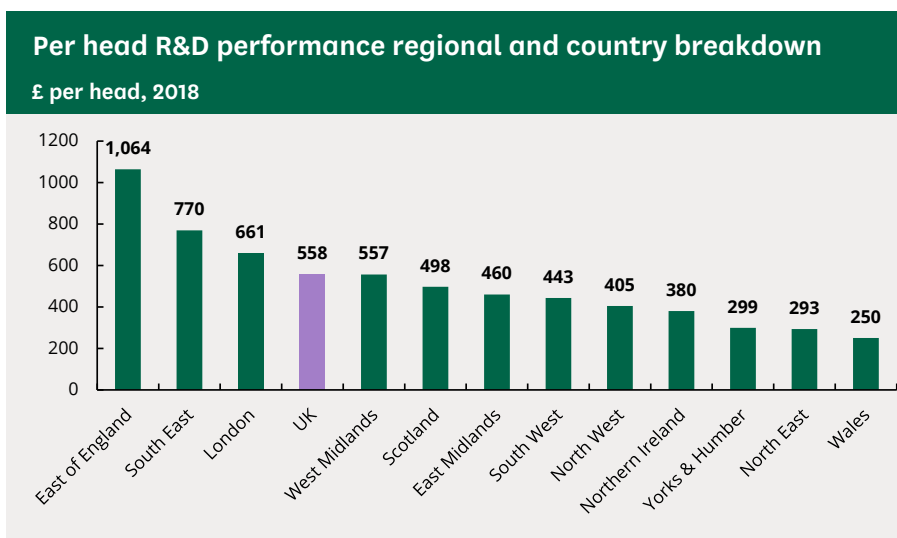
Wales, Northern Ireland and the North East of England saw less than £800 million worth of R&D investment each.



Source: ONS, Source: ONS, [Gross domestic expenditure on research and development](#), Regional tables

Per head R&D expenditure was £558 in the UK as a whole in 2018. In the East of England it was substantially higher – £1064 per head.

At the other end of the scale, the North East and Wales had R&D investment per head of £293 and £250.

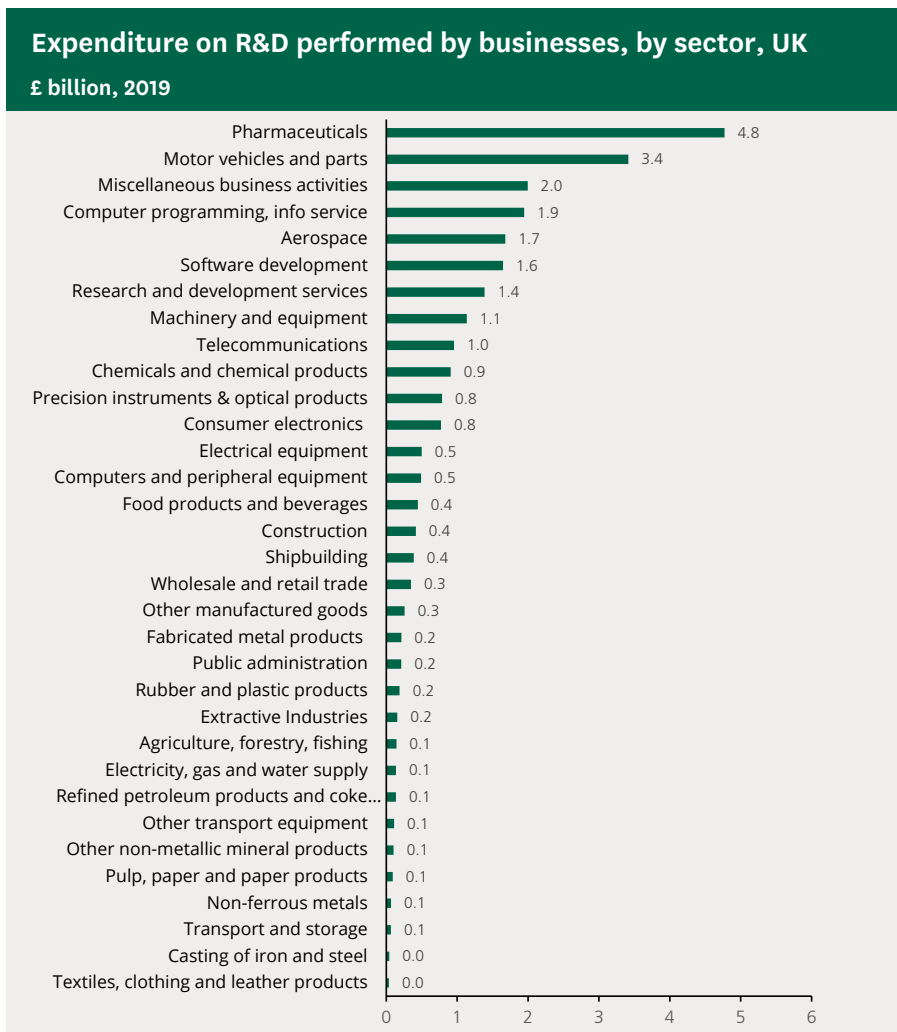


Source: ONS, Source: ONS, [Gross domestic expenditure on research and development](#); House of Commons Library calculations

## 5. R&D by sector

Expenditure on R&D performed by businesses is available broken down by sector.<sup>5</sup>

In 2019, the pharmaceutical industry performed the most R&D in the UK – worth £4.8 billion. The automotive manufacturing industry performed the second most R&D, worth £3.4 billion.



Source: ONS, [Business enterprise research and development, UK: 2019](#), Data table 2

<sup>5</sup> ONS, [Business enterprise R&D](#), November 2020

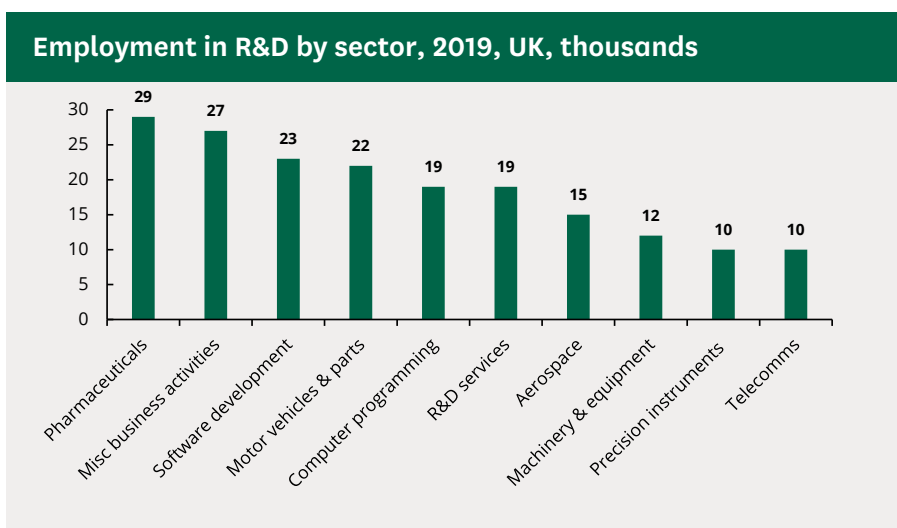
## 6. Employment in R&D

In 2019, there were 263,000 people working in R&D related roles in the UK. 50% of these (132,000) work were scientists or engineers. Technicians made up 29% of all R&D employment and administrative staff made up the remaining 21% of R&D staff.<sup>6</sup>

The following chart shows the number of R&D roles in the ten largest R&D employing sectors.

The pharmaceutical sector employs the most the most people in R&D related roles at 29,000, equal to 11% of all people employed in R&D in 2019.

In 2019, 263,000 people worked in R&D related roles in the UK



Source: ONS, [Business enterprise research and development, UK: 2019](#), data table 13

<sup>6</sup> ONS, [Business enterprise R&D 2019](#), November 2020

## 6.1 Historic R&D employment

The following chart shows employment performing R&D in UK companies since 2008.

Since 2008, employment in R&D roles in the UK has increased steadily. There has been an increase of over 100,000 between 2008 and 2019.

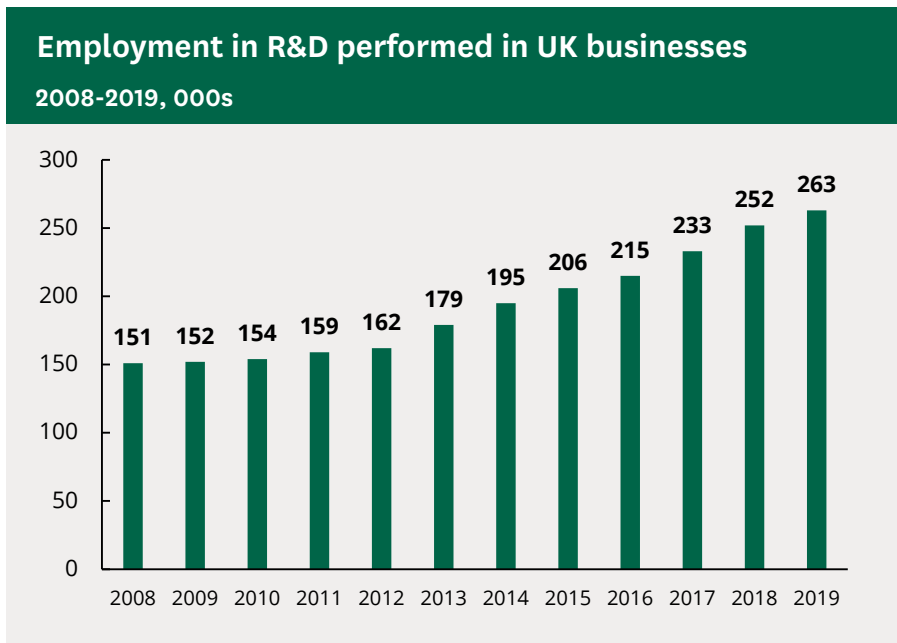
Over the past year, employment in R&D has increased by 11,000 or 7%.

The increase in R&D related employment has been driven by an increase in civil R&D employment, which has increased by 114,000 or 86% between 2008 and 2019. Defence R&D employment has fallen by 2,000 or 11%.

In 2008, civil R&D employment made up 87% of all R&D employment compared to 94% in 2019.

R&D employment has increased by 112,000 since 2008

94% of R&D employment is in civil R&D.



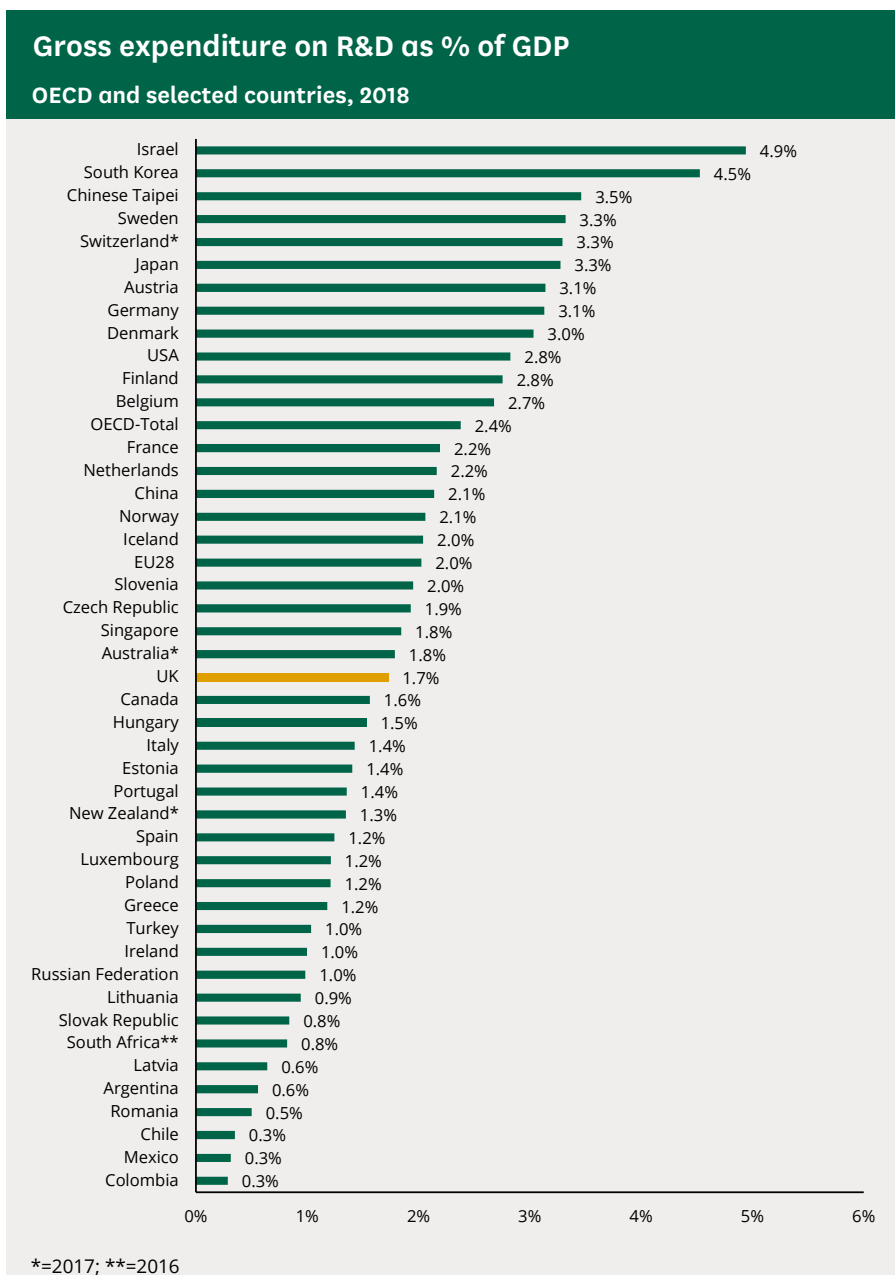
ONS, [Business enterprise research and development, UK: 2019](#), data table 14

## 7. R&D: international comparisons

The following chart shows total R&D investment as a proportion of GDP in each of the Organisation for Economic Co-operation and Development (OECD) member countries and several other major economies such as China<sup>7</sup>

UK R&D investment equivalent to 1.7% of GDP in 2018 is below the EU28 average of 2.0%, and below the OECD average of 2.4%.

UK has a lower level of R&D investment than competitor countries such as the France (with R&D investment equivalent to 2.2% of GDP), the US (2.8%) and Germany (3.1%).



Source: OECD, [Main Science and Technology Indicators](#), Volume 2020, Issue 1

<sup>7</sup> OECD, [Main science and technology indicators](#), Volume 2020, Issue 1



## 8. Top 10 R&D companies

The European Commission publishes an annual ranking of companies by the amount of R&D they perform.<sup>8</sup> The table below shows the top ten R&D funding companies in the world in 2019.

Alphabet (Google's parent company) funded more R&D than any other company in the world in 2019 – €23.2 billion, 24% up on the previous year. Microsoft funded €17.2 billion 2019, up 14% on the year. Six of the top ten R&D funding companies were in the US; two were in Europe and two were in Asia.

World top 10 companies performing R&D in 2019					
World rank	Company	Country	Industry	R&D funding (€ billion)	% change on year
1	Alphabet	US	Software & Computer Services	23.2	24%
2	Microsoft	US	Software & Computer Services	17.2	14%
3	Huawei	China	Technology Hardware & Equipment	16.7	31%
4	Samsung	South Korea	Electronic & Electrical Equipment	15.5	8%
5	Apple	US	Technology Hardware & Equipment	14.4	14%
6	Volkswagen	Germany	Automobiles & Parts	14.3	5%
7	Facebook	US	Software & Computer Services	12.1	32%
8	Intel	US	Technology Hardware & Equipment	11.9	-1%
9	Roche	Switzerland	Pharmaceuticals & Biotechnology	10.8	6%
10	Johnson & Johnson	US	Pharmaceuticals & Biotechnology	10.1	5%

Source: European Commission, [The 2020 EU Industrial R&D Investment Scoreboard](#)

The following table shows the top ten R&D funding companies in the world in 2019.

GlaxoSmithKline was the highest funding R&D UK company in the 2019, funding R&D worth €5.1 billion. This is slightly more than AstraZeneca funded in 2019 (€4.8 billion).

UK top 10 companies performing R&D in 2019				
World rank	Company	Industry	R&D funding (€ billion)	% change on year
29	GlaxoSmithKline	Pharmaceuticals & Biotechnology	5.1	16%
32	Astrazeneca	Pharmaceuticals & Biotechnology	4.8	2%
84	HSBC	Banks	1.9	17%
123	Rolls-Royce	Aerospace & Defence	1.3	-2%
135	Lloyds Banking	Banks	1.2	-1%
160	APTIV	Automobiles & Parts	1.0	1%
169	Barclays	Banks	1.0	206%
193	Royal Dutch Shell	Oil & Gas Producers	0.9	-2%
198	Unilever	Food Producers	0.8	-7%
253	BT	Fixed Line Telecommunications	0.6	1%

Source: European Commission, [The 2020 EU Industrial R&D Investment Scoreboard](#)

<sup>8</sup> European Commission, [The 2020 EU Industrial R&D Investment Scoreboard](#), January 2020; [R&D ranking of the world's top 2,500 companies](#)

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