Industry in Focus

International Research Funding Systems: A Comparative Analysis

April 2025

pwc

Foreword

The government has set a clear ambition to drive economic growth that raises living standards and creates wealth across the entire UK. Research and Development (R&D) will be central to achieving this ambition, expanding human knowledge, advancing society, and driving the creation of new products, spinouts and jobs.

The UK's research base consistently outperforms its global competitors. The UK has the highest Field-Weighted Citation Impact ratio (FWCI) in the world, a measure of the impact of research outputs[1]. The country's innovation ecosystem has also delivered substantial economic benefits through successful spinouts and commercial ventures and is 5th on the Global Innovation Index—outperforming key competitor nations such as The Netherlands and Germany.

The UK is at a critical juncture to determine its role as a world leader in science and innovation. The upcoming Spending Review will set the financial parameters for the higher education sector and research base for the remainder of this Parliament. With significant public finance constraints, the government will face a set of difficult decisions. It is more essential than ever that the UK's R&D funding system is designed to maximise efficiency and impact, making the best possible use of available resources.

To support decision-making, we commissioned PwC, funded by Wellcome, to conduct a comparative analysis of international R&D funding systems. Alongside the UK, this report closely examines four countries: Canada, Germany, the Netherlands and South Korea. These nations were selected for their strong R&D performance, distinct yet relevant approaches, and structural comparability to the UK, to provide valuable lessons for potential reform. Additionally, the report includes a high-level overview of six further research funding models, to provide a broader view on research funding practices internationally.

Drawing on these findings, the Russell Group has developed a set of recommendations to strengthen the UK's R&D funding system:

- **Driving research excellence through performance-based block grant funding.** This supports institutions to pursue long-term strategic priorities and high-risk, high-reward research, which complements project-based funding aligned with government and industry needs.
- **Driving innovation excellence by supporting university-industry engagement** to leverage in domestic and overseas business investment in R&D as the UK is lagging behind other nations.
- **Avoid prioritising applied research at the expense of basic research funding** to ensure continued support for long-term scientific discovery and cement the UK's place in the global research system as a true innovation leader, rather than a "fast follower".
- **Streamlining funding mechanisms to improve efficiency and reduce bureaucracy** to maximise the return on investment for public spending.

We invite policymakers, academic leaders, higher education and research sector organisations and industry stakeholders to engage with the insights in this report and we welcome an open conversation about the implications of the findings. By maximising the value of the UK's assets - including its world-leading researchers and research base - we can collectively shape a stronger, more innovative, and economically resilient future for the UK.

Dr Tim Bradshaw

Chief Executive

Russell Group

RUSSELL GROUP

[1]. International comparison of the UK research base, May 2022, Department for Business, Energy & Industrial Strategy

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Appendix document available

Introduction

Background

The UK is internationally recognised both for its research excellence and for its world-leading Higher Education Institutions (HEIs), who themselves are major players in our UK R&D ecosystem with c.75,000 academic staff contributing to research output in the UK. 80% of all research activity across the UK nations was classed as either world-leading or internationally excellent in the latest Research Excellence Framework (REF) 2021 assessment[1]; and c.90% of outputs were judged to have a very considerable or outstanding impact on society.

To support these outputs, the UK Government relies on a dual system for R&D funding, with both project grants and formula-based block funding for institutions Quality-Related (QR) funding. This formula-based funding supports longer term, strategic investment in talent, infrastructure and emerging ideas, and helps to cover some of the wider indirect costs of undertaking research. Even with this funding, HEIs often undertake research activity at a net loss, estimated to be c.£5.3bn in 2022/23[2], requiring cross-subsidy (from international student fee income in particular). At a time when HEIs are faced with increasing financial challenges, and a government which has stated that it is seeking to unlock growth and innovation across the country, the effectiveness of R&D funding systems seems particularly pertinent.

We take this opportunity, then, to undertake a comparative review of government R&D funding systems across successful international counterparts, identifying relative strengths and weaknesses, in order to understand what the UK can learn from differently designed funding systems.

Approach

Our work commenced with a high-level desktop comparison of ten comparator countries, selected for comparison because they were considered to:

- Be successful research ecosystems on an international stage.
- Operate within a political, cultural and social context that is not significantly different to the UK to mitigate the impact of material external factors on any comparison.
- Be sufficiently transparent and for which data on funding systems is available.
- When taken together, present a range of funding systems, some with similarities to the UK and some that are quite different.

From our review of a long list of ten countries (see appendix), a shortlist has been selected for a deep dive comparative analysis. The analysis on the shortlist will seek to comment on the relative strengths of each system, and the extent to which these areas of system differentiation correlates to R&D output, research excellence and innovation.

The following countries have been selected in order to enable further analysis on their different characteristics, and therefore offer variety in terms of core funding mechanisms, regional variation and level of reliance on industry R&D:

Canada

Almost solely based on project grants provided at a federal level, with limited strategic institutional block funding and significant variation of funding available by province. Limited industry R&D.

Germany

Highly devolved R&D government funding system; whilst a material amount of project grant funding is provided at a federal level, states have responsibility for a large proportion of R&D funding for HEIs, and employ a mix of project grants and strategic institutional block funding themselves.

Netherlands

Significant reliance (c.68%) on strategic institutional block funding specifically for R&D, alongside project grant funding, predominantly provided at a national level with limited regional variation.

South Korea

Overall R&D ecosystem relies heavily on industry R&D; government funding is predominantly provided through project grants at a national level with limited regional variation, and limited use of strategic institutional block funding.

The report first presents the assessment and deep dive summaries of these shortlisted countries, followed by the high-level summaries for the other long list countries (in a separate appendix).

The topic of R&D is wide-ranging, particularly given the range of countries in this paper. As such, our assessment is not intended to be exhaustive, but to highlight key trends and lessons that can be learned on an international stage. Our research took place primarily between October and December 2024 and as such, any subsequent changes to funding systems (e.g. in USA following change in presidency) may not be reflected in this report.

[1]. Research Excellence Framework 2021
[2]. OfS Annual TRAC 2022-23 Sector Summary and Analysis, Table 5

Key takeaways

Key takeaways

From our assessment, it is evident that a successful R&D funding system is one that appropriately balances a number of competing but interrelated objectives, and it is a choice as to where to appropriately strike this balance:

Strategic alignment to government priorities vs institutional or researcher autonomy

Whilst there are clear benefits to government being able to direct public funding towards current, often cross-disciplinary, issues of national importance (e.g. COVID), if the ability of government to direct funding becomes disproportionate, it risks inhibiting academic freedom, or neglecting fields of research that are less likely to garner government attention.

At its extreme, a disproportionate reliance on mission-led or priority-driven project grant funding, with limited strategic institutional funding, inhibits the ability of institutions to invest outside of government priority areas, and will drive R&D activity towards short-term government priorities that are subject to change, resulting in less long-term strategic investment.

Driving research excellence vs building broader capacity

The use of competitive or strongly performance-based institutional funding (e.g. Quality-Related funding in the UK) rewards and therefore drives excellence. The countries we have analysed have made different decisions based on local context about whether to concentrate funding on excellence, or to enable capacity building across the research base.

In general, a focus on excellence rewards strategic investment in, and focus on, R&D strengths, as opposed to broad brush R&D activity. This may be a more efficient use of funding both at an institutional and national level, and drives research excellence in outputs.

Basic research vs applied research

Across the diversity of economies that our comparator countries represent, there is a clear inclination to encourage productivity and innovation through R&D funding mechanisms.

This can lead to a positive increase in funding to support industry-academia collaboration, however taken too far, it can also lead to an over-indexation of funding for applied research, that risks crowding out the private sector, or neglecting basic research that is less likely to receive industry funding.

Whilst balance is evidently critical, finding the right equilibrium between these objectives - and in the relative proportions of project grant funding versus strategic institutional funding - inevitably depends on the economy and political landscape within which the R&D system is operating.

In particular system design must consider and be influenced by the nature and level of industry R&D, and the degree of regional devolution or geographical distribution of institutions.

Comparative analysis summary

Assessment criteria

Methodology

This comparative analysis provides detailed summaries on each of the shortlisted countries' government R&D funding systems and assesses them against a set of criteria that seek:

- Firstly to analyse the key attributes of the system through the lens of five assessment criteria. Whilst some of these key attributes will be deliberate choices by government (e.g. degree of autonomy), some may be an accident of history or geography, or by-products of other choices in the design of the current funding systems; and
- Secondly, to measure the objective success of the system through two output criteria, Research Excellence and Innovation Excellence, in terms of its ability to produce high quality research and innovation outputs.

Where possible, all criteria have been substantiated with quantitative metrics (e.g. number of highly-cited articles, ratio of patents to researchers). There is a broad range of metrics that could be used to measure research and innovation excellence, and continual debate around how those two criteria could be defined, and, as such, this report has referred to a range of metrics that are available for our comparator countries, and has sought to control for country size on a per capita basis where appropriate, before ranking each country against the other ten comparator countries (including the UK). Certain metrics have not been included due to data availability for comparator countries (e.g. university spinouts).

For the seven criteria, each country's government R&D funding system have been given a score of Low, Medium-Low, Medium-High and High, relative to the comparator group based on the quantitative evidence and qualitative commentary.

The assessment will be summarised in a number of key takeaways, highlighting the relative strengths and weaknesses of the different funding systems, with a particular focus on lessons relevant for the UK dual funding system.

1. Strategic alignment to government priorities - Assesses alignment with government priorities based on qualitative research undertaken through stakeholder interviews and desktop investigation. Within this criteria, a High score would signal that the design of the government R&D funding system facilitates or proactively orchestrates strong alignment of R&D activity to national priorities. Where relevant, this criteria also captures alignment of R&D activity to devolved government agendas as well.

2. Autonomy - Measures the degree of autonomy within the system based on qualitative research undertaken through stakeholder interviews and desktop investigation. Within this criteria, a High score would describe a system that is designed to provide autonomy to institutions and individual researchers in how they spend R&D funding and the areas that they choose to research.

3. Stability and sustainability - Evaluates the long-term viability and resilience of the funding system through qualitative investigation, supplemented by contextual data around historic growth rates of outputs. Within this criteria, a High score would describe a system that is designed to support long-term R&D investment and commitment, enabled by certainty or long-term funding mechanisms and cost recovery of wider indirect costs.

4. Efficiency - Determines value for money and coordination in funding allocation through a combination of quantitative metrics such as number of documents and citations produced against Gross Expenditure on R&D (GERD), and qualitative investigation. Within this criteria, a High score would describe a funding system that achieves a relatively high level of outputs for every $ of expenditure, and has limited examples of duplication or inefficiencies.

5. Leveraging investment - Assesses the ability of the public funding system to attract external investment and collaborations through a combination of quantitative metrics such as volume of investment from industry and international sources, and qualitative investigation. Within this criteria, a High score would describe a system that is designed to encourage collaboration in R&D activity, and to effectively leverage a high degree of private sector and international R&D investment.

6. Research excellence - Measures the global competitiveness of research output through a quantitative analysis of a range of available metrics such as number and percentage of highly-cited articles, FWCI ratio, Nature Index ranking, and number of Nobel Prizes. Number of documents and citations (per capita) are also presented in this section to provide context around volume of output, to the extent that it informs considerations around quantity over quality.

7. Innovation excellence - Evaluates the system's ability to translate academic research into real world applications through a quantitative analysis of metrics including number of patents, patent to researcher ratio and Global Innovation Index ranking. Note that due to data availability, our assessment therefore reflects only a subset of innovation activity across the comparator countries and conclusions should therefore be treated with care.

Comparative analysis summary

Summary

		UK	Canada	Germany
Research funding system typology		Dual support system, with block funding (QR) element 32%, as well as project grants	Predominantly project grant funding (c.90%), with limited block or formula-based funding	Funding system driven by individual Länder (state) choice of funding mechanism - significant variety, but majority use 'discretionary' (block) funding
Strengths of the system		• Provision of long-term strategic institutional funding • Funding research excellence through robust performance-based allocations • Balanced funding streams • Protected principle of independence for project grant reviews • Streamlined government funding ecosystem • Introduction of cross-disciplinary investigator-led project grants • Efficiency of periodic REF review process for funding allocation	• Pockets of block funding to reimburse indirect costs • Long-term, strategic operating project grants • Promotion of research capacity building in smaller institutions • Supplemental, locally-aligned provincial funding • Ability to leverage high levels of international investment • System consciously designed to empower researchers to explore a breadth of research	• High degree of regional autonomy on R&D priorities • Effective federal-state coordination • Streamlined federal project funding system • Stability of funding through significant block funding component and long-term budget commitments • High levels of industry funded R&D
Potential weaknesses of the system		• Project grant funding below full economic cost • High levels of bureaucracy in REF framework • Limited visibility of how QR allocations are spent • Underfunding of charity-funded research grants • Lack of focus on capacity building within the system • Real-term decline in QR funding	• Fragmentation noted within the system • Recent overemphasis of mission-led funding • Limited long-term, stable R&D funding for HEIs • High administrative burden associated with high reliance on project grants • Criticisms of research support allocation methodology • Limited leverage of industry investment • De-prioritisation of R&D funding and falling research intensity	• Complex decentralised system may lead to inefficiency in funding • Risk of unhealthy levels of competition and/or duplication of provision • Wider complexity of research landscape • Limited ability for federal government to influence HEI activity
Wider considerations		• High degree of cross-subsidy by international student fee income • Strategic institutional block funding allocated through devolved authorities, but managed centrally	• Regional responsibility for universities • Highly fragmented business sector with large proportion of SMEs	• Regional responsibility for universities and R&D policy and funding • Significant role of institutions in R&D ecosystem
Assessment criteria	Strategic alignment			
	Autonomy			
	Stability and sustainability			
	Efficiency			
	Leveraging investment			
Output criteria	Research excellence			
	Innovation excellence			

For sources, see report main body.

Comparative analysis summary

Summary

		Netherlands	South Korea
Research funding system typology		Dual-funding system, with significant (c.68%) block funding element	Predominantly project grant funding of different types, alongside institutional funding for national institutes and university basic operational grants
Strengths of the system		• Highly streamlined government funding ecosystem • High proportion of stable and predictable institutional funding • High degree of institutional autonomy • Numerous mission-led funding calls to align R&D efforts to national priorities • Mechanisms to leverage international and industry funding	• Strong coordinating bodies and highly strategically aligned R&D • High risk, high reward grants • Ability to leverage private sector investment in collaborative R&D
Potential weaknesses of the system		• Uncertainty over long-term R&D funding and HEI autonomy • Inefficient and ineffective elements of project grant system • Ad hoc targeted regional funding outside of primary system	• Reliance on private sector • Overemphasis on high growth innovation and applied research to the detriment of basic and fundamental research • Limited stable R&D funding, and therefore limited autonomy for HEIs • Inefficient use of funds (based on volume of output) • Low levels of international funding
Wider considerations		• Relatively small size of country • Low levels of private sector R&D due to high share of services industry • Recent change in government and significant budget cuts announced	• Considerable economic growth over past few decades, driven by industrialisation and private sector R&D • Signalling shift towards more basic research in future • Significant role of institutions in R&D ecosystem
Assessment criteria	Strategic alignment		
	Autonomy		
	Stability and sustainability		
	Efficiency		
	Leveraging investment		
Output criteria	Research excellence		
	Innovation excellence		

Shortlisted country analysis

Shortlisted country analysis

UK deep dive analysis

Strengths of the system

Provision of long-term strategic institutional funding

The UK's dual support system includes a significant proportion of strategic institutional block funding for universities to use at their discretion, enabling them to respond in an agile way to new opportunities and blue sky projects, to pursue their own strategic objectives and to provide career stability to researchers. In enabling these endeavours, it improves the stability of the R&D system as whole.

Funding research excellence through robust performance-based allocations

The use of the Research Excellence Framework (REF) and the Knowledge Exchange Framework (KEF), using Higher Education - Business and Community Interaction (HE-BCI) data, to measure performance in research quality and knowledge exchange, respectively, incentivises positive behaviours, focuses on long-term impact and drives investment of strategic institutional funding in a virtuous circle to ultimately improve the UK's research and innovation. This drives excellence, not just in large research intensive universities, but also rewards those institutions that invest strategically to develop their research strengths. The robustness of the REF process in particular, and the quasi-competitive basis of the allocation is a unique feature of the system, not observed in comparator countries, and ensures that research excellence is funded and rewarded.

Balanced funding streams

Enshrined in the HERA[1], the dual support system is structured so as to preserve a dynamic balance between strategic institution funding, and project grant funding, to ensure the ability to deliver both top-down, strategically-relevant research, and bottom-up, blue-sky or investigator-led research.

Protected principle of independence for project grant reviews

The Haldane principle, also enshrined in the HERA, makes explicit the value of expert opinion in the review and decision process of individual project grant funding applications, preserving a degree of objectivity as opposed to a more political-led agenda.

Streamlined government funding ecosystem

With the establishment of UKRI, in response to observed fragmentation in the system, UK R&D funding has now shifted towards a more streamlined system, facilitating collaboration and improving efficiencies across all areas of research.

Introduction of cross-disciplinary investigator-led project grants

The new Cross-Research Council Responsive Mode pilot scheme provides a channel for truly cross-disciplinary, bottom-up research that may not have previously had a natural council lead. The popularity of the pilot scheme indicates a potential gap in provision prior to its establishment.

Efficiency of periodic REF review process for funding allocation

Despite criticisms of the REF review being a large and costly exercise, given it takes place every six to eight years, it is a significantly more cost effective way to allocate funding, than through project grant applications. Costs to undertake represent only 3-4% of the total QR funds distributed in line with REF, compared to c.12% for project grant applications. REF is also undertaken for a number of broader reasons (e.g. accountability, quality standards benchmarking), not just for funding allocations.

Potential weaknesses of the system

Project grant funding below full economic cost

Research council project grants are structured to provide only 80% of the full economic cost of undertaking research, thereby relying on cross-subsidy within university budgets. In practice, however, research council project grants appear to fund c.69% of full economic cost, according to 2022/23 OfS TRAC data and it is becoming increasingly difficult for HEIs to fund this gap, with many relying on cross-subsidising research with international student fee income, which has proven to be volatile in recent years. Ultimately this results in an unsustainable system in which research capacity is dependent on other factors.

High levels of bureaucracy in REF framework

By virtue of its robustness, the REF framework has also been criticised for being overly bureaucratic, and a large task to undertake for both the funding bodies and for HEIs.

Limited visibility of how QR allocations are spent

Whilst the REF provides accountability for research quality, outputs and impact, there are no specific reporting requirements on QR expenditure, and as such the system inhibits a full understanding of how government funding is being spent and whether it is being used as efficiently as it could be. However, Research England are currently piloting a new approach to providing greater transparency on the use of QR funding.

Underfunding of charity-funded research grants

Grants from charities typically cover an even lower level of full economic cost and although this was intended to be supported by the government's Charity Support Fund, this fund has not increased in line with research funding from charities, resulting in the need for further cross-subsidy within universities.

Lack of focus on capacity building within the system

The majority of funding delivered through the UK's dual support system for research is allocated on a competitive basis in order to deliver impact and value for money. There is less of a focus on capacity building across the research base with the exception of some place-based funding mechanisms. It is therefore harder for institutions that have not yet developed research strengths to secure funding and scale their research activities.

Real-term decline in QR funding

Against a backdrop of inflationary pressures, QR funding has not kept apace resulting in a real-term decline, and has lowered the balance of QR funding compared to project grant funding. Universities UK (UUK) analysis found that there has been a 16% drop in real-term QR funding from 2010/11-2024/25 compared to an increase in Research Council grant funding over the same period. They identified even more severe declines in the value of QR-equivalent funding are being seen in the devolved administrations.

Sources: Annual TRAC 2022-23; 2023 Independent Review of the UK's RDI Organisational landscape; Technopolis; Universities UK

[1]. Higher Education Research Act (see UK deep dive summary for further explanation)

UK deep dive analysis

Strategic alignment to government priorities

Medium-Low

From a structural perspective, the UK's streamlined R&D funding landscape (as a result of bringing together all the research councils under UKRI) has facilitated improved cross-departmental coordination and collaboration, which enables the alignment of funding to government priorities. The 2022 Sir David Grant independent review in fact notes the agility and speed within which the UKRI has been able to help mobilise its research base to address cross-cutting problems such as COVID, which would not have been possible prior to the merger. UKRI's role across devolved nations further streamlines the landscape.

UKRI manages a number of mission-led funds for government to address key priorities in line with its industrial strategy, for example the Strategic Priorities Fund, and has removed ring-fencing on these funds that might otherwise inhibit cross-disciplinary responses to national priorities. To support government strategic alignment, there are priority-driven and themed funding calls throughout the year - balanced alongside extensive bottom-up funding calls to simultaneously encourage investigator-led research.

The Haldane principle ensures a degree of objectivity in how individual project grant funding decisions are made, as it notes the key role of the science community in the research councils, and independence from government.

By balancing this project-funding with a significant proportion of strategic institutional block grant QR funding, the government funding system also provides HEIs with the ability to direct R&D funding to their own priorities that may not align to the wider government agenda. This balance between QR funding and project grant funding is a founding principle of the system, enshrined in the HERA, and limits the government's ability to impose its priorities on how R&D funding is distributed.

Whilst there is a lack of transparency over how QR funding is spent by HEIs, preventing government from fully understanding whether funding is being invested in their priority areas or not, the REF framework for allocating QR funding places a focus on impact, including how research has influenced or supported government policymaking. This incentivises strategic alignment to government priorities on a long-term impact and outcomes basis, rather than alignment with priority funding areas of the current government.

Autonomy

Medium-High

The significant proportion of strategic institutional block funding within the government's R&D funding system provides a high degree of autonomy for institutions, who have discretion over how these funds can be spent, and can focus their R&D activity outside of mission-led project grants focussed on national priorities.

The lack of reporting requirements on how QR funding is spent within HEIs enhances this autonomy such that funding considerations can remain focussed on internal considerations and strategy driven by scientific expertise, and are not at risk of being influenced by external scrutiny of reporting. As previously mentioned there is still incentivisation in the REF framework to consider how research activities are likely to score for societal impact in line with government outcome priorities.

Conversely the ambitions of institutions seeking to grow their research capacity are somewhat constrained by the six to eight year REF cycle, although there are opportunities to bid into other pots of funding for this purpose.

Stability and sustainability

Medium-High

The dual support system is designed to provide a more stable funding system whereby HEIs can choose to invest their strategic institutional block grant funding in longer term priorities and projects, in providing bridge funding for wrap-around support and infrastructure to support project grant applications, and in supporting career stability and development pipeline by funding salaries in between successful grant applications.

Strategic institutional funding also provides HEIs with more flexibility to act in an agile manner and respond quickly to opportunities as they arise - including leveraging investment opportunities with the private sector - and to absorb external shocks or changes.

QR funding remains relatively stable year on year, with REF cycles occurring every six to eight years and thereby limiting fluctuations in the block grant HEIs receive, providing HEIs with longer term certainty.

QR funding provides significant benefits to the larger research intensive universities that are producing high quality research outputs, incentivising positive behaviours and driving excellence of the ecosystem as a whole in the long term.

The structural underfunding of UKRI project grants, intended to cover 80% of full economic cost recovery, but in practice c.69%, hinders the R&D ecosystem, and,

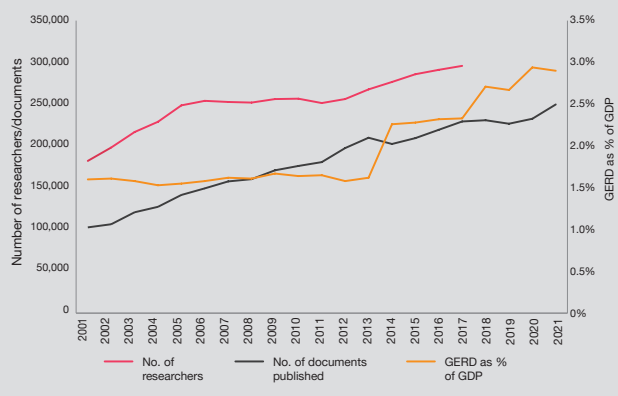
Sources: NSERC, CIHR; SSRCH; Scimago
*Note number of researchers relates to all researchers across the business enterprise sector, the higher education sector, and the government sector.

UK deep dive analysis

alongside a real-terms decline in QR funding and wider economic pressures, makes the sustainability of overall R&D landscape dependent on external factors such as international student income.

This is most severe for research grants funded by charities which tend to provide an even lower cost recovery rate, and require further university cross subsidy. More generally the structural underfunding from government may play into a wider culture and acceptance of underfunding of research activity across the sector, even for industry-contracted research, exacerbating the financial pressures for HEIs.

Since 2001, number of researchers and research outputs (documents) have grown at a CAGR of 3-5%, the lower end of our comparator group, although above Germany.



Efficiency

Medium-Low

The increased centralisation of the R&D funding landscape under UKRI has improved coordination and reduced inefficiencies and duplication, previously identified as fragmentation in the system in independent reviews. Improvements include cross-council funding programmes and the removal of ring-fencing around programmes such as the industrial Strategy Challenge Fund and the Strategies Priorities Fund.

The 2022 Sir David Grant independent review noted that risks to efficiency remain due to legacy systems and processes, insufficient cross-council cooperation and a lack of clarity on overall organisational purpose, however, the UKRI has set out plans to address the majority of these.

Reviews of the system have also highlighted the dangers of policy volatility inhibiting long-term, strategic investment as a result of a high and increasing turnover in government policies and schemes, with little or no integration, resulting in wasted expenditure and resource.

Reliance on the REF system has at times been criticised for its high level of bureaucracy, and its inflexibility with seven year cycles, which may result in sub-optimal allocation of funds.

Lack of transparency on how QR funding is spent within HEIs means it is difficult to understand whether QR is being spent efficiently by universities.

Despite criticisms of the REF review being a large and costly exercise, given it takes place every six to eight years, it is a significantly more cost-effective way to allocate funding, than through project grant applications. Costs to undertake represent only 3-4% of the total QR-related funds distributed in line with REF, compared to c.12% for project grant applications. REF is also undertaken for a number of broader reasons (e.g. accountability, quality standards benchmarking), not just for funding allocations.

The UK's efficiency metrics rank consistently in the middle of our comparator group in relation to research outputs, suggesting significant room for improvement in terms of outputs achieved for each $ spent. Notably the UK ranks at the bottom of the group for patents, reflecting, perhaps the historic weakness identified by the 2015 Nurse review in driving commercialisation, and a focus of funding towards basic research over applied or development research. However, it should be noted that the UK has considerable success in other innovation metrics, such as spin-outs, for which comparable international data is not available.

Key outputs per million $ GERD (2021)	#	Comparator Ranking
Published documents per $ million GERD	2.4	5th
Citations per $ million GERD	26.2	5th
Highly-cited documents per $ million GERD (Elsevier SciVal)	0.4	5th
Patent applications per $ million GERD	0.5	10th

Leveraging investment

Medium-High

The UK performs in the bottom half of our comparator countries for industry funded R&D, however, a relatively high proportion of Higher Education Expenditure on R&D (HERD) is funded by industry, suggesting that whilst the broader government's strategy for encouraging industry R&D is underperforming, the government R&D funding system is successfully leveraging private sector collaboration and investment into higher education R&D activity.

Sources: Scimago 2023, as at November 2024, OECD MSTI July 2024 data; Horizon Europe; Evaluation of the Higher Education Innovation Fund programme: 2008 - 2020; Technopolis; Elsevier SciVal, WIPO Statistics database as at November 2024

*Note number of researchers relates to all researchers across the business enterprise sector, the higher education sector, and the government sector. There is no OECD data for the UK from 2017 onwards. Note due to an anomalous data point in 2016 for no. of documents, the line graph has been smoothed between 2015 and 2017.

UK deep dive analysis

The use of Higher Education Innovation Funding (HEIF), and its performance basis, encourages HEIs to seek collaboration with industry. The long-term and certain nature of HEIF funding offers a more stable basis for longer term, strategic partnerships and joint ventures, and has helped develop core knowledge exchange capabilities within HEIs, by funding permanent staff and providing them with career stability. Whilst HEIF is permitted to be spent on a broad spectrum of activities, certain parameters are in place to further ensure it leverages investment - for example it cannot be used to fund any research projects that do not involve external non-HEI partners, and there is a requirement for accountability statements to be prepared to monitor expenditure and alignment to government objectives.

An evaluation between 2008 - 2020 found that HEIF funding has resulted in a shift from ad-hoc, project-based knowledge exchange initiatives, to more strategic, long-term collaborations with external partners that are aligned with government priorities.

The 2022 Sir David Grant independent review of UKRI noted, however, that whilst UKRI has established mechanisms for engaging with small businesses, it is yet to develop effective processes for engaging with larger businesses. It also noted that the benefits of having Innovate UK within UKRI have not yet been fully realised, citing ad-hoc coordination with research councils and no clear strategic plan for coordination, which may be hampering efforts to leverage private sector investment.

Whilst there has historically been an observed London and South-East bias in terms of wider UKRI funding allocation, Innovate UK actually spends more outside the Greater South-East, encouraging investment more widely across the UK regions in line with regional business innovation strengths.

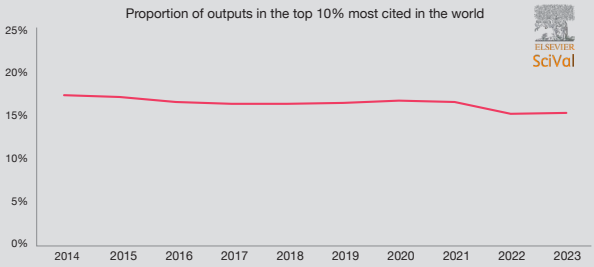
The UK is highly successful in leveraging international funding, ranking second out of our comparator countries with 10.6% of GERD financed by international sources. Given that there is likely to be a lag in reporting data, this high ranking may reflect the UK's historic success in obtaining Horizon 2020 funding in particular, and the UK's wider international appeal for foreign direct investment as a result of its world-leading reputation. This metric or ranking may worsen for short period when the data catches up with UK's hiatus from Horizon Europe between 2021-2024.

Leveraging investment (2021)	#	Comparator Ranking
% of GERD financed by business enterprise sector	58.5%	6th
% of GERD financed by rest of the world	10.6%	2nd
% of HERD financed by business enterprise sector	9.3%	3rd

Research excellence

High

Key outputs	#	per million capita	Comparator Ranking
Published documents (scientific output) (2023)	238,568	3,490	4th
Citations (2023)	272,435	3,986	4th
Highly-cited documents (2023)	36,631	536	4th
Field-Weighted Citation Ratio (FWCI) (2020)	1.57	-	1st
Nobel prizes (1901 - 2023)	143	2.09	2nd
# universities in top 100 of QS ranking (2025)	15		
Rankings			
Nature Index Rank (2024)	4th	-	3rd
Clarivate Research Fronts Leadership (2023)	3rd	-	2nd



Sources: Horizon Europe; Evaluation of the Higher Education Innovation Fund programme: 2008 - 2020; OECD MSTI July 2024 data; Horizon Europe; HEIF; UKRI; 2022 Sir David Grant Review 2022; Scimago 2023; Elsevier SciVal;; World Population Review;

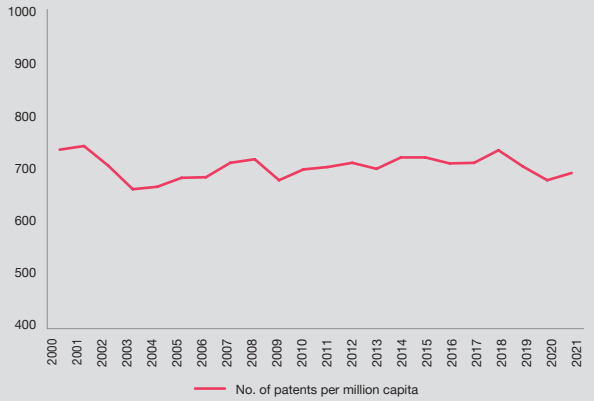
International comparison of the UK research base, gov.uk, 2022; QS Rankings; Nature Index; Clarivate. Note all data is as at November 2024.

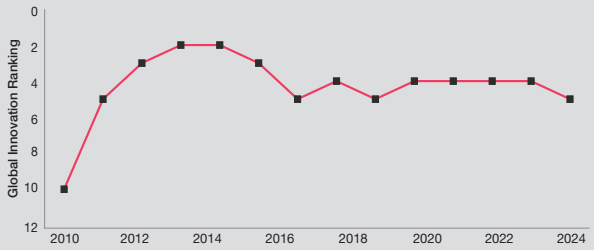
UK deep dive analysis

Innovation excellence

Medium-High

Key outputs	#	per million capita	Comparator Ranking
Patents (2023)	48,297	707	8th
Ratio of patents to researchers (2021)	n/a (0.16 in 2017)	-	n/a (9th in 2017)
Rankings			
Global Innovation Index (2024)	5th	-	3rd





UK Summary

The UK government R&D dual support funding system is underpinned by a protected principle of balance between strategic institutional funding and project grant funding that can be aligned to government priorities, all managed under one umbrella organisation, UKRI.

As a result, the government R&D funding system is highly streamlined and, whilst there is room to improve efficiency, it has been designed to encourage long-term stable investment in R&D through sizeable strategic institutional block grants for both research and knowledge exchange over which HEIs have full discretion, and that are quasi-competitive performance-based allocations to drive excellence, a feature unique amongst our comparator countries.

Sources: OECD MSTI July 2024 data; WIPO Statistics database; Global Innovation ranking.
Note all data as at November 2024

Shortlisted country analysis

Canada deep dive analysis

Strengths of the system

Pockets of block funding to reimburse indirect costs

Research Support Fund (RSF) provides formula-based funding for indirect cost reimbursement, acknowledging the additional cost burden of undertaking research.

Long-term, strategic operating project grants

Certain competitive multi-year 'operating' grants provided specifically to assist with ongoing costs of undertaking research and achieving long-term objectives - and can therefore be used at recipient's discretion, albeit these can be confined to certain research areas.

Promotion of research capacity building in smaller institutions

RSF formula (and several other project grant programmes) favour smaller institutions by using a reverse income tax model to help them cope with relatively higher overhead costs due to diseconomies of scale, and therefore to strengthen their capacity and encourage wider participation in research activity.

Supplemental, locally-aligned provincial funding

Ability for provinces to supplement federal funding in line with specific regional priorities, however highly dependent on province budgets.

Ability to leverage high levels of international investment

Ranking third of our comparator countries, Canada's government R&D funding system has successfully leveraged a high level of international investment - including as an associated partner of Horizon Europe Pillar II - through government initiatives such as the Canadian International Innovation Programme (CIIP).

System consciously designed to empower researchers to explore a breadth of research

The Canadian system has been intentionally designed to promote academic freedom of individual researchers through a focus on bottom-up, investigator-led project grant funding, and the recent increases in mission-led project grant funding has been identified as a potential issue to address.

Potential weaknesses of the system

Fragmentation noted within the system

Despite relatively few funding bodies, the 2023 Advisory Panel found high levels of fragmentation, leading to duplication and gaps in provision, and lack of agility to respond to interdisciplinary needs, as well as sub-scale granting entities.

Recent overemphasis of mission-led funding

Movement towards more mission-led funding in recent years has been criticised for inhibiting autonomy and freedom of investigator-led research - albeit there has been improvement in funding for investigator-led research since this was first acknowledged in the Fundamental Science Review in 2017.

Limited long-term, stable R&D funding for HEIs

A lack of ongoing institutional funding prevents long-term visibility of funding for HEIs and limits their ability to invest strategically, outside of project grant remit.

High administrative burden associated with high reliance on project grants

Significant administrative resource required on an ongoing basis to apply for almost all R&D funding through grant applications.

Criticisms of research support allocation methodology

There is significant criticism that the current formula calculation for RSF penalises the more research-intensive institutions who have already successfully built up their research capacity, thereby choosing to prioritise funding towards building capacity elsewhere, as opposed to driving excellence where it already exists. This leads to a wider distribution of funding across institutions, but may as a result limit the impact that each C$ of funding can have with less concentration of resources. A consensus cannot be reached on how to amend the formula.

Limited leverage of industry investment

Lowest levels of GERD funded by business sector in all comparator countries (46%), and low levels of industry-academic collaboration - and criticisms that Industrial Research Assistance programme (IRAP), and the Strategic Innovation Fund (SIF) funding is unpredictable.

De-prioritisation of R&D funding and falling research intensity

Decline in funding and research intensity over past two decades has seen Canada fall out of the top 30 research intensive nations globally, and increase the risk of 'brain drain' as grants do not keep apace with international competitors. So far policy interventions to reverse this have not succeeded.

Canada deep dive analysis

Strategic alignment to government priorities

Medium-High

Compared to some long list countries, the Canadian system is fairly concentrated with the Tri-Agency directing most project funding, which should improve cross-departmental coordination and thereby strategic alignment to national priorities. However, it has been observed that there is still a high degree of fragmentation in the government system, leading to a lack of agility to respond to interdisciplinary needs - this may improve if the 'capstone' initiative is pursued.

The lion's share of funding originates from federal mechanisms, with no specific R&D budget granted to provinces for them to distribute. This enables government priorities to federal priorities, greater coordination and consistency, but also results in significant variation of funding levels at a province level.

Whilst certain provinces have more funds to be able to direct regional R&D efforts towards local strategies and priorities, other less wealthy provinces - that are also likely to be less well-equipped to undertake federal grant applications - will receive significantly less provincial funding and less federal funding, which may exacerbate geographical disparities.

Given the limited use of block or institutional funding for R&D that can be used at HEIs' discretion, the government funding system is more able to direct funding to specific sectors and / or priorities through project funding.

An increased use of mission-led or priority-driven project funding (e.g. Canada First Research Excellence Fund) has been noted over the last decade, driven by federal or other partner priorities rather than being instigated by researchers - which increases overall strategic alignment of funding to R&D activity and output, but has been criticised for being too large a proportion of funding in recent years.

Canada's recent industrial strategy highlighted the long-standing need to tackle the business sector's innovation challenge - specific federal funding pools have been set up to facilitate this (SIF, Innovation Superclusters Initiative).

Autonomy

Medium-Low

Autonomy can be considered at three levels: regional, institutional and individual researcher.

From a regional perspective, provinces have autonomy to invest and distribute R&D as they see fit, subject to their own budgetary constraints. This allows for alignment with regional priorities and therefore differentiation in how funds are used. In collaboration with universities, provincial governments also determine the number of university-based researchers who can seek support from federal agencies.

From an institutional perspective, the limited use of block funding inhibits institutions' ability to invest in more strategic endeavours, to plan ahead, or to channel funding into particular areas of focus. Alongside an increase in priority-driven grants, this will hinder investment in emerging fields and fields that are not currently favoured by the federal or provincial government. Note that with federal funding falling in recent years, HEIs have ended up funding more of their own R&D, which has given them more discretion, however this will only be possible for those with sufficient scale and resources and is not an adequate long-term strategy if other sources of income prove to be more precarious.

Whilst strategic institutional block funding provides HEIs with autonomy, the Canadian system has been intentionally designed to provide autonomy to the individual researcher through open calls for investigator-led project grant funding. However, in recent years Canada has seen a higher proportion of project grants that are priority-driven or mission-led, aligned to national priorities, which will limit academic freedom in the sector. This shifting balance has been criticised in recent reviews, with recommendations to ensure the proportion of investigator-led funding is protected.

The use of multi-year 'operating grants' that can be used at a researcher's discretion for longer term objectives, partially mitigates the lack of institutional block funding (e.g. Natural Sciences and Engineering Research Council of Canada (NSERC)'s Discovery Grant). These grants typically range from C$50,000 to C$1m a year for 2-5 years. Whilst this provides researchers and institutions with more autonomy than other funding systems reliant solely on short-term, prescriptive, project grant funding, 'operating grants' still require applications and can be constrained to certain areas prescribed by government and in some cases applicants are encouraged to review the government's priority challenges, even if they are not stated as evaluation criteria.

Stability and sustainability

Medium-Low

A high reliance on project grant funding generally limits long-term certainty and stability of funding, as it requires grant applications and is limited to grant terms.

The Canadian federal government does provide some formula funding for institutions through the RSF (c.10% of funding) that provides indirect cost reimbursement to support institutions with the additional cost burden of undertaking research (i.e. facilities and overheads).

Sources: NSERC, CIHR, SSHRC, ISED-ISDE; Fundamental Science Review 2017; Advisory Panel on the Federal Research Support System (2023)
*Note number of researchers relates to all researchers across the business enterprise sector, the higher education sector, and the government sector.

Canada deep dive analysis

This facilitates longer term resource planning, including for personnel needed to apply for grant funding.

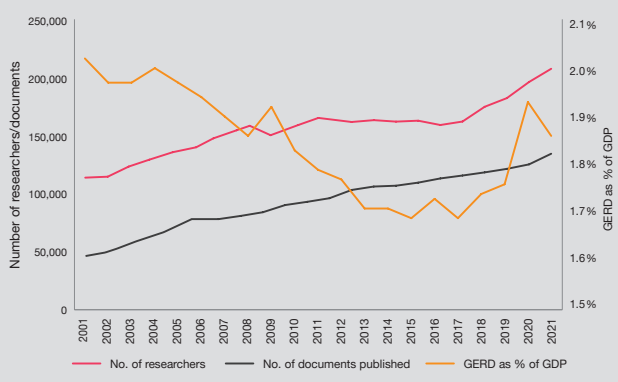
It is acknowledged however, that even with the RSF, often federal funds do not provide full recovery for indirect costs, and provincial basic funding ends up cross-subsidising these activities. Similarly the Tri-Agency provides operating grants to researchers that can be used at their discretion for long-term goals and to facilitate access to funding from other programmes (e.g. NSERC's Discovery Grants - see further details below).

The RSF formula favours smaller institutions to reduce barriers to entry and mitigate diseconomies of scale, however, it results in penalising research success and those most impacted are inadvertently institutions in a scaling up phase, not the large research intensive HEIs that may be more able to bear the brunt of it. Inadvertently this may limit production of the highest quality research and therefore the overall impact of the system.

Funding for industry-academic and industry R&D (SIF, IRAP) and grants have both been noted as unpredictable and ad hoc sources of funding that limit the ability to adequately plan R&D activity in the medium to long term.

With federal funding falling in recent years, HEIs have ended up funding R&D through their own or other sources (e.g. philanthropy), to make up for the shortfall. Whilst some of these sources may be predictable income streams for some universities, a reliance on top-up funding generally does not seem to be a sustainable approach for the federal funding system. With the funding increases set out in the 2024 budget, however, this is likely to improve.

Despite a decline in funding, since 2001 there has been a steady increase in researchers and research outputs (documents), growing at a CAGR of 3-6% between 2001 - 2021.



Efficiency

Medium-High

The vast majority of funding is managed by the Tri-Agency, and is therefore a fairly streamlined system.

Whilst fragmentation has been noted, resulting in some duplication and inefficiencies, and there have been calls for improved federal-provincial-territorial coordination - these issues have been acknowledged with measures announced to further improve efficiency, including through the Capstone initiative.

Despite the system being reliant on short-term project grants that require application processes, Canada ranks fairly highly in terms of outputs per $ of GERD, and the Value-for-Money achieved through the government's funding system. However, its funding appears to be less efficient in terms of patents - reflecting perhaps Canada's ongoing struggle with kick-starting innovation, and commercialisation.

Key outputs per million $ GERD (2021)	#	Comparator Ranking
Published documents per $ million GERD	3.4	3rd
Citations per $ million GERD	34.6	3rd
Highly-cited documents per $ million GERD (ELSEVIER SciVal)	0.5	4th
Patent applications per $ million GERD	0.7	8th

Leveraging investment

Low

For a number of decades, Canada has struggled with industry investment in R&D, in part due to the fragmented nature of its industry sector, with a high proportion of SMEs. As a result, it performs poorly next to the comparator countries, with the lowest proportion of GERD financed by business (46%) - likely impacting its lower innovation scores as well.

The Federal Government's industrial policy seeks to address this imbalance, and has put in place a number of initiatives, to drive local and international private sector investment in priority sub-sectors. These include modernising existing funds such as the SIF and IRAP, and establishing the Canada Growth Fund in 2022, a C$1.5bn independent public investment fund. There are some criticisms, however, that SIF and IRAP

Sources: Scimago 2023, as at November 2024, OECD MSTI July 2024 data; Horizon Europe; Technopolis; Canada Growth Fund; ISED-ISDE; , Elsevier SciVal, WIPO Statistics database as at November 2024; NSERC, Fundamental Science Review 2017, Advisory Panel on the Federal Research Support System (2023); 2024 Budget;

*Note number of researchers relates to all researchers across the business enterprise sector, the higher education sector, and the government sector.

Canada deep dive analysis

are unpredictable sources of funding, inhibiting businesses' ability to plan ahead and make long-term commitments to R&D.

A move towards more priority-driven, collaborative project grants in recent years may explain Canada's better ranking for HERD financed by business, with an increasing number of industry-academic partnerships.

Concerns were, however, raised in the 2017 Fundamental Science Review about a de-prioritisation of basic research over the previous decade, as a result of more funds being dedicated towards applied research (particularly tempting during challenging economic periods, and when trying to address barriers to innovation). Generally governments are considered the primary funder of basic research, as a risky and patient investment given its distance from commercial application and lower likelihood of achieving a return on investment. Recent federal budget announcements may now correct for this trend, but if not, there is a risk that private sector investment in applied research is crowded out whilst the basic research needed to facilitate innovation is neglected.

From an international perspective, Canada benefits from a high proportion of GERD financed by the rest of the world, ranking third of all comparator countries. Initiatives such as CIIP support companies to engage in collaborative R&D with foreign entities.

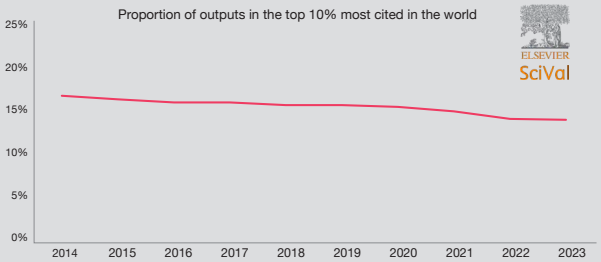
Canada is associated to Pillar II of Horizon Europe giving Canadian researchers and organisations the opportunity to participate in Horizon funding on equal terms with their EU counterparts, such that they can now join and lead research consortia across the world to tackle global challenges together. Similarly, Canada researchers are welcome to apply to European Research Council grants.

Leveraging investment (2021)	#	Comparator Ranking
% of GERD financed by business enterprise sector	46.4%	10th
% of GERD financed by rest of the world	10.4%	3rd
% of HERD financed by business enterprise sector	6.9%	5th

Research excellence

Medium-Low

Key outputs	#	per million capita	Comparator Ranking
Published documents (scientific output) (2023)	128,502	3,205	5th
Citations (2023)	137,877	3,439	5th
Highly-cited documents (2023)	18,455	460	5th
Field-Weighted Citation Ratio (FWCI) (2020)	1.43	-	3rd
Nobel prizes (1901 - 2023)	28	0.7	7th
# universities in top 100 of QS ranking (2025)	4	-	-
Rankings			
Nature Index Rank (2024)	7th	-	6th
Clarivate Research Fronts Leadership (2023)	7th	-	6th



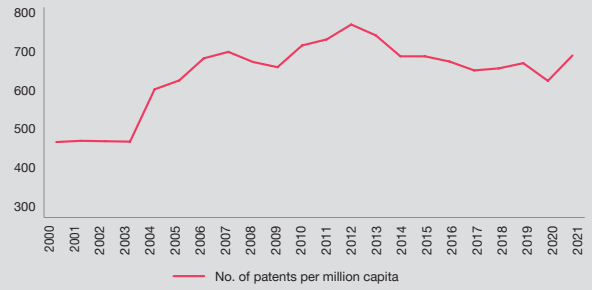
Sources: OECD MSTI July 2024 data; Horizon Europe; Canada Growth Fund; ISED-ISDE MSTI July 2024 data; Scimago 2023; Elsevier SciVal;; World Population Review; International comparison of the UK research base, gov.uk, 2022; QS Rankings; Nature Index; Clarivate; Field-weighted Citation Ratio. Note all data is as at November 2024

Canada deep dive analysis

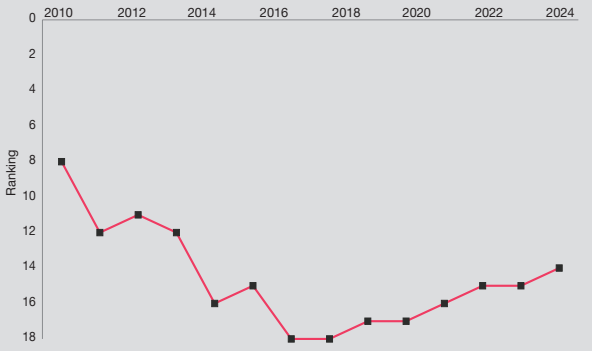
Innovation excellence

Low

Key outputs	#	per million capita	Comparator Ranking
Patents (2023)	24,145	602	9th
Ratio of patents to researchers (2021)	0.13	-	9th
Rankings			
Global Innovation Index (2024)	14th	-	9th



Global Innovation Ranking



Summary

The Canadian R&D funding system is largely dependent on project grant funding at a federal level, and, whilst there is some variation at a province level, this facilitates a close strategic alignment to federal government's priorities. This should be further supported as the funding landscape becomes more streamlined in line with recent review recommendations that note fragmentation in the system. Conversely, the limited use of strategic institutional block funding for R&D (through the Research Support Fund (RSF)) limits HEI autonomy, long-term visibility and certainty of funding, which inhibits their ability to invest in more strategic endeavours or to plan ahead, and to pursue their own particular areas of research focus. Whilst government partially mitigates this by offering more strategic multi-year funding mechanisms such as 'operating grants', these can be constrained to certain priority areas and still require grant applications.

Canada performs in the middle of the comparator group on a research excellence basis, with a strong FWCI, and achieves better Value-for-Money per $ of funding than most, however, there is a risk that they fall further behind given the de-prioritisation of basic research funding in recent years. The shift towards applied research funding may be in response to Canada's challenge to stimulate industry R&D and leverage private sector investment that has seen it lag behind comparator countries in innovation rankings and outputs.

Sources: OECD MSTI July 2024 data; WIPO Statistics database; Global Innovation ranking.
Note all data as at November 2024

Shortlisted country analysis

Germany deep dive analysis

Strengths of the system

High degree of regional autonomy on R&D priorities

State governments have the flexibility to allocate funding without federal jurisdiction, which can facilitate alignment to local economic needs and priorities, promote specialisation and clustering, and generate a degree of healthy competition between states.

Effective federal-state coordination

There are mechanisms in place to ensure Federal and Länder coordination, such as the Joint Science Conference (Gemeinsame Wissenschaftskonferenz (GWK)) facilitating collaboration between federal and state governments on supra-national initiatives. Whilst states can set their own agenda, these tend to mirror federal strategic priorities, with local specificities and implementation (e.g. Bavaria Hightech agenda).

Streamlined federal project funding system

Institutional block funding is complemented by project grant funding at both a federal and state level to direct R&D activity towards national and local strategic priorities, such as the High-Tech Strategy 2025. At a federal level, the vast majority of funds are managed by the German Research Foundation (Deutsche Forschungsgemeinschaft, (DFG)), with direct funding from the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, (BMBF)), resulting in a fairly streamlined federal overlay on top of the decentralised system.

Stability of funding through significant block funding component and long-term budget commitments

Although there is variation between states, the majority of state R&D funding is provided as institutional block funding, driven by historical metrics and performance indicators to incentivise excellence, as well as through non-competitive project specific grants. This provides long-term visibility and continuity of funding for HEIs, allowing them to invest strategically and with autonomy, whilst ensuring funds are available on a non-competitive basis for specific needs. Similarly, agreements such as the Pact for Research and Innovation (3% annual funding increase for Public Research Organisations (PROs)) provide predictability for research institutions and a long-term budget commitment.

High levels of industry funded R&D

Germany has a high proportion of GERD financed by industry, and in particular has the second highest percentage of HERD financed by industry, highlighting the ability of the system to leverage private sector investment to drive research and innovation through various public funding programmes and incentives for industry-academia collaboration.

Potential weaknesses of the system

Complex decentralised system may lead to inefficiency in funding

Whilst the decentralisation of the German R&D funding system has diversification benefits, with funding programmes and research agendas at both the federal and the state-level, there is a risk of duplication, overlapping priorities and redundant grant calls in certain areas. Due to the autonomy of the Länder, state-level research priorities may not always align with national strategic goals, which could conflict with or cannibalise the impact of federal initiatives.

Risk of unhealthy levels of competition and/or duplication of provision

With 16 different Länder pursuing independent research priorities, there is a risk that states compete over the same R&D areas as a result of a lack of coordination between them, sometimes reducing efficiency and missing opportunities for joint innovation efforts. To mitigate this, high levels of cross-regional coordination and negotiation may be required, which will add to resource burden.

Wider complexity of research landscape

The existence of other federal and state research institutions, and PROs like the Max-Planck-Gesellschaft, Helmholtz Gemeinschaft, and Fraunhofer-Gesellschaft add to the diverse, but complex R&D landscape and adds to the risk of duplication and competition for national funding calls, and private sector investment.

Limited ability for federal government to influence HEI activity

The existing decentralised funding system has to date limited the ability of the Federal Government to align HEIs research activities with national priorities. This limitation has led to the recent changes being overlaid onto the core decentralised funding system, such that the Federal Government can now provide direct R&D funding to HEIs, in the Excellence Strategy.

Sources: BMBF, DFG

Germany deep dive analysis

Strategic alignment to government priorities

Medium-Low

Given the decentralised nature of the government R&D funding system, to date the Federal Government has had more limited ability to influence HEI R&D activity, compared to comparator countries with more centralised systems - however, it has more influence over federal research institutions and PROs, who play a key part in the R&D ecosystem.

Each state sets its own higher education and R&D priorities, which provides strong strategic alignment to regional needs, but may not always align with federal-level strategic goals. The Joint Science Conference (GWK) was established to mitigate this to some extent by coordinating research funding between federal and state governments, and facilitating joint funding initiatives.

The individual Länders' choice of funding type (i.e. block funding through indicator-based formula or incremental discretionary, versus priority-driven project grants) determines the extent to which the regional funding systems direct funding towards regional priorities or provide HEIs with a high degree of autonomy.

Although there is variation, states provide a high degree of institutional block funding, which does give HEIs more autonomy and will limit regional government's ability to ensure alignment to regional priorities. This is, however, balanced with a range of state-level project grants, that are mission-led and also that reflect broader federal priorities.

The introduction of the "Excellence Strategy" is the first example of the Federal Government providing direct R&D funding to universities, somewhat overriding the existing decentralised system design which may clear the way for more federal direction or alignment to key strategic priorities.

The significant role of federal and state-run research institutes and PROs within the R&D ecosystem provides a means for the federal and state governments to channel a large proportion of funding (c.31% in 2024) in line with government strategic objectives, which may mitigate the need to exert as much influence on HEIs R&D activity.

Autonomy

Medium-High

From a regional perspective, the German research system is highly decentralised, providing individual Länder with autonomy over R&D policy and funding, far more than other international systems. The 16 Länder have control over their universities, determining funding priorities and hiring policies. The Federal Government and the German states act independently with regard to the funding and organisation of research, although there are measures to ensure coordination between the two.

For R&D, universities receive a proportion of institutional block funding from their Länder governments, over which they have autonomy to decide how that funding is internally allocated. This is balanced to differing extents across the different Länder with non-competitive project or specified funding that is earmarked for certain uses or initiatives, and therefore over which HEIs have limited autonomy.

Similarly broader financial autonomy for HEIs varies across the different Länder - for example, whilst universities in Hesse and North Rhine-Westphalia, can retain any public funding annual surplus, there are specific restrictions on this in Brandenburg; and whilst universities in Hesse cannot borrow money, those in North Rhine-Westphalia and Brandenburg can. None of these three Länder permit universities to own their own real estate, which may restrict HEIs ability to make long-term investment decisions around capacity building - and is unusual compared to European counterparts.

The 'Excellence Strategy' signals a move towards more federal involvement in long-term strategic university R&D funding. Whilst many Länder will likely welcome this additional funding, it will be important that this compliments and doesn't conflict with, or crowd-out state support and initiatives, and it does not impinge on Länder autonomy.

The existence of federal and state-run research institutes and PROs may provide an alternative channel for funding earmarked by government to achieve certain objectives, such that HEIs can be given more of a free rein on how they approach R&D.

Stability and sustainability

Medium-High

Long-term, institutional funding is primarily provided at a Länder level, and therefore varies by state. This means that the responsibility falls on the state governments to support the long-term sustainability of R&D activity in their region.

Whilst there is variation across the Länder, the primary funding mechanism for R&D is block institutional funding based on indicators and incremental discretionary measures. This provides longer term stable funding and therefore increased visibility and predictability of funding, enabling more strategic investments and capacity building.

The introduction of direct institutional funding from the Federal Government (in the Excellence Strategy) may add to long-term stable funding sources, however, this relatively new initiative is an overlay on the core funding system and the extent to which it will interact with decentralised R&D decision-making may impact

Sources: Scimago
*Note number of researchers relates to all researchers across the business enterprise sector, the higher education sector, and the government sector.

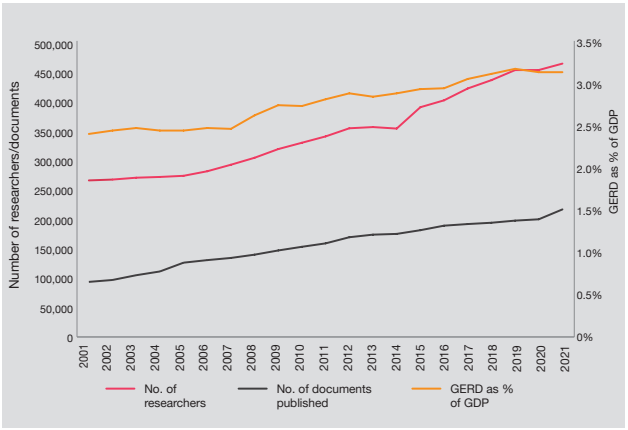
Germany deep dive analysis

its ability to provide funding sustainability in the long term. This is also only currently available for 11 Universities of Excellence, and so does not support the wider ecosystem.

At the margins, tweaks have also been made to the sustainability of federal funding procedures so as to prevent discontinuation of large, crisis-driven research projects, and mitigate the resulting impact on researchers.

Federal institutions receive more long-term, sustainable operational funding from federal government, and therefore have a stable source of R&D funds.

As the graph below shows, the number of researchers, and outputs (documents published) has steadily risen since 2001, growing at a CAGR of 3% and 4% respectively. GERD as a % of GDP has increased at a steady pace over the past 20 years, increasing from 2.4 to 3.1%, although growth has tailed off in recent years.



Efficiency

Low

At a federal level, the system is easy to navigate as there are limited actors, with a sole granting agency German Research Foundation (DFG) and the majority of funding provided by the Federal Ministry of Education and Research (BMBF).

However, given the decentralised system, there is a significant risk of overlapping or conflicting priorities, duplication, or inefficiencies, as a result of both the federal and state governments issuing project grant funding, and now direct institutional funding. Whilst there are measures to coordinate federal and state governments, this adds to the administrative burden, and renders the system less efficient.

Similarly, different funding models across the 16 Länder inevitably requires considerable coordination between the states, and potential duplication and inconsistency that can reduce overall efficiency in terms of outputs achieved at a national level.

Some tweaks have been put in place to improve the efficiency of the federal funding system, including more flexibility in project funding durations and simplifying reporting obligations, and to enable 'rapid response' to R&D funding needs.

Nonetheless, as a consequence of the above, Germany performed in the middle to bottom third out of the comparator countries for publications and citations produced per $ spent. Germany performs slightly better in terms of innovation, with a middle ranking for patents per $ spent.

Key outputs per million $ GERD (2021)	#	Comparator Ranking
Published documents per $ million GERD	1.3	8th
Citations per $ million GERD	12.2	8th
Highly-cited documents per $ million GERD (ELSEVIER SciVal)	0.2	8th
Patent applications per $ million GERD	0.9	5th

Leveraging investment

Medium-High

Germany performs strongly in terms of leveraging external investment as it performs in the top four comparator countries in terms of GERD financed by the business enterprisee sector (62.8%), and is second in terms of HERD financed by the business sector.

The private sector plays a dominant role with large companies driving a significant portion of R&D funding, particularly in manufacturing, and incentivised by public funding in Germany programmes such as the Industrial Collective Research (IGF). The top three companies with the highest R&D expenditure are Volkswagen, Mercedes Benz and Robert Bosch with a combined R&D expenditure of of €34.9bn.

The Federal Government facilitates a high degree of industry-academia collaboration through initiative such as the Central Innovation Programme for SMEs (ZIM), run by the Federal Ministry of Economics and Climate Action (BMWK), to support SME R&D and cooperating research institutions through an annual budget of c.EUR600m. DFG actively encourages collaboration between academia and industry by funding over 100 knowledge transfer projects per year.

Despite some international collaboration programmes, and access to Horizon Europe, Germany appears in the bottom third of comparator countries for international

Sources: Sources: Scimago 2023, as at November 2024, OECD MSTI July 2024 data; Horizon Europe; Technopolis; Elsevier SciVal, WIPO Statistics database as at November 2024; BMWK; DFG; Research in Germany *Note number of researchers relates to all researchers across the business enterprise sector, the higher education sector, and the government sector.

Germany deep dive analysis

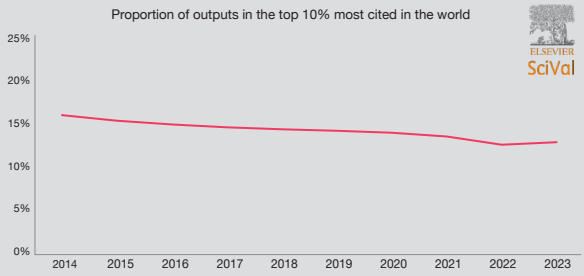
funding of GERD. Unlike the Netherlands, there is no evidence of a government matched funding scheme in place for Horizon Europe to incentivise German researchers, but nonetheless Germany has been one of the largest recipients of EU funding to date, receiving c.€6.7bn or 15% of Horizon Europe funds to date (2021-2024), a significant proportion of which was allocated to the research institutes such as Max-Planck Gesellschaft, and €2.3bn was allocated to Germany universities.

Leveraging investment (2021)	#	Comparator Ranking
% of GERD financed by business enterprise sector	62.8%	4th
% of GERD financed by rest of the world	6.9%	8th
% of HERD financed by business enterprise sector	13.1%	2nd

Research excellence

Medium-High

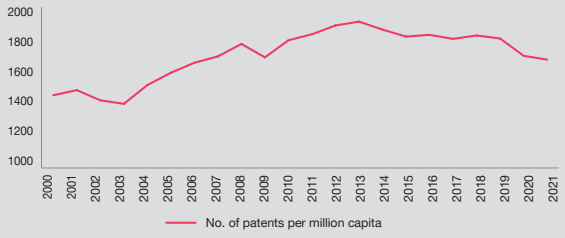
Key outputs	#	per million capita	Comparator Ranking
Published documents (scientific output) (2023)	202,397	2,395	7th
Citations (2023)	202,876	2,400	7th
Highly-cited documents (2023)	26,588	315	7th
Field-weighted Citation Ratio (FWCI) (2020)	1.32	-	5th
Nobel prizes (1901 - 2023)	115	1.36	3rd
# universities in top 100 of QS ranking (2025)	5	-	-
Rankings			
Nature Index Rank (2024)	3rd	-	2nd
Clarivate Research Fronts Leadership (2023)	4th	-	3rd



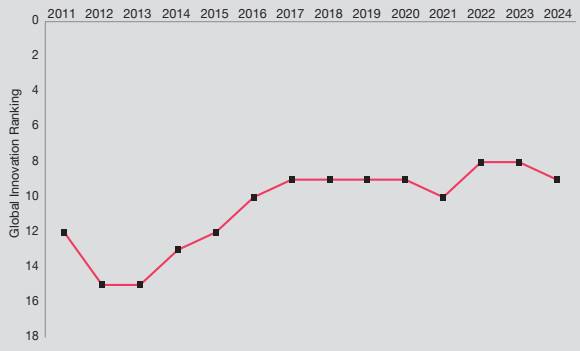
Innovation excellence

Medium-High

Key outputs	#	per million capita	Comparator Ranking
Patents (2023)	133,140	1,575	4th
Ratio of patents to researchers (2021)	0.30	-	4th
Rankings			
Global Innovation Index (2024)	9th	-	6th



Global Innovation Ranking



Sources: Horizon Europe; OECD MSTI July 2024 data; Scimago 2023; Elsevier SciVal;; World Population Review; International comparison of the UK research base, gov.uk, 2022; QS Rankings; Nature Index; Clarivate; WIPO Statistics database; Global Innovation ranking. Note all data is as at November 2024.

Germany deep dive analysis

Summary

The German government R&D funding system is uniquely characterised by its high degree of regional autonomy and the significant role that research institutions play in the wider R&D ecosystem, who themselves receive large sums of institutional block funding from the Federal Government. From a university perspective, the individual Länder provide dual funding, combining a mix of state-level project grant funding, as well as institutional block funding based on indicators. The relative proportions of this vary by state and by Länder, but overall the Länders' significant use of block funding provides HEIs with more stability and considerable autonomy to allocate internal funds and direct R&D activity. The Federal Government also provides project grant funding, and is now venturing into some direct institutional funding as well, despite the de-centralised model.

Perhaps as a result of the inherent complexity of and duplication within a decentralised system, German government R&D funding is relatively inefficient in terms of outputs per $ of GERD, and only sits in the middle of the comparator table in terms of FWCI ratio. It performs better from an innovation perspective, which aligns with the system's close degree of collaboration with industry, and ability to leverage private sector investment.

Sources: OECD REVIEWS OF TERTIARY EDUCATION - NETHERLANDS

Shortlisted country analysis

Netherlands deep dive analysis

Strengths of the system

Highly streamlined government funding ecosystem

Despite a degree of duplication noted across funding bodies, with the vast majority of government R&D funding provided by the the Ministry of Education, Culture & Science (Ministerie van Onderwijs, Cultuur en Wetenschappen (OCW)), and funnelled through the Dutch Research Council (Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO)), the funding landscape is easy to navigate and fairly streamlined. This reduces the complexity that often comes with multiple agencies, ensures a more efficient allocation of resources, and reduces administrative overheads.

High proportion of stable and predictable institutional funding

The Dutch system benefits from a significant amount of block grant funding specifically for R&D activities, which provides universities and research institutions with stable and predictable financial support, alongside project grants. This predictable funding model aids in long-term planning and can help maintain research continuity.

High degree of institutional autonomy

With a higher block funding proportion than most countries, HEIs are able to invest strategically in areas of interest at their discretion, as opposed to being constrained by funding solely from mission-led funding calls, or specific project grant eligibility criteria. Of the block funding, only a small component of institutional funding needs to be spent in prescriptive ways.

Numerous mission-led funding calls to align R&D efforts to national priorities

Long-term institutional funding is balanced with a number of mission-led funding programmes, managed by the NWO to enable the Dutch government to target investment in key sectors (e.g. Knowledge and Innovation Contracts (KIC), and Dutch National Research Agenda (NWA)). The National Growth Fund also plays a crucial role here, directing investment into mission-driven sectors that are strategically important for the future of the Netherlands.

Mechanisms to leverage international and industry funding

The Netherlands benefits from access to Horizon Europe funding, as do many other European nations. What enhances this EU funding in the Netherlands is the existence of the Netherlands government matching scheme, which provides additional national funding to cover the matching costs required for participation in Horizon Europe projects. Similarly, despite structural challenges hampering broader industry R&D, the government R&D funding system successfully leverages industry investment into HE-performed R&D, ranking 4th in the comparator group, as a result of successful co-funding programmes and incentives that encourage industry-academia collaboration.

Potential weaknesses of the system

Uncertainty over long-term R&D funding and HEI autonomy

Whilst the design of the system provides a degree of stability, the recent budget cuts of €1bn in higher education and research funding raise concerns about the long-term strategic direction of Dutch R&D. This could lead to smaller allocations of block funding to individual universities, a subsequent increase in competition for project grant applications, and a significant shift in the current system's equilibrium. Alongside budget cuts, the new government has interrupted previous efforts to set up an investment fund to support stability through staff retention for example, and has asked the sector to set out what resources they need to deliver in specialised fields. There is a risk that this limits academic freedom outside of a specified remit, and impinges on autonomy.

Inefficient and ineffective elements of project grant system

NWO project grants are considered to be more restrictive than international counterparts, offering fewer funding programmes with rigid, pre-set modules. The system is highly competitive, with success rates dropping in recent years to 10%, making it harder for researchers to secure funding. Additionally, NWO's peer review process is costly, as it does not utilise the most cost-effective reviewers. We heard from stakeholders that significant resources are allocated to maintaining numerous small research programmes.

Ad hoc targeted regional funding outside of primary system

The funding for Operation Beethoven (see page 61) has been provided outside the existing funding system and policy frameworks, as the current structure is not designed for such regionally directive funding. We heard that this ad hoc funding now sits external to core funding management and reporting frameworks, with some uncertainty as to how this will be taken forward.

Sources: University world news; Rathenau; Eurostat; NWO; Horizon Europe

Netherlands deep dive analysis

Strategic alignment to government priorities

Low

The R&D ecosystem operates at a national level and is fairly streamlined, with c.70% of funding originating from a single ministry, and the vast majority of project funding channelled through NWO - the sole research council. This enables greater coordination, consistency, and strategic alignment across the ecosystem. Similarly the limited role of provinces avoids further fragmentation that can be seen in some other countries with decentralised R&D funding models.

A high proportion of block funding that can be spent at the discretion of universities, limits the national government's ability to direct R&D activity and align it to wider government strategy or priority sectors.

This is balanced with a wide range of mission-led and thematic project grants administered by the NWO to support the Dutch National Research Agenda.

On top of these stable funding routes, the Dutch government has made use of ad hoc funding mechanisms and programmes such as Operation Beethoven, and the National Growth Fund (NGF) that both sit outside of existing funding systems, to direct investment into mission-driven sectors that are strategically important for the future of the Netherlands.

The NGF's overall impact on the broader research landscape is relatively limited in scale. With €0.5bn allocated for R&D over the three-year period 2023 - 2026, the fund represents only a small fraction of the total Dutch government R&D budget. In comparison, the government allocated €7.5bn to R&D in 2022 alone, highlighting that the NGF, while important, is not a major funding pillar for research and innovation.

The need for Operation Beethoven to be funded outside of the existing funding system and policy framework, highlights the current system's inflexibility to accommodate emerging strategic priorities. Going forward there is a lack of clarity on how that funding is to be managed and reported outside of the existing framework.

Approximately €600m of Dutch government funding is earmarked for matching EU R&D funding (Horizon Europe) over the period 2023 - 2029. While this access to European funding expands the total R&D budget, it is dictated by European-level priorities and regulations, which may not fully align with the national R&D or industrial strategy.

Autonomy

High

The significant proportion of block funding within the government's R&D funding system provides a high degree of autonomy for institutions, who have discretion over how these funds can be spent, and can focus their R&D activity outside of mission-led project grants focussed on national priorities.

Unlike some other European countries, there are no restrictions as to how HEIs allocate the block funding internally - however, recent changes have come into place whereby HEIs can only retain a surplus on public funding up to a maximum limit, based on certain HEI characteristics, which slightly reduces their autonomy, as noted in the 2022 University Autonomy scorecard. More generally greater HEI financial autonomy relative to European counterparts (e.g owning their real estate, no restrictions on borrowing) in the Netherlands will allow HEIs to strategically invest on their own terms, in line with their own priorities for example in research capacity building.

An increasing element of project grant funding is mission-led, particularly with the introduction of the NGF that will inevitably limit researchers' funding options outside of government priority areas - however, there remains a significant component of curiosity-driven grants to encourage academic freedom.

The prescriptive nature of the NWO's project grants options may also be a limiting factor on academic freedom of applicants.

There is a risk that autonomy will be impacted due to recent signalling from the new government on how they will support the sector going forward, including the potential for specialisation that may limit HEI's long-term flexibility and autonomy.

Stability and sustainability

High

With approximatelytwo thirds of government R&D funding in the form of block grant funding, the Dutch system offers more support for long-term investment and planning by HEIs than in those countries where HEIs are reliant solely on project grants. The predictability and visibility of funding provides stability and sustainability, and enables forward planning for larger-scale, capacity-building investments to reach longer term objectives and goals.

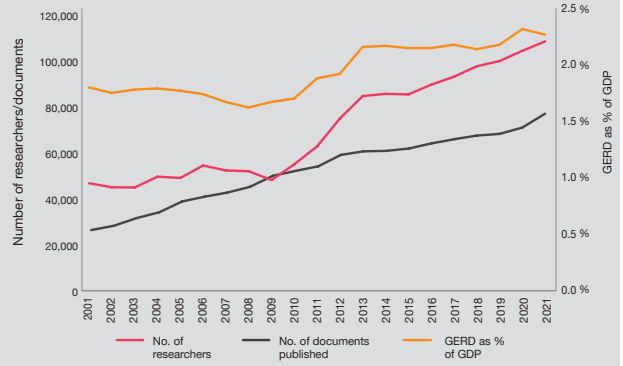
The Dutch university and research ecosystem also does not rely heavily on alternative funding sources, for example philanthropic funding or large endowments. Some R&D in the Netherlands is financed by private non-profit funds (mostly health funds). However, in 2021

Sources: Horizon Europe, NWO, NGF, Rathenau, University Autonomy in Europe IV: The Scorecard 2023, EUA
*Note number of researchers relates to all researchers across the business enterprise sector, the higher education sector, and the government sector.

Netherlands deep dive analysis

these funds supported €192m in research (which is a minimal percentage of the government's R&D budget). Whilst not a characteristic of the system, recent government budget cuts and policy changes could significantly impact the stability and sustainability of the system going forward. Firstly, by halting efforts to set up an investment fund to provide further financial stability and staff retention, but also, depending on how it impacts the proportion of block vs project grant funding, it could either reduce the proportion of block funding received by HEIs and inhibit their ability to invest strategically, or it could raise competition for grant funding, reducing success rates.

As the graph below shows, the number of researchers, and outputs (documents published) has steadily risen since 2001, growing at a CAGR of 4% and 6% respectively. GERD as a % of GDP, has increased at a steady pace over the past 20 years, from 1.8% to 2.3%.



Efficiency

Medium-High

A fairly streamlined system with a small number of primary funding agencies makes for a more efficient and manageable ecosystem, reducing administrative burden, the need for coordination and the risk of duplication or inefficiencies. The Netherlands' relatively small size may also help from a coordination perspective, with less regional authorities required to work together and to align.

As noted above, a smaller ecosystem is easier to navigate, however, we recognise that an element of duplication between NWO and The Royal Netherlands Academy of Arts and Sciences (KNAW) has been noted by ecosystem participants. They also noted that too large a proportion of research funds are being spent on continuing very small research programmes that may be sub-scale, and also that, due to the wider financial climate, the R&D block funding plays a part in subsidising university tuition.

The Netherlands has performed in the top third of comparator rankings for research and innovation outputs per $ spent of GERD, demonstrating the efficiency of its R&D ecosystem, despite potential diseconomies of scale, given it is much smaller than most other comparator countries.

Key outputs per million $ GERD (2021)	#	Comparator Ranking
Published documents per $ million GERD	2.8	4th
Citations per $ million GERD	34.1	4th
Highly-cited documents per $ million GERD (Elsevier SciVal)	0.5	3rd
Patent applications per $ million GERD	0.9	4th

Leveraging investment

Medium-Low

The Netherlands sits at the lower end of the group in terms of GERD financed by business enterprise sector (56.5%).

Whilst the Dutch government offers a generous tax scheme as incentivisation (Research and Development Promotion Act (WBSO)), there is a relatively low level of industry R&D investment in the Netherlands. This is considered by stakeholders to be a result of the industrial structure of the country, with a low share of high intensive R&D companies, and a dependency on a small number of major multinational companies (e.g. Philips, Shell).

The Netherlands is, however, in the top half of the comparator countries for HERD financed by the business enterprise sector, indicating that, despite generally low levels of industry R&D investment, the funding system design has been able to leverage substantial collaboration between industry and academic through the use of project grants such as NWO consortium grants (to encourage the building of successful consortium to perform scientific research collaboratively), and KIC grants that require co-funding from the private sector of between 10-30%.

As mentioned previously, the Netherlands performs strongly in terms of leveraging external investment from international sources, ranking 4th in our comparator group. This demonstrates the success that Dutch researchers have had through Horizon Europe, with researchers highly incentivised through the government matched funding scheme.

Sources: Scimago 2023, as at November 2024, OECD MSTI July 2024 data; Horizon Europe; Technopolis; Elsevier SciVal, WIPO Statistics database as at November 2024

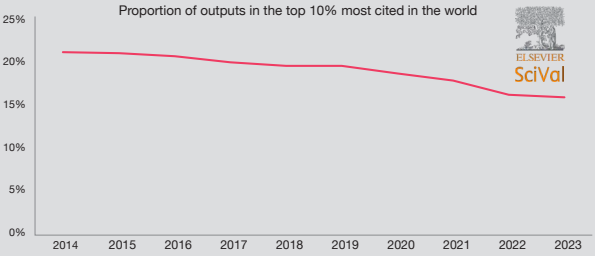
Netherlands deep dive analysis

Leveraging investment (2021)	#	Comparator Ranking
% of GERD financed by business enterprise sector	56.5%	7th
% of GERD financed by rest of the world	10.3%	4th
% of HERD financed by business enterprise sector	7.5%	4th

Research excellence

Medium-High

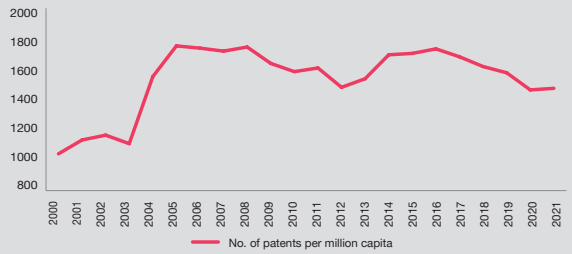
Key outputs	#	per million capita	Comparator Ranking
Published documents (scientific output) (2023)	72,640	4,063	3rd
Citations (2023)	88,906	4,973	3rd
Highly-cited documents (2023)	12,053	674	3rd
Field-Weighted Citation Ratio (FWCI) (2020)	1.72*	-	n/a*
Nobel prizes (1901 - 2023)	22	1.23	5th
# universities in top 100 of QS ranking (2025)	2	-	-
Rankings			
Nature Index Rank (2024)	14th	-	10th
Clarivate Research Fronts Leadership (2023)	11th	-	9th



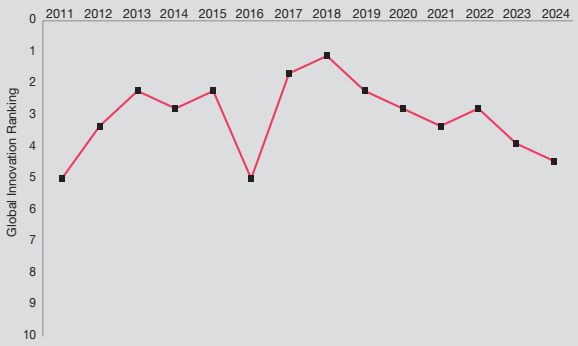
Innovation excellence

Medium-Low

Key outputs	#	per million capita	Comparator Ranking
Patents (2023)	25,921	1,450	6th
Ratio of patents to researchers (2021)	0.24	-	6th
Rankings			
Global Innovation Index (2024)	8th	-	5th



Global Innovation Ranking



Sources: Horizon Europe; OECD MSTI July 2024 data; Scimago 2023; Elsevier SciVal;; World Population Review; International comparison of the UK research base, gov.uk, 2022; QS Rankings; Nature Index; Clarivate; WIPO Statistics database; Global Innovation ranking. Note all data is as at November 2024

* Note that whilst FWCI 2020 data was not available for the Netherlands, a March 2024 Elsevier report on the Netherlands estimates a 1.72 FWCI based on academic output between 2018-2022 (Netherlands as a Science Nation, 2024). Germany, UK and Canada remain at similar FWCIs in this report, however, there is no datapoint for South Korea, so the Netherlands has not been included in the comparator ranking.

Netherlands deep dive analysis

Summary

The Dutch R&D funding system is a dual funding system, offering a balance of institutional autonomy and long-term predictable funding for HEIs through a large block funding component, alongside a streamlined project grant system channelled primarily through one sole research council, the NWO. The Dutch system performs well in terms of objective research excellence, with considerable efficiency compared to comparator countries, given inevitable diseconomies of scale.

Whilst structurally the Dutch R&D ecosystem is disadvantaged by low levels of business investment, and this may be hampering innovation metrics, collaboration has been successfully encouraged through a number of government funding mechanisms.

Sources: OECD REVIEWS OF TERTIARY EDUCATION - NETHERLANDS

Shortlisted country analysis

South Korea deep dive analysis

Strengths of the system

Strong coordinating bodies and highly strategically aligned R&D

Clear accountable bodies, the National Research Council of Science & Technology (NST) and Korean Council of R&D Funding Agencies (CORFA), are responsible for setting R&D national strategic direction and policies, and coordinating across different government ministries and funding agencies to ensure a cohesive approach, including joint funding programmes for interdisciplinary research. As a result the system has proven to be effective at targeting national priority sectors through strong coordinating roles, government-led research institutions, mission-led and challenge-based project funding calls.

High risk, high reward grants

Introduction of innovation-focused project grant models through a strategic reform initiative by the Ministry of Science and ICT (MSIT), aimed at fostering a high-risk, high-reward R&D ecosystem to accelerate disruptive innovations and strengthen South Korea's global research competitiveness.

Ability to leverage private sector investment in collaborative R&D

South Korea has the highest levels of industry funded and performed R&D in our comparator list, demonstrating the ability of the R&D government funding system to successfully incentivise and leverage private sector investment in public sector R&D, through collaborative initiatives, particularly in applied and development research. More broadly, a strong culture of collaboration has been successfully engendered between universities, research institutes, and corporations in South Korea, evident in partnerships and joint programmes such as the Samsung University partnerships, Hyundai- KAIST Future Mobility Research etc.

Potential weaknesses of the system

Reliance on private sector

With a large proportion of R&D funding in South Korea funded and performed by the private sector, there is a risk that the government has limited control over expenditure areas, and a risk of sudden loss of capacity, and less control in the event of economic downturns or if industry priorities diverge from the national strategy.

Overemphasis on high growth innovation and applied research to the detriment of basic and fundamental research

As a result of this focus on industry-led research to drive innovation, c.65% of R&D is focussed on applied research, somewhat neglecting basic research historically. Similarly we heard from stakeholders that a government-mandated emphasis on quantitative output metrics has incentivised a culture of quantity over quality. Both these examples may reflect a short termist approach that could be viewed as potential weaknesses in the longer term. These weaknesses have, however, been acknowledged and are starting to be addressed by government through additional financial support for basic research, and a review of quality assessment processes.

Limited stable R&D funding, and therefore limited autonomy for HEIs

University research in South Korea is predominantly reliant on project grant funding, which may limit the ability of universities to undertake long-term, strategic research projects and to develop stable research programmes and staffing. Given that a high proportion of project grant funding is aligned to government strategies it also limits universities' autonomy and their ability to invest outside of national priority areas.

Inefficient use of funds (based on volume of output)

South Korea's research output, measured by the absolute number of published documents, citations, or researchers per dollar of R&D expenditure, remains relatively low, suggesting an inefficient allocation and utilisation of R&D funds, which is corroborated by industry commentators, highlighting in particular the reliance on short-term project grants.

Low levels of international funding

Ranking last in our comparator list for internationally funded R&D, South Korea has historically not focussed on international collaboration. This is set to change with a renewed focus in the 2025 budget, and South Korea's new agreement to participate in Horizon Europe funding (the first East-Asian country to do so), allowing researchers to collaborate internationally and increase funding opportunities.

Sources: MSIT; MOEF; Horison Europe, OECD MSTI; NST; CORFA

South Korea deep dive analysis

Strategic alignment to government priorities

High

The government R&D funding system is designed to enable strong strategic alignment to national priorities through effective coordinating bodies such as NST and CORFA - however, the OECD and the Korean government have nonetheless noted persistent challenges in cross-ministerial coordination on R&D policy and implementation.

Whilst project grants are now more varied, allowing for bottom-up investigator led research, as well as top-down directed research, stakeholders have noted a long-standing emphasis on mission-led or challenge-based directed project funding compared to other countries. This has encouraged a high degree of strategic alignment to national strategies, and has proven to be effective in driving growth in priority sectors.

The existence of government-funded public research institutes and the limited use of block or institutional R&D funding that can be used at HEIs' discretion, further enables the targeting of government R&D funding towards its strategic priorities i.e. through project funding calls. With a predominantly (mission-led) project grant based funding system, and budgets re-aligned to government's Science & Technology investment priorities every c.5 years, the South Korean system is considered by stakeholders to be highly affected by political change.

From an overall R&D ecosystem perspective, the high proportion of industry performed and funded R&D might limit the government's ability to influence a significant portion of R&D activity - however, the numerous government initiatives to foster close collaboration between industry, research institutes and universities, mitigates this significantly.

Autonomy

Low

With the majority of research funding allocated through project grants, HEIs receive limited long-term institutional funding for them to spend at their discretion on R&D, beyond their basic operational financing for tuition, thereby limiting their ability to invest strategically for the long term.

Whilst there are various types of project grants, including top-down, middle-up, and bottom-up projects, there is a high proportion of mission-led or challenge-led project grants, governed by national priorities, resulting in limited opportunities to explore fields outside of a specified remit and impinging on academic freedom. Overly burdensome administrative processes and high degrees of micro-management on National Research Foundation of Korea (NRF) research projects has limited researcher autonomy and created disincentives in recent years. In response, the government has made a number of efforts to increase the flexibility of research funding, the freedom of researchers and the institutional autonomy of universities, notably through measures set out in the National R&D Innovation Act, which took effect in 2022 (e.g. giving freedom to researchers to adjust funding requirements to reflect changing circumstances or new needs during a project).

Stability and sustainability

Low

With a focus on project grant funding, and a lack of long-term block funding, the current system encourages a short-term focus, and limits institutions' visibility and certainty of funding sources such that they can invest in long-term strategic objectives or capacity building.

Since national R&D priorities change with each election (five-year horizon), developing long-term research agendas and building large research teams is difficult when the system relies significantly on project-based funding at a national level.

That said, project funding is relatively easily accessible and success rates for applications are quite high, compared to other countries' project grant systems.

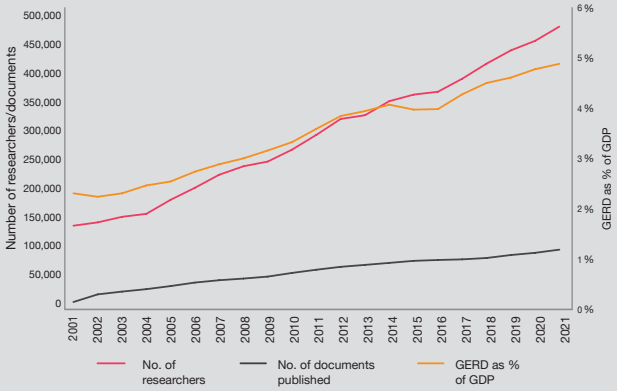
The Korean government does provide some general operational funding for universities, and has recently introduced some pockets of block funding. However, general operational funding has stagnated in recent years, and, with the lowest tuition expenditure per student in the OECD, the overall university funding system has become less sustainable as a whole, and there are limited funds to spare on R&D.

As the graph below shows, the number of researchers and documents has steadily risen since 2001, growing at a CAGR of 6-12% - the highest of our comparator countries, perhaps thanks to the high levels of research intensity and reflecting the focus on quantitative metrics over quality, which may change going forward.

There is, however, increasing concern about sustainability of the R&D workforce going forward, firstly in the context of decades of declining birth rates, resulting in projected declining numbers of students and therefore researchers, and secondly, due to the significant gender imbalance, with women accounting for only around 18% of principal investigators on government-funded research projects. In August 2023, the government announced a number of measures to boost researcher numbers and attract international students to mitigate this trend, and there were proposals for providing increased support for living expenses within project grants.

Sources: Scimago
*Note number of researchers relates to all researchers across the business enterprise sector, the higher education sector, and the government sector.

South Korea deep dive analysis



Efficiency

Low

The research funding landscape in South Korea appears clearly structured, with limited regional complexity, and dedicated funding agencies for each ministry and separate agencies for research institutes, and with bodies in place (NST, CORFA) to encourage coordination.

However, the OECD has noted the "overly burdensome" multi-step process to determine strategic directions for science, technology and innovation across the government, with new priorities addressed through a reshuffling of funding pots rather than the development of a coherent fully-funded policy. The Korean government, too, identified a number of inefficiencies around sub-scale programme budgets, slow implementation and lack of coordination between ministries.

Despite recent efforts by government to simplify administrative procedures, with a high reliance on short-term project grants, and the applications required to obtain funding, the current system requires administrative resource on an ongoing basis.

As a result Korea has been criticised for the inefficiency of public R&D funding, which is substantiated by its ranking for outputs per $ of R&D expenditure, the second lowest of all our comparator countries (above Japan).

It performs notably better, however for innovation outputs in the guise of patents per $ of expenditure - which is likely to reflect the sharper focus on applied and development research and the role of industry.

Key outputs per million $ GERD (2021)	#	Comparator Ranking
Published documents per $ million GERD	0.8	10th
Citations per $ million GERD	7.8	10th
Highly-cited documents per $ million GERD (ELSEVIER SciVal)	0.1	10th
Patent applications per $ million GERD	2.2	2nd

Leveraging investment

High

The private sector plays a dominant role with large multinational corporations (chaebols), including Samsung, LG, and Hyundai, driving a significant portion of research funding. This is substantiated by South Korea's second place ranking in the comparator group for the proportion of GERD financed by industry, and its top ranking for industry financed HERD.

This aligns with South Korea's long-standing emphasis on industry R&D investment as a national priority to drive industrial development, facilitated by government initiatives such as generous tax credits and export performance incentives.

The R&D government funding system also fosters a high level of collaboration through industry-sponsored research, consortia projects, university-enterprise partnerships, and government initiatives, such as the University Innovation Fund.

Many of the project grants provided by the government also now have a pre-requisite for including industry partners to be eligible for the grant, fostering cross-sector collaboration. For instance, the Korea Institute for Advancement of Technology (KIAT), which manages funding provided by the Ministry of Trade, Industry and Energy (MOTIE), mandates that project consortia include at least one private enterprise.

There are also examples of public universities putting in place specific incentive mechanisms to encourage industry collaboration through promotion criteria and direct impacts on salaries.

Despite such initiatives, the OECD notes that academia-industry collaboration remains below its potential with multiple barriers to collaboration still present, including high pressure on academics for publication numbers and easy availability of non-industry project-based funding.

Sources: Scimago 2023, as at November 2024, OECD MSTI July 2024 data; Horizon Europe; Technopolis; , Elsevier SciVal, WIPO Statistics database as at November 2024; NRF; MSIT; MOEF; MOTIE

South Korea deep dive analysis

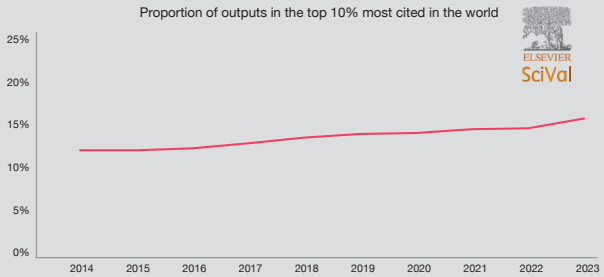
Despite the strong global presence of Korean multinationals, research institutes and universities undertake a limited amount of international co-publications and collaboration, and South Korea ranks last in our comparator group for R&D financed by international sources. Only recently has the South Korean government turned its focus on the benefits of international collaboration, and as of January 2025 it became the first East-Asian country to be a part of Horizon Europe's funding programmes, indicating a trend towards more international collaboration and investment in the future.

Leveraging investment (2021)	#	Comparator Ranking
% of GERD financed by business enterprise sector	76.1%	2nd
% of GERD financed by rest of the world	0.3%	10th
% of HERD financed by business enterprise sector	14.1%	1st

Research excellence

Low

Key outputs	#	per million capita	Comparator Ranking
Published documents (scientific output) (2023)	101,414	1,962	9th
Citations (2023)	103,479	2,002	8th
Highly-cited documents (2023)	15,608	302	8th
Field-Weighted Citation Ratio (FWCI) (2020)	1.06	-	7th
Nobel prizes (1901 - 2023)	3	0.06	11th
# universities in top 100 of QS ranking (2025)	5	-	-
Rankings			
Nature Index Rank (2024)	8th	-	7th
Clarivate Research Fronts Leadership (2023)	13th	-	10th



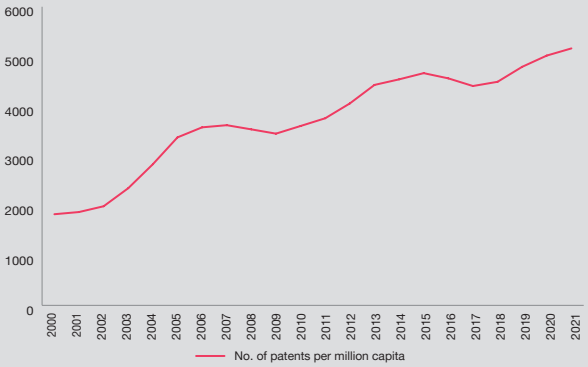
Sources: Horizon Europe; OECD MSTI July 2024 data; Scimago 2023; Elsevier SciVal;; World Population Review; International comparison of the UK research base, gov.uk, 2022; QS Rankings; Nature Index; Clarivate. Note all data is as at November 2024

South Korea deep dive analysis

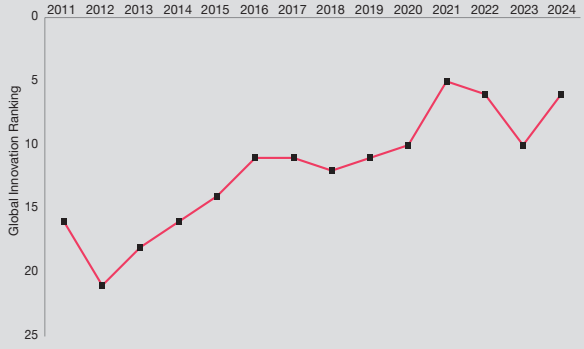
Innovation excellence

High

Key outputs	#	per million capita	Comparator Ranking
Patents (2023)	288,001	5,572	1st
Ratio of patents to researchers (2021)	0.57	-	2nd
Rankings			
Global Innovation Index (2024)	6th	-	4th



Global Innovation Ranking



Summary

The South Korean government R&D funding system can be characterised as having strong alignment to national priorities and limited institutional autonomy, due to a heavy reliance on project grants that are often mission or challenge-led, and very limited block funding. Although somewhat overshadowed by industry R&D investment levels, South Korean public funding is readily available with high grant success rates, but to date it has followed a somewhat short-termist approach, concentrated on applied research at the expense of basic research, and on quantity over quality, resulting in relatively poor levels of funding efficiency and low research excellence outputs and rankings, compared to comparator countries.

Conversely a strong focus on applied research has led to high levels of innovation outputs, and has come hand in hand with the government's success in driving industry-academic collaboration and leveraging high levels of industry investment.

Whilst high levels of industry R&D and a strong government steer has driven high levels of growth, the system currently suffers from high levels of inefficiency and fails to provide long-term stable funding for institutions or leverage international investment, and a potential overreliance on industry R&D investment poses a risk in the longer term. New developments in the 2025 budget seek to redress some of these challenges to establish the foundations needed for a sustainable system going forward.

Sources: OECD MSTI July 2024 data; Horizon Europe; WIPO Statistics database; Global Innovation ranking. Note all data as at November 2024

Shortlisted country deep dives

Shortlisted country deep dives

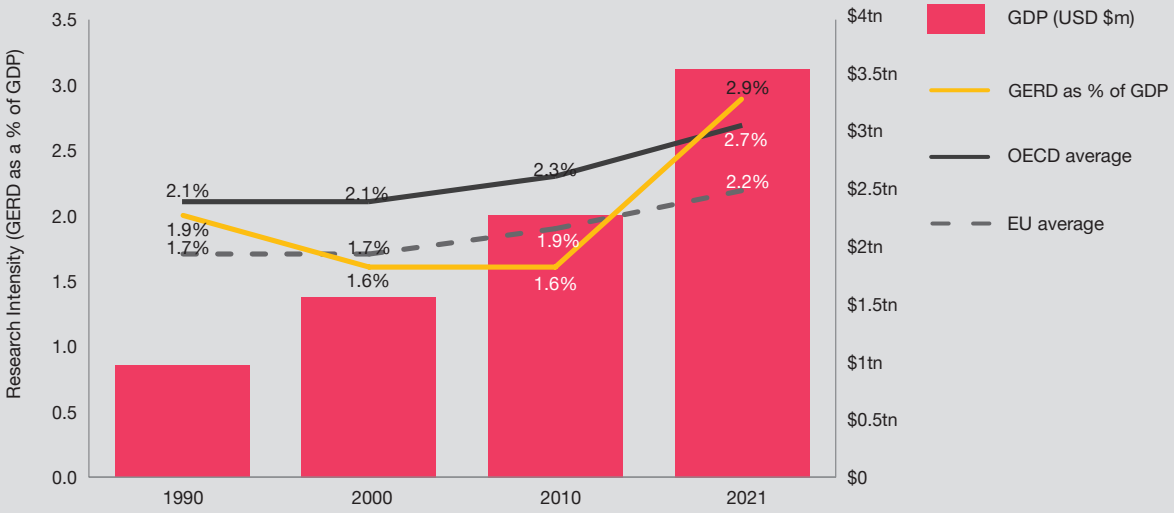
UK

Background and context of UK R&D

In 2021, Gross Expenditure on R&D (GERD) in the UK totalled £66bn ($103bn)[1] and has been growing at a compounded annual growth rate (CAGR) of c.6.5% since 2018.

This represents 2.9% of GDP, above the OECD and EU average, and fourth highest in the G7 (below USA, Japan and Germany).

Since 1990, UK's GERD as a percentage of GDP had been consistently lower than the OECD average, but has now remained above the OECD average every year since 2018 - almost doubling from 1.6% in 2010 to 2.9% in 2021. Note that the ONS changed its GERD calculation methodology in 2022 to better estimate R&D performed by business and the higher education sector, and is reflected in figures from 2014 onwards at a UK level, and 2018 at a detailed level.



The current UK R&D ecosystem

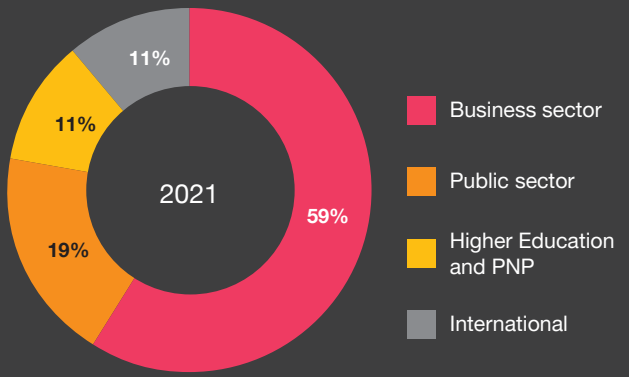
UK R&D is performed and funded by a number of different parties within the research ecosystem - at a high level more than half (c.59%) of all R&D is funded by the business sector, and even more (71%) is performed by the business sector.

Once business sector-funded R&D is removed, of the remaining c.£27.4bn of R&D the government funds the majority - 47%, followed by the Higher Education and private non-profit sector - 28%, and then international funders - 26%.

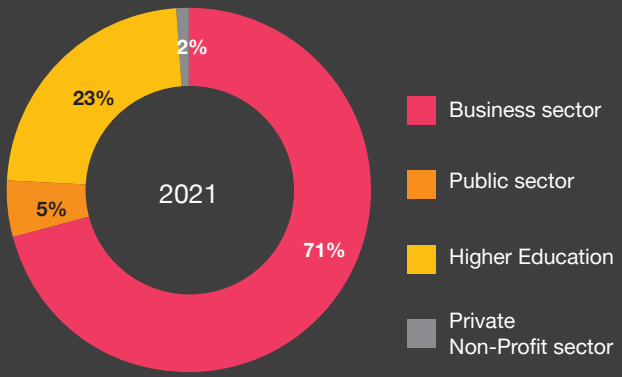
Public sector-performed R&D is predominantly undertaken by the higher education sector - 77%. Whilst there are c.300 HEIs in the UK, a significant proportion of HE research is undertaken by the larger research intensive universities.

In addition the public sector performs £3.4bn of R&D itself through institutes, and a small amount of private non-profit organisations performed c.£1bn in 2021.

R&D funding by sector



R&D perfomance by sector



Sources: OECD MSTI July 2024 data
Note: Due to lack of data OECD and EU averages for 1990 are assumed the same as 1991
[1] Presented in USD as per OECD MSTI July 2024 data for GERD in current Purchasing Power Parity (PPP) USD

UK

Government research funding system

Overview

UK public sector R&D funding is delivered through what is known as a 'dual support system' that combines both strategic institutional formula-based funding that can be used at the university's discretion and is allocated based on research performance, and project grants that universities and other R&D actors can competitively bid for.

The majority of government funding for UK public sector R&D is provided from the Department for Science, Innovation and Technology (DSIT) either via UK Research and Innovation (UKRI), a non-departmental government body or directly to other public sector institutions (such as the UK Space Agency and the Met Office).

Other government departments also provide funding for public sector R&D - in particular the Ministry of Defence (MoD), which spent c.£2bn on R&D in 2023/24, a c.30% increase on the prior year, and the Department for Health and Social Care (DHSC), which funds the National Institute for Health and Care Research (NIHR). To a lesser extent other civil departments also provide funding for R&D such as the Department for Business and Trade, and the Department for Energy Security and Net Zero (formerly part of BEIS).

Background

The 2015 Nurse review highlighted areas to improve the effectiveness of the UK research and innovation system, including:

- A lack of strategic join-up between disciplines, and between the research base and policy-makers;
- A fragmented approach to investment that inhibits the ability to deliver inter-disciplinary research.
- A historic weakness in driving commercialisation.

In response to this, UKRI was established on 1 April 2018 (under the Higher Education and Research Act (HERA)) to bring together the seven research councils, Research England and Innovate UK under one umbrella organisation to increase integrative cross-disciplinary research.

Government R&D funding through UKRI is governed by two underpinning principles enshrined in law by HERA:

- The Haldane principle - which states that detailed decisions on how research money is spent are for the science community to make through the research councils, independently from government.
- The balanced funding principle - which states that a dynamic balance of two funding streams (Quality-Related (QR) research funding and project grant funding) must be protected and preserved to ensure the delivery of research that is both strategically relevant and internationally peer reviewed, as well as research that is directed from within institutions themselves. In practice this means hypothecated budgets for the combined budget of the seven research councils, and for Research England.

Regional context

Whilst UKRI and its constituent research councils offer project grant funding to all devolved nations, each devolved administration is responsible for their equivalent to QR strategic institutional research funding. This is managed and allocated by the Scottish Funding Council, MEDR (the Commission for Tertiary Education and Research in Wales), and the Northern Ireland Department for the Economy (higher education division, respectively, drawn from their block grant to institutions in their areas.

Sources: UKRI; Gov.UK; ONS; House of Commons Library; Invest 2035: the UK's modern industrial strategy, Nov 24 ; Higher Education and Research Bill 2016; 2015 Nurse Review

UK

Government funding bodies

UKRI provides funding to universities, research organisations, businesses, the NHS, charities and other institutions, and is made up of nine funding bodies:

- Seven research councils provide project funding to support specific programmes and projects across the UK. These councils have their own disciplines (for example, the Arts and Humanities Research Council).
- Research England (and devolved equivalents) provide strategic institutional block grant funding to higher education providers in England that is based on performance-related annual allocation formula and is intended for strategic use, rather than being tied to specific project applications.
- Innovate UK provides competitive funding primarily for business-led innovation, including some funds for HEIs through partnership schemes such as Knowledge Transfer Partnerships.

UKRI provides two main types of R&D funding:

1. Recurrent block funding

Allocated annually by formula to higher education providers. Re-occurs at relatively stable levels from year to year, including QR funding, Research Capital Investment Fund, and Higher Education Innovation Fund (HEIF).

2. Non-recurrent funding

Are used to secure change or support activities that cannot be addressed through recurrent research and knowledge exchange funding, including funding for national facilities and initiatives and dedicated project funding.

In FY24, the UKRI spent c.£9.3bn*:

- £2.3bn on institutional block funding to higher education providers in England for research and knowledge exchange (26% of UKRI budget).
- £1.6bn in research and development grants, including fully open funding opportunities and targeted opportunities focused on specific priorities (18%).
- £1.4bn towards specialist institutes, centres, facilities and catapults that provide national capabilities in specific research and innovation areas, including specialist equipment, expertise and knowledge (16%).
- £0.9bn in infrastructure, from laboratory equipment to international research facilities (11%).
- £0.7bn in international partnerships to collaborate with leaders in their fields worldwide (8%).
- £0.7bn in innovation project grants that support innovative small and medium-sized enterprises (8%).
- £0.6bn in skills and training for the next generation of researchers, innovators and technicians (7%).
- £0.5bn in collaborative challenge-led funding to address specific national and global priorities (5%).

In addition to UKRI, the National Institute for Health and Care Research (NIHR) was founded in 2006 and is the government's major funder of clinical, public health and social care research, working alongside the Medical Research Council and funded by DHSC. In 2023/24 NIHR spent c.£1.3bn on research (excluding Official Development Assistance), of which c.£690m was spent on infrastructure, c.£460m on research programmes, and c.£145m on training and development. DHSC contracts with a number of NHS Trusts, universities and life science organisations to host NIHR's coordinating centres.

Sources: UKRI Annual Report 2023-24; NIHR Annual Report 2023-24
*Note that these figures and percentages do not sum to 100%, but they have been taken directly from UKRI's annual report and have not been amended by PwC.

UK

Approximately

32%[1]

of UK government HEI R&D funding is disbursed through strategic institutional block funding, and c.68% through project grant funding

Government funding mechanisms

Project grants

Project grants provide funding to recipients that have applied for funding for specific projects or programmes of work, with an assessment of the grant application undertaken against pre-set, weighted and published criteria. Applications are assessed by the grant making organisation and peer reviewed with awards made based on the results.

Project grants are a core R&D funding mechanism employed by the UK government. Most project grants are provided by UKRI via one of its seven Research Councils, Research England or Innovate UK, as set out above, and can be bottom-up, investigator-led (e.g. responsive mode) or priority-driven, themed funding calls (e.g. Strategic Priorities Fund). Project grants are structured to cover only c.80% of the full costs of undertaking the research activity, however, in practice OfS TRAC data estimates that it only covers c.68%.

In response to the 2015 Nurse review and the 2022 Grant review, UKRI established a pilot scheme for cross research council response mode project grants aimed at funding new, creative inter-disciplinary ideas emerging from the research community outside of existing disciplinary boundaries and without a natural lead research council to apply to.

UKRI specifically manages a number of project grant funds that are mission-led or priority-driven, such as:

- The UKRI Challenge Fund, developed as part of the government's 2017 industrial strategy, to address 23 societal challenges, across the four themes of government's industrial strategy. The fund is backed by £2.6bn of public money, with £3bn in matched funding from the private sector.
- The Strategic Priorities Fund - a £830m investment that supports 34 multidisciplinary and interdisciplinary research programmes across eight key themes through the government's National Productivity Investment Fund.
- UKRI Technology Missions Fund - a £320m fund to enable new and existing capabilities in AI, engineering biology, future telecoms, and quantum technologies.

1. Percentage of block funding for the UK R&D system has been calculated based on 2022-23 TRAC data, taking from Table 5 "Recurrent research grant funding from the Funding Councils / Research England, as a percentage of total TRAC income originating from the Research England, Research Councils, Other government departments and funds related to Training and supervision. Sources: UKRI; OfS TRAC data 2022-23; 2015 Nurse Review; 2022 Grant Review

UK

Block grant funding

Strategic institutional block grant funding represents 32%[1] of total government R&D funding for HEIs. The larger component of this block grant funding from Research England is called quality-related research (QR) funding and accounts for c.£2bn per year of R&D funding. This is coupled with similar block grant funding provided in the devolved nations respective bodies for Scotland, Wales and Northern Ireland, bringing the total "quality-related" funding per year to c.£2.4bn.

QR funding is allocated to universities based on the quality, volume and relative cost of research in different subject areas, and can be used at HEIs discretion, often used to support their own strategic research priorities. The total amount of block grant funding is relatively stable year on year, allowing universities to use their autonomy to pursue longer term priorities.

There are five different tranches of QR funding:

1. Mainstream QR which accounts for c.64% of total.
2. QR research degree programme (RDP) supervision fund.
3. QR charity support fund.
4. QR business research element - research with business and industry.
5. QR funding for National Research Libraries - for five research libraries of national importance.

Mainstream QR funds are quasi-competitive in that institutions need to enter submissions into the REF framework process and not all institutions receive funding. It allocated based on a formula that captures:

- The volume of research based on numbers of submitted staff with significant responsibility for research.
- The quality of research as measured in the REF.
- Subject cost weights reflecting, for example, that laboratory-based research is more expensive than library-based research.
- London weighting to reflect the higher costs incurred by HEIs in London.

Research volume and quality is measured in a periodic exercise known as the REF, managed by Research England on behalf of all the devolved nations in order to:

- Provide accountability for public investment in research and produce evidence of the benefits of this investment.
- Provide benchmarking information.
- Inform the selective allocation of research funding.

The REF is a large-scale national exercise that requires universities to provide examples of their research outputs, their impact beyond academia and their environment that supports research. These examples are then subject to expert review by over 1,000 assessors and 34 subject-based panels, overseen by four main panels and advised by specialist panels for interdisciplinary research and equality, diversity and inclusion.

Given the scale of the task, the REF framework has been criticised for being overly bureaucratic and burdensome as a quality review framework, however, it is only undertaken every six to eight years in comparison to ongoing project grant applications. The costs to HEIs of undertaking REF 2021 increased by 50% compared to the REF 2014 as a a result of an expanding scope of review. Future changes outlined for REF 2029 may introduce further complexity.

The cost of undertaking REF 2021 was estimated by Technopolis at £471m, of which £430m was born by HEIs in preparing for their submissions, £17m spent on direct costs by the funding bodies and £24m for the cost of panel member effort. Whilst this seems high, it represents 3-4% of total funding distributed on the basis of REF, which is lower than the equivalent figure for project-based research funding of around 12%.

In addition, Research England provides two further key 'formula-based' block funding grants for HEIs, as well as other less material block grants to support open access, Doctoral Training Partnerships and Impact Acceleration accounts:

Higher Education Innovation Fund (HEIF) - Supports knowledge exchange, allocations are spent by universities to support a range of commercialisation and innovation activities. With a budget of £260m per year, HEIF is allocated based on institutional performance in knowledge exchange (primarily using HE-BCI data) and is only available to eligible providers if they meet the performance threshold. It provides long-term, stable funding to enable and encourage investment in knowledge exchange activities, and necessitates collaboration with external non-HEI partners.

Research Capital Investment Fund (RCIF) - This comprises formula-based funding which supports the long-term sustainability of research, including contributions to replace premises or infrastructure/ improved use of space. In the financial year 2023/2024, £220m was distributed for formula-based research capital.

Sources: UKRI (Research England)
[1]. As per previous page, percentage of block funding is based on 2022-23 Annual TRAC data

UK

Other government funding mechanisms

The Advance Research and Invention Agency (ARIA) was established in 2023 following the success of the ARPA model in the USA, as a non-departmental public body, sponsored by DSIT, to focus on high-risk, high-reward projects with the potential to produce transformative technological change, and placing emphasis on the role of programme directors who retain creative control. Whilst funding is still based on project grants, the model is based around two primary modes:

- Large Scale programmes (£50-80m) that require investment across disciplines and institutions, for a portfolio or projects.
- Opportunity seeds (up to £500k) to support individual research teams uncover new pathways.

Tax incentives

- More broadly the UK Government supports industry R&D in the form of a volume-based R&D tax allowances, and has historically offered one of the more favourable tax relief schemes internationally - particularly for SMEs, who have benefited from super-deductions particularly for R&D intensive SMEs.

Sources: gov.uk

UK

System developments

University funding and R&D budgets

Given the low level of cost recovery on research activity, increasingly in recent years universities have been accelerating their reliance on international student fee income to cross-subsidise both research and domestic teaching (which has been subject to a fee cap freeze since 2012). This means that research activity is largely dependent on external factors - which became particularly evident in 2023/24 when there was a material fall in international student applications.

Prior to forming the new government in July 2024, the Labour Party's manifesto promised to "scrap short funding cycles for key R&D institutions in favour of ten-year budgets that allow meaningful partnerships with industry…and reduce micromanagement with a mission-driven approach".

In October 2024, the new government announced £20.4bn in investment for UK R&D to drive economic growth, including fully funding the UK's association with Horizon Europe. DSIT's own R&D budget increased to £13.9bn, and core research funding was also increased to a record £6.1bn, bolstering the UK's leading research base. The Budget announcement also included:

- The Life Sciences Innovative Manufacturing Fund (LSIMF), starting with £70m in grants, as part of a long-term commitment of up to £520m to secure major life sciences manufacturing investments across the UK.
- The new R&D Missions Programme (RDMP), with an initial investment of £25m, to address specific challenges, such as advancing healthcare and transitioning to cleaner energy.
- An investment of £40m over five years in a Proof of Concept Fund, to turn pioneering university research into successful companies.

In November 2024, the new government published its industrial strategy Green Paper, noting the UK's R&D considerable strengths, but that the UK often struggles to translate these into commercial good and services domestically and, as such, the need to accelerate the adoption and diffusion of the technologies that the UK's R&D landscape generates.

Horizon Europe

Horizon Europe is the EU's framework programme for research and innovation for 2021-2027, with a budget of €95.5bn. The UK was amongst the most successful countries in bidding for funding under its predecessor programme, receiving 12.1% (over €7bn) of total programme funding.

Following the UK's decision to leave the EU in 2016, the UK government needed to establish a new arrangement to access Horizon Europe, which had previously provided a significant amount of funding for the UK research system.

In the interim, a guarantee scheme was set up by the government in lieu of Horizon Europe and paid out an average of £740m annually between 2021 and 2023 (compared to an average of c.£940m annually between 2014 and 2020 with Horizon Europe), representing a c.25% annual reduction.

In December 2023, the UK and the EU signed a bespoke new agreement to confirm UK's association to Horizon Europe and Copernicus (the EU's earth observation programme), allowing UK researchers to bid for grants in a similar way to EU member states, with some limited exceptions.

2023 Nurse review

The independent 2023 Nurse review of the R&D landscape highlighted the danger of underinvestment by successive governments that has undermined the resilience of the system as a whole, and set out 29 recommendations for government, including:

- Reducing policy volatility across R&D landscape, given an increasing turnover of new initiatives, schemes and programmes.
- Increasing funding levels and provision of 'end-to-end' funding beyond direct research costs to provide more stable and properly costed funded structures.
- Reducing excessive bureaucracy with too much emphasis on audit-oriented reviewing and reporting rather than the quality of research produced.

Sources: Gov.uk; UK participation in EU programmes, December 2023; Labour Manifesto 2024; 2023 Nurse Review

Shortlisted country deep dives

Canada

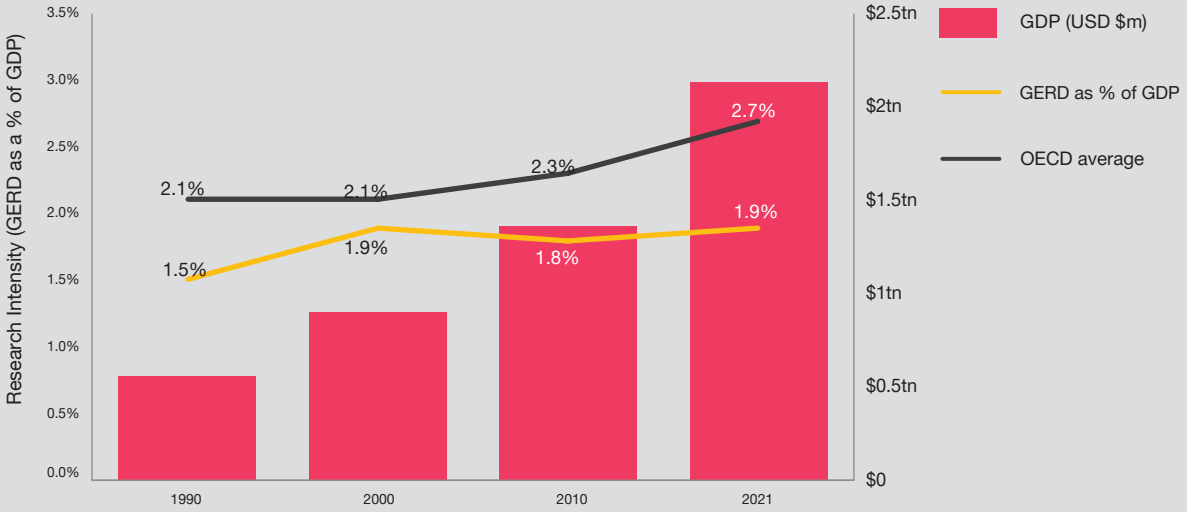
Canadian R&D investment levels

In 2021, Gross Expenditure on R&D (GERD) in Canada totalled C$47bn ($40bn)[1] and had been growing at a compound annual growth rate of 7.3% since 2018.

This represented 1.9% of GDP in 2021, below the OECD and EU average, the sixth highest in the G7 (below USA, Japan, Germany, UK and France), and the third lowest of our comparator countries.

Canada's GERD as a percentage of GDP has been consistently lower than the OECD average since 1990, and despite increasing from 1.5% to 1.9% between 1990 and 2021, it has increased by less than the OECD average.

More recent data from 2023 (not available for all comparator countries), shows continued growth to a GERD of C$49bn ($42bn), albeit this represents a reduction in research intensity to 1.7% of GDP.



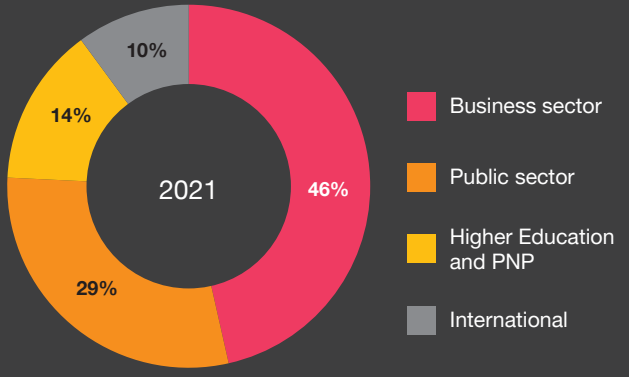
The current Canadian R&D ecosystem

Canadian R&D is performed and funded by a mix of public sector organisations (both federal and provincial) and private sector organisations (business and non-profit), with the business sector funding c.46% (the lowest in our comparator group), and performing 58% (second lowest, above Australia) in 2021.

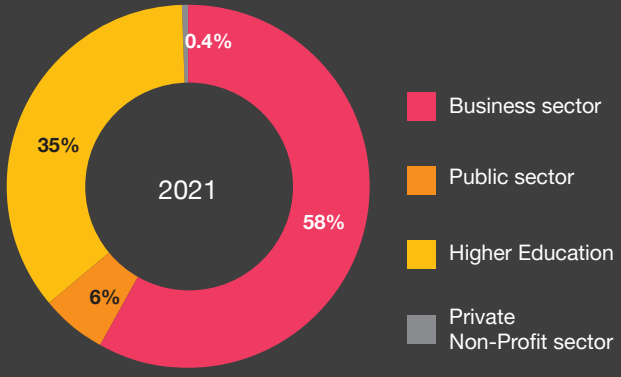
Once business sector-funded R&D is removed, the remaining C$25bn of R&D is primarily funded by the federal and provincial public sector (54%), followed by higher education and private non-profit sector (26%) and international funders (19%).

Public sector-performed R&D is predominantly undertaken by the higher education sector (C$16.6bn or 85%) through c.223 public and private universities, with the remaining performed by the public sector itself through government research centres (C$2.8bn), and a small amount of private non-profit organisations (C$188m).

R&D funding by sector



R&D perfomance by sector



Sources: OECD MSTI July 2024 data
Note: Due to lack of data OECD and EU averages for 1990 are assumed the same as 1991
[1] Presented in USD as per OECD MSTI July 2024 data for GERD in current Purchasing Power Parity (PPP) USD

Canada

Government research funding system

Overview

Innovation, Science and Economic Development Canada (ISED) is the federal department that supports research and innovation and leads the ISED portfolio made up of 18 federal departments and agencies, as well as regional agencies, working together to leverage resources and exploit synergies to drive innovation, economic growth, trade and investment.

The majority of public R&D funding in Canada is now managed by the Federal Government through the Tri-Agency, composed of the three primary research funding agencies:

- **Canadian Institutes of Health Research (CIHR)** - reporting to the Minister of Health.
- **Natural Sciences and Engineering Research Council (NSERC).**
- **Social Sciences and Humanities Research Council (SSHRC)** - both reporting to the Minister of Innovation, Science and Industry.

Alongside the Tri-Agencies, in 1997 the Federal Government established the Canadian Foundation for Innovation (CFI), an arms' length non-profit corporation, to make large investments into Canadian science by funding state of the art research infrastructure. Although previously only funded on an ad-hoc basis, the CFI now receives permanent funding.

The Canada Research Coordinating Committee (CRCC) also has a mandate to achieve greater harmonisation, integration and coordination of research-related programmes and policies across the granting agencies and the CFI.

A number of other federal agencies also provide project grant funding to support research specific to their mandates (e.g. the Agriculture Clean Technology programme through Agriculture and Agri-Food Canada), and ISED in particular funds a number of other grant funding programmes through the National Research Council (NRC).

The Federal Government also provides funding to a number of independent arm's-length organisations, such as Genome Canada, through the Strategic Science Fund.

Regional context

University operating costs are a provincial responsibility, for which the provinces receive federal transfers, first introduced in 1967. Provincial funding mainly focuses on their educational mandate for which they provide block funding.

Provincial governments also contribute funds to support research, representing approximately one quarter of total government research funding in Canada (C$1.4bn of c$5.7bn in 2022/23[1]). However, financial support for research varies considerably by province, with no commonly agreed or mandated approach. For example in 2022/23, Québec and Alberta's provincial funding made up c.40% of total government funding, compared to 15% in Ontario, and 10% in Manitoba[1].

1 Statcan November 2024 data.
Sources: CIHR, ISED-ISDE, NSERC, SSHRC, NRC

Canada

Government funding bodies

The Tri-Agency is comprised of three federal government agencies, who support R&D through project grant funding:

1. **Canadian Institutes of Health Research (CIHR):** Comprised of 13 institutes focused on health research and invests approximately C$1.3bn each year (2022/23).
2. **Natural Sciences and Engineering Research Council (NSERC):** Supports natural sciences and engineering research with an annual budget of C$1.3bn (2022/23).
3. **Social Sciences and Humanities Research Council (SSHRC)**: Provides funding for social sciences and humanities, through c.C$591m in grants and awards for research and training, and an additional C$452m on institutional support for indirect costs of research (see Research Support Fund (RSF) below) (2022/23).

In addition to their core funding programs in support of investigator-driven research, the agencies also administer some programs that target federal priority areas, and they jointly administer a number of programs that span all discipline areas (known as tri-agency programs), of which the largest include:

Research Support Fund (RSF) - formula-based funding introduced in 2003 to provide HEIs with an annual grant to assist with the indirect costs (administrative support, workplace training, maintenance) associated with conducting research. Only institutions that have previously received Tri-Agency funding are eligible for the RSF programme. Currently has a budget of nearly C$450m per annum and serves more than 150 postsecondary institutions.

Canada Research Chairs (CRC) programme - funding designed to attract top scientists across the world by creating highly funded research professorships for 5-7 years.

Canada Graduate Scholarships - awarded to support masters and doctoral programmes for 12 months and 3yrs, respectively.

Canada First Research Excellence Fund - awards to institutions in support of ambitious research objectives to become world-leaders, and expected to be invested alongside institution's own resources.

College and Community Innovation (CCI) programme - primarily project grant funding designed support applied research and collaborations that lead to business innovation and commercialisation.

The Canadian Foundation for Innovation (CFI) supports the Tri-Agency providing capital awards of c.40% of project costs for the development of research platforms and facilities (with the remaining 60% from other sources, primarily provincial government). It also provides some operating and maintenance support equal to 30% of the capital award. In 2024, CFI funded 218 projects with a total contribution of c.C$320m, making a cumulative total of C$9.2bn since 1998.

The Federal Government also provides funding to a number of arm's-length organisations that either award research funding or conduct research themselves. Typically, these organisations are independent, not-for profit corporations with their own by-laws and boards of directors, and funding decisions are typically made on an ad-hoc basis, expressed through the annual Budget. One of the most significant receipients of this funding is:

Genome Canada invests in and manages large scale genomics research projects in selected areas, supporting six independently incorporated regional Genome Centres through project grants, as part of a pan-Canadian network to optimise investment by aligning regional strengths and needs with national priorities. In 2024 it invested c.C$40m and leveraged C$59m from co-founders, including provincial government, industry, not-for-profit organisations, and other federal sources.

Sources: ISED-ISDE, CIHR, NSERC, SSHRC, Genome Canada, CFI

Canada

Approximately

90%

of Tri-Agency funding is disbursed through project grants, and c.10% through strategic institutional block funding

Government funding mechanisms

Project grants

Projects grants are the primary mechanism for government funding of R&D, primarily awarded by the Tri-Agencies, although other departments and agencies do award certain specific grants as well. Grants are awarded to individual researchers or institutions based on merit, rather than to an institution, with the intention of supporting academic freedom and innovation.

Grants are awarded across three main areas:

1. Standard Operations

To support ongoing programmes of research and long-term objectives, and can generally be used at the recipient's discretion, so long as activities remain in line with awarding bodies' mandate (note, however, that CIHR's Operating Grants generally are provided in response to priority areas and specific research needs, so discretion is limited). (Examples include: NSERC's Discovery Grant, CIHR's Operating Grant, SSHRC's Insight Grant - note, however, that CIHR's Operating Grants generally are provided in response to priority areas and specific research needs, so discretion is limited).

2. Partnerships and knowledge mobilisation

To support collaboration and short-term objectives of commercialisation and knowledge translation, and to respond to specific challenges from non-academic partners to aid long-term collaboration. (Examples include: SSHRC's Partnership grant, Connections Grant, NSERC's Alliance programme).

3. Research equipment

To support purpose of specialised research and / or laboratory equipment. (Examples include: Applied Research Tools and Instruments Grant, CFI's John R. Evans Fund).

Sources: ISED-ISDE, CIHR, NSERC, SSHRC

Canada

Government funding mechanisms

Block grant funding

Block funding is relatively limited in the Canadian funding system. Where it is provided, it is directed primarily at covering indirect research costs, including:

- **The Research Support Fund (RSF) (c.C$450m):**

Allocated to HEIs based on the amount of funding its researchers receive from the federal funding agencies. It is allocated on a sliding scale so as to provide higher rates of funding for institutions that receive the least amount of money from federal agencies to strengthen research capacity of smaller institutions.

Major research-intensive institutions receive the lowest "funding rates" expressed as a percentage of the direct research funding they receive from granting agencies, as a result of the progressive funding formula - but they are eligible for additional top up funding from the Incremental Projects Grant and the Research Security Grant.

Institutions must re-apply every year, and meet reporting requirements, in order to continue receiving funds.

- **Canada Research Chairs (CRC) programme:** Funding to support the recruitment of top researchers as "Research Chairs" for their institutions (e.g. C$200,000 annually for 7yrs tenure, renewable once).
- **Social Sciences and Humanities Research Council (SSHRC) Institutional Grants:** Annual block grants for three-year terms to help eligible institutions fund small-scale research activities through "Explore Grants" and "Exchange Grants" based on the number of faculty members and the institution's SSHRC competition funding performance, with an additional annual supplement for institutions with less than 250 faculty members.

In addition to the primary funding agencies and programmes, ISED provides additional federal support to industry and other R&D participants for a range of activities related to research, industry and innovation, for example the Industrial Research Assistance programme (IRAP), or the Strategic Innovation Fund (SIF):

- The SIF is a key component of Canada's National Science and Innovation Strategy announced in 2017, designed to support large-scale, transformative projects that drive innovation, economic growth, and job creation across various sectors of the economy. It aims to encourage businesses to invest in R&D, adopt new technologies, and scale up their operations to compete globally.
- Funds from the SIF are awarded to applicants based on criteria such as innovation potential, economic impact, and alignment with SIF objectives. The fund has a budget of C$1.3bn over five years and provides financial support through various types of funding mechanisms, including grants, repayable contributions, and non-repayable contributions.
- Initially established in the 1960s, the Industrial Research Assistance Program (IRAP) is Canada's leading innovation assistance program for small and medium-sized businesses, providing funding as well as innovation services.

Challenge Funding

Challenge funding is also available on an ad hoc basis for mission-led activity driven by current government priorities, for example:

- ISED's 2019 National Research Council's Challenge programmes were allocated C$150m over 5yrs to fund NRC researchers and their partners.
- Launched in 2017, the Impact Canada Initiative is an example of challenge-based funding as part of a broader effort from the government to address complex societal challenges such as clean technology, smart cities, and social innovation through innovative and collaborative methods. Led by the Privy Council Office, these funds are flexible and outcome based, awarded to the best solutions put forward either by individuals, or organisations. The initiative aims to foster collaboration among government, industry, academia, and the public to create impactful and sustainable solutions.

Other government funding mechanisms

The Federal Government is also one of a number of funding partners that contributes to other organisations that conduct or support research. For example through the Stategic Science Fund, the Federal Government funds the not-for-profit organisation Mitacs that supports internships and fellowships in industry, contributing C$282m between 1999 and 2021. Similarly the Perimeter institute, an independent non-profit theoretical physics research institute, to which the Federal Government contributed C$50m over 5yrs from 2017/18, with each dollar matched with two dollars from other partners.

Established in 2022, Canada Growth Fund Inc. (CGF) is a C$15bn independent and arm's length public fund that aims to help Canada speed up the deployment of technologies in its efforts to reduce emissions, transform its economy and support the long-term prosperity of Canadians - as such, it fund activities outside of R&D as well.

More broadly, to incentivise R&D within industry, the Federal Government administers the Scientific Research and Experimental Development (SR&ED) programme, one of the most generous R&D tax credit programmes globally with the total tax subsidy reaching up to 65% of eligible R&D costs.

Sources: Canada's Fundamental Science Review 2017; ISED-ISDE, Canada.ca; SSHRC; NSERC, CIHR, SIF Canada Growth Fund; OECD

Canada

System developments

Fundamental Science Review (2017)

The Fundamental Science Review (FSR) undertook a study of federal systems of support for extramural research in Canada, identifying areas of improvement and setting out a number of key recommendations.

The review highlighted, amongst other observations, that there had been a shift away from independent investigator-led research, towards priority-driven research. It also observed that universities had begun to fund a higher proportion of research activity themselves (50% of HERD in 2015) as a result of federal government funding lagging behind.

The report also noted significant levels of fragmentation in the system, with granting councils and a number of other disconnected entities tasked with similar but uncoordinated mandates, many of which are sub-scale, and therefore the need for streamlining and coordination amongst funding agencies.

The FSR set out 35 recommendations, including to:

- Increase coordination between granting agencies and streamline the system, with the establishment of a new National Advisory Council on Research and Innovation (NACRI) and a formal research coordinating committee.
- Increase funding for investigator-led research to redress the imbalance caused by favouring priority-driven research over the past decade.
- Provide CFI with a stable annual budget and mandate CFI to increase its matching share ratio.
- Increase funding to the RSF such that institutions receive 40% indirect cost reimbursement.

Whilst many of these recommendations have been completed or are in progress, the recommendation to boost funding for project grants has still only been partially addressed, despite significant government investment - and the sector has repeatedly highlighted the increasing risk to future research talent unless there is an immediate funding increase to support young scientists.

Stagnating funding levels and low research intensity

In contrast with its G7 peers, and the comparator countries in this report, since 2000 R&D intensity as a whole has declined year-on-year - most recently declining from 1.9% in 2020 and 2021, to 1.7% in 2023. This decline has been ascribed to low levels of business sector investment, and federal funding not keeping pace with inflation and international competitors' investment levels.

At a provincial level investment trends vary significantly; in the past 5yrs, certain provinces have substantially increased their contribution to research funding (Quebec and New Brunswick's funding has increased by 50% since 2018/19), whereas others have suffered significant funding declines (British Colombia saw a 32% drop in provincial research funding since 2018/19).

As Canada saw an overall decline in national research funding, and subsequently fell out of the top 30 research-intensive nations, two comprehensive reviews have been undertaken on Canada's academic sciences and research ecosystem in the past 10yrs: the Fundamental Science Review in 2017, and the Advisory Panel on the Federal Research Support System in 2023.

Sources: StatCan; Fundamental Science Review 2017; OECD MSTI

Canada

System developments

Advisory Panel on the Federal Research Support System (2023)

Whilst the 2023 Advisory Panel noted some improvements since the 2017 FSR (e.g. establishment of the CRCC), it noted legacy structures and systems that have inhibited further harmonisation, and that funding levels have still not kept pace with evolving needs.

The report recommended the establishment of a new governance mechanism the Canadian Knowledge and Science Foundation (CKSF), designed to better support coordination, streamline the suite of programmes, and encourage urgent, interdisciplinary and mission-driven research in Canada. The intention was for the CKSF to supplant the CRCC, and to proceed with the creation of an independent advisory body (as the FSR had recommended, but had since stalled).

The report highlighted increased funding as a top priority, recommending an increase of at least 10% annually for five years to the granting councils' total base budgets for core grant programming, as well as new funding for CKSF, and increased funding for students and postdoctoral fellows to an internationally competitive level.

In addition it proposed a more coherent approach to funding large research facilities that provides more predictable and appropriate funding over a facility's lifecycle, starting first with a national portfolio road-mapping exercise for large scale research infrastructure investments.

The 2024 Budget

In part in response to the Advisory Panel review, in its 2024 budget the Federal Government announced a historic level of investment in research and innovation, including a five-year plan allocating C$1.8bn of enhanced federal support for core research grant funding, and C$825m to granting councils to increase scholarship funding, as well as a C$600m in new tax incentives for companies to invest in R&D.

In addition it announced the establishment of a new "Capstone" research organisation to coordinate funding among Canada's existing research councils, similar to the establishment of UKRI in 2017. Whilst the exact timing and details of this new entity remain to be worked through, the Budget noted that the granting agencies will each continue to exist within this new organisation, and continue supporting excellence in investigator-driven research.

The Capstone initiative aims to continue supporting excellence in investigator-driven research whilst also helping to advance internationally collaborative, multi-disciplinary and mission-driven research.

Source: Advisory Panel on the Federal Support System (2023); Canada.ca

Shortlisted country deep dives

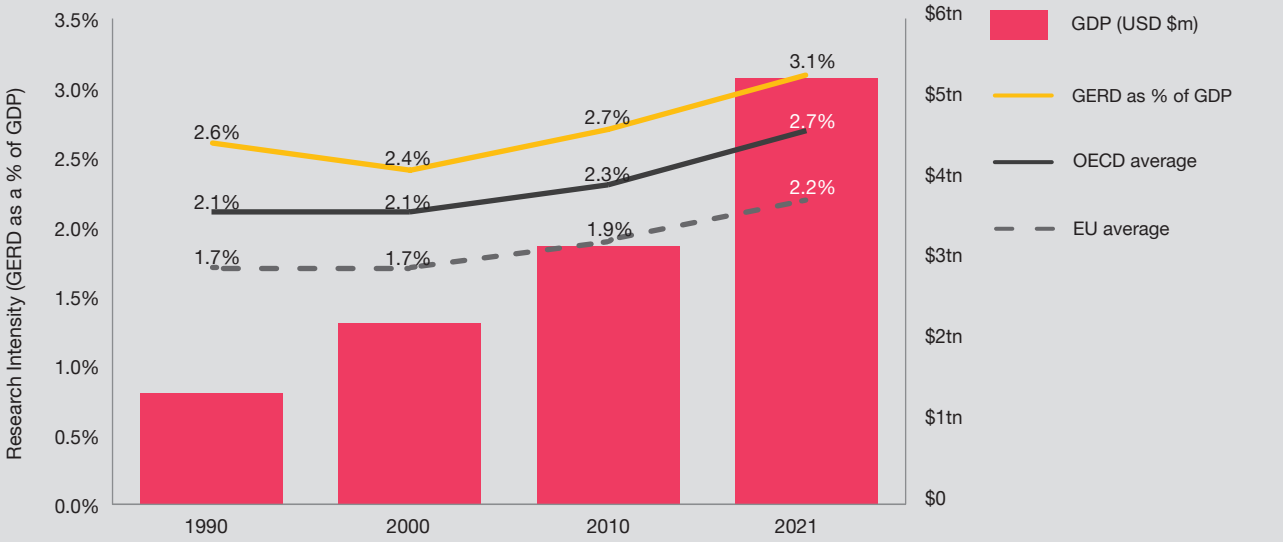
Germany

German R&D investment levels

In 2021, Gross Expenditure on R&D (GERD) in Germany totalled €113bn ($161bn)[1] and has been growing at a compounded annual growth rate of 4.2% since 2018.

This represented 3.1% of GDP in 2021, which is above the OECD and EU average, and third highest in the G7 (below USA and Japan). It is fifth highest in our comparator group.

Germany's GERD as a percentage of GDP has been consistently higher than both the OECD and EU average since 1990, falling slightly in 2000 before increasing in similar proportion to the OECD average.



The current German R&D ecosystem

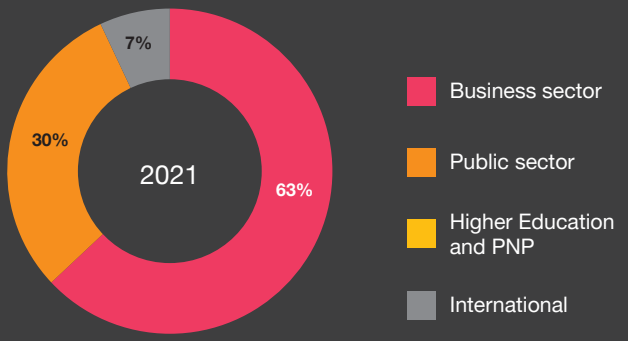
German R&D is performed and funded by a number of different parties within the research ecosystem - at a high level more than half (c.63%) of all R&D is funded by the business sector, and even more (67%) is performed by the business sector.

Once business sector-funded R&D is removed, the public sector funds 81% of the remaining c.€42.1bn, followed by international funders - 19%, and then Higher Education and Private non-profit sector - 1%.

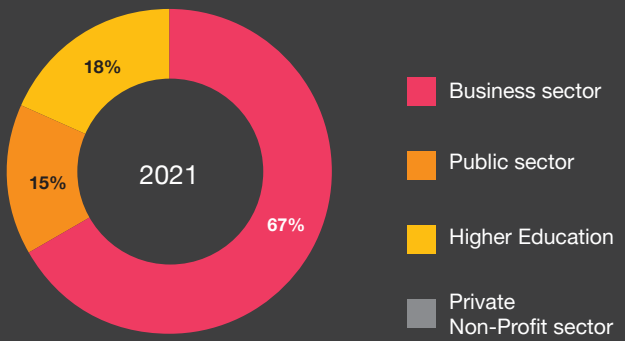
Public sector-performed R&D is predominantly undertaken by the higher education sector - 55%. Whilst there are c.420 HEIs in Germany, a significant proportion of research is undertaken by universities of which there are 109.

In addition, the public sector performs €16.8bn of R&D itself through public research organisations, federal research institutions and state research institutions, of which there are more than 1,000.

R&D funding by sector



R&D perfomance by sector



Sources: OECD MSTI July 2024 data
Note: Due to lack of data OECD and EU averages for 1990 are assumed the same as 1991
[1] Presented in USD as per OECD MSTI July 2024 data for GERD in current Purchasing Power Parity (PPP) USD

Germany

German research landscape

R&D in Germany is undertaken by a number of different bodies - set out in the diagram below along two spectrums to illustrate both their funding source and research focus.

Public Research Organisations (PROs):

- **Fraunhofer-Gesellschaft:** An applied research organisation, focusing on key future technologies and transferring research to industry to drive innovation.
- **Helmholtz Gemeinschaft:** 18 Helmholtz Centres conduct research on behalf of the state and society, with the goal of addressing key societal challenges.
- **Leibniz Gemeinschaft:** The Liebniz Gemeinschaft is an umbrella organisation of 96 research institutions tackling societal and global challenges across humanities, social sciences, natural sciences, and engineering. Leibniz institutions, universities and industry partners work together on interdisciplinary issues.
- **Max-Planck-Gesellschaft:** Germany's premier, non-university research organization dedicated to fundamental research at 84 Max Planck Institutes.

Academies (of sciences and humanities): Associations of renown scholars collaborating in interdisciplinary research to address societal challenges.

Federal research institutions: Germany has 44 federal research institutions that focus specifically on research issues relevant to politics and government.

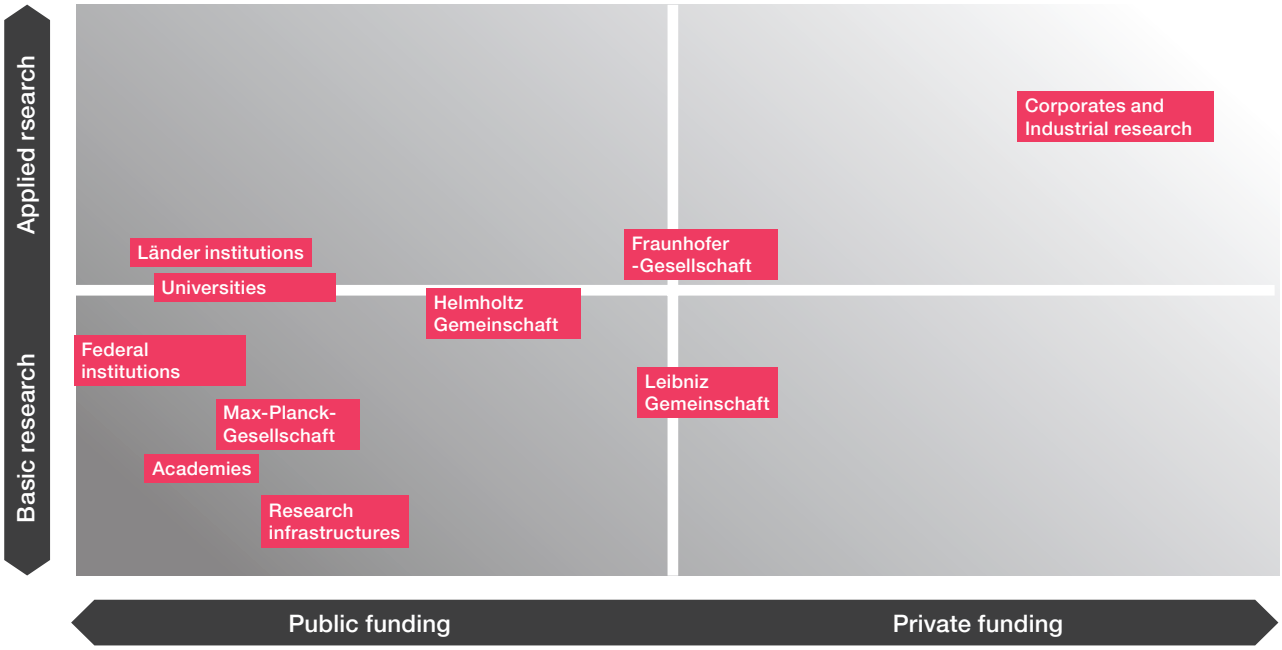
Länder research institutions: Across Germany there are almost 140 state-level institutions covering a broad range of research areas.

Universities: Funded through a mixture of federal and state funding sources, and to differing degrees undertake research in a range of fields, from basic research through to applied.

Corporates and Industrial research: Funded and performed by the private sector, with a focus more on applied, or even experimental development, research, with more immediate commercial application.

For relative context, in 2023, of the €24bn total government R&D expenditure:

- c.€7.5bn (31%) was allocated to non-profit research and science organisations, including Max-Planck-Gesellschaft, Fraunhofer-Gesellschaft, (of which c.€4.3bn was allocated to the 18 Helmholtz research centres).
- c.€3.8bn (16%) was allocated to Länder (of which c. €3bn or 12% went directly to universities and university hospitals, and only €0.2bn went to Länder institutions).
- c.€2.5bn (10%) was allocated to the German Research Foundation (DFG) to fund project grants.
- c.€2.1bn (9%) was allocated to federal institutions.
- c.€1.9bn (8%) was allocated to other public research organisations.



Sources: BMBF; Research in Germany

Germany

Government research funding system

Overview

The German government research funding system is delivered through both the Federal Government and the 16 individual states (Länder), and R&D activity is undertaken by universities as well as a large number of public (federal and state) research organisations.

R&D funding is overseen at a federal level by the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, (BMBF)) who funds research at a number of public research organisations (PROs) and who also funds project grants through the DFG.

Whilst the BMBF sets the federal budget for higher education and research, the Länder have jurisdiction over the higher education and research funding within their respective regions, primarily funded by their tax revenues.

The DFG (funds research primarily through project grants and administers earmarked projects, such as the Excellence Strategy. The DFG's €3.9bn annual budget comes primarily from the Federal Government (70%), with the Länder contributing the remaining 30%.

With considerable authority over R&D expenditure delegated to the individual states, coordination is managed by the Joint Science Conference (GWK), a decision-making body responsible for joint funding of science, research, and education. It consists of federal and state (Länder) ministers for science and finance, each holding an equal share of votes. The GWK is primarily responsible for decisions on joint science funding for initiatives of supra-regional importance. This includes, among other things, pacts between the Federal Government and the Länder, such as the Excellence Strategy and the funding of research infrastructures and large-scale facilities at universities.

As noted, the main government ministry for funding R&D with the largest expenditure on R&D is the Federal Ministry of Education and Research (BMBF). Aside from this, R&D is funded by many other ministries, we note the eight key ones below.

Rank	Federal government expenditure on R&D per department - 2023	€m (2023)	% share (2023)
1	Federal Ministry of Education and Research	13,577	56.3%
2	Federal Ministry for Economic Affairs and Climate Action	5,039	20.9%
3	Federal Ministry of Defence	1,870	7.8%
4	General Fiscal Administration	1,119	4.6%
5	Federal Ministry of Food and Agriculture	840	3.5%
6	Federal Ministry for Digital and Transport	444	1.8%
7	Federal Ministry of Health	341	1.4%
8	Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection	242	1.0%
#	9 other Government Ministries with a total share sub 1%	641	2.7%

Other government funding sources

In addition to the DFG, individual scholarships and research project funding is provided by the German Academic Exchange Service (DAAD) and the Alexander von Humboldt Foundation, both of which focus primarily on international exchanges.

DAAD's €840m budget in 2023 was 57% funded by the Federal Government, (primarily by BMBF and the Foreign Office), and 40% funded by the EU.

The Alexander von Humboldt Foundation's €165m budget in 2024 was almost solely funded by the Federal Government (BMBF and the Foreign Office), and supported international scholarships and collaborative projects.

Sources: BMBF, DFG, DAAD, Alexander von Humboldt Foundation, Research in Germany

Germany

The German government R&D funding system is diverse, thanks to its decentralised model. Whilst the Federal Government provides a considerable amount of project grants through the DFG, it only provides strategic institutional block funding to federal research institutions and PROs.

Universities and their funding falls under the jurisdiction of individual Länder governments, and therefore the proportion of block funding versus project grant funding varies by state. At a high-level Länder provide a dual funding system including a significant proportion of block funding, and supplemented with both competitive and non-competitive project grants.

Primary government funding mechanisms

Block funding is a core funding mechanism employed by the individual Länder to fund university activity, including R&D. The Länder are principally responsible for public research financing within their region, including the opportunity to provide non-competitive block funding to universities that could support R&D activity.

The 16 Länder are highly autonomous in matters of education policy and funding approaches, based on their own budget (with their own taxes revenues), resulting in effectively 16 different models for the allocation of research funding as there is not a standardised approach.

Separately, the Federal Government provides block operational funding for federal research institutions and PROs.

Project grants are also available for universities and PROs and are mainly provided at a federal level by the DFG, either through calls for proposals, or through specifically earmarked funds. Länder governments provide additional competitive and non-competitive project grants of their own, aligned to regional priorities.

The DFG itself has a wide range of funding instruments which means it provides funding both for individuals (i.e. investigator-led, thematic and infrastructure-related) as well as for institutions (e.g. for major research infrastructure and core facilities).

In 2023, 48% (c.€11.5m) of federal government R&D expenditure was spent on direct project funding and departmental research, compared to c.45% provided for basic funding of institutions, including federal institutions.

Other government funding

The new Federal Agency SPRIN-D was established in 2019 as a joint initiative by the BMBF and the Ministry for Economic Affairs and Climate Action (BMWK) to discover and support highly innovative research projects through challenge competitions. SPRIN-D was initially planned for a period of ten years, with an anticipated budget of c.€1bn for that period, and has been assigned special powers to enable more agility in its provision of funding and investment outside of federal government bureaucracy, allowing it to using more flexible funding instruments such as creating subsidiaries, and private-law financing instruments.

Generally the Federal Government offers few tax incentives, however, in 2019 introduced the “Forschungszulage“, a 25% tax subsidy for R&D for personnel expenses and contract research, recently enhanced in the German Growth Opportunities Act adopted in March 2024. In addition further tax incentives may be available at a state level depending on each individual Länder. In contrast to other OECD countries, R&D tax incentives are a very small proportion of public sector support for business R&D investment in Germany.

Source: BMBF; BMWK; SPRIN-D; OECD

Germany

Länder research funding system

As discussed, the 16 Länder are highly autonomous in matters of education policy and funding approaches, based on their own budget.

Länder typically employ various methods for distributing R&D funding to HEIs: incremental discretionary, contract or mission-based, and indicator-based. Whether or not institutions then have full discretion over the use of this funding, depends on the Länder.

- Incremental discretionary - This is the traditional and most common funding approach, where funding is determined based on historical allocations, with periodic adjustments (based on inflation).
- Contract or mission-based - Through negotiated agreements based on specific missions, strategic goals, or research priorities, however, this is generally non-competitive, to distinguish from competitive project grant funding calls.
- Indicator-based - This model links institutional funding directly to performance metrics, rewarding universities that achieve higher research output, external funding success, or academic impact.

As a result, universities receive a mix of federal and state, block grant and project grant, funding, and the reliance on each source and type of funding will vary by state and by university.

Once all funding sources (federal, state, industry etc) are taken into account, three states; being Baden-Württemberg, Bavaria, and North Rhine-Westphalia, account for 61% of the total R&D expenditure in Germany. This suggests a material imbalance in distribution across the Lander, likely driven by research capacity, investment attractiveness, number of universities, and wealth of individual Lander.

Rank	Länder	Regional distribution of total R&D expenditure (millions of euro) 2022	Regional share of total R&D expenditure (% share) 2022
1	Baden-Württemberg	32,526	26.8%
2	Bavaria	24,388	20.1%
3	North Rhine-Westphalia	17,628	14.5%
4	Hesse	10,105	8.3%
5	Lower Saxony	9,153	7.5%
6	Berlin	5,771	4.8%
7	Rhineland-Palatinate	4,826	4.0%
8	Saxony	4,412	3.6%
9	Hamburg	3,089	2.5%
10	Thuringia	1,960	1.6%
11	Schleswig-Holstein	1,913	1.6%
12	Brandenburg	1,495	1.2%
13	Bremen	1,183	1.0%
14	Saxony-Anhalt	1,176	1.0%
15	Mecklenburg-Western Pomerania	942	0.8%
16	Saarland	745	0.6%
Total		121,312	100%

Source: BMBF

Germany

Länder research funding: Bavarian example

To illustrate the funding system at a state-level, we have researched the system in place in Bavaria, which receives the second most R&D funding from regional sources.

Universities in Bavaria receive public funding from both federal and Länder sources, including federal project grants, (mainly delivered through either the BMBF or the DFG), state block funding and state level project grants.

Bavaria is home to two out of the 11 Universities of Excellence - Technical University of Munich (TUM) and Ludwig Maximilian University of Munich (LMU), and therefore additionally benefits from federal institutional funding on a seven yearly funding cycle, based on quality and performance metrics.

The Bavarian government sets specific research priorities, and announces Länder-specific research programmes for which it will provide financial support. In practice, Länder R&D priorities are often influenced by the broader national strategic vision; for instance, there is a strong emphasis presently on enhancing artificial intelligence research to compete globally.

Examples of Bavaria's implemented state level funding programmes include:

Bavarian Collaborative Research programme (BayVFP)

This programme supports industrial research. Eligible applicants include companies based in Bavaria, non-university research institutions, universities, and small and medium-sized enterprises (SMEs).

The Bavarian Bioeconomy Strategy is an example of how Bavaria sets its own state-level priorities and will direct funding accordingly. These priorities may align with federal objectives or diverge completely, reflecting the state's independent approach to innovation and economic development.

To encourage collaboration between academia, industry, and state government, Bavaria has also established several collaborative platforms:

Bavarian Research Alliance (BayFOR)

A private organisation promoting Bavaria as a hub for science and innovation within the European Research Area. BayFOR supports scientists and stakeholders from Bavarian universities and the private sector in securing European research, development, and innovation funds.

Bavarian Research and Innovation Agency

This agency provides comprehensive support to Bavarian R&D stakeholders seeking to translate research into innovation, guiding them from the initial idea to the final product. It offers expertise in research and innovation funding, knowledge and technology transfer, patents, licenses, and business start-ups.

In response to the federal High-Tech Strategy, the state of Bavaria has established its own state-level initiative to take this forward, called Hightech Agenda Bavaria. The initiative comprises approximately €5.5bn of investment and includes establishing 1,000 new professorships in key fields for the future, such as artificial intelligence, cleantech and aerospace.

As part of Bavaria's high-tech agenda, the state engages with industry on a national level as well - for example, HOCHTIEF (German multinational construction company) is expanding Rosenheim Technical University as part of Bavaria's high-tech agenda. The expansion involves building a technology park with laboratory and machinery facilities. Of the total project value of €190m, HOCHTIEF's share amounts to around €140m. In addition, 13,000 new study places are to be created, more than 20 centres of excellence are to be established and built throughout the country and regional university initiatives are to be promoted and accelerated.

Sources: Bavarian; Bayern Innovation; BMBF; Research in Germany, BayVFP, BayFOR; STMWI; Hightech Agenda; THI.com

Germany

System developments

Federal strategy

The High-Tech Strategy or Agenda is an interministerial strategy that sets the mid-term strategic orientations for Germany's R&D and innovation activity, and aims to guide the economy towards its objective of spending 3.5% of GDP on R&D, given that growth in research intensity has stalled in recent years.

At a federal level it has set out the following priorities and organised mission-oriented initiatives around achieving them:

- Health and Care: Advancing medical research to improve healthcare outcomes.
- Sustainability, Climate Protection, and Energy: Promoting sustainable practices and technologies to combat climate change.
- Mobility: Developing safe, networked, and clean transportation solutions.
- Urban and Rural Areas: Enhancing living conditions and infrastructure in diverse communities.
- Safety and Security: Ensuring the protection and resilience of society against various threats.
- Economy and Work 4.0: Preparing the workforce for the digital transformation and future economic landscapes.

One such example of these mission-oriented initiatives is the "Society of Ideas - Competition for Social Innovation" that provides competitive project grants to address societal challenges.

The strategy also considers the effectiveness of research funding and has brought in measures to provide for more flexible handling of extensions to the duration of funded projects and to simply reporting obligations - aimed at maintaining research operations in times of crisis, to prevent the discontinuation of certain research projects (e.g. pandemic-related), so as to minimise the consequences for researchers in those areas.

The use of a "rapid response" funding tool at a federal level, previously used in response to the Ebola epidemics, has facilitated the deployment of billions of euros in 2020 in response to the Covid-19 pandemic.

The Excellence Strategy

In 2005, the BMBF introduced "The Excellence Initiative" (later renamed "The Excellence Strategy"), run by the DFG and the German Science and Humanities Council ("Wissenschaftsrat"), to strengthen university R&D through two key pillars: Clusters of Excellence and Universities of Excellence. Whilst the Clusters funding is project based, with an allowance for indirect costs, the Universities funding is institutional funding, based on a seven yearly funding cycle and in some ways similar to the UK REF in terms of quality scoring approach.

Initially established as temporary funding, the Universities of Excellence programme was made permanent following the amendment to Article 91b of the Basic Law, which enabled the Federal Government to provide long-term, direct funding to universities, primarily through the DFG.

In September 2018, the Excellence Commission awarded 11 universities the title 'University of Excellence,' with total funding of €148m annually. Additionally, it approved 57 Clusters of Excellence at 34 universities, which will receive €385m in the first phase (January 1, 2019 - December 31, 2025). The interdisciplinary research projects will be funded for seven years with up to €10m annually as of 2019, with 75% funded by the Federal Government and 25% by the relevant Länder.

Sources: BMBF; Research in Germany, Hightech Agenda

Shortlisted country deep dives

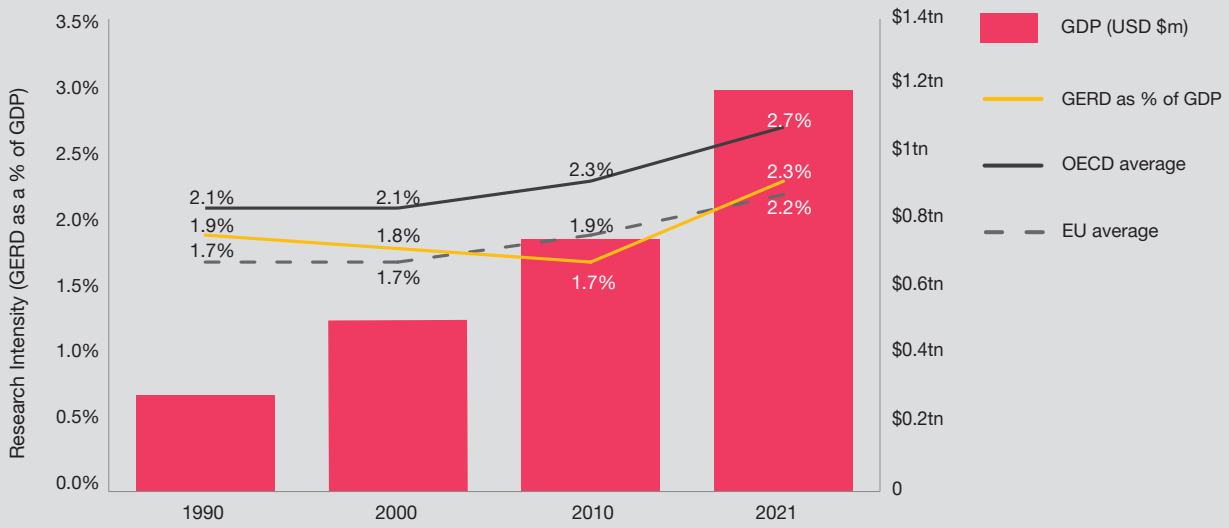
Netherlands

Netherlands R&D investment levels

In 2021, Gross Expenditure on R&D (GERD) in the Netherlands totalled €20bn ($27bn)[1] and has been growing at a compounded annual growth rate of 8.1% since 2018.

This represented 2.3% of GDP in 2021, below the OECD average but above the EU average.

Netherlands GERD as a percentage of GDP has been consistently lower than the OECD average since 1990, declining between 1990 and 2010, before a substantial increase to 2021, where it overtook the EU average once again.



The current Netherlands R&D ecosystem

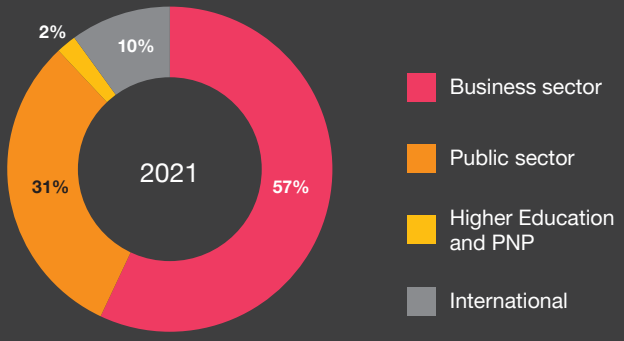
Netherlands R&D is performed and funded by a number of different parties within the research ecosystem - at a high level more than half (c.57%) of all R&D is funded by industry (the third lowest in our comparator group, just below the UK), and 66% is performed by industry (middle of comparator group).

Once business sector-funded R&D is removed, of the remaining c.€8.6bn of R&D, the government funds the majority - 71%, followed by international funders - 24%, and then the Higher Education and private non-profit sector - 6%.

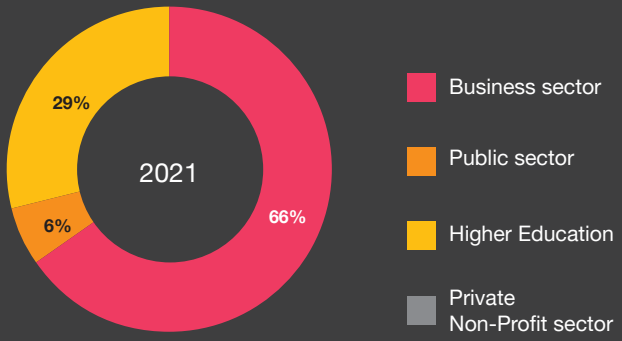
Public sector-performed R&D is predominantly undertaken by the higher education sector (84%). Whilst there are a total of 55 universities in the Netherlands, a significant proportion of R&D is undertaken by 14 larger research-intensive universities.

In addition, the public sector performs €1.1bn of R&D itself through 29 public research organisations including government laboratories.

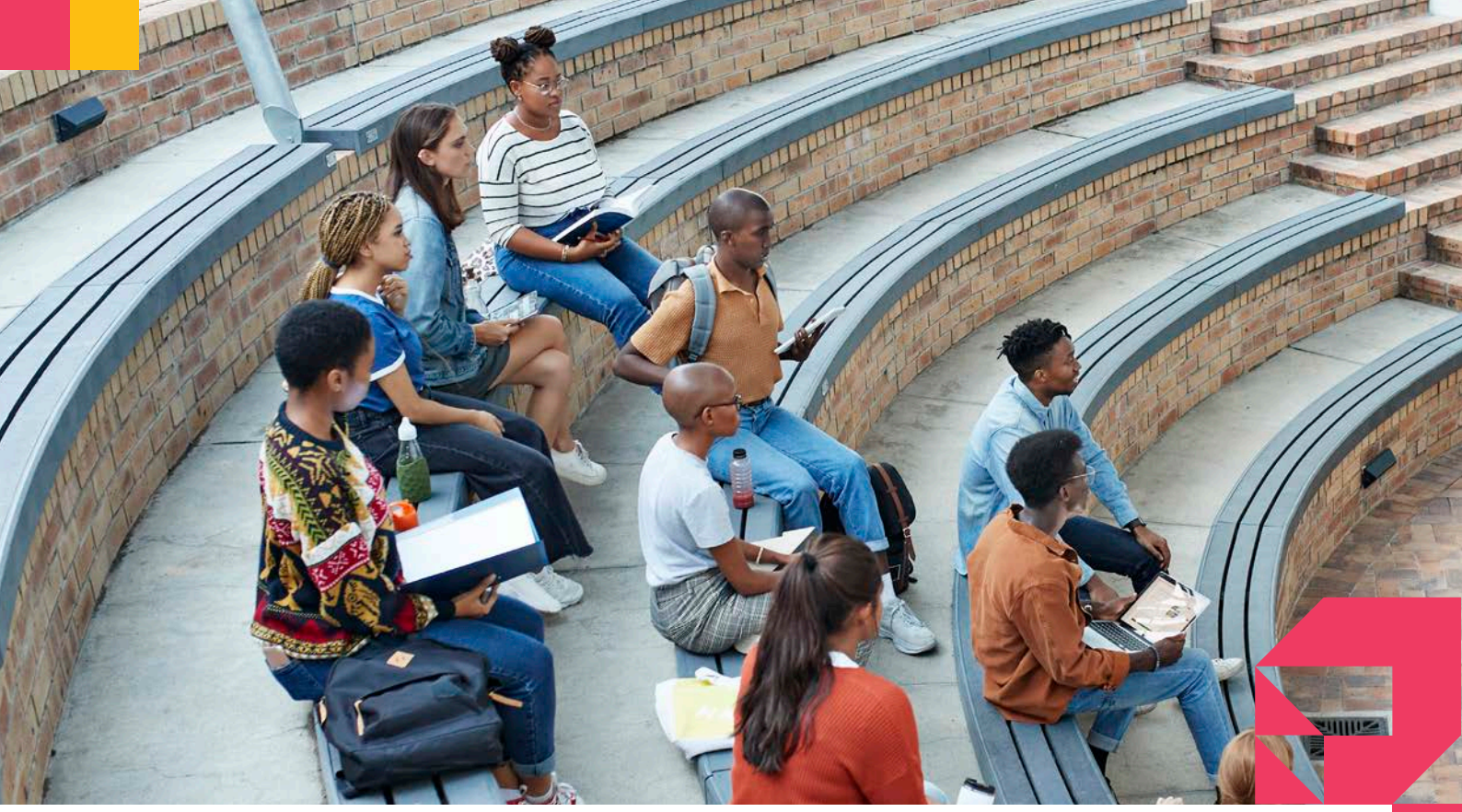
R&D funding by sector



R&D perfomance by sector



Sources: OECD MSTI July 2024 data
Note: Due to lack of data OECD and EU averages for 1990 are assumed the same as 1991
[1] Presented in USD as per OECD MSTI July 2024 data for GERD in current Purchasing Power Parity (PPP) USD



Netherlands

Government research funding system

Overview

In 2022, public R&D funding in the Netherlands totalled €7.5bn across the 11 government departments that fund R&D activities. The vast majority of this funding is administered by three ministries:

1 **The Ministry of Education, Culture and Science ("OCW")** funds c.70% of the total public funding in the Netherlands for R&D.

85% of the OCW's R&D funding is distributed as institutional block funding with the remainder (c.15%) provided through project grant funding.

2 **The Ministry of Economic Affairs** is the second largest R&D funder amongst government departments. This ministry funds c.13% of the total public funding in the Netherlands for R&D.

c.65% of the Ministry is provided as institutional block funding.

3 **The Ministry of Health, Welfare and Sport** is the third largest R&D funder amongst government departments. This ministry funds c.7% of the total public funding in the Netherlands for R&D. It does so mainly via project grant funding.

Eight other ministries fund the remaining c.10% of public funding in R&D in the Netherlands.

Sources: Rathenau.nl

Netherlands

Government funding bodies

NWO (The Dutch Research Council)
is majority funded by the Ministry of Education, Culture and Science (c.90%), including both discretionary funding and specifically earmarked funding. The remainder of NWO funding comes from third party contributions (other government ministies, industry and the EU).

NWO was initially established in 1950 as Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek (ZWO) alongside a separate research organisation established specifically to focus on applied research Netherlands Organisation for Applied Scientific Research (Toegepast Natuurwetenschappelijk Onderzoek, "TNO"). In 1988 ZWO was renamed as NWO and was given a broader mission to include applied, strategic, and thematic research.

NWO's main function is the allocation of research funds through competitive project grants. NWO offers different grant types and programmes. Researchers and research institutions can submit an application for funding for research projects or for large equipment as soon as NWO publishes a call for project proposals.

In 2022, NWO funded a total of €1.3bn of scientific research and infrastructure projects. The majority (c.53%) of the NWO's funds are awarded to universities, followed by NWO institutes (14%) and c.10% to other research institutes.[1]

ZonMw
is a sister organisation of the NWO. ZonMw designs programmes on behalf of the Ministry of Health, Welfare and Sport, the Dutch Research Council (NWO) and other organisations. In 2023, it distributed €456m in projects and programmes.

The Royal Netherlands Academy of Arts and Sciences (KNAW)
is an independent advisory council responsible for ten national research institutes and two institutes that provide research infrastructure. The KNAW offers competitive project grants and manages various programmes for travel, fellowships and awards.

The KNAW is majority funded by the Government (c.60% in 2023) through lump sum funding from the Ministry of Education, Culture and Science. The second largest funding source comes from contract work for third parties, (c.23% in 2023) provided on an annual basis, but forming part of multi-year project contracts. Most of the expenditure of the KNAW is spent on KNAW personnel and the personnel of the KNAW institutes.

Public research organisations and laboratories, of which there are 29 including for example the TNO and the Maritime Research Institute Netherlands (MARIN), are funded through a mix of project grants and institutional block funding from various ministries. In 2022 this totalled €2.8bn, of which €1.7bn was block funding.

Provincial government bodies also provide some R&D and innovation funding, however, these funds are relatively small, generally amounting to under €200m across the country, with Gelderland receiving the largest amount.

Sources: The Rathenau Instituut; Rijksoverheid; NWO.nl. 1. 2023 figures; ZonMw

Netherlands

Approximately

68%[1]

of government R&D funding in the Netherlands - primarily provided by the Ministry of Education, Culture & Science - and only 32% of government funding is distributed via project grants

Government funding mechanisms

Block funding

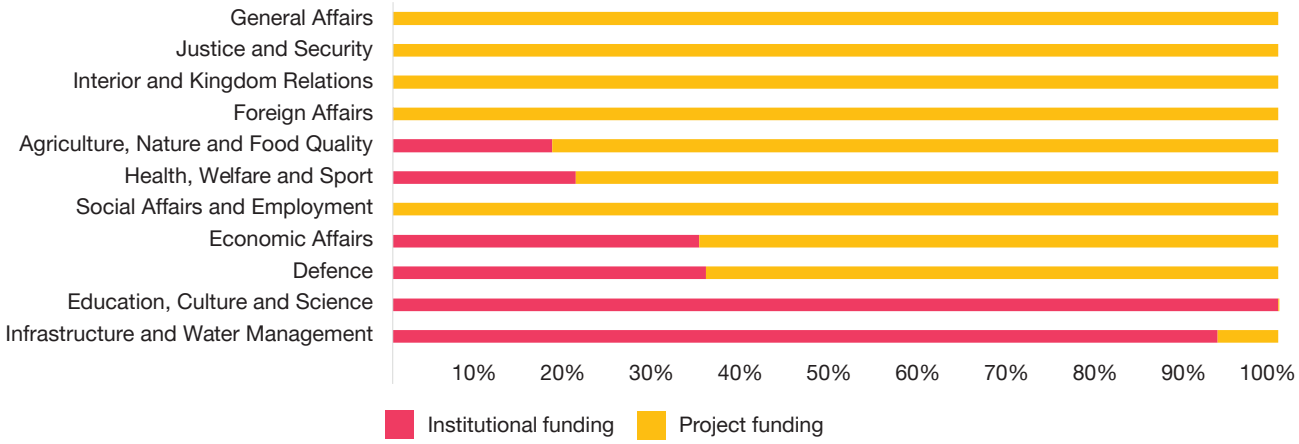
Block funding is a primary funding mechanism for the Dutch government, accounting for c.68% (€5.1bn) of government R&D funding in 2022. €4.4bn of this came from OCW primarily through the basic university block funding allocations.

The R&D component of this basic university block funding provided by OCW is allocated based on a performance related component and a Strategic Considerations Component, including number of PhDs, research schools and historic considerations around research provision. All universities are allocated an initial fixed element, however, newer universities receive slightly less due to legacy assumptions.

Whilst allocated based on research parameters, it is not ringfenced for R&D spend only, however, universities do not have complete discretion as to how it is used, with a proportion required to be spent on specific programmes and national guidelines - for example, rolling grants for young scientists (£150k per individual) must be disbursed for all eligible scientists employed.

The remaining c.€730m of block funding is provided by a number of other ministries, as detailed below:

Proportion of direct government support for R&D in 2022 per department by type of funding.



[1] Rathenau.nl
Sources: The Rathenau Instituut; RVO.NL; Business.gov.NL

Netherlands

Project grants

Project grants are an increasingly important part of the Netherlands R&D ecosystem, representing 32% of government funding in 2022 (compared to 23% in 2005), and primarily disbursed by the NWO, but also provided by the government ministries, ZonMW, KNAW, and The National Growth Fund (recently introduced, see below).

The NWO offers five main lines of project funding, across a mix of investigator-led or curiosity-driven opportunities and mission-led or priority-driven opportunities:

1 Open Competition: Curiosity-driven

2 Talent scheme

Curiosity-driven, responsive-mode research aimed at research talent.

3 Knowledge and Innovation Contracts (KIC)

For programmes and projects in partnership with external parties, part of the government's mission-driven innovation policy to realise economic benefit. From 2024-2027, €138m will be available for funding across priority areas determined by the Ministry of Economic Affairs (e.g. circular economy).

4 Dutch National Research Agenda (NWA)

Thematic programming to tackle economic and societal challenges, with budgets varying by theme, but an annual funding round of €108m in 2024.

5 Research Infrastructure grants

In addition to the above, project grants are also offered via the Netherlands Enterprise Agency (RVO), which is part of the Ministry of Economic Affairs. The RVO is responsible for granting patents and for programmes to stimulate entrepreneurship in the Netherlands. The RVO offers a variety of subsidies and programmes which can be used throughout the different phases of a startup.

Matching Horizon Europe Subsidy Scheme

Horizon Europe is the EU's key funding programme for research and development.

In the Netherlands, there is a subsidy scheme available for matching Horizon Europe's funding. If the knowledge institution is participating in a Horizon Europe project, there is partial compensation available from the Dutch government.

If more costs are incurred than funding received from Horizon Europe grants, these are referred to as matching costs. Through the Dutch Government's scheme "Matching Horizon Europe", partial compensation can be received for these matching costs.

The subsidy can be used for:

- Non-economic activities (including conducting research or providing education).
- Investments in preparing a new Horizon Europe application.

The budget may be spent over multiple years, in the period 2023-2029 a total budget of c.€560m is available. The budget for 2025 is c.€80m.

The amount received is based on the Horizon Europe project subsidy agreement that the European Commission (EC) grants the knowledge institution. This is determined according to the eCORDA database. The subsidy per project amounts to between 8% and 15% of the subsidy amount that the EC grants to the knowledge institution.

This scheme is eligible to knowledge institutions that receive public funding for conducting research, including Universities and institutes under KNAW, NWO or ZonMw.

This scheme is administered by the RVO which is operated under the Dutch Ministry of Economic Affairs, and therefore does not go through the NWO.

Sources: RVO.NL; Horizon Europe; Business.gov.NL; The Rathenau Instituut

Netherlands

Other government funding mechanisms

For industry, there are also a number of advantageous R&D tax credits aimed at simulating private sector R&D investment. In 2016 two existing schemes were merged into the new WBSO (Research and Development Promotion Act) scheme that provides a 16-32% deduction on labour costs related to R&D. In addition the Innovation Box scheme offers a reduced corporate income tax rate (of 9% compared to 26%) for profits relating to self-developed intellectual property (e.g. patents, software etc). In 2021, R&D tax relief provisions accounted for c.64% of total public support for business R&D, which is on the higher end within the OECD.

The **National Growth Fund** (NGF) was founded in 2020 with the goal of boosting the Netherland's sustainable earning capacity. This fund is managed by the Ministry of Economic Affairs and Climate Change, and the Ministry of Finance. It targets knowledge development and research, development and innovation. An independent advisory committee assesses the projects and issue recommendations to the government on project grant funding.

The NGF invests in projects that ensure sustainable economic growth in the longer term. This fund has earmarked a total of €20bn over the period 2021-2025, part of which is available for R&D. Over the period 2023-2026, it is expected that the NGF will spend more than €0.5bn on R&D annually.

The NWO is one of the implementing organisations of the NGF, including organising grant programmes and deploying investment. Compared to NWO it offers more bespoke, and less prescriptive funding application modules, and is explicitly intended for projects that contribute to the government's plans for long-term economic growth.

The NGF's final two allocation rounds have, however, now been cancelled by the new government, appointed in July 2024, as part of their budget cuts - explained in more detail below.

Sources: OECD, NGF

Netherlands

System developments

Operation Beethoven

In 2023, the government announced Operation Beethoven, its investment of €2.5bn in the microchip sector based in the Eindhoven region - of which €1.3bn will come from the NGF, given the growth potential that the chip industry represents. The package includes measures for education, knowledge and spatial infrastructure, intended to strengthen the Dutch chip industry and level the playing field internationally.

Secondary and higher vocational education institutes and universities in the Brainport Eindhoven region will receive the largest proportion. This type of regionally-focussed, but large-scale university R&D funding is an example of strategic funding that is driven by national objectives but that could not be disbursed through existing primary funding mechanisms.

Political Change

In July 2024, the Netherlands saw a significant shift in its political landscape with a new coalition forming the government, with the PVV as the largest party.

As this new government takes power, three new ministries have been created: Ministry of Asylum and Migration, Ministry of Climate Policy and Green Growth & Ministry of Housing and Spatial Planning.

The Ministry for Climate and Green Growth was spun out from Ministry of Economic Affairs and Climate Policy, and is likely to play a significant role in R&D funding.

In November 2024, the Dutch House of Representatives made a significant decision with a vote to cut higher education and research funding by approximately €1bn on a structural basis. The cuts include a €300m reduction in the international education budget, which will specifically impact international partnerships, exchange programmes, and the recruitment of international students.

Prior to the new government, higher education sectoral plans had been developed, setting research and teaching priorities across Dutch universities, promoting specialisation, by focusing specific research areas within select institutions. The sector plans were developed bottom-up, with each academic sector independently setting its priorities and managing funding allocations.

The new Dutch government originally planned to cut funding for these national higher education sector plans, but, following considerable backlash, the government shifted the focus of the cuts to starter and incentive grants instead.

Starter (startersbeurzen) and incentive grants (stimuleringsbeurzen) are government funded allocations for each university to reduce staff workload and provide more stability to the workforce as a way of easing pressure on researchers constantly applying for NWO project funding. Starter grants (€300k each) were awarded to newly employed university lecturers, allowing them to finance research independently. Universities responded by offering more permanent contracts to young lecturers, but demand exceed available grants. In January 2024, universities were given permission to split starter grants in half to accommodate more lecturers.

As a result of these budgetary cuts, starter grants and incentive grants for researchers and teachers will now be discontinued by 2025.

Aside from the sector plans, the plans for higher education and research proposed in the outlier coalition agreement of 16 May 2024 also included:

- Reduction in the Fund for Research and Science (€150m, year-on-year) - this fund provides structural support for curiosity driven research and institutions.
- Cancellation of the final two rounds of the National Growth Fund.

Sources: BBC News University world news

Shortlisted country deep dives

South Korea

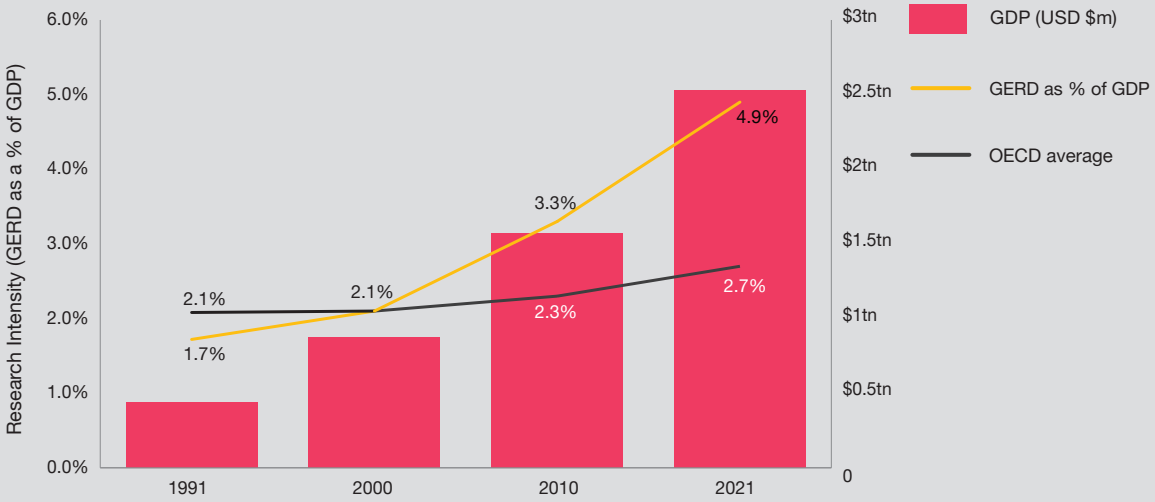
South Korean R&D investment levels

In 2021, Gross Expenditure on R&D (GERD) in South Korea totalled ₩102tn ($123bn)[1] and has been growing at a compounded annual growth rate of 7.2% since 2018.

This represents 4.9% of GDP, above the OECD average, and is materially higher than the comparator group.

Whilst more recent data is not available for all comparator countries, it is noted that South Korea's research intensity has continued to increase, reaching 5.21% in 2022.

South Korea's GERD as a percentage of GDP broadly tracked the OECD average between 1991 and 2000, before accelerating up to current levels, far above the OECD average.



The current R&D ecosystem

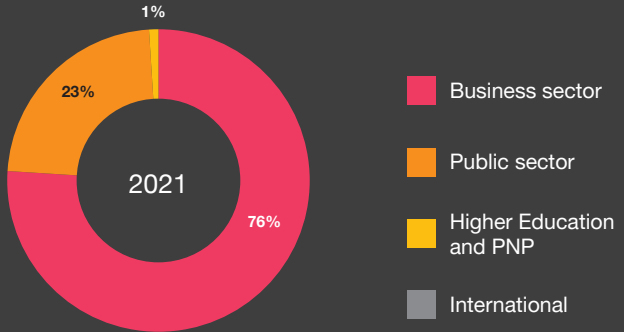
South Korean R&D is performed and funded by a number of different parties within the research ecosystem, with the business sector funding more than three quarters (76% - second highest in the comparator group, behind Japan), and performing even more at 79% (joint highest), demonstrating the larger role that industry plays in South Korea's R&D ecosystem compared to other countries.

Once business sector-funded R&D is removed, the public sector funds almost all (95%) of the remaining ₩24 tn, followed by a minor proportion from higher education and the private non-profit sector (3%) and international funders (1%).

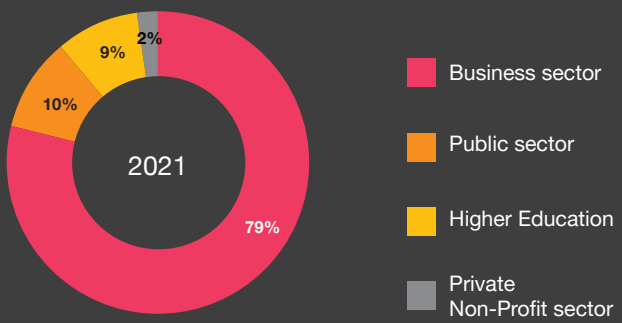
44% of public sector-performed R&D is undertaken by the higher education sector. Whilst there are over 400 HEIs in South Korea (including public universities, local universities private universities and junior colleges), the majority of research is undertaken by research universities.

The public sector performs ₩10.0tn of R&D (47% of public sector performed R&D) itself through 25 government research institutes, and a small amount of private non-profit organisations performed ₩2.1tn of R&D in 2021.

R&D funding by sector



R&D perfomance by sector



[1] Presented in USD as per OECD MSTI July 2024 data for GERD in current Purchasing Power Parity (PPP) USD

Sources: OECD MSTI July 2024 data; 2021 UK Science and Innovation Network. No OECD data is available for South Korea's GERD or GDP in 1990, so 1991 has been used instead.

South Korea

Government research funding system

Overview

In 2024, the total government R&D budget in South Korea amounted to ₩26.5 trillion, marking a 9.5% decrease from the previous year. The budget distribution for the top five ministries was as follows:

- Ministry of Science and ICT (MSIT): ₩8.9 trillion (33.7%).
- Ministry of Trade, Industry, and Energy (MOTIE): ₩4.8 trillion (18.2%).
- Defence Acquisition programme Administration: ₩4.6 trillion (17.5%).
- Small and Medium Business Administration: ₩1.4 trillion (5.3%).
- Ministry of Education: ₩1.3 trillion (4.8%).

Research and development is undertaken by both government research institutes and universities, each funded and managed in different ways through independent bodies.

Research granting agencies

Central government R&D funding flows to public universities and government research institutes through 17 specialised research management agencies responsible for planning, soliciting, evaluating, and managing research projects for each government ministry. In 2007, the Korean Council of R&D Funding Agencies (CORFA) was created from the previous Office of Science and Technology Innovation to coordinate these 17 funding agencies and to manage the national research projects.

The National Research Foundation of Korea (NRF) is the primary public funding body, managing university research funds for MSIT and MOTIE, and reporting into MSIT. Within the NRF, there are five departments, each focused on specific areas of research funding, namely:

- Academic research & University funding (32% of 2019 budget).
- National Strategic R&D programmes (32%).
- Basic research and engineering (29%).
- Humanities & Social Sciences (4%).
- International Cooperation and other areas (c.3%).

The National Research Council of Science & Technology (NST) & Research Institutes

The National Research Council of Science & Technology (NST) is responsible for R&D across government research institutions and for overseeing and supporting the country's national research initiatives.

The NST was established under MSIT and ICT, and manages R&D across a broad range of government-backed research institutions that operate in fields such as engineering, life sciences, information technology, and energy.

NST is responsible for 23 research institutes, including for example, the Korea Institute of Science and Technology (KIST), the Electronics and Telecommunications Research Institute (ETRI), and the Korea Research Institute of Bioscience and Biotechnology (KRIBB). Research institutes can either be government-funded institutes or public policy research institutions. In this capacity, the NST provides financial support through multiple programmes, including grants for basic and applied research, initiatives for young researchers, and projects that encourage international collaboration.

Despite institutes having a significant role in the R&D ecosystem, the OECD notes that there is limited evidence of collaborative research between institutes and the university sectors, such as you see in other countries (e.g. Germany, Sweden).

Sources: 2024 budget analysis frank report; CORFA; NRF; NST Annual Report 2023

South Korea

Government funding bodies

Regional context

Regional funding mechanisms are less developed in South Korea, and contributions from municipalities and county councils constitute only a minor proportion of the total government R&D expenditure. However given the reliance on private sector R&D investment, funding levels of regional R&D vary significantly.

The capital region, which includes Seoul, Gyeonggi, and Incheon, accounts for the largest share of South Korea's total R&D expenditure, representing 70% with a total of ₩83.573 trillion (compared to c.45% of the total population). This is followed by Daejeon with ₩11.085 trillion (9%), and other regions collectively contributing ₩24.416 trillion (20%).

In 2023, the government initiated a national masterplan (RISE, managed by NRF) to restructure and decentralise the higher education system, with 30 regional universities selected for additional support of ₩100bn over a five year period launching in 2025. This effort comes in response to criticism over regional imbalances and that centralised bureaucratic control from the ministry, through their programme funding, restricts universities' self-reliance, autonomy and competitiveness.

Sources: 2023 KISTEP; Statista; MSIT; NST; NRF

South Korea

Government funding mechanisms

R&D funding in South Korea is disbursed primarily through project grant funds, and only a minor proportion through block funding.

Project grants

Project grants are the primary government funding mechanism in South Korea, with the NRF allocating c.₩8tn of grants across its five departments in 2019.

These grants vary in nature and are not solely competitive, with many grants directed by government priorities and some grants only applicable for certain universities or research institutes (on a non-competitive basis). For example, c.32% of NRF grant funding relates to National Strategic R&D programmes, such as programmes to support space technology for which only the Korean Aerospace Research Institute is eligible.

The NRF provides project grants for individual researchers, groups and consortia, infrastructure and talent development. Its open competition research projects generally fall into three categories:

- Individual basic research projects: ~2bn ₩/year.
- Small group projects (3-5 researchers): ~5bn ₩/year.
- Large group projects (around 10 researchers): ~20bn ₩/year.

Other projects are selected through technology demand surveys before solicitation and can range from tens of millions of ₩ to several hundred billion ₩ per year.

Funding bodies issue Requests for Proposals (RFPs) and call for project submissions. These projects may be of 3 different kinds:

1. Top-down projects, typically initiated on a competitive basis by the government.
2. Middle-up projects, RFPs are issued with some flexibility, leaving room for researchers to propose additional elements within the given framework.
3. Bottom-up projects, allowing researchers to propose projects on freely chosen topics, often related to fundamental science or academia.

NRF is also responsible for providing more strategic, stable "project" grant funding for universities to innovate and enhance their basic capacity in research, education and industry cooperation, such as the RISE programme, or the Support programme for University development, for which 131 universities are eligible for the basic funding through a voluntary agreement (rather than an evaluation and selection process). Nonetheless this funding remains short-term, rather than long-term strategic, with short grant period (e.g. three years). Enhanced funding for such projects employ evaluation and performance criteria, albeit this process has been criticised for low incentivisation for improved performance.

Challenge-based funding

In recent years, Korea has demonstrated increasing interest in mission-oriented innovation policies with associated project funding. It launched three challenge-led schemes to pursue ambitious goals following the DARPA model, with funding provided for up to nine years:

- **The Korea Advanced Research programme (KARPA)** - established by MSIT for 2020 to 2024, with an annual budget of c. ₩1.4-1.8bn.
- **The Alchemist** - established in 2019 by MOTIE, with the second wave of funding between 2022-27 estimated at ₩375bn (and ₩c.50bn of funding from the private sector).
- **The Future Challenge Technology Development programme** - with the MoD.

Whilst each ministry must follow normal budgetary processes for their KARPA programmes, the STI Office offers them more flexibility and attention to accommodate their specific nature.

The government has also established a number of challenge-based funding programmes that focus on industry and international collaboration efforts, for example the K-Startup Grand Challenge, funded by the Ministry of SMEs and Startups.

Sources: NRF; MSIT; MOTIE; KARPA; OECD

South Korea

Block funding

Public universities also receive "General University Funds" directly from government, which are institutional operational grants, based on evaluation criteria (including research performance and output), however, the lump sum amount allocated is intended to cover all university operating expenditure, including tuition, so the proportion that ends up being spent on R&D is unclear, and may be quite limited.

The Ministry of Education is the primary government agency responsible for overseeing such block funding to universities. The evaluation criteria for university funding allocations was recently amended in 2023 to cut funding to underperforming universities and reallocate to those with the highest evaluation scores.

Whilst universities can choose to use some of this to support their R&D activities and enhance their R&D capacity, given that tuition funding has stagnated for the last 10 years, (and is one of the lowest government expenditures per student in the OECD), there may be a limited amount allocated for R&D.

Some block funding for research has been introduced for universities under MSIT and recently also at national and public universities. However, block funding remains a minor proportion of the overall R&D funding provided by the government to HEIs - although it does represent an important funding stream for research institutions who are operationally funded by the NST.

Other government funding

To stimulate R&D activities, the government provides tax credits for development of research, up to 25% for most activities, however, for priority technology areas designated by the government (e.g. AI), there are further preferential rates ranging from 20-40%. In addition there are tax credits for technology transfer amongst SMEs, and for corporate merger or acquisition of innovative SMEs. As a percentage of total tax incentives for corporate investment in Korea, the R&D tax credit is the largest.

Korea was placed in 2020 among the OECD countries that provide the largest level of total government support to business R&D as a percentage of GDP, at a rate equivalent to 0.29% of GDP, according to the latest report published by the OECD - with R&D tax credits only one component of that.

Other key funding sources

International

As of 1 January 2025, South Korea also joined Horizon Europe and now has access to Pillar II funding, allowing it to access additional funding programmes that target climate, energy, digital economy and health. It is the first East-Asian country to join Horizon Europe, promoting internation research and innovation cooperation.

The role of industry

The private sector, or the 'chaebol', is a major contributor to R&D activity in South Korea, including large international conglomerates such as Samsung, LG, Hyundai, Kia Motors etc, and, encouraged by government, the chaebol plays an important collaborative role in the wider R&D ecosystem.

The South Korean government provides substantial tax incentives to stimulate R&D investment in the private sector, including up to 25% tax credit on general R&D expenditures, depending on company size and investment level, super deductions for additional benefits as R&D spending increases, and up to 40% credits for priority technologies like Artificial Intelligence. These policies are complemented by grants and low-interest R&D loans to further incentivize private sector investment.

As well as undertaking R&D in their own in-house teams, large corporations fund fundamental research through open competition. A notable example is Samsung Future Technology Promotion programme, which has contributed approximately ₩1.5tn in funding. In addition, companies also provide small-scale philanthropic research funding to universities and university hospitals.

In major government-led research initiatives, universities, research institutes, and corporations are actively encouraged by government policy to form consortia and submit joint proposals. Similarly, universities and research institutes often address industrial challenges through industry-sponsored research initiatives.

University Innovation Funds is an example of a government initiative, aimed at encouraging universities to collaborate with industry partners to commercialize their research findings. Through this fund, universities can access additional financial resources to transform research discoveries into commercially viable products and services.

As a result of industry funding such a large proportion of R&D in South Korea, in 2022 65% of R&D funding was spent on development research, compared to 20% on applied research and 15% on basic research (for context, this proportion of basic research is comparable to Japan and the US, but significantly lower than others e.g. France).

Sources: OECD Education GPS; Innovation News Network, 2025; Samsung; Invest Korea, 2023

South Korea

System developments

The rise of industry-led R&D and an emphasis on applied research

Korea launched its industrialisation drive in the 1960s with significant investments in human resource and industrial development, and a five year economic development plan aimed at developing its industrial base. It was only in the 1980s, however, that the Korean government acknowledged that to sustain further development, it needed to build indigenous R&D capability.

The National R&D programme was launched in 1982, still with a strong focus on incentivising private sector investment through tax credits, worker development and strategies to incentivise firms to invest heavily in R&D through global competition and financial incentives linked to export performance. This gave rise to the 'chaebols', larger firms benefitting from significant economies of scale, who are well-placed to engage in longer term, riskier R&D.

As industry R&D investment increased, government spending declined, falling to 16% in 1990 (compared to 54% in 1981). The dominant role of industry also meant a heavy emphasis on applied research and experimental development (accounting for c.83% in the 1980s), and a staggering growth of patents granted (average annual growth rate of 15% between 1981 and 2005).

Shifting focus of R&D funding

The rate of pace and investment has not slowed since, with research intensity increasing from 2.1% in 2000 to 5.2% in 2022, the highest of all comparator countries by some margin, and GERD as a whole growing by a CAGR of 10% over that period.

This growth has, however, primarily favoured top-down, mission-led projects intended to boost competitiveness in priority sectors, and often in partnership with the private sector, and there was increased acknowledgement of the need to invest in basic research so as to become a 'first mover' instead of a 'fast follower'. In 2020, the amount spent on basic research investigator-led grants became approximately equal to the top-down, mission-oriented projects.

The government-led drive for high growth resulted not only in an emphasis on mission-led, applied research activity, but also, in some stakeholders' view, a focus on quantity over quality, as a result of government-mandated emphasis on metrics. The staggering growth of patents was later mirrored in the quantity of research outputs, which grew by 450% between 2000 and 2023, or a CAGR of 7% - significantly higher than all comparator countries (average CAGR of 3%, and only 114% increase in the period). According to industry commentators, there is a renewed effort to enhance the quality of research going forward, however there remain concerns as to how to objectively assess quality.

2025 Budget

The government R&D budget for 2025 is ₩24.8tn ($17.9bn), the largest public sector R&D investment in the country's history, announced alongside a reform of the R&D budgeting approach in a bid to improve efficiency of spending and focus in on three priority investment areas: AI-semiconductors, biotechnology and quantum technology. The reforms include a renewed focus on increasing support for international cooperation and high-risk, high-reward R&D, creating a more stable research environment through talent development funding, and an increase in the funding levels for basic research in particular.

In 2025, c.₩1tn will be invested through a new high-risk, high-reward investment track called "Innovative and Bold R&D" in target research fields identified by the government, with 21 projects so far identified across six ministries.

Mirroring developments in the US with the ARPA model, this funding process grants project leaders with more autonomy, and more flexible milestones, and is intended to support the creation of disruptive innovations even at the risk of failure.

In addition, the 2025 budget announced a record level of investment in basic research at ₩2.9tn, designed to make research easier, more strategic and more stable with programmes such as the Leapfrog Research programme and the Pioneering Research programme. This represents an increase of 13% in the funding levels for basic research, and comes alongside a new "National Agenda Basic Research" Initiative offering strategic "middle-up" support for basic research that aligns with government policies and societal needs.

Sources: 2023 South Korea R&D Activity Survey: Key Findings; Korea.net; OECD, 2021; Issues in Science & Technology, 2007; National Atlas, Korea; UK SIN, South Korea, 2024; Nature Index 2020 South Korea; Korea.net

Further detail

Our assessment of the shortlisted countries set out above was preceded and informed by a high-level desktop study of ten long list countries. A summary of each of these long list countries (excluding those shortlisted) is set out in the accompanying appendix document, alongside further data summary tables and graphs.

Glossary

Term / Acronym	Definition
GERD	Gross Domestic Expenditure on Research & Development
Research Intensity	GERD as a percentage of GDP
HERD	Higher Education Expenditure on R&D
BERD	Business Expenditure on R&D
Citations	Number of citations received in the selected year by a journal to the documents published in the three previous years, --i.e. citations received in year X to documents published in years X-1, X-2 and X-3. All types of documents are considered. Source: Scimago
Highly-cited documents	Number of high-cited articles amongst the top 10% in the world. Note in 2023, the threshold for a publication being in the top 10% most highly-cited, was 9 citations. The data shown in this report was prepared and published using Elsevier's SciVal tool, part of its portfolio of products serving research institutions, government agencies, and funders. Whether your institution is conducting research or funding it, Elsevier provides the objective and analytical insight needed to improve your ability to establish, execute, and evaluate national and institutional research strategy. For more information about Elsevier's academic and government portfolio, please visit: elsevier.com/academic-and-government
Field-Weighted Citation Impact Ratio (FWCI)	Field-Weighted Citation Impact is the ratio of the total citations actually received by the denominator's output, and the total citations that would be expected based on the average of the subject field. A Field-Weighted Citation Impact of more than 1 means that the output is more cited than expected according to the global average; for example, 1.20 means 20% more cited than expected. Metrics in this report have been sourced from the UK government's 2022 International comparison of the UK research base analysis
Nature Index Rank	The Nature Index tracks contributions to research articles published in high-quality natural-science and health-science journals, chosen based on reputation by an independent group of researchers. The Index ranks countries and, as such, is an indicator of global high-quality research output and collaboration. See more information at www.nature.com.
Clarivate Research Fronts Leadership Index	The Research Leadership Index (RLI) is a comprehensive evaluation measure to determine the degree of activity in Research Fronts. A Research Front is composed of a group of highly cited core papers along with subsequent papers that cite the core literature. Source: Clarivate.
Investigator-led	Funding that is provided to projects that are proposed by individual researchers, or investigators, rather than to address government priorities.
Mission-led / Priority Driven funding	Funding that is provided only to address specific priorities or mission as set out by government. Applications for such funding will only be eligible if the research proposed will address the specified mission.
Block or strategic institutional funding	Funding that is provided as a lump sum to a university or institution and can be used primarily at their discretion.

Contacts

Damien Ashford

Education Lead and Government and Health Industries Restructuring Leader
damien.j.ashford@pwc.com

Karen Best

Partner
Deals Education Leader
karen.best@pwc.com

Paul Kett

Senior Adviser and Global Director
Education and Skills
paul.kett@pwc.com

Kitty Kent

Associate Director
Education Lead Advisory
kitty.kent@pwc.com

Malvika Mundkur

Manager
Lead Advisory
malvika.mundkur@pwc.com

Emma Whan

Manager
Lead Advisory
emma.whan@pwc.com

pwc.co.uk

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