



A National Statistics publication for Scotland



The Scottish
Government
Riaghaltas na h-Alba

BUSINESS AND ENERGY

Gross Expenditure on Research and Development Scotland 2019

This annual publication presents information on research and development (R&D) undertaken by businesses, higher education, government and private non-profit sectors in Scotland in 2019, as well as revisions to published data for earlier years. The majority of data in this publication are sourced from surveys conducted by the Office of National Statistics (ONS). Further information about Scottish R&D activity and the full set of tables can be found at:

<https://www.gov.scot/collections/business-and-innovation-statistics/>

The Gross Expenditure on R&D (GERD) publication is used by the Scottish Government to monitor performance and inform policies. External users of R&D statistics, published by the Scottish Government, include the Enterprise Networks and Local Authorities.

This publication provides information on the National Performance Framework (NPF) Indicator: Spend on Research and Development¹, which measures Scotland's GERD as a percentage of GDP.

¹ Information on the range of targets and indicators which comprise the National Performance Framework can be found on the website: <https://nationalperformance.gov.scot/>

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1. Gross Expenditure on Research and Development

Gross Expenditure on R&D (GERD) comprises R&D undertaken by the Business Enterprise (BERD), Higher Education (HERD), Government (GovERD) and Private Non-Profit (PNP) sectors.

1.1 Key points

- Scotland's GERD was £2,789 million in 2019, 7.2% of the UK total. For Scotland this represents an increase of 0.4% in real terms on 2018 (+£11 million) - UK GERD increased by 0.9%. In Scotland, GERD is at its highest level in the series (which goes back to 2001).
- Scotland's GERD in 2019 represented 1.66% of Gross Domestic Product (GDP), below that for the UK (1.74%), the EU (2.10%) and the OECD (2.47%). Spending on R&D in Scotland remained constant at 1.66% of GDP between 2018 and 2019.
- Scotland's BERD spend is still relatively low compared with other countries: in 2019, Scotland's BERD spend as a share of GDP ranked eighth of the twelve countries/regions of the UK, and ranked in the third quartile of the OECD. Scotland's BERD spend was £1,409 million in 2019 - up 1.5% in real terms between 2018 and 2019, compared to a 0.8% real terms increase for the UK over the same period.
- Scotland's HERD spend was £1,150 million in 2019 – down 0.3% in real terms between 2018 and 2019, compared to a 1.3% increase for the UK. Scotland's HERD expenditure as a share of GDP ranked top of the twelve countries/regions of the UK, and ranked seventh highest (top quartile) in the OECD in 2019.

2. Scottish Government's National Indicator on R&D

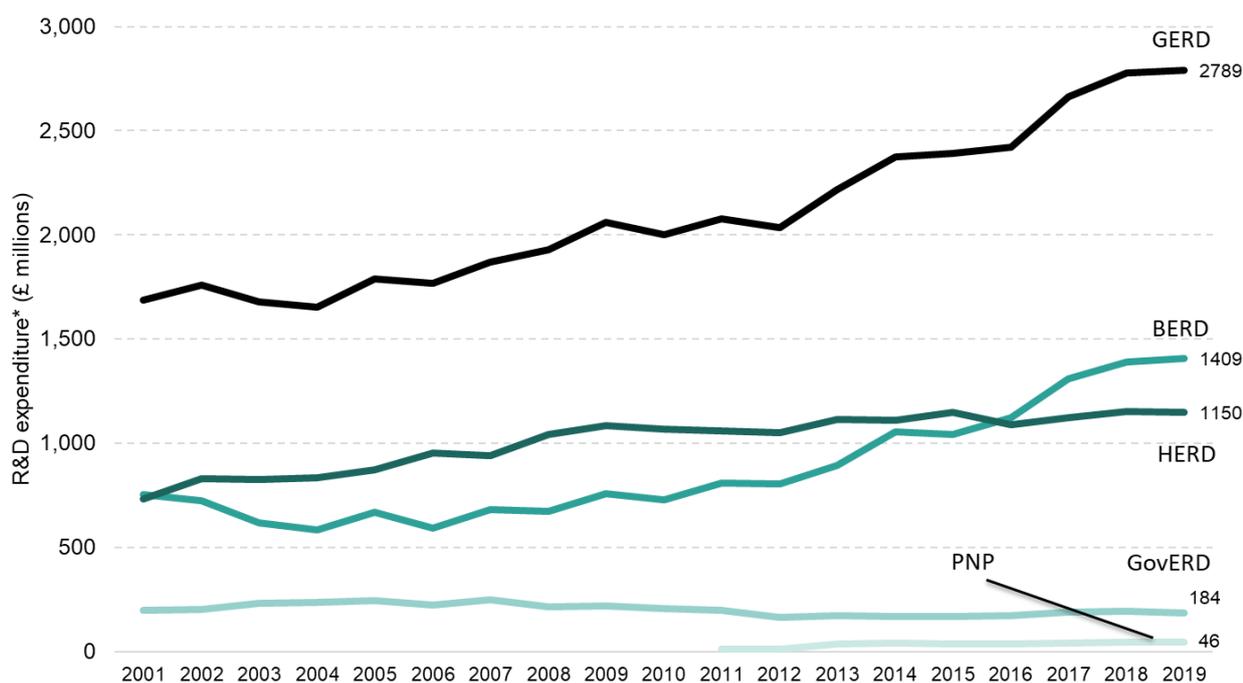
The Scottish Government's National Performance Framework assesses Scotland's progress against 11 National Outcomes. To do this, 'national indicators' are used to track progress.

'Spend on Research and Development' is one of the 'national indicators' under the 'Economy' National Outcome. This indicator measures Gross Expenditure on Research and Development (GERD) as a percentage of GDP. In 2019, total research and development spending (GERD) as a share of GDP was 1.66% for Scotland. Spending on R&D in Scotland remained constant between 2018 and 2019, at 1.66% of GDP².

3. Expenditure and components of GERD

In 2019, Scotland's GERD was £2,789 million, 7.2% of the total UK GERD (Table 3A). Between 2018 and 2019, Scotland's GERD increased by 0.4% in real terms, up £11 million, from £2,778 million in 2018 (Figure 1). In comparison, UK GERD increased by 0.9% in real terms over the same period. Over the longer term, Scotland's GERD increased by 49.3% between 2007 and 2019 (Table 1B), whereas across the UK, GERD increased by 25.9%.

Figure 1. GERD, BERD and PNP increased between 2018 and 2019. GERD, BERD and PNP reached their highest level in the time series in 2019.



*2019 prices

Source: ONS and the Scottish Government

² Please note that these figures are back revised every year, as GDP series are back revised, and these figures are therefore not comparable with those previously published.

3.1 Business Enterprise Research and Development (BERD)

In 2019, Business Enterprise Research and Development expenditure was £1,409 million in Scotland, 5.4% of the total UK BERD spend (Table 4A). Between 2018 and 2019, Scotland's BERD spend increased by 1.5% (£21 million) in real terms, from £1,388 million in 2018 (Table 1B). Over the same time period, UK BERD expenditure increased by 0.8% in real terms. In 2019, BERD continued to be the largest component of Scotland's GERD (Figure 1).

Over the longer term, Scotland's BERD spend increased 107.2% between 2007 and 2019, whereas UK BERD spend increased by 32.2% in real terms. At 0.84%, Scotland's BERD spend as a percentage of GDP was below that of the UK (1.17%) in 2019, but higher than it was in 2018 (0.83%).

3.2 Higher Education Research and Development (HERD)

In Scotland, HERD spend was £1,150 million in 2019, 0.3% lower (£4 million) in real terms than it was in 2018 (Table 1B). Scottish HERD spend represented 12.7% of the total UK HERD expenditure (Table 5A), which increased by 1.3% between 2018 and 2019.

Over the longer term, HERD spend in Scotland increased by 22.3% between 2007 and 2019, compared to a 23.6% real terms increase during this period in the UK. As a share of GDP, Scotland's HERD spend (0.69%) was higher than that of the UK (0.41%) in 2019.

3.3 Government Expenditure on Research and Development (GovERD)

In 2019, GovERD in Scotland was £184 million, 4.7% (£9 million) lower in real terms than in 2018 (Table 1B). It represented 6.9% of the total GovERD in the UK, which decreased by 0.2% in real terms between 2018 and 2019 (Table 6A). GovERD as a percentage of GDP was 0.11% for Scotland and 0.12% for the UK in 2019. This was the only component of GERD that decreased over the longer term, falling by 25.8% in Scotland and 9.6% in the UK, between 2007 and 2019.³

3.4 Private Non-Profit (PNP) Research and Development

In Scotland, PNP R&D spend was £46 million in 2019, 5.5% of the UK total and 0.03% of GDP (Table 7A and 7B). Between 2018 and 2019, Scotland's PNP R&D spend increased by 4.5% (£2 million; Table 1B), compared to 3.7% in the UK.

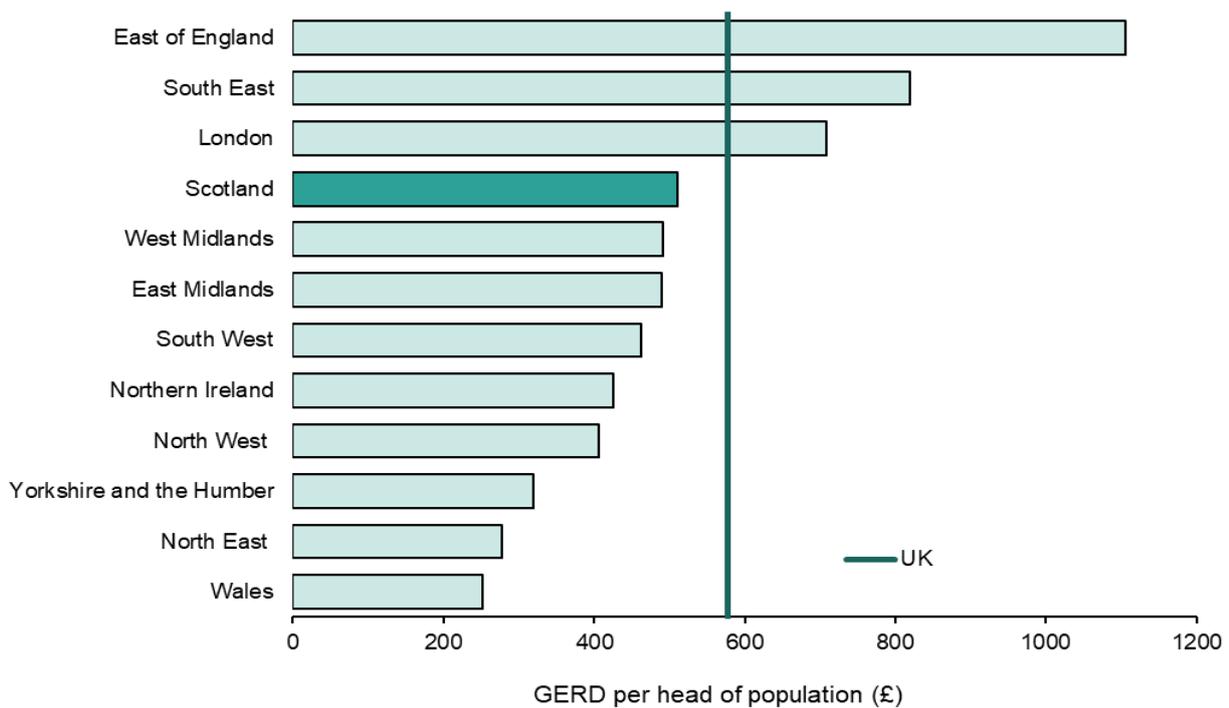
³ Further details on Government expenditure on Research and Development can be found in the [ONS publication SET Statistics – Science, engineering and technology indicators](#). This publication contains historic expenditure on research and development by the Scottish Government from the annual ONS Government Research and Development Survey.

4. Comparisons with UK countries/regions

GERD represented 1.66% of GDP in Scotland, whereas it was over twice as high in the East of England (3.54%). Scotland remained in fifth place among the 12 regions/countries of the UK for GERD as a percentage of GDP, behind the East of England, South East, East Midlands and West Midlands. London had the fourth lowest GERD as a percentage of GDP (1.25%).

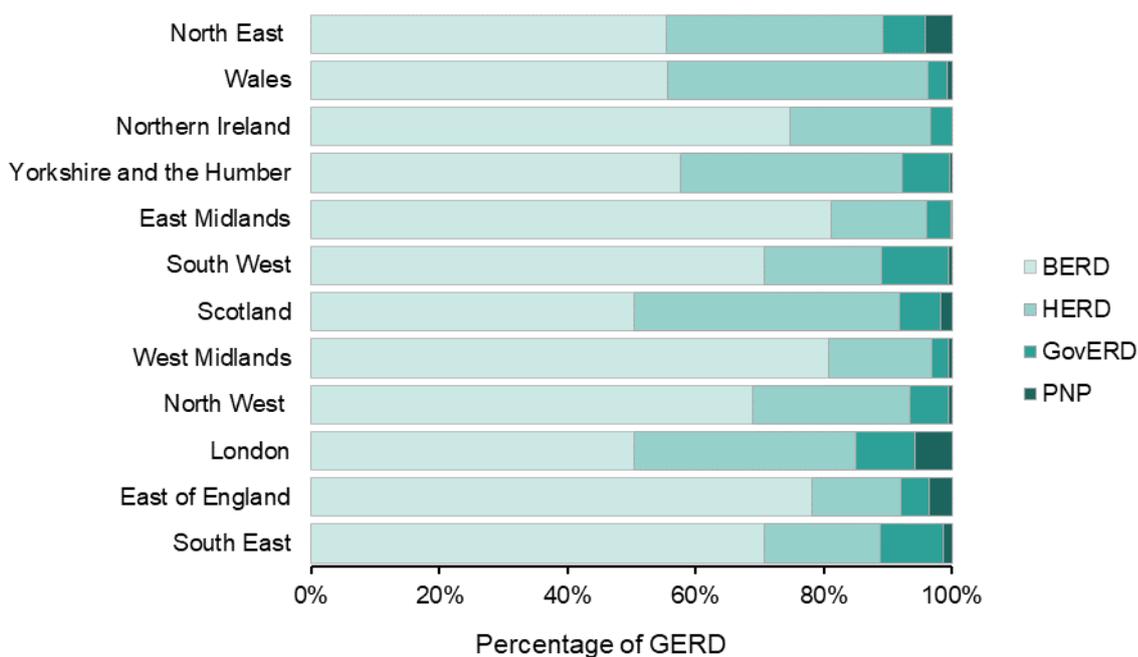
In 2019, GERD per head of population in Scotland was £510, lower than the average across the UK, which was £577 (Table 2). The East of England had the highest GERD per head, £1,106, which was more than double that for Scotland, and Wales had the lowest, £252. In terms of spend per head, Scotland was in fourth place among the UK regions/countries in 2019 (Figure 2). This was one place higher than in 2018, when Scotland ranked fifth.

Figure 2. In 2019, GERD per head of population was highest in the East of England and lowest in Wales. Scotland had the fourth highest GERD per head.



The composition of GERD varies considerably between the UK regions/countries (Figure 3). In Scotland BERD spend made up 50.5% of total GERD, which was low compared to some of the other regions, like the East Midlands, where BERD spend made up 81.2% of GERD. On the other hand, HERD spend made up a larger proportion of total GERD (41.2%) in Scotland than in most other regions, such as in the East of England, where HERD spend only comprised 14.0% of GERD.

Figure 3. In Scotland and London, BERD spend made up a relatively small proportion of GERD compared to other regions. HERD made up a larger proportion of GERD in Scotland and Wales compared to other regions.

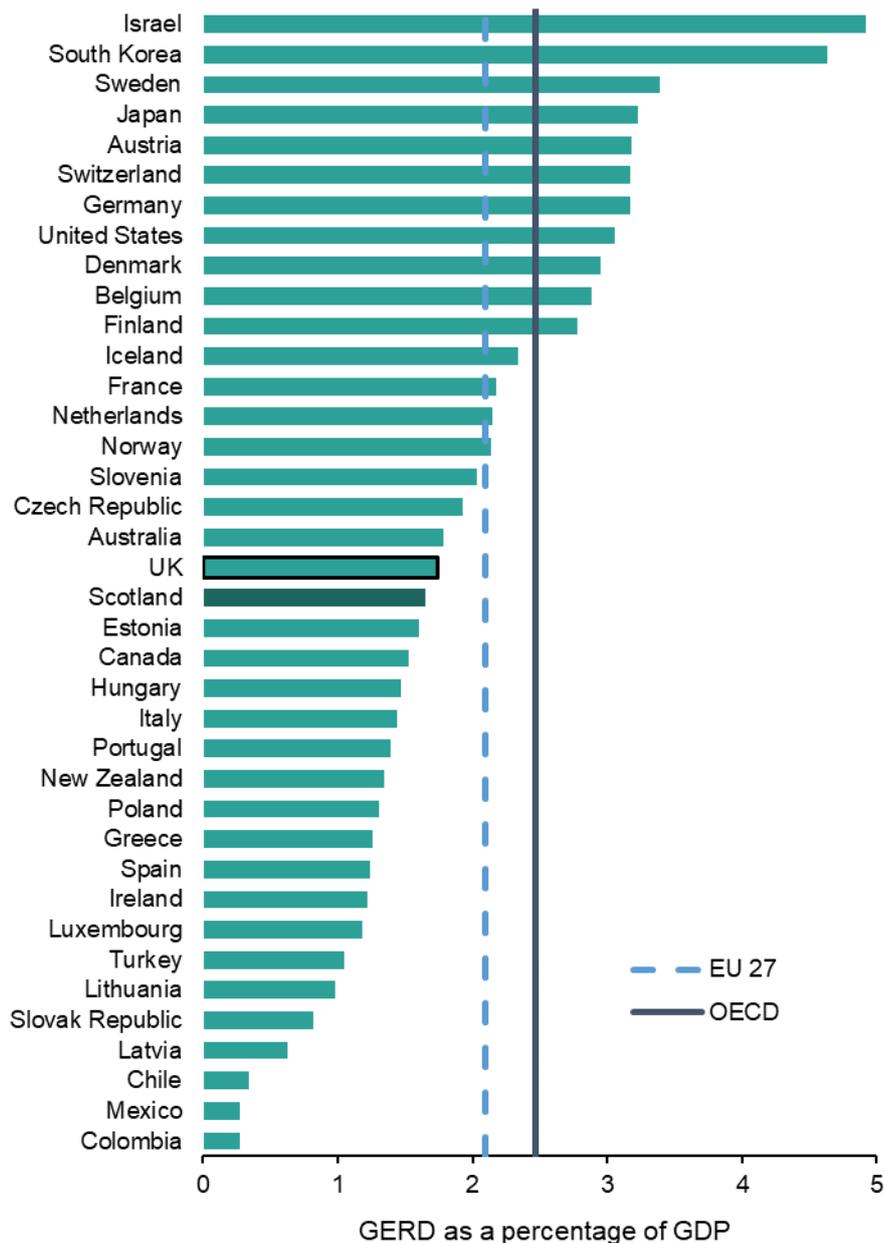


In terms of BERD spend as a percentage of GDP, Scotland ranked eighth amongst the 12 countries/regions of the UK (Table 4A), whereas Scotland ranked top for HERD spend as a percentage of GDP (Table 5B).

5. EU and OECD comparisons

At 1.66%, Scotland's GERD as a percentage of GDP was below that of the EU (2.10%) and the OECD (2.47%) in 2019. As a result Scotland's GERD as a percentage of GDP ranked in the third quartile of the OECD countries in 2019, as it did in 2018 (Table 8A & Figure 4).

Figure 4. Scotland's GERD as a percentage of GDP was below that of the UK, EU and OECD averages in 2019.

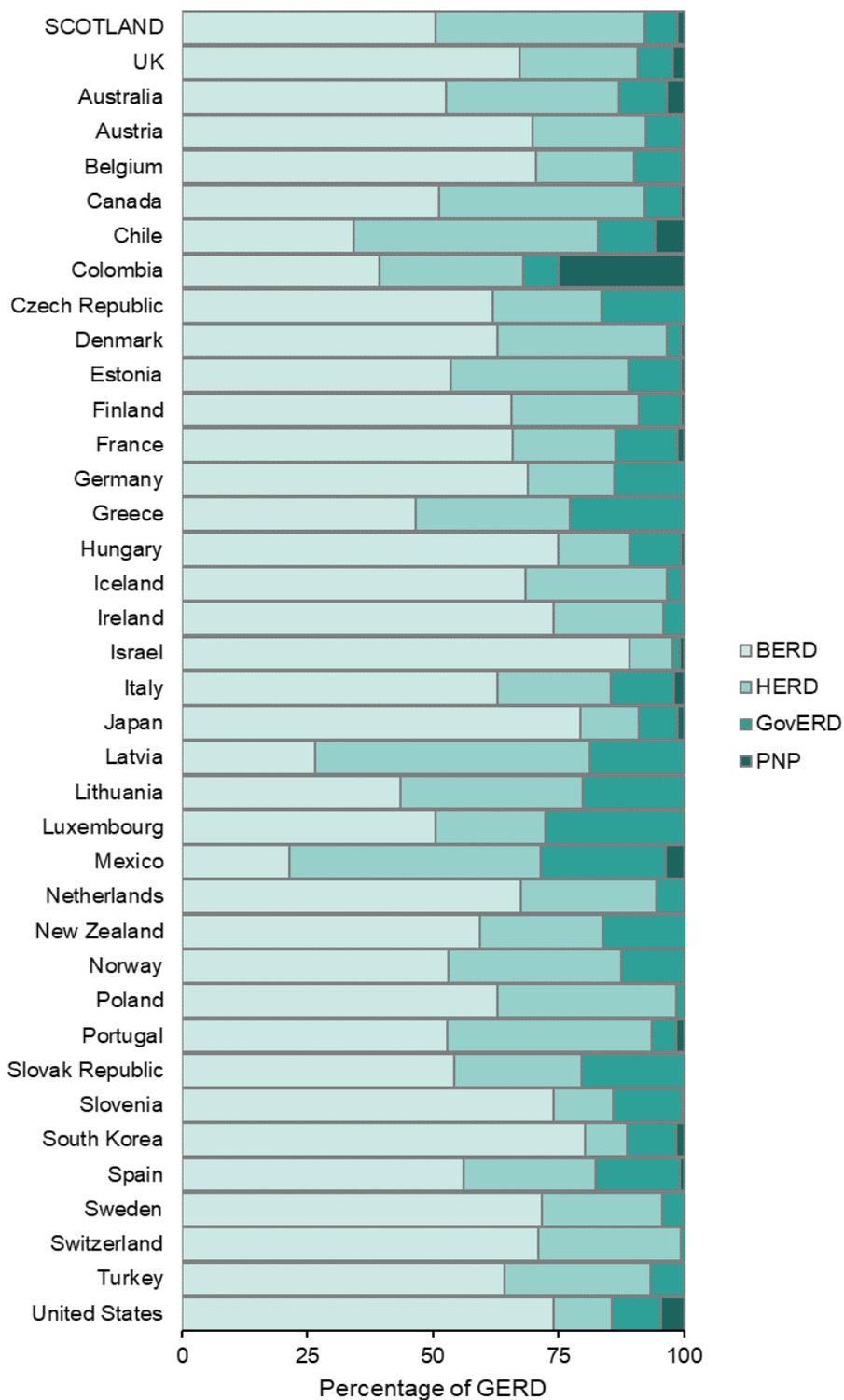


Source: MSTI, ONS and the Scottish Government

Note: Australia, New Zealand, Switzerland, and Chile did not report in 2019. 2018 data is used for Chile, and 2017 data is used for Australia, New Zealand and Switzerland.

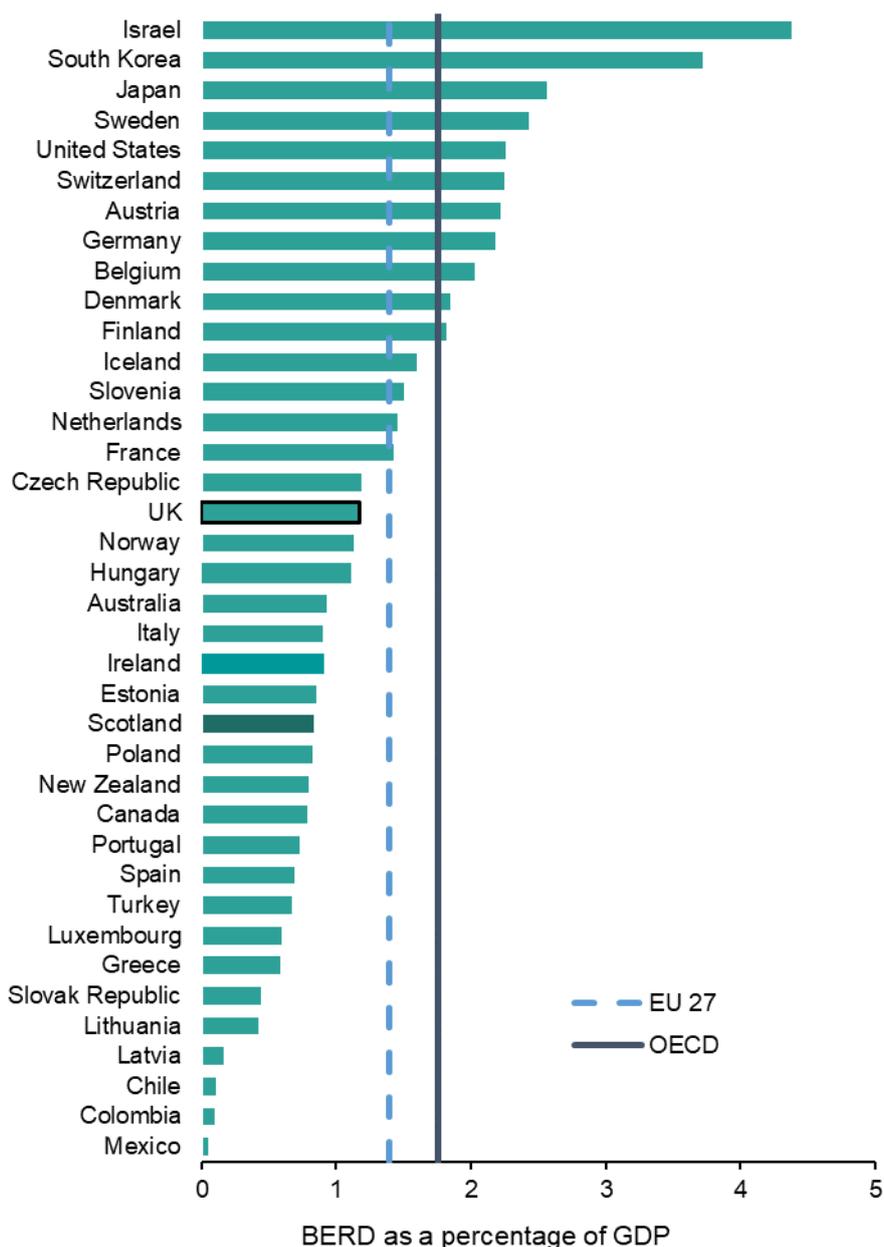
Among the OECD countries the composition of GERD varies considerably: in Scotland HERD spend comprised a larger proportion of GERD than in most other OECD countries. Both BERD spend and GovERD made up a smaller proportion of GERD in Scotland than in many other OECD countries (Figure 5).

Figure 5. Compared to most other OECD countries, Scotland’s HERD spend made up a relatively large proportion of total GERD, and Scotland’s BERD spend and GovERD made up a relatively small proportion.



At 0.84%, Scotland's BERD spend as a percentage of GDP ranked in the third quartile of the OECD countries in 2019, well below the EU (1.39%) and OECD (1.76%) averages, whereas the UK ranked in the second quartile (Table 8B & Figure 6). Although there was no change in the quartile positions between 2018 and 2019, the gap between BERD as a percentage of GDP in Scotland and the OECD increased by 0.03 percentage points, from 0.89 percentage points in 2018 to 0.92 percentage points in 2019.

Figure 6. Scotland's BERD spend as a percentage of GDP was well below that of the UK, EU and OECD averages in 2019.

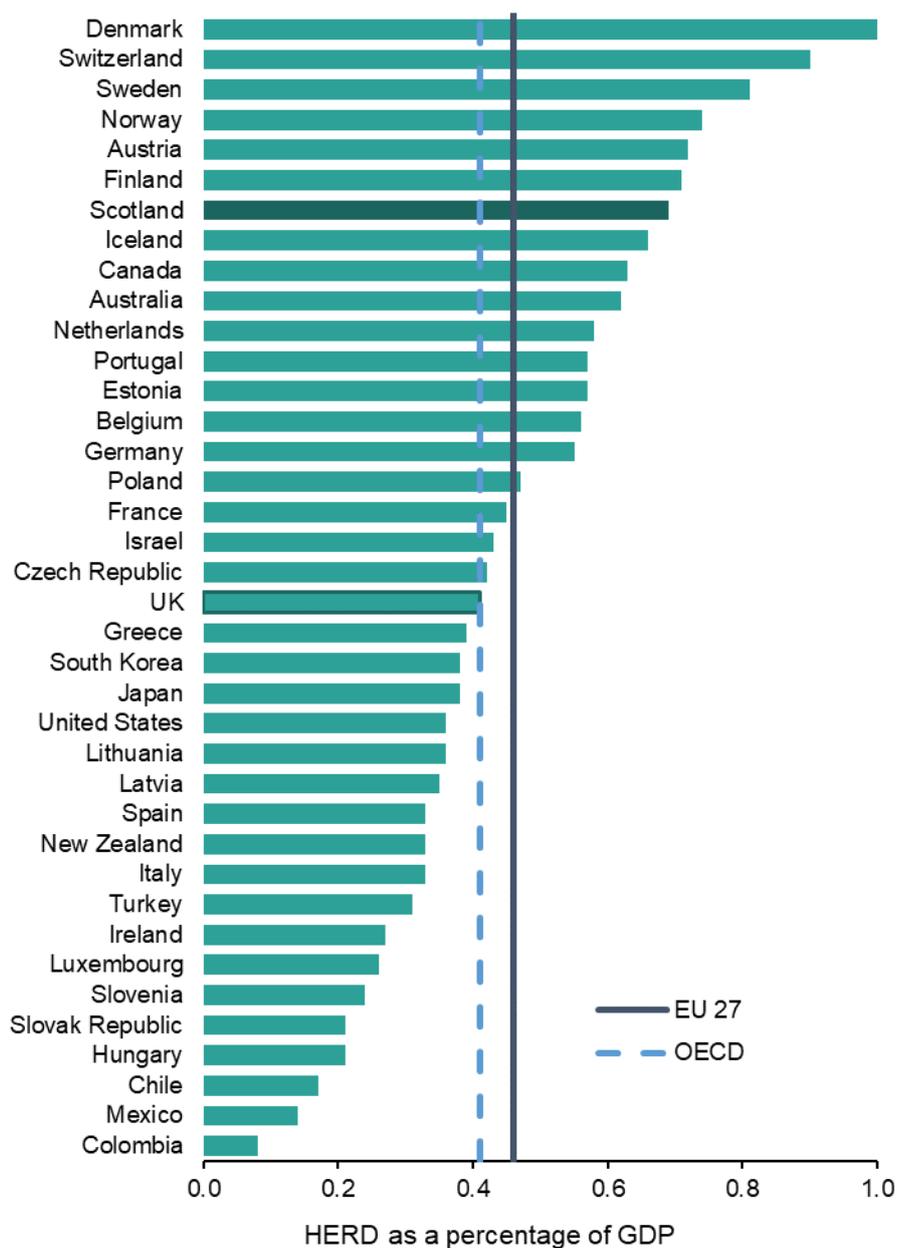


Source: MSTI, ONS and the Scottish Government

Note: Australia, New Zealand, and Switzerland, and Chile did not report in 2019. 2018 data is used for Chile and New Zealand, and 2017 data is used for Australia, and Switzerland.

In 2019, Scotland ranked seventh among the OECD countries for HERD spend as a percentage of GDP, putting it in the first quartile, whereas the UK ranked in the third quartile. In 2019, HERD spend as a percentage of GDP in Scotland was 0.69% compared to 0.41% in the OECD (Table 8C & Figure 7).

Figure 7. Scotland ranked seventh among the OECD countries for HERD spend as a percentage of GDP in 2019, well above the UK, EU and OECD averages.

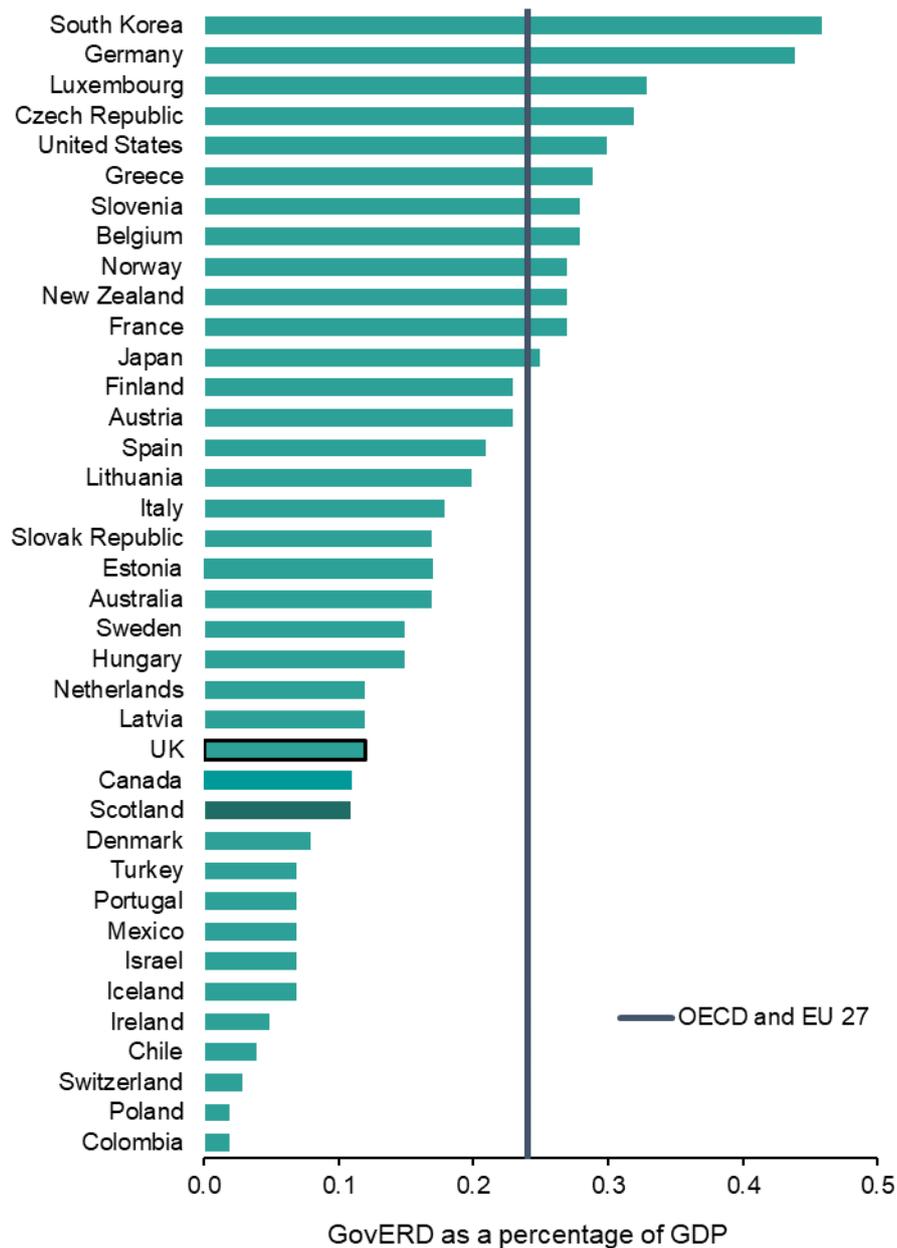


Source: MSTI, ONS and the Scottish Government

Note: Australia, New Zealand, Switzerland, Chile and United States did not report in 2019. 2018 data is used for Australia, Chile, and United States. 2017 data is used for New Zealand and Switzerland.

In 2019, Scotland ranked in the third quartile for GovERD as percentage of GDP (0.11%), at less than half the level of the EU (0.24%) and OECD (0.24%). GovERD as a percentage of GDP decreased slightly in Scotland between 2018 and 2019 (from 0.12%, to 0.11%) and decreased by 0.05 percentage points over the longer term from 2001 to 2019 (Table 8D & Figure 8).

Figure 8. Scotland and the UK are in the third quartile for GovERD as a percentage of GDP in 2019, well below the EU and OECD averages.



Source: MSTI, ONS and the Scottish Government

Note: Australia, New Zealand, and Switzerland, and Chile did not report in 2019. 2018 data is used for Chile and Australia, and 2017 data is used for New Zealand, and Switzerland

6. Technical Notes

6.1 Sampling and regional Estimates

1. This release presents estimates of Gross Expenditure on Research and Development (GERD) in Scotland in 2019. The majority of the data presented in this release come from Research and Development (R&D) surveys conducted by the Office for National Statistics (ONS). This latest release includes the estimates for R&D expenditure in 2019 carried out by the following sectors of the economy in Scotland:

- Business Enterprise
- Higher Education
- Government, which includes Research Councils
- Private Non-Profit

More detailed information on Scottish Business Enterprise R&D (BERD) specifically is available at:

<https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2020/12/business-enterprise-research-and-development-2019/documents/business-enterprise-research-and-development-2019-report/business-enterprise-research-and-development-2019-report/govscot%3Adocument/BERD%2B2019%2Bpublication%2B-FINAL.pdf>

The ONS GERD Statistical Bulletin is available at:

<https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/bulletins/ukgrossdomesticexpenditureonresearchanddevelopment/2019>

2. GERD is the measure most commonly used for international comparisons. It covers all R&D performed in the country concerned, irrespective of who pays for it, including funding from abroad. However, it excludes R&D performed abroad even if it is funded from the UK. The components of GERD relate to R&D performed in four sectors of the economy:
3. **Business** (BERD) – The UK BERD survey sample size is approximately 5,400 businesses (4,000 in GB and 1,400 in NI). The response rate for the 2019 BERD survey in Great Britain was 56%, which was lower than usual because of the coronavirus (COVID-19) pandemic. The rate for 2018 was 84%. This means that these estimates are subject to more uncertainty than usual because of fewer responders on which to base the survey results.
4. For Great Britain, a stratified random sample is used where the strata are defined as: businesses that have previously reported R&D expenditure above a threshold (greater than £5.7 million for the 2019 survey (referred to as “large R&D performers”)). The remaining businesses identified as (or potential) R&D

performers (referred to as “smaller R&D performers”) are allocated into strata using their employment and industry product group.

5. In 2019, the large R&D performers accounted for around 80% of total expenditure. Each of these large R&D performers is asked to name all the sites at which the business performed R&D and to estimate the R&D spend at that site, this expenditure is then allocated to the appropriate region. Regional data for the smaller R&D performers are estimated from sample returns.
6. **Government (GovERD)** – an annual census of the government sector collects R&D expenditure by region. The methodology for producing regional estimates of expenditure on R&D for the government (including research councils) sector was reviewed by the ONS (2015 figures onwards). Estimates previously used departments’ full-time equivalent (FTE) R&D employees by region as a proxy to calculate regional expenditure. Departments now provide actual breakdowns of their R&D expenditure by region.
7. **Higher Education Research and Development (HERD)** – estimated by the Higher Education Funding Councils (HEFC) for England, Scotland, Wales and the Department for Education in Northern Ireland.
8. **Private Non-Profit (PNP)** – data are collected in a biennial survey which was introduced in 2011 with around 200 organisations being selected. The estimates from this survey were used in the compilation of the 2011 UK GERD publication, the first time since 2003 reference year. Previously, UK estimates had been based on a number of different sources. Each organisation is asked to provide the workplace postcodes for all the sites at which the organisation performed R&D, and to allocate the total expenditure figures of the organisation performed R&D, and to allocate the total expenditure figures of the organisation to the sites on a percentage basis. As this survey is a census, any non-responder’s expenditure estimates are allocated regionally using the county region codes from the business register.
9. The PNP survey is run biennially, so this survey was last run in 2020 to collect 2019 data. The next survey will run in 2022 to collect 2021 data from an updated list of R&D performers in this sector. Results for the PNP sector as a performer in 2012, 2014, 2016 and 2018 have therefore been estimated. Estimates of the PNP sector for Scotland are available from 2011 onwards.
10. **Coronavirus (COVID-19)** - The effect the coronavirus (COVID-19) pandemic has had on the collection of the data contained in this statistical bulletin has varied between sectors. The business and private non-profit sectors have been subject to lower response as a result, with the higher education sector witnessing more of a delay in reporting rather than a lower response rate overall. The government sector has been unaffected.
11. ONS have produced, as part of the UK GERD release, a summary quality report for the GERD output. This is available at:
<https://www.ons.gov.uk/businessindustryandtrade/business/businessinnovation/gmi/s/ukgrossdomesticexpenditureonresearchanddevelopmentgmi>

12. The quality report describes, in detail, the intended uses of the statistics presented in this publication, their quality and the methods used to produce them.
13. As part of the BERD 2011 ONS release, there were two information notes available, aimed at assisting users with their understanding of R&D. The first, Coverage of the Business Enterprise Research and Development Survey, reports on the completeness of these estimates. The second, Coherence of UK Research & Development Statistics, draws attention to the coherence of BERD R&D estimates with other UK and international measures of R&D. These notes are available at:
14. <http://www.ons.gov.uk/ons/guide-method/method-quality/specific/business-and-energy/research---development-surveys/information-note--coverage-of-the-business-enterprise-r-d-survey.pdf>
15. <http://www.ons.gov.uk/ons/guide-method/method-quality/specific/business-and-energy/research---development-surveys/information-note--coherence-of-uk-r-d-statistics.pdf>
16. A summary quality report for the ONS BERD survey is available at: <https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/methodologies/ukbusinessenterpriseresearchanddevelopmentsurveyqmi>

6.2 Discontinuities in the data

17. Between the release of the 2007 and 2008 GovERD figures, a large R&D employer in Scotland was reclassified from the government sector to the higher education sector. This reclassification resulted in a considerable decrease in GovERD expenditure between 2007 and 2008.
18. The BERD, GovERD and PNP questionnaires were redesigned by ONS after the 2010 survey to better reflect user needs, including new National Accounts and European Union requirements. These followed large revisions to both the BERD and GovERD surveys for the 2007 data collections. The 2007 changes were made to address concerns about data quality and difficulty in completion. A new methodology was introduced by ONS for compiling the R&D expenditure for the PNP sector as a performer in 2011 (see background note 8). While all of these changes are viewed as being an improvement, they may have an impact on the comparability of the data over time. It is not possible to measure this impact.

6.3 Definition of R&D

19. The ONS R&D surveys follow the definition of research and development proposed by the Organisation for Economic Cooperation and Development (OECD) and published in the 'Frascati' Manual. According to the manual, R&D is defined as:
20. "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”. R&D must contain an appreciable amount of novelty.

21. The Frascati Manual was originally written by, and for, the experts in OECD member countries that collect and issue national data on R&D. The definitions provided in this manual are internationally accepted and now serve as a common language for designing, collecting and using R&D data.
22. Please note an updated Frascati Manual (2016) (<http://www.oecd.org/publications/frascati-manual-2016-9789264239012-en.htm>) was introduced in October 2016 which improved the definitions and explanations of R&D.

6.4 Real Terms

23. The cash values are converted to real terms using Treasury GDP deflators at market prices; 2019=100. The deflators are available at: [GDP deflators at market prices, and money GDP September 2020 \(Quarterly National Accounts\) - GOV.UK \(www.gov.uk\)](http://www.gov.uk/government/statistics/gdp-deflators-at-market-prices-and-money-gdp-september-2020-quarterly-national-accounts)

6.5 Time period which the results relate to

24. Respondents to the ONS BERD and PNP surveys were asked to make a return for the calendar year or the nearest 12 month period for which figures were available. The GovERD figures relate to the financial year and the HERD figures relate to the academic year.

6.6 Revisions

25. The methodology for producing regional estimates of expenditure on R&D for the government sector was reviewed by the Office for National Statistics (ONS) (2015 figures onwards). Estimates previously used government departments' full-time equivalent (FTE) R&D employees by region as a proxy to calculate regional expenditure. Departments now provide actual breakdowns of their R&D expenditure by region. To allow comparison of the government data, values using both methods were published by the ONS for the 2015 year only. For this Scottish Government publication we back-revised the government sector data for Scotland to bring the series into line with the revised methodology. Note that although this methodological change is significant for the regional government sector figures in themselves, the overall impact on regional Gross Expenditure on R&D (GERD) is relatively small given the relatively small size of government sector R&D spend compared to that of the higher education and business sectors.

26.

Year	Scotland GovERD (£ - current prices)		
	Old Method	New Method	New Estimates - using 2015 new method figure revised back according to old method trend
2001	226		136
2002	237		143
2003	277		167
2004	286		172
2005	307		185
2006	288		174
2007	329		198
2008	291		176
2009	302		182
2010	292		176
2011	280		169
2012	237		143
2013	258		156
2014	255		154
2015	257	155	155

27. Following further quality assurance of the flow of funding within the higher education sector ONS decided to remove the element relating to funding between higher education establishments; the earliest point of revision is 1992 for the UK series and 2001 for the UK region/country (including Scotland) series.
28. Business and higher education estimates of R&D for 2017 and 2018 have been revised to take account of late returns and misreporting.
29. Note that all series expressed as real terms and expressed as a proportion of GDP are revised back to 2001 due to underlying revisions to deflators and GDP respectively.

6.7 Code of Practice for Official Statistics

30. This is a National Statistics publication. It has been produced to the high professional standards set out in the Code of Practice for Official Statistics.
31. In 2012, the Research and Development statistical publications were assessed by the United Kingdom Statistics Authority (UKSA) for compliance against the Code of Practice for Official Statistics. Details of the assessment are available at: [Statistics on Scottish Businesses and Research and Development \(Scottish Government\)](#).
32. The United Kingdom Statistics Authority has designated these statistics as National Statistics, in accordance with the Statistics and Registration Service Act 2007 and signifying compliance with the Code of Practice for Official Statistics.

33. Designation can be broadly interpreted to mean that the statistics:
 - Meet identified user needs;
 - Are well explained and readily accessible;
 - Are produced according to sound methods, and
 - Are managed impartially and objectively in the public interest.
34. Once statistics have been designated as National Statistics it is a statutory requirement that the Code of Practice shall continue to be observed.
35. In 2012 a UKSA assessment was also carried out for the ONS Research and Development statistical publications. Details of the assessment are available at: [Statistics on Research and Development \(Office for National Statistics\)](#).

6.8 User Engagement

36. If you would like to be kept informed about on-going developments with regards to the Scottish R&D publications and future releases of R&D data, please register to receive updates via ScotStat (under Economy topic pick R&D and Innovation).
37. <http://register.scotstat.org/Subscribe/Step1>
38. There is also the ScotStat Scottish Economic Statistics Consultation Group (SESCG) – more information on the group is available at:
39. <https://www.gov.scot/groups/scottish-economic-statistics-consultation-group/>
40. If you would like to provide feedback on the Scottish GERD publication please contact us at:
41. e-mail: industrystatistics@gov.scot
42. There is also an ONS-led user community that may be of interest to R&D users. Details of this are available at the Business and Trade Statistics community on <http://www.statsusernet.org.uk>.

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The United Kingdom Statistics Authority has designated these statistics as National Statistics, in accordance with the Statistics and Registration Service Act 2007 and signifying compliance with the Code of Practice for Official Statistics.

Designation can be interpreted to mean that the statistics: meet identified user needs; are produced, managed and disseminated to high standards; and are explained well.

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e-mail: statistics.enquiries@gov.scot

How to access background or source data

The data collected for this statistical bulletin:

- are available in more detail through Statistics.gov.scot
- may be made available on request, subject to consideration of legal and ethical factors. Please contact industrystatistics@gov.scot for further information.
- cannot be made available by Scottish Government for further analysis as Scottish Government is not the data controller.

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