Australian Government

Strategic Examination of R&D discussion paper

12 February 2025

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Purpose of the strategic examination

The immense potential of Australian research is a resource we've been sharing freely. It's time to harness this great resource to reignite our economy. A high performing research and development (R&D) system that delivers more firepower, from our boardrooms to our labs, will allow us to compete with the best in the world.

Consistent investment in Australian R&D and its outcomes are crucial for building the Australia we aspire to. This includes having the ability to respond to anticipated changing conditions, such as in health, climate, environment, energy, security, and economic; and the unpredictable.

The Australian Government has commissioned a strategic examination of Australia's R&D system. An independent expert panel leads the examination. The panel includes Robyn Denholm, Chair, along with Emeritus Professor Ian Chubb AC, Winthrop Professor Fiona Wood AO and Dr Kate Cornick. They will explore how Australia can encourage more home-grown ideas, more research, and more translation. This will lead to beneficial outcomes and prosperity for all Australians for decades to come.

The panel has developed this discussion paper to inform and help develop advice.

The panel will present advice to the Minister for Industry and Science, the Treasurer and Minister for Education by the end of 2025.

The Terms of Reference require the panel to consider opportunities to:

- maximise the value of existing investment in R&D, across government, universities, philanthropy and industry
- strengthen linkages between research and industry, allowing greater mobility of researchers and innovators between sectors and addressing barriers to meaningful collaboration
- support the achievement of national priorities, including mechanisms to improve coordination and impact of R&D funding and programs across government and through our science agencies
- drive greater R&D investment by industry, and boost creation and industry adoption of innovation
- uplift Australia's overall R&D intensity.

In doing so, the panel will examine:

- the current state of Australia's R&D system, and comparable state of OECD (Organisation for Economic Co-operation and Development) investment in R&D, including levels of investment in R&D, R&D infrastructure and R&D workforce, across sectors
- barriers and risks impacting on Australia's capacity to maintain R&D competitiveness
- ways to better measure the value and impact of R&D investments and maximise efficiencies
- ways to ensure R&D benefits are equitably distributed across regions and communities.

The strategic examination will consider recent and ongoing reviews commissioned by Australian governments relating to Australia's research, innovation and productivity performance. This includes the Australian Universities Accord and the National Science and Research Priorities.

The panel's recommendations will also consider the contribution of First Nations knowledge, knowledge systems and leadership of research. This has impactful, transformative outcomes for all Australians, but especially First Nations peoples.

The panel is seeking informed views, ideas, and analysis from interested parties to help with this important work. Responses will inform potential strategies to optimise Australia's R&D system. The expert panel will consult through targeted and public consultation. We expect this to include surveys, commissioned research, workshops and roundtables.

The independent expert panel

Robyn Denholm, Chair

Ms Robyn Denholm is an international executive with extensive experience in technology and advanced manufacturing R&D and innovation.

Ms Denholm is the Chair of the Board of Directors of Tesla, Inc. She is also the Inaugural Chair of the Technology Council of Australia, Board Director of Blackbird Ventures and Chair of Wollemi Capital Group.

Previously Ms Denholm served as the COO, CFO and Head of Strategy at Telstra and as the Executive Vice President, CFO and COO of Juniper Networks, Inc and held various executive roles at Sun Microsystems. Ms Denholm also served on the NSW Government's Investment Attraction Council.

Ms Denholm was awarded a Doctor of Business (Honoris Causa) from the University of New South Wales in 2019. She also holds a Bachelor of Economics from the University of Sydney, and a Masters in Commerce from the University of New South Wales. Ms Denholm is a Fellow of the Institute of Chartered Accountants of Australia New Zealand, and a member of the Australian Institute of Company Directors.

Emeritus Professor Ian Chubb AC

Emeritus Professor Ian Chubb has had a distinguished career across the university and government sectors.

Professor Chubb is Chair of the Inter-Governmental Policy Reform Group, established by the Commonwealth government to implement policy reform in health and medical research in collaboration with all jurisdictions.

His previous roles include Vice-Chancellor of Flinders University (1996–2000) and the Australian National University (2001–2011), Chief Scientist of Australia (2011–2016) plus numerous boards and committees including the Board of CSIRO and the CRC Advisory Committee (2015–2020).

Professor Chubb was elected a Fellow of the Australian Academy of Science (AAS) in 2017 and is a member of the AAS Council, leading the development of Australian Science, Australia's Future: Science 2035, a 10-year plan to position science in support of our national ambitions. He is also a Fellow of the Academy of Technological Sciences and Engineering (ATSE), the Australian College of Educators and the Royal Society of NSW.

Winthrop Professor Fiona Wood AO

Winthrop Professor Fiona Wood is one of Australia's most innovative and respected surgeons and researchers.

Professor Wood is the Director of the Burns Service of Western Australia, and Winthrop Professor in the School of Surgery at The University of Western Australia.

In October 2002, Professor Wood led the team at Royal Perth Hospital to treat the largest proportion of survivors from the 2002 Bali bombings, saving many lives. Professor Wood pioneered the innovative 'spray-on skin' technique (Recell), used worldwide today.

Professor Wood was awarded an Order of Australia Medal in 2003, was named Australian of the Year 2005 and received the Officer of the Order of Australia (AO) in 2024.

Dr Kate Cornick

Dr Kate Cornick has considerable experience in technology and innovation across start-ups, academia, corporate and government.

Dr Cornick is the Chief Executive Officer of LaunchVic, Victoria's startup agency. She has held a number of Board positions, and is currently Chair of the University of Melbourne's Genesis Pre-Seed Fund Investment Committee, and Director and Investment Committee Member of the Alice Anderson Fund. She is also a member of the Charles Sturt University Council.

Previously Dr Cornick developed a human resources technology startup and was CEO of ASX listed Rision Ltd.

Dr Cornick undertook her PhD in optical telecommunications at the University of Melbourne.

Process for submission

The examination is seeking feedback on this discussion paper through the Department of Industry, Science and Resources (DISR) consultation hub: https://consult.industry.gov.au/strategic-examination-rd-discussion-paper.

You can find the consultation and survey questions on page 41.

You will also be able to upload a submission and supporting research or analysis if you have more to say on this topic.

The government understands that some submissions might contain commercially sensitive or proprietary information. We will publish responses to this consultation. However, you can choose to remain anonymous or make a private response.

We have outlined a preliminary consultation plan on page 40.

Discussion paper webinars

Online webinars will have more about the Strategic Examination of R&D and the topics raised in the discussion paper

Consultation hub

Share your feedback through the Department of Industry, Science and Resources consultation hub.

consult.industry.gov.au/

More information

You can find more information on the Department of Industry, Science and Resources website.

industry.gov.au/StrategicR&D

Executive summary

Despite decades of prompting, Australia has not used one of its great capabilities – our research. It is imperative we realise its value to broaden our economic base and build a sustainable nation resilient to local and global shocks.

Other countries, such as the UK, USA, China, Israel and Singapore, have successfully adopted new strategies for leveraging R&D and innovation for social and economic gain.

Despite decades of aiming to be a 'clever country' defined as much by our talents as our resources, we have not seen material changes. As a result, Australia is at risk of being left behind.

We have the capability to change, we just need the will.

Australia is a high performer in research. We produce 3.5% of the world's publications and 5.8% of the world's citations, and 15% of Australian publications are in the top 10% of global publications.

But much of this research rarely addresses the needs of the main users of research and innovation in Australia – industry, government and the community.

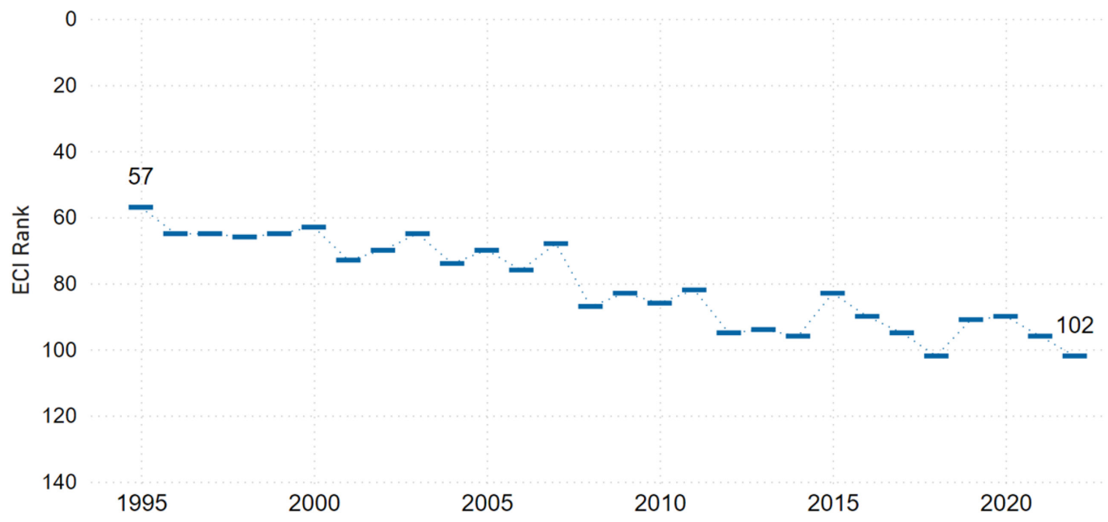
There is the challenge.

Australia needs to protect the natural desire to learn more about the world we inhabit. But how can we do this while ensuring our research efforts benefit all Australians by building resilience, a stronger society and an economy diverse enough to survive shocks?

We have not met the challenge.

The Australian economy is one of the least differentiated in the world. Our research output is laudable, and our talent pool is substantial. Yet, our economy and our culture have not been able to find a way to use these assets to translate research into products and services at meaningful scale. This is despite decades of inspiring rhetoric.

Australia's economic complexity is falling (Economic Complexity index (ECI) ranking over time)



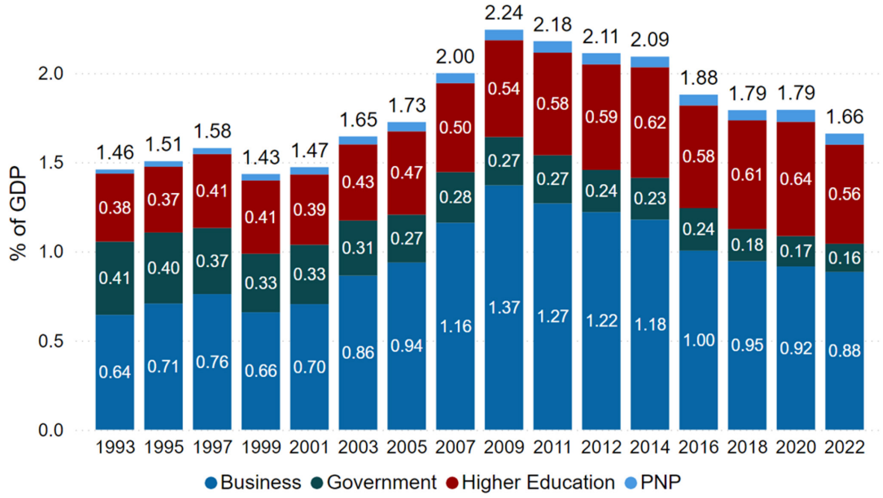
Source: *[The Atlas of Economic Complexity]*

The need for change is inarguable.

Australian investment in R&D has declined over 15 years to 1.66% of GDP – now only 60% of the OECD area's R&D intensity of 2.73%.

The main driver of this decline is falling business and government R&D expenditure.

Australian expenditure on R&D by sector as a percentage of GDP



Source: ABS, Research and Experimental Development, Businesses, Higher Education Organisations, and Government and Private Non-Profit Organisations

Attempts to bring coherence to Australia's R&D system have been limited.

- National research priorities have not significantly influenced Australia's research profile.
- Programs linking researchers to business have barely changed the dial.
- R&D investments are rarely fully funded.

Investments have been made to support a more dynamic economy, such as through developing local startup ecosystems. However, these sectors are still evolving compared to global leaders, including cities in the USA, Canada, UK and Singapore.

Nevertheless, we have been able to sustain growth in income and wealth primarily through dependence on our natural resources, tourism and education.

There are many challenges confronting Australia. The solutions are dependent on innovation and developing new and better ways to support our community – not continued over reliance on our good fortune.

Australia is unprepared to achieve sustained growth based on a complex economy and highly-skilled workers. This is because of:

- an R&D system that is siloed and barely engaged with the national need
- a business community that is largely indifferent
- too little planning to maximise value and minimise inadequacies.

Rebuilding investment in our capacity to grow our R&D and embrace the benefits to drive innovation will improve Australia's ability to:

- seize new opportunities when they emerge
- pivot as circumstances change
- tackle global challenges.

The expert panel is clear that no opportunity should be ignored or bypassed. This will ensure the country is well-equipped to increase innovation, build economic growth and improve the wellbeing of all Australians.

Boosting a focus on R&D will prevent Australia's slide into mediocrity. It will ensure we will be offered a seat at the international table at which big global decisions are made – because we earn it.

The case for R&D

R&D: growth, productivity, prosperity and sustainability

Australia's standing in the top 20 nations by GDP per person is an indicator of the strength of our economy.

Australia's position will change. Economic growth is slowing because of lower population growth and reduced workforce participation (The Treasury, 2023). This increases the importance and role of productivity, but our productivity is backsliding and is expected to continue to do so (Figure 1).

R&D gives better and more efficient ways of doing things through new knowledge, products and processes, resulting in economic growth (Romer, 1986) (Zachariadis, 2004). Investment in R&D and the translation of research into products and services yields pathways to navigate economic conditions.

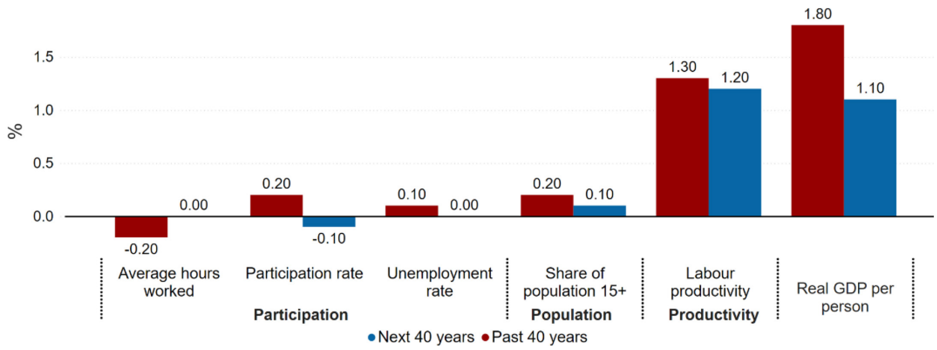
Investment in R&D creates new industries and new, high value, well-paid jobs. It raises productivity in all types of services, from hospitals to digital systems (McKinsey Global Institute, 2024). In the medium-term, R&D has a stronger effect on productivity than other types of investment (IMF, 2021) (Figure 2).

The impact of R&D on productivity is greater when R&D investment works in concert with other factors in the innovation system. This includes domestic and international competition, international investment and broader workforce skills and mobility (Zuniga, 2024).

In the medium and long-run, R&D investment decreases unemployment (Jindal, 2021). In advanced economies, it is estimated that R&D investment creates more jobs than any type of infrastructure investment (World Economic Forum, 2020).

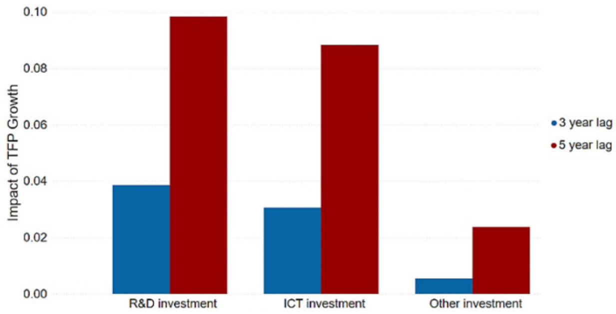
Complex challenges like decarbonisation, supply chain security and geopolitical shifts depend on knowledge and the ability to translate knowledge into innovation at pace and scale (OECD, 2024). The Treasury's 2023 Intergenerational Report highlights the need to make choices now (The Treasury, 2023).

Figure 1: Drivers of real GDP per person growth



Source: Intergenerational Report, The Treasury

Figure 2: Elasticity (responsiveness) of different types of investment on total factor productivity



Source: IMF and OECD staff calculations, IMF Australia Country Report, 2021

R&D supports increased levels of innovation and economic complexity

The OECD defines R&D as creative and systematic work undertaken to increase the stock of knowledge and to devise new applications of available knowledge (OECD, 2018).

R&D is a key input into the broader process of innovation. Innovation focuses on implementing new or improved products or processes using knowledge in new ways. This review is examining R&D, its contribution to the innovation ecosystem, and how it can build a stronger Australian society and economy.

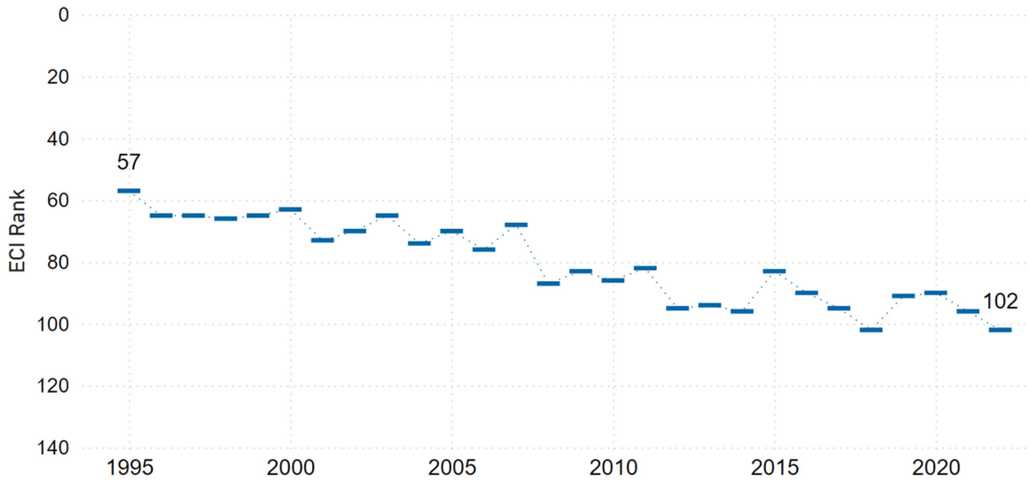
Innovation arises both from the local creation of new technologies and the adoption of foreign technologies (WIPO, n.d.). R&D-fuelled innovation supports higher export performance through businesses exploiting competitive advantages in technology and skills (Zaman & Tanewski, 2024). The competitiveness of businesses in our private sector is a large factor in Australia's prosperity. The rate and type of firm-level innovation directs this competitiveness (OECD, 2015).

For advanced economies, complex innovation is positively correlated with both economic complexity and economic growth (World Intellectual Property Organization, 2024).

Economic complexity is a strong predictor of the trajectory of future growth (Hausmann, et al., 2013).

Australia ranks low in export diversity, the standard measure of economic complexity (noting the measure considers goods exports and does not capture services exports). Our position has been in decline since 1995 (Figure 3). Australia ranks high in scientific and technological knowledge base complexity (Table 1).

Figure 3: Australia's economic complexity index (ECI) ranking over time



Source: [The Atlas of Economic Complexity]

Table 1: Australian economic complexity index rankings

Year	2002	2022*	Change
Harvard ECI	70 (of 144)	102 (of 145)	↓ 32
OEC Trade ECI	35 (of 103)	78 (of 133)	↓ 43
OEC Technology ECI	4 (of 69)	13 (of 89)*	↓ 9
OEC Research ECI	3 (of 87)	4 (of 123)	↓ 1

** The latest OEC Technology ECI rankings are for the year 2021.*
Source: The Atlas of Economic Complexity; The Economic Complexity Observatory

Innovation through adoption is not sufficient

Technological change through technology development and adoption is central to economic growth (Gordon, 2018).

Australia has relied on technology adoption as the primary mechanism for innovation (Reserve Bank of Australia, 2023). However, despite 46% of Australian firms claiming to be 'innovation-active' (ABS, 2023), productivity growth has stalled.

The Productivity Commission describes that 'novel innovation' is an important source of economic performance. Only 1–2% of Australian businesses engage in this type of innovation – the new to the world innovation that stems from R&D.

Australian businesses are not keeping up to the frontier of innovation. Further, they may not be aware of how far they lag behind (Productivity Commission, 2023)**.**

R&D does not always result in profitability or immediate economic impact. Some companies experience returns from their R&D efforts, while others may incur losses despite investment. Nonetheless, R&D investment offers spillover benefits beyond financial gains – which is why governments worldwide including Australia incentivise R&D through tax incentives (OECD, 2024).

Australia has a strong research base. The difference between the innovation novelty of our firms and our research output indicates we have underused national resource. Australian research is being developed into globally transformational technologies – most often by other countries.

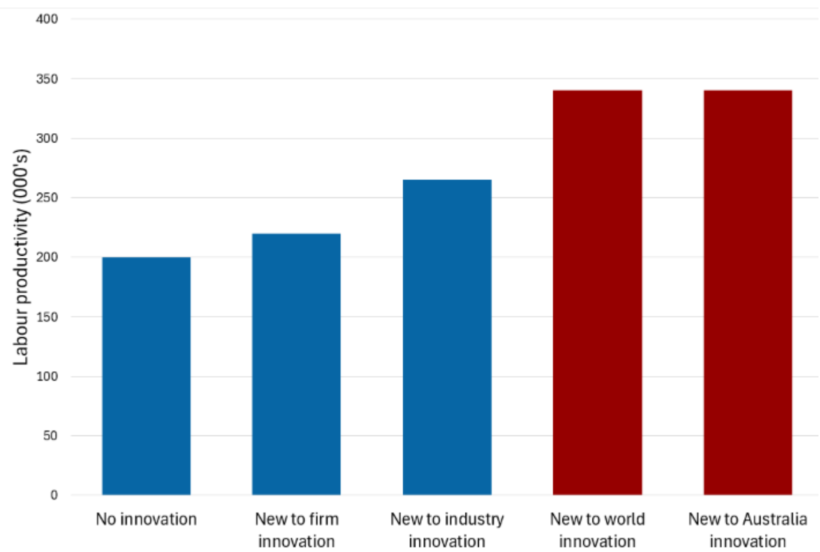
The old approach – waiting on other nations to turn our ideas and discoveries into products and services that we then adopt at higher cost – is not the path we want or need.

Undertaking R&D is critical to creating new-to-Australia and new-to-world innovation. This is prominent in industries such as manufacturing and professional, scientific and technical services (PSTS[1]).

Analysis of Australian data shows that Australian firms with higher innovation novelty exhibit about 1.6 times higher labour productivity compared to firms that introduced incremental innovations. It's also about 1.7 times higher than firms that introduced no innovations (Figure 4) (Majeed & Breunig, 2023).

Moreover, firms that engage in R&D build absorptive capacity and increased ability to develop and commercialise new ideas. Aligning investments in R&D with education institutions and building talent enriches the absorptive capacity needed to exploit new technological ideas (David Sarpong, 2023).

Figure 4: Median labour productivity increases relative to innovation novelty



Source: Determinants of innovation novelty: Evidence from Australian administrative data, Majeed and Breunig, 2023

[1] These services include scientific research, architecture, engineering, computer systems design, law, accountancy, advertising, market research, management and other consultancy, veterinary science and professional photography.

Strong Australian R&D equals the national interest

R&D plays a crucial role in protecting and advancing our national interest and sovereignty. It fosters our ability to develop and apply the new technologies needed for key national capabilities. It is essential to a nation's ability to act autonomously, remain economically competitive and address societal challenges (Edler, Blind, Kroll, & Schubert, 2023). This ensures we have capacity to cope with threats from foreign interference and larger market players.

Given recent changes in the global economy and geostrategic environment, countries are diversifying and strengthening supply chains and domestic capabilities. This is especially true for critical technologies, which are essential to national and economic security. Examples include the USA's CHIPS and Science Act, Japan's Economic Security Promotion Act and the European Chips Act. In contrast, Australia rarely builds clear plans for the R&D needed to address national priorities.

Moreover, the shifting international balance in research activity has seen China and the USA becoming the biggest by volume with an ever-diminishing quality gap. In 2022, China and the USA each contributed over one-fifth of total global research publications and around 13% of the top 10% most frequently cited papers (compared to Australia's 15%). China's share of highly cited papers has increased by nearly 30% over the past decade, while the US's share has declined slightly (Clarivate Incites, 2012-2022).

To navigate these realities, Australia's R&D system needs careful, long-term planning and consistent bipartisan support. R&D should be prioritised as a national asset and its application weaved into key industry and innovation policies.

The National Science and Research Priorities (NSRPs) emphasise the science and research collaborations Australia will need to solve our greatest challenges (DISR, 2024). The priorities were developed in consultation with leaders from industry, research and government. They will guide Australian science and research efforts by the Australian Government, university and private sectors.

The $15 billion National Reconstruction Fund has been established to diversify and transform Australian industry. The fund aims, among other goals, to create secure jobs and an adaptable workforce, boost supply chain resilience and commercialise Australian innovation. It focuses on 7 identified priority areas, including renewable and low emissions technology, and defence capability (DISR, 2023).

Australia's Critical Technologies Statement underscores the importance of championing Australia's research, ideas, industrial strengths and capabilities to ensure ongoing access to critical technologies (DISR, 2023).

The Future Made in Australia (FMiA) and the supporting National Interest Framework responds to the need to adapt to the evolving political landscape and intensifying geostrategic competition (The Treasury, 2024). The FMiA agenda will invest in areas of national interest across 2 streams:

- the Net Zero Transformation stream, focusing on industries where Australia has strengths
- the Economic Resilience and Security stream, targeting industries where domestic capability is crucial.

Australia's defence industry is essential to our ability to respond to geostrategic changes. Self-sufficiency is unlikely. R&D investment in defence is important to ensure innovation in the defence sector and dual-use goods and technologies for the broader economy.

The AUKUS agreement requires Australia to take specific and deliberate steps to lift our R&D intensity. This is to improve sovereign capabilities and strengthen international collaborative R&D relationships. Pillar II of the AUKUS agreement highlights the opportunity for Australia to build industrial capacity and develop capabilities through defence-led R&D.

Protecting the integrity of Australian R&D from threats such as foreign interference needs diligence across Australian businesses, public research entities and government departments. Effective integrity measures, research security, and coordination with international partners will be critical to secure collaborations and safe foreign investment in R&D.

R&D addresses complex challenges

Overcoming Australia's current and future challenges hinges on our ability to develop, access, adapt and apply new knowledge to our circumstances. The Australian Universities Accord (Department of Education, 2024) emphasises the need to bolster our research sector and promote the effective use and commercialisation of research results.

The National Science and Research Priorities (DISR, 2024) highlighted that climate change, public health, and social issues are pressing concerns for Australia (Table 2).

R&D is crucial to Australia and the world's sustainable energy transition and adaptation to climate change. In 2023, the International Energy Agency (IEA) estimated that new technologies were needed to achieve around 35% of the emissions reductions to reach net zero in 2050 (IEA, 2023). There is a need for innovation to reduce emissions in many industries, particularly in non-energy emission-intensive business and industrial processes. Hard to abate sectors like steel, aviation and agriculture need new R&D to become cost competitive.

There is also a need to advance decarbonisation processes, low-emissions mobility and circular economy models for production and consumption. Without significant progress in these areas, efforts to mitigate climate change, reduce pollution and safeguard biodiversity will fail (OECD, 2024).

Australia faces significant public health challenges, including an ageing population and chronic diseases. Ten of these chronic diseases account for most of Australia's disease burden, hospitalisations and deaths (Department of Health and Aged Care, 2024). R&D powers innovation in diagnostics, medical devices, therapeutics and vaccines to better prevent, detect and treat diseases. COVID-19 also highlighted the importance of investment in R&D for preparedness and response (National Academy of Medicine, 2016).

R&D can also help to address social challenges. It can boost local economies and reduce regional inequality (Ma, Ortega-Argiles, & Lyons, 2024). Renewable energies can improve access to reliable and affordable electricity (Department of Climate Change, Energy, the Environment and Water, 2024). Digital technologies and artificial intelligence (AI) can help improve healthcare in remote and rural areas (KPMG, 2020).

Table 2: Examples of societal needs requiring R&D

Societal needs	R&D opportunities
Disease and illness	Treatments for rare, tropical and zoonotic diseases, cancer, neurological and cardiac conditions. Age-related illnesses. Cell and gene therapies. Regenerative medicine. AI-guided diagnostics Telehealth services.
Ageing population and disability	Wearable health monitoring devices. Robotic assistive devices. Brain-computer interfaces.
Food and water security	Drought-resistant crops. Precision agriculture. Water-efficient irrigation systems. Water desalination technologies. Pest detection and treatment systems. Biosecurity.
Climate change and environmental management	Energy generation, storage and transmission. Sustainable agriculture. Waste management. Biodegradable plastics. Marine environment.
Cybersecurity and digital privacy	Advanced encryption algorithms. Cybersecurity software. Personal security.

A framework for assessing R&D

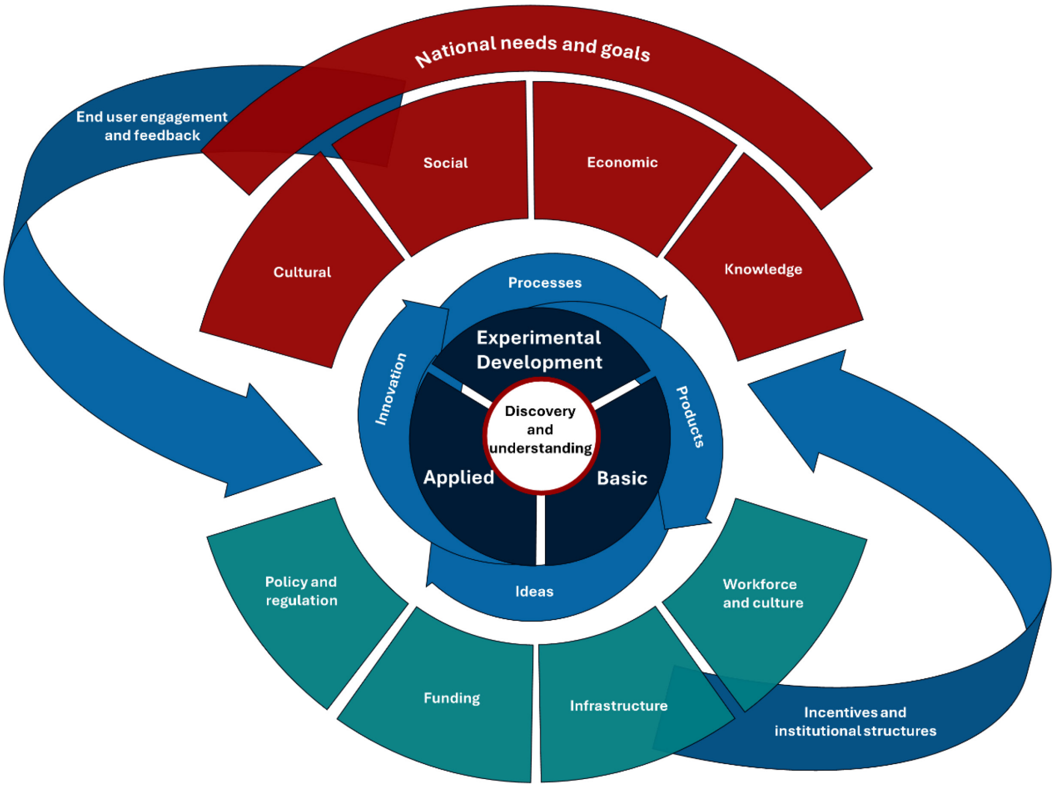
Internationally (OECD, 2015), R&D is categorised into 3 types of activity:

- Basic research: experimental or theoretical work to understand the underlying principles of phenomena and observable facts, without aiming for a specific application or use in mind.
- Applied research: original investigation undertaken to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.
- Experimental development: systematic work, drawing on knowledge gained from research and practical experience and producing extra knowledge. This is directed to producing new products or processes or to improving existing products or processes.

The strategic examination has identified **the main elements of the R&D ecosystem to help frame consideration and identify opportunities** (Figure 5).

- R&D effort across basic, applied, and experimental development promotes generating new ideas, insights, innovation, and new or improved products and processes.
- Foundational pillars support Australia's R&D capacity, information dissemination, fair use and integrity. These pillars include infrastructure, funding, workforce and culture, and policy and regulations.
- Factors that shape the system's operation, its efficiency and the behaviour of participants include:
    - institutional (including public and private) structures and incentives
    - feedback pathways from end-users and the market.
- The outcomes of the system need to be assessed across the different aspects of Australian life—social, economic, cultural and advancing knowledge.
- The ability of the system to address national needs and goals will mainly determine its effectiveness and relevance.

Figure 5: Conceptual diagram of Australia's R&D system



The state of Australia's R&D system

Australia has strong foundational research system

Australian is globally recognised as a strong research performer.

Our research accounts for 3.5% of the world's publications and is cited 42.2% higher than the world average (Figure 6).

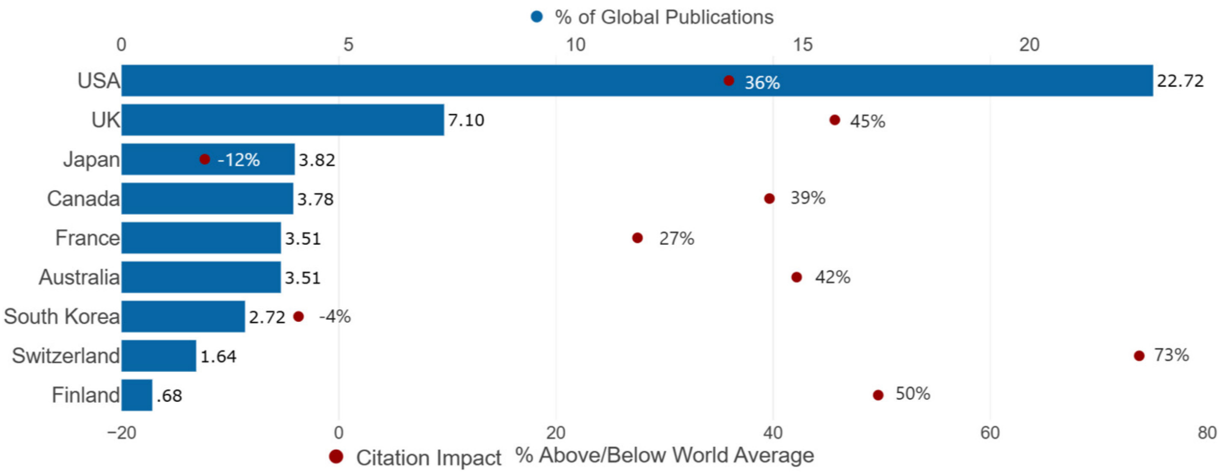
Australian universities are at the core of this foundational research effort.

In the 2025 QS World University rankings, Australia had 15 universities rank in the top 200 overall (QS Quacquarelli Symonds, 2024). Eighteen universities ranked in the top 200 for the R&D category of citations per staff, highlighting the productivity of Australian universities.

Australia performs strongly across fields including biomedical and clinical sciences (69.1% above world average), information and computing sciences (68.7%), and physical sciences (66.7%) (Figure 7).

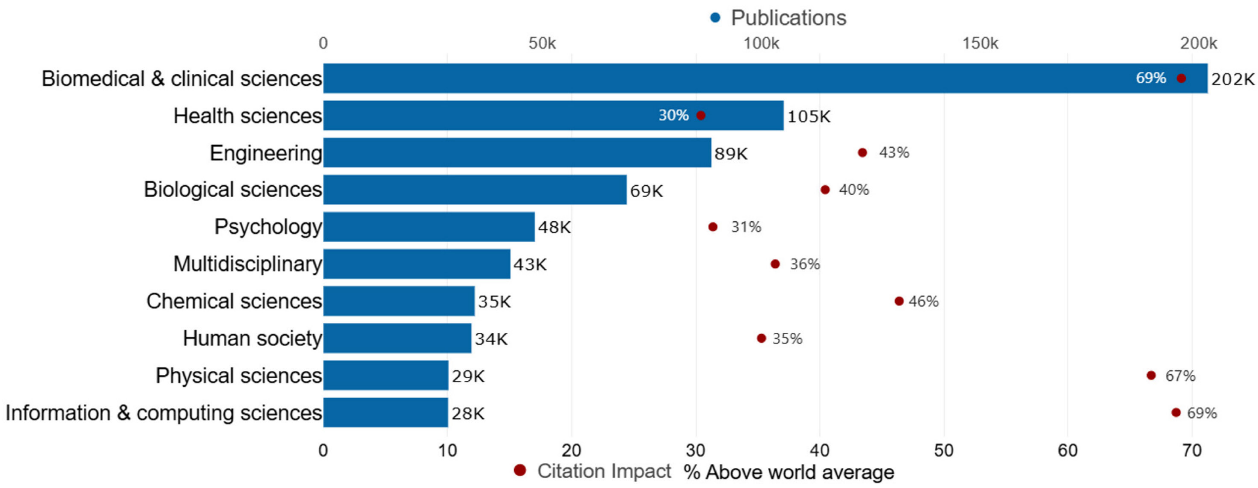
However, these metrics do not assess the value, impact, or efficiency of the R&D system.

Figure 6: Share of world citations and publications, and relative impact



Source: [Clarivate InCites](#) Location Analysis, 2019–2023

Figure 7: Citations of Australian research publications relative to world average



Source: [Clarivate InCites](#) Research Area Analysis, Category Normalised Impact, 2019–2023

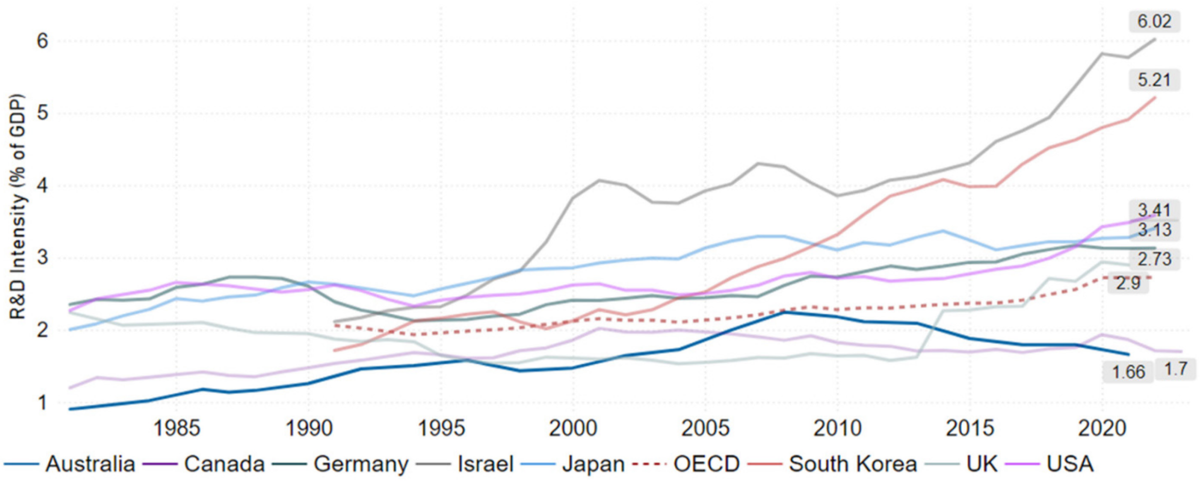
R&D investment is below our peers

Australia's gross expenditure on R&D (GERD) was 1.66% of GDP in 2021-22. This is below the OECD's 2.73% and falling from a peak of 2.24% in 2008-09 (ABS, 2023); (OECD, 2024). This contrasts with competitor countries such as South Korea, USA, Japan and Germany which are all investing heavily in R&D (Figure 8).

The trend of Australia's overall declining R&D intensity coincides with declining R&D intensity in business and government. Business R&D intensity (BERD as a proportion of GDP) at 0.88% has declined from its peak of 1.37% (Figure 9). Government investment has declined from 0.27% of GDP to 0.16% over the same period.

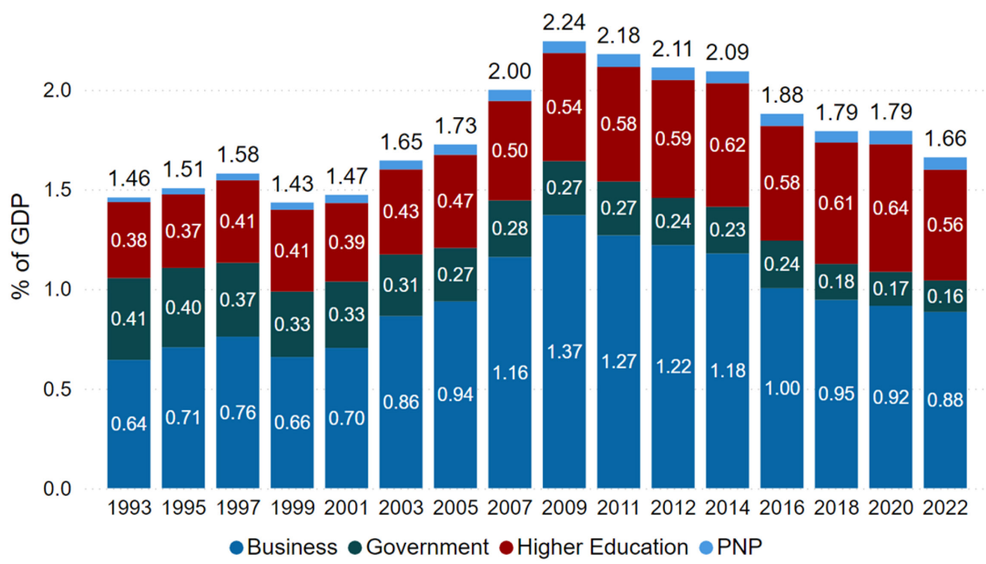
Australia's changing economic structure has added to recent declines in BERD and GERD. This includes the mining sector's shift from an exploration and development phase to a production phase. There was also a shift from manufacturing to a service-based economy which began in the 1960s. R&D expenditure in the professional, scientific and technical services sector has been increasing. In 2021–22 this accounts for 34% of BERD (ABS, 2023).

Figure 8: R&D intensity of OECD countries over time



Source: *OECD Main Science and Technology Indicators*

Figure 9: Australian expenditure on R&D by sector as a percentage of GDP



Source: *ABS, Research and Experimental Development, Businesses, Higher Education Organisations,* *and* *Government and Private Non-Profit Organisations*

We don't do enough experimental development

In Australia, R&D investment is mainly directed to basic and applied research, at similar levels to comparator countries (Figure 10a). However, nations with high R&D intensity invest significantly more in experimental development than Australia.

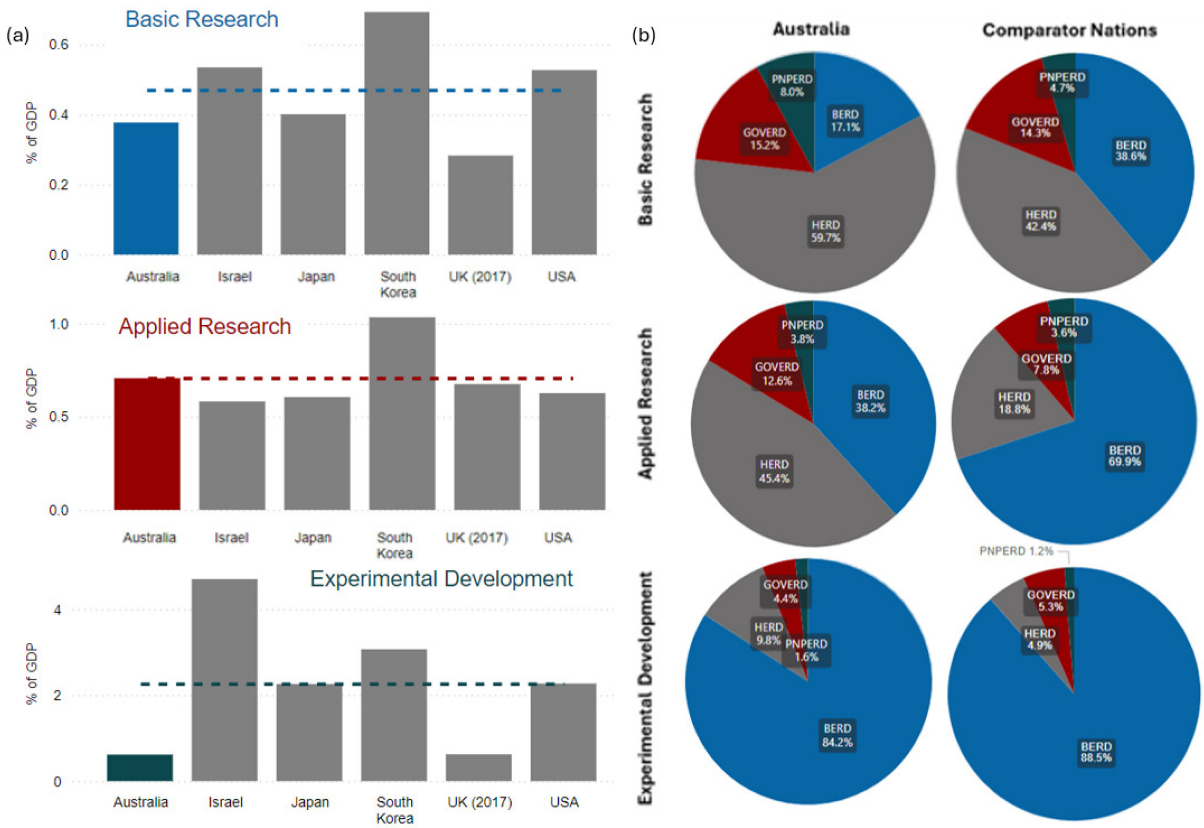
Australian higher education institutes conduct 60% of the country's **basic research**. This is comparable to France (61%), but higher than the UK (46%) and the US (45%). In comparator nations, the business sector invests a significant amount in basic research (Figure 10b). Businesses in Japan and South Korea conduct 47% and 58% of their national basic research efforts, respectively.

Higher education institutes account for 50% of **applied research** expenditure in Australia. By comparison, universities contribute 14% of applied research in France and South Korea, 18% in the United States and Japan, and 30% in the United Kingdom. In many other countries, businesses are the main players in applied research activity (Figure 10b).

The sectoral contribution to **experimental development** in Australia is comparable to other nations. However, Australia's substantially lower experimental development investment levels can be attributed to our lower BERD. International data highlights that increasing BERD intensity leads to increased effort on experimental development.

The pattern of research investment across sectors shows a challenge for Australia. The low alignment between industry and academia leads to poor collaboration and research translation (Figure 10b). The high proportion of applied research investment by Australian universities reflects their efforts to translate their output. However, industry needs to meet this investment to seize commercialisation opportunities across all parts of the R&D ecosystem.

Figure 10: Levels of gross R&D expenditure by type of research (a) and types of research activity by institutional sector expenditure (b).



Source: [OECD Main Science and Technology Indicators](). Dashed line indicates OECD standard. Dashed line is average of comparator nations: Israel, Japan, South Korea, United Kingdom and the United States.

We have a diffuse system of funding and incentives

Public funding systems and regulatory arrangements that governments implement substantively frame the R&D system. However, most sectors in the economy finance the bulk of their research activity through resources generated in their own sector.

For example, 94% ($19.4 billion) of BERD and more than half (51%, or $7.2 billion) of higher education expenditure on R&D (HERD) is supported from own funds (Figure 11). Funding for private non-profit expenditure on R&D (PNPERD) is more evenly sourced from government, business, donations/bequests and the private non-profit sector.

As a result, both public and private R&D performing organisations have a high level of autonomy in determining where their R&D effort is focused.

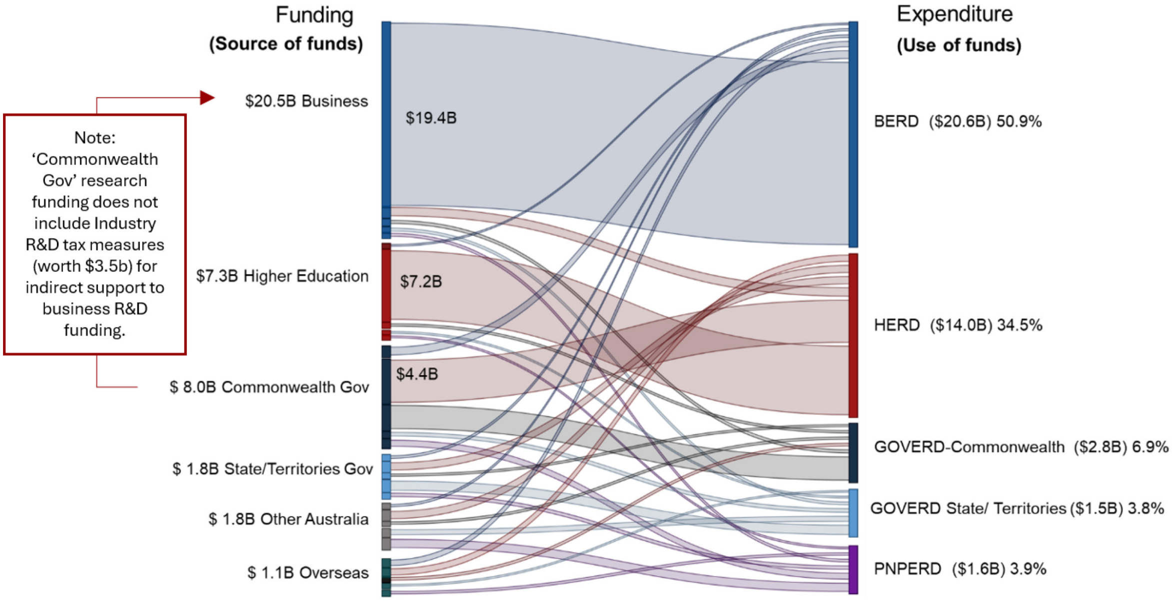
Different factors can influence these decisions, including:

- organisational factors such as generating profits, balancing budgets and boosting reputation and rankings
- a response to external incentives such as from business, end users or government
- ability to create positive return on investment to investors
- researcher motivations such as meeting output targets, or reputational and career factors
- broader altruistic academic motivations in advancing knowledge for humankind.

Governments have a modest level of influence in funding terms, providing less than 20% of total R&D funding to non-government sectors (Figure 11). However, they play an important strategic role in the R&D system. They incentivise innovation, support core capability and ensure long-term economic prosperity.

Reform and improvements to the R&D system need collaboration and engagement from all players in the system. Reform needs to give flexibility for each organisation to excel, derive value and continue to invest in a more sustainable system.

Figure 11: R&D flows from funding source to performer (2021–22)



Source: ABS, Research and Experimental Development, Businesses, Higher Education Organisations, and Government and Private Non-Profit Organisations

** The $20.5b business funding includes indirect support by the Commonwealth through the R&D Tax Incentive*

Key issues

Research institutions

Australia's R&D platform encompasses an array of institutions. This includes:

- 40 universities
- 55 medical research institutes (MRIs)
- more than a dozen publicly funded research agencies (PFRAs), such as CSIRO (Commonwealth Scientific and Industrial Research Organisation) and ANSTO (Australian Nuclear Science and Technology Organisation)
- not-for-profit and private organisations.

Despite their substance, and the investment of 'patient capital' by governments that support it, the connection between the researchers and end users remains poor. There has been not substantial change despite policy initiatives over decades. Australia is therefore left with an unbalanced innovation ecosystem where basic research capacity is not matched to investment in translation.

There are pressures on research institutions' operating models

Despite growth in research activity and output, Australia's research institutions and businesses cite continuing financial pressures impacting their ability to sustain their research activities.

The complexity, along with uncertain timeframes and outcomes of R&D needs patient investment through stable mechanism that can also deal with the increasing costs.

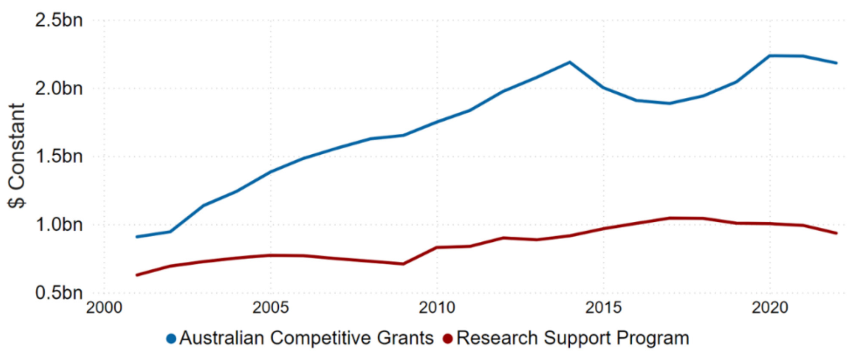
Publicly funded research institutions in particular have identified the funding structure for their research activities as a critical constraint (Universities Australia, 2024). Universities highlight the difference between the growth rate of funding for the direct and indirect costs of research.

Competitive R&D grant funding for Australian universities increased by 140% from 2001 to 2022 in real terms. In contrast, funding for the indirect costs (such as administration, utilities, maintenance, taxes) of R&D grew by 49% over the same period (Figure 12). Independent medical research institutes claim they received less than 40% of funding needed to cover indirect costs of research in 2020 (AAMRI, 2023).

Universities have responded by using their own discretionary funds – largely from international student revenue. This comes at the cost of other strategic agendas (Department of Education, 2024).

The substantial reliance on international student revenue by Australian universities means that R&D capacity is linked to enrolment patterns in student markets. It does not reflect the quality and impact of research or its contribution to national priorities (Department of Education, 2024).

Figure 12: Growth in university competitive grants and systemic costs support



Source: 2022 constant prices using Department of Education, [Research block grants consolidated time series datasets,](#) and DISR, [Science, research and innovation (SRI) budget tables, 2024–25](#)
** Research Support Program: base funding only; funding prior to 2016 relates to predecessor programs*

Maximising the impact of Australia's research

The balance across Australia's research institutions has undergone significant change over the last few decades. In 1993, government expenditure on R&D ($1.8 billion) was more than the higher education sector ($1.7 billion) (Figure 13). The amount of private non-profit R&D (PNPERD) was minimal ($0.1 billion).

Since then, there has been a surge in R&D activities by universities and the private not-for-profit sector, including medical research institutes.

By 2022, university R&D expenditure was $13.0 billion, and the private not-for-profit sector's expenditure had increased to $1.5 billion.

By contrast, government expenditure had grown to $3.7 billion, representing a decline in real terms from 0.41% of GDP to 0.16%. This is reflected in the modest funding increases for PFRAs over time. From 2012-13 to 2023–24, CSIRO funding increased from $0.90b to $0.92b, and for Defence Science and Technology Group (DST) from $0.54b to $0.65b (DISR, 2024).

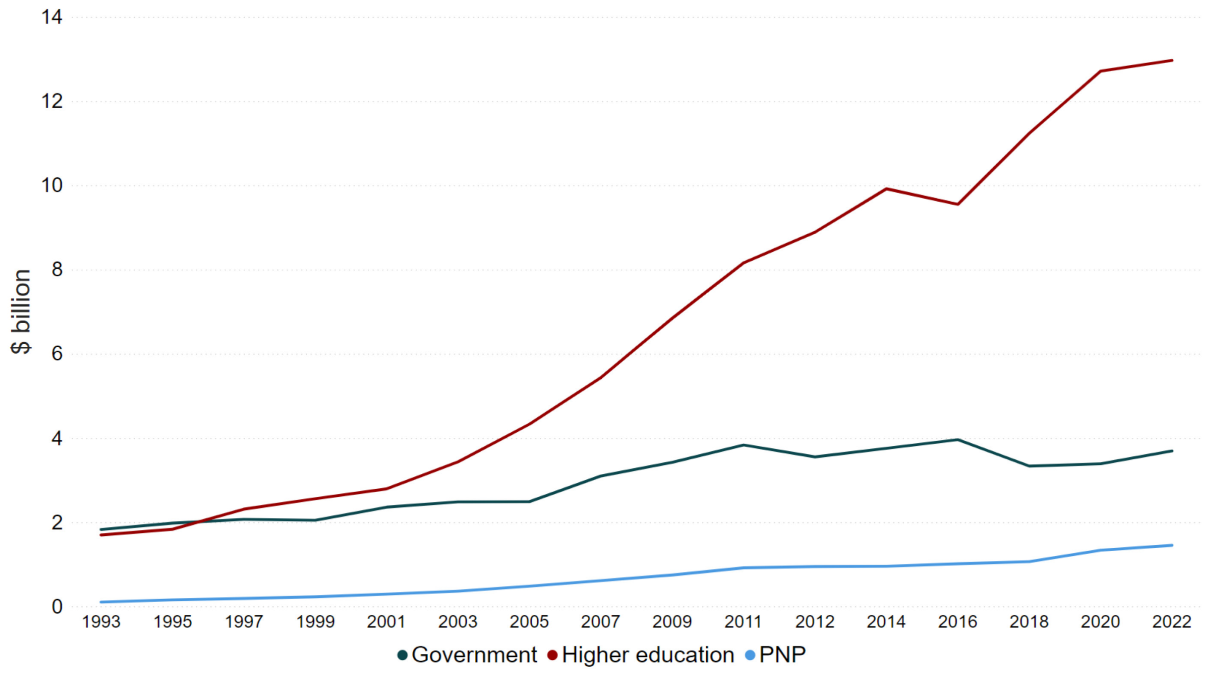
Australia's universities have expanded significantly in enrolments and budgets in recent decades. Most universities have built this growth on a broad profile of student enrolments, resulting in a staffing and research profile that is similarly broad-based.

This broad approach can be beneficial. It allows universities to support a broad range of students, pursue a wide range of R&D initiatives and enable cross-disciplinarity.

However, setting R&D profiles in response to student enrolment can hinder building strategic research agendas. This would prevent prioritising local industry needs or aggregating effort and resources to achieve world-leading research and technology outcomes.

Universities Australia highlighted this in response to the Australian Universities Accord discussion paper. To 'maximise the value universities can provide as part of a strong post-secondary system, we need policy and funding settings that recognise that university education and research make our nation stronger' (Universities Australia, 2023).

Figure 13: Growth in R&D expenditure by Australia's research sectors



Source: *ABS, Research and Experimental Development, Higher Education Organisations,* and *Government and Private Non-Profit Organisations*

Researchers face mobility and career challenges

Maintaining a high-calibre and attractive R&D workforce starts with the effectiveness of our education system. Education is also crucial to show the community how discovery impacts all aspects of daily life.

Traditional academic programs, especially higher degree by research such as PhDs, often focus on fundamental research skills in a specific discipline. This is crucial for understanding the process that underpins R&D. However, it may not align with the diverse career aspirations of research graduates – or the needs of the wider R&D system.

The PhD model has not changed at scale to reflect the needs of graduates and the broader economy. The model of 'research training' needs a better balance to cater for the requirements of academia. It also needs to cater for careers (and employers) in other parts of the economy.

PhD graduates and researchers report challenges securing successful and diverse careers, whether entrepreneurial, academic research, teaching or industry pathways (Chen, Mewburn, & Suominen, 2024).

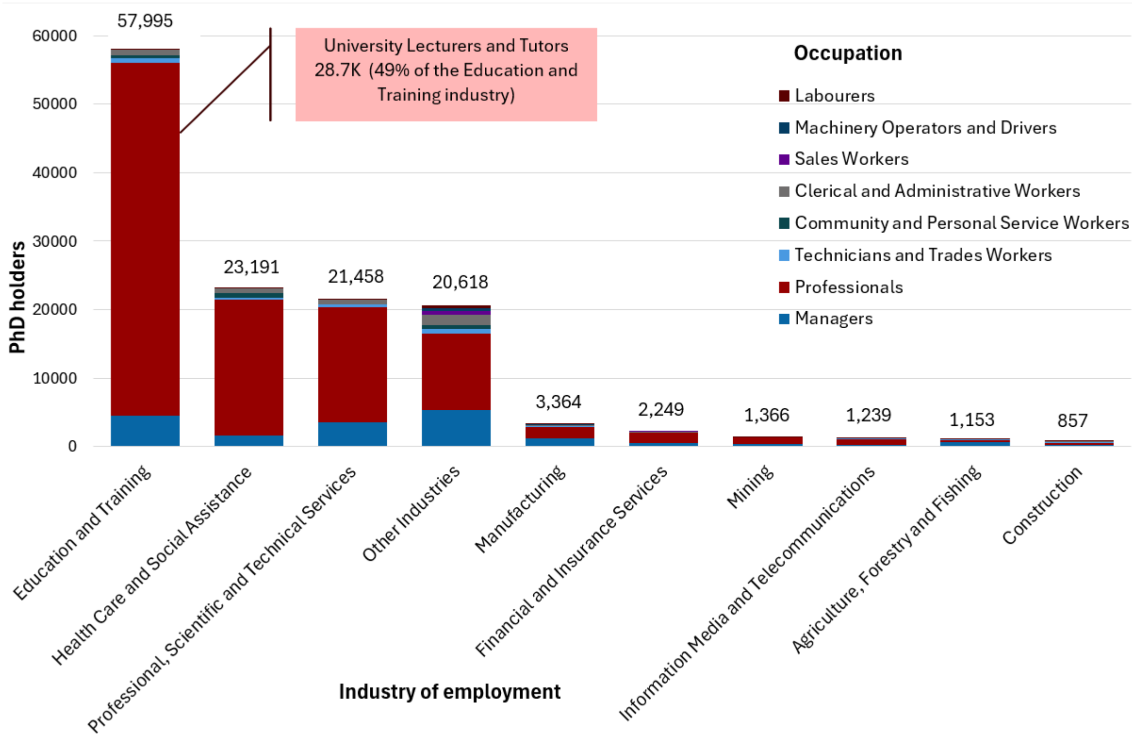
Key impediments to effectively using our research workforce include mobility barriers:

- Limited knowledge and networks with people in other sectors can make it difficult to consider career changes.
- Leaving academia, even temporarily, can be seen as a 'one way door' because of the value placed on publication and the undervaluing of cross-sectoral experience.
- Industry employers may be sceptical of the value of PhDs, their expectations, or the alignment of their skillsets with needs.

Academic progression pathways should evolve. Researcher performance assessment may not sufficiently reward high-risk groundbreaking research, collaboration or community leadership (ACOLA, 2023).

Recent initiatives focus on encouraging industry-focused PhDs, giving opportunities to work in collaboration with businesses. The small scale and narrow scope of these initiatives limit their influence.

Figure 14: PhD holder employment by industry of employment and occupation (2021)



Source: ABS, Education in Australia, 2021 census

Business and industry

Businesses that can translate research through collaboration and commercialisation, or do their own experimental development, contribute to economic diversification, resilience and growth. Businesses operating at the frontier of innovation that are address growing market needs result in the creation of secure, high value and well-paid jobs (César Alonso-Borrego, 2002) (Stefan Lachenmaier, 2011).

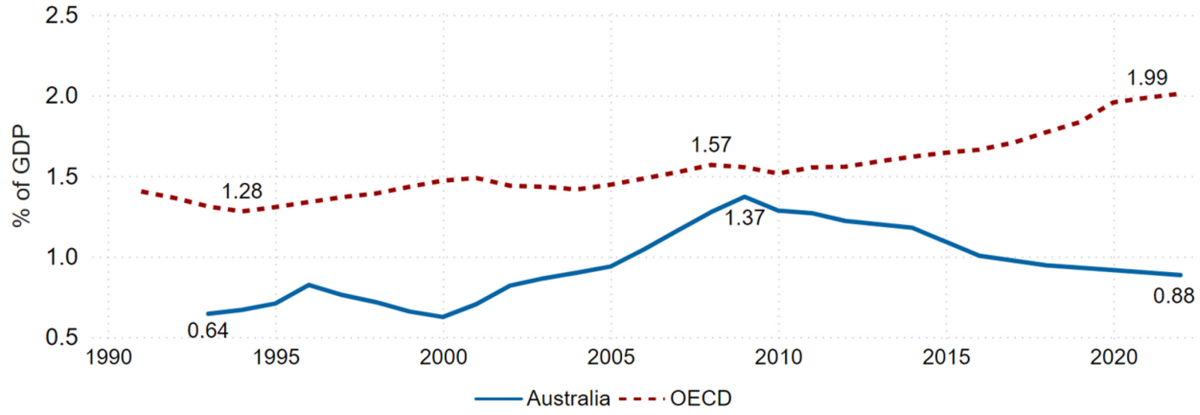
Australia needs to rebuild R&D investment by business

Australia's BERD intensity is significantly lower than the OECD. It has been sliding since its peak of 1.37% in 2008–09 (Figure 15).

This decline can be largely attributed to the mining sector's shift from exploration and development to a production phase (AlphaBeta, 2020).

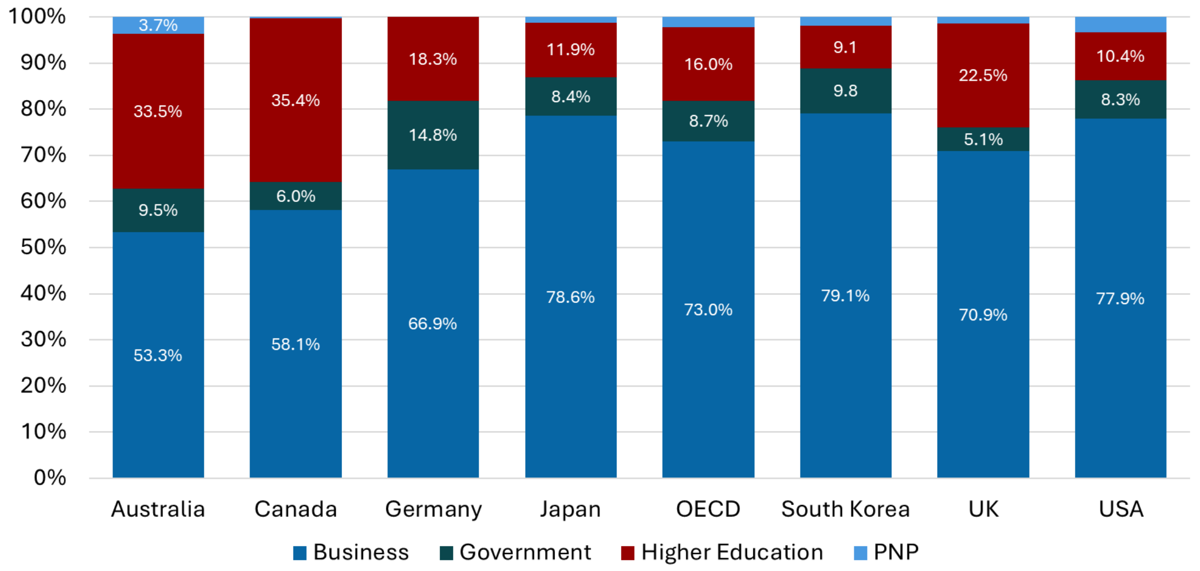
Australia's industry mix can explain around 80% of the difference in BERD intensity between Australia and different higher R&D intensive peer countries. The differences in R&D intensity in individual sectors explains around 20% of the variation (DISR).

Figure 15: BERD as a share of GDP



Source: OECD [Main Science and Technology Indicators]

Figure 16: Components of Gross Expenditure on R&D in countries in 2021



Source: OECD [Main Science and Technology Indicators]

Stronger manufacturing is critical to improved R&D performance

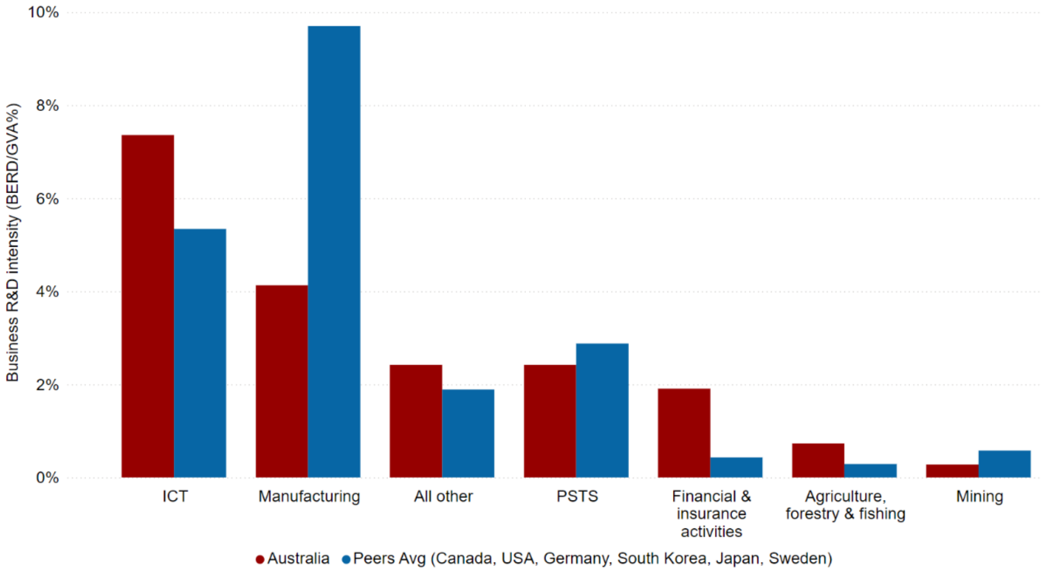
The manufacturing sector has historically been the dominant contributor to higher R&D intensity in peer countries. In Australia, manufacturing has both lower R&D intensity (Figure 17) and contribution to Gross Value Added (GVA) than peer countries (Figure 18).

Australia has higher R&D intensity in ICT than peer countries, but its ICT contribution to Gross Value Added (GVA) is lower at 2% (ABS, 2023). ICT R&D has cross-cutting benefits captured in other sectors. Further, ICT is an important pathway for the future as an enabling technology (Guerrieri & Padoan, 2007).

New emerging technologies will significantly impact future industries and need R&D investment to exploit new opportunities.

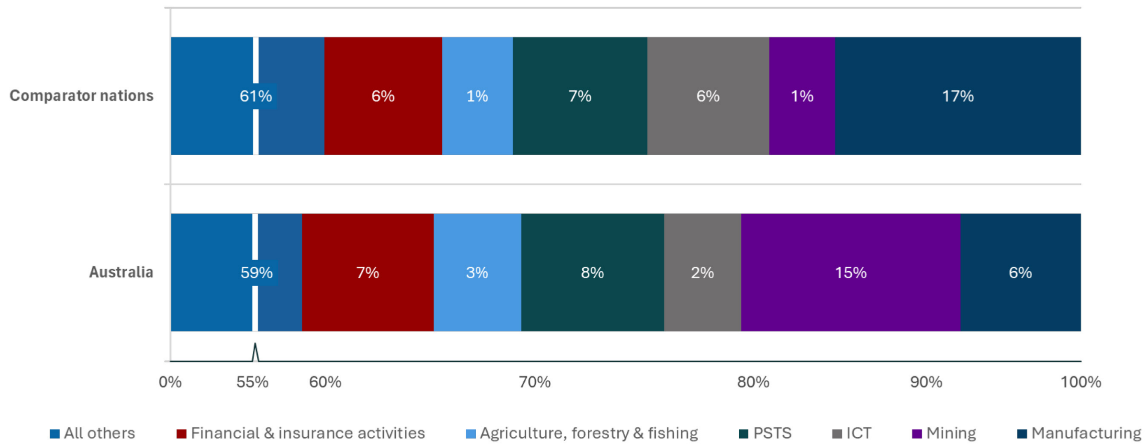
Initiatives such as Future Made in Australia can support the growth of manufacturing sectors. This can be done by leveraging Australia's strengths in R&D to foster globally competitive industries and value-add to exports.

Figure 17: Business R&D intensity by industry sector



Source: OECD [Analytical Business Enterprise R&D, 2020-21; ABS Research and Experimental Development, Businesses, 2021-22]

Figure 18: Industry sector share of Gross Value Added (GVA)



Source: ABS, Australian System of National Accounts, 2024; OECD [Analytical Business Enterprise R&D, 2020-21]. Comparator nations: average for Canada, Germany, Japan, South Korea, Sweden, United States

Australia has a vibrant, and still maturing, startup scene

Startups matter to research translation opportunities as they are a pathway to bring new solutions to market. Startups provide a dynamic environment for translating basic and applied research from universities or large firms into tangible economic benefits. They can also perform their own experimental research. Their success stories can inspire other entrepreneurs, stimulating further innovation and investment in R&D.

Australia has a vibrant startup scene that ranks 8th in the G20 (Startup Genome, 2024). The startup community is a testament to the continuing flow of great ideas and entrepreneurial spirit in Australia. However, the connection between these startups and Australian universities is weak.

A critical opportunity for Australia is strengthening the startup ecosystem. Building diverse startups that can apply Australian ideas and research to markets and challenges.

This requires more than just capital. The startup journey is fraught with challenges. Securing a market and raising funds were ranked the biggest challenge by startup founders (Startup Muster, 2024). Other challenges include:

- availability of talent
- time-pressures
- navigating regulatory landscapes.

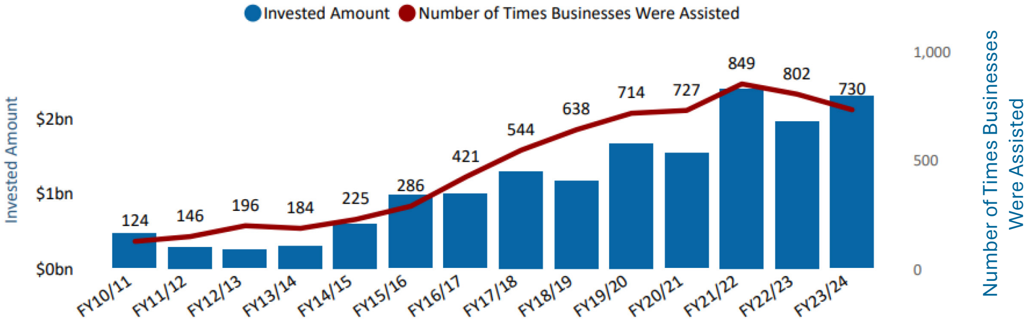
Startup failures are normal. Global research shows that for those startups that achieve venture backing, 5% will achieve a significant return to investors, 25% will achieve some success and 70% will fail (Dealroom, 2023). The number of 'unicorns' (startups that achieve at least a $1 billion company valuation) originating from Australia is lower compared to other startup ecosystems.

Policy efforts have focused on strengthening the pathways for startups, such as CSIRO's ON innovation programs and similar state government programs. Many universities have also developed programs to support students and staff to pursue startups. These include pre-accelerator and accelerator programs to increase a startup's chances of success. These are a good start, but more needs to be done to ensure domestic firms can emerge and succeed.

Venture capital (VC) is crucial for startup financing (Figure 19). In Australia, however, VCs tend to prefer financial technology and enterprise technology businesses, investing less in R&D or 'DeepTech' companies (Cut Through Venture, 2024):

- Enterprise/Business software ($505m) and Fintech ($331m) sectors were the highest funded in 2023
- Hardware/Robotics/Internet of Things ($301m), Bio/MedTech ($269m) and Climate/Cleantech ($268m) were the next highest VC-invested sectors
- DeepTech ($45m) startups use frontier science and engineering, relying on R&D applied to tangible products or processes (MIT Management, 2023). They have different characteristics and risk profiles to other startups because of their R&D intensiveness (Dealroom, n.d.).

Figure 19: Venture capital amounts and rates registered under the *Venture Capital Act 2002*



Source: *DISR venture capital dashboard 2023-24*

Australia is increasingly relying on SMEs to lift business R&D

Over the past 15 years, R&D investment by **small and medium-sized enterprises** (SMEs) in Australia has grown. This trend adds to the dynamism of the economy and pathways for innovation.

The growing reliance on SMEs to drive BERD in Australia contrasts with other advanced economies (Figure 20). Elsewhere, BERD is dominated by large companies that can support larger, sustained investments in R&D (Shefer & Frenkel, 2005) over longer time horizons.

Relying only on SME efforts is unlikely to achieve the scale of investment growth needed to compete with global industry, especially in deep research.

For any business, R&D requires a significant amount of time, money and skilled employees. It can be a lengthy process, and businesses may not see returns on their investment for years. This can make it difficult to justify deep investment in R&D. Especially for small businesses that need immediate cash flow to develop and maintain their core business.

The challenges facing SMEs engaged in R&D are well documented in surveys and studies (Reserve Bank of Australia, 2024) (Walden, Lie, Pandolfo, Lee, & Lockhart, 2018):

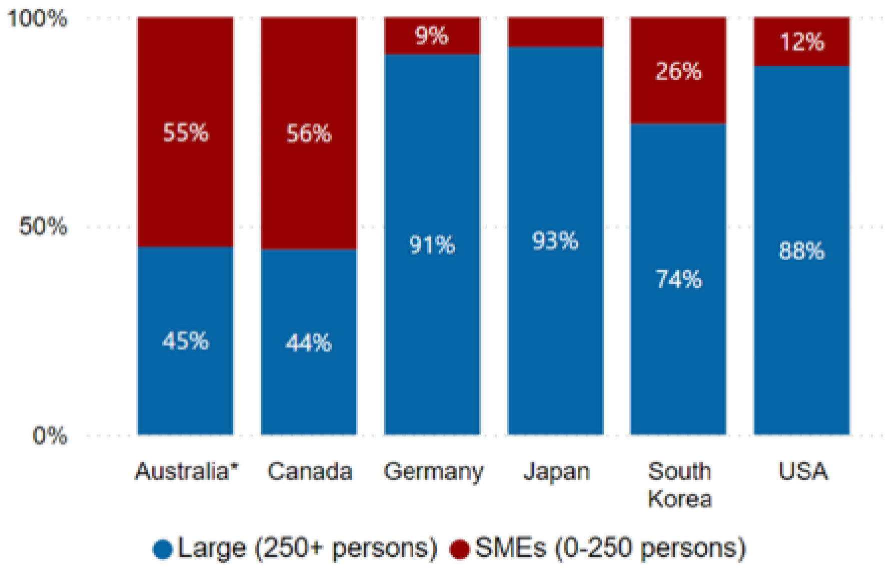
- number and skills of staff
- limited capital
- limited access to advanced technology
- difficulties in creating robust distribution networks
- competition from well-established firms.

Moreover, SMEs must also manage the complexities of maintaining steady cash flow and balancing innovation with day-to-day operational demands.

Without the backing of larger companies or public research institutions, the overall R&D output of Australia's SMEs is unlikely to meet the needs of a rapidly advancing global economy.

Encouraging and expanding contribution to R&D by SMEs (including startups) remains important to building the capacity for innovation in the Australian economy. However, it must be part of a broader effort to strengthen business R&D at all levels and firm sizes.

Figure 20: Proportion of BERD by Business Size



Source: ABS, Research and Experimental Development, Businesses; OECD Research and Development statistics
**The Australian Bureau of Statistics (ABS) defines large businesses as 200+ persons, international records set the threshold at 250 persons.*

Australian SMEs face growth and scale challenges

The number of Australian small business is growing. However, the *Barriers to collaboration and commercialisation report* (Industry Innovation and Science Australia, 2023) shows Australia has experienced a dramatic contraction in the number of medium and large businesses since 2008.

In particular, the number of **medium-sized businesses** has decreased by over 21% across sectors over the period 2008–2021.

They face significant growth barriers such as the impact of regulation and access to markets.

Despite this, medium-sized businesses are major contributors to R&D spending across the different sectors in Australia. In sectors such as the financial and insurance services, medium sized firms are lifting BERD (Figure 21).

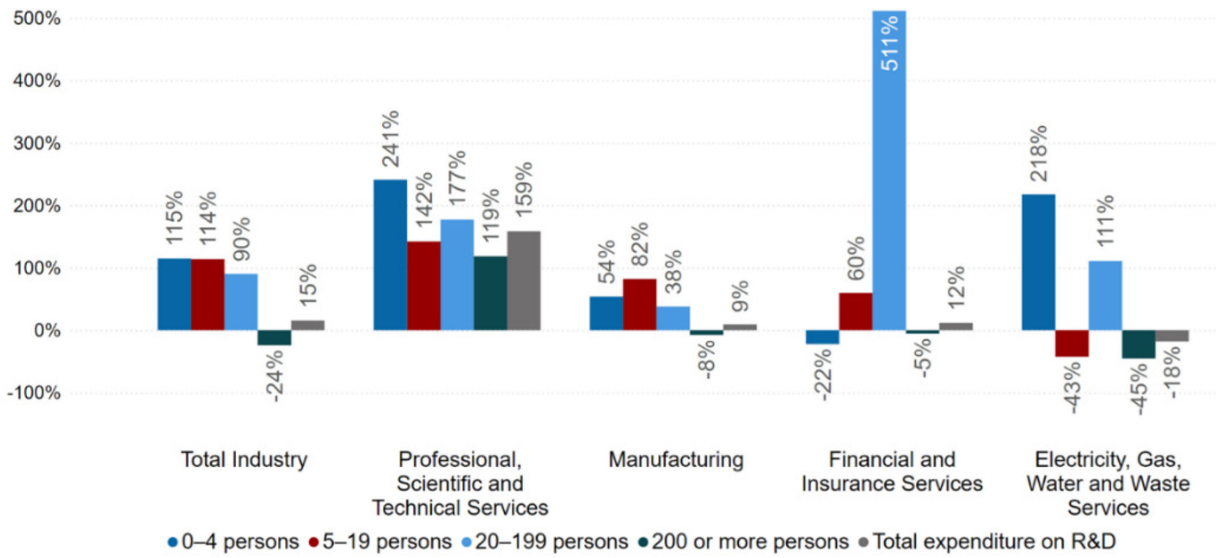
Medium-sized businesses are crucial for transforming our industrial base.

Compared to small firms, they are more likely to have the capacity to support collaboration, build supply chains and exploit market opportunities.

The *Barriers to collaboration and commercialisation* report recommends creating an environment to attract and grow medium enterprises in targeted industries. This includes focusing on building capabilities to de-risk market adoption and develop innovative business models.

Removing barriers to business dynamism and competitive pressures, and encouraging firms to approach the innovation frontier, will lead to improved labour productivity performance (The Treasury, 2022).

Figure 21: Change in R&D expenditure by size of business in select industry sectors



Source: ABS Research and Experimental Development, Businesses, 2010-11 to 2021–22

Large enterprise investment in R&D in Australia is in decline

The growing reliance on SMEs to drive BERD in Australia contrasts with other advanced economies, where **large companies** primarily lead BERD (Figure 20).

In Australia, large businesses have decreased R&D expenditure (Figure 22). This crosses most industry sectors, excluding professional, scientific and technical services (Figure 21).

Larger firms spend more on both the research and development components of R&D in absolute terms. However, studies describe a 'division of labour' between small and large R&D conducting firms (Baumol, 2002). Smaller firms are reported as providing breakthrough applications, while larger firms focus on developing innovations to create value (Arora & Gambardella, 2010).

The contribution of large businesses to Australia's R&D system needs to lift. Large businesses can be central pillars in innovation ecosystems.

Through collaboration with startups, research institutions, government agencies and their physical presence, large companies can create a dynamic environment where ideas are translated into products and services. Corporate venturing, merger and acquisitions of smaller innovative firms, business incubators and precinct development can also support this process (Regional Australia Institute, 2022).

Large mature businesses often need to balance R&D investment decisions against other investments to protect their market position and the need to ensure returns to shareholders.

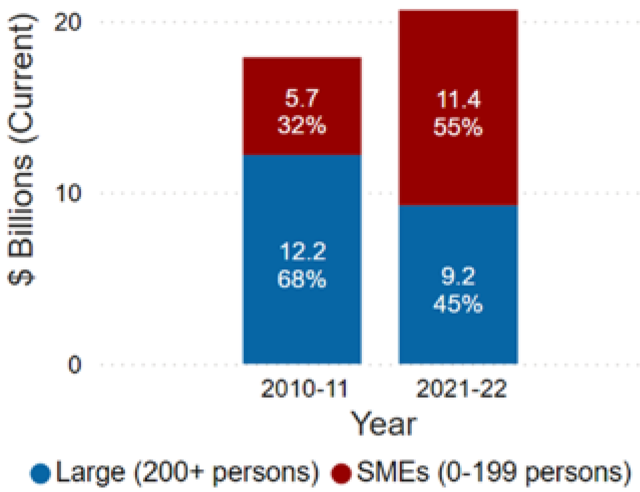
Studies (Mathews, 2019) (Bergmann, 2016) highlight that Australia is a relatively high dividend-paying market by international standards. This has the potential reduce business investment in R&D and innovation.

Risk tolerances of directors and boards in Australia influence their decisions. Large businesses might be less inclined to invest in R&D because of:

- shifting focus from innovating to protecting market position (Akcigit, 2024)
- safety and regulatory compliance (Industry Innovation and Science Australia, 2023)
- capital intensity (Giebel & Kraft, 2024)
- workforce variability risks (AiGroup, 2023).

Further, factors such as cost, available talent and competition also influence the amount and location of R&D. Growing Australian businesses face global access and competition barriers, and the domestic market is perceived as subscale for large multinationals.

Figure 22: Australian BERD by business size



Source: ABS, Research and Experimental Development, Businesses

National

Commonwealth R&D investment is spread broadly and thinly

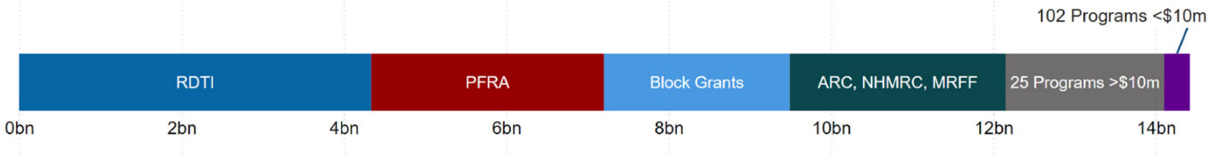
Public investment guides national priorities and leads the R&D system on where and how to focus efforts. In 2024–25, the Australian Government will invest an estimated $14.4 billion in R&D across 14 portfolios and 151 programs (Figure 23).

Of this, around $12.1 billion (84%) is 'bottom-up funding'. This includes the R&D Tax Incentive (RDTI), PFRAs, research block grants, and competitive grants through the Australian Research Council, National Health and Medical Research Council, and Medical Research Future Fund.

$2 billion (14%) is allocated to the 25 nationally significant programs focused on priorities (with investment of more than $10 million per year). This includes the National Collaborative Research Infrastructure Strategy (NCRIS), the Cooperative Research Centres (CRC) Program, Australia's Economic Accelerator (AEA), Square Kilometre Array (SKA) Radio Telescope Project and the government-funded component of the rural research and development corporations (RDCs).

$315 million (2%) is spread across 102 smaller programs, each receiving less than $10 million annually with an average funding pool of $3 million. Many of these programs focus on specific purposes, rather than being part of a system to achieve broader government policy goals.

Figure 23: Australian Government R&D funding



Source: DISR Science, research and innovation (SRI) budget tables, 2024–25

Much of the Commonwealth's R&D funding is funding through broad-based mechanisms. This includes entitlements to businesses, competitive grants and block funding to universities and PFRAs such as CSIRO and ANSTO. For example, funding for businesses through the RDTI is broad-based across industry sectors and open to businesses of all sizes.

This 'bottom-up' or 'patient capital' investment is vital because it allows researchers, entrepreneurs and businesses to pursue their own ideas. This leads to diverse and unexpected breakthroughs that can increase innovation and address a range of societal challenges.

However, funding for 'top-down' or purpose-led R&D remain subscale, disjointed and focused on grants.

R&D funding in high-performing jurisdictions often recognises that spillover benefits of R&D vary and emphasise investments in national missions. For instance, funding in the United States, Germany and South Korea is more strategically directed and intentional, led by national agencies or specific strategies.

Often, the R&D contribution of procurement strategies in key public programs are explicitly recognised. Capacity building investments such as the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs in the USA provide seed capital to promote problem focused R&D agendas.

Dispersed public investment results in a diverse range of grant systems and compliance measures. This creates a complex system for researchers, increases administrative burdens, and reduces data efficacy as an analysis tool.

For state and territory governments, limited independent funds mean leveraging commitments from universities, PFRAs and the Australian Government is essential. This restricts their capacity to support R&D and compels them to align priorities with other funding opportunities to maximise impact.

A stronger role for missions or targeting societal challenges to be addressed through R&D could increase impact. The Medical Research Future Fund (MRFF) Research Missions target big health challenges. For example, aiming to double brain cancer survival rates by 2027 and defeat brain cancer in the long term.

The importance of First Nations peoples in our R&D system should be elevated

Elevating First Nations knowledge and knowledge systems are a national priority. This is reflected in the National Science and Research Priority to elevate Aboriginal and Torres Strait Islander knowledge systems (DISR, 2024).

Historically, First Nations knowledges were replaced with a Eurocentric model (Morrison, Rigney, Hattam, & Diplock, 2019). *The Big Mob: STEM it Up* report highlights the results. The report found that teaching approaches in science assimilate First Nations knowledges. This risks under-representing First Nations contributions and missing valuable First Nations insights. Despite this, most First Nations people who contributed to the report were positive about the benefits of STEM individually, and for their communities (Figure 24).

Other challenges to protecting First Nations knowledges include intellectual property (for example, copyright and patents) and data rights, which do not cover cultural skills and practices. First Nations knowledges can be misappropriated and inappropriately commercialised (IP Australia, 2021). IP Australia has several work streams in the protection and management of First Nations knowledges, including working towards creating an Indigenous Advisory Panel.

First Nations knowledges are central to the outcomes of the Closing the Gap National Agreement (Closing the Gap, 2020). It found that inequality First Nations people face is because of 'disregard for Aboriginal and Torres Strait Islander people's knowledges and solutions.' Areas of opportunity to support First Nations knowledges can be found across the 4 Closing the Gap Priority Reform areas:

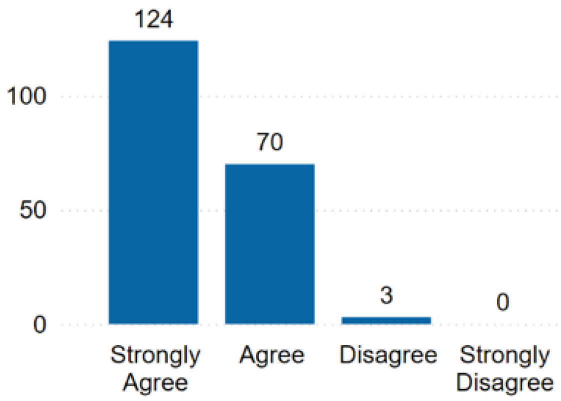
- Formal partnerships and shared decision-making
- Building the community-controlled sector
- Changing government organisations
- Shared access to data and information at a regional level.

First Nations peoples have historically had insufficient involvement in decision-making in research that affects them. This is contrary to the standard of Free, Prior and Informed Consent (FPIC) embedded in the universal right to self-determination created by the United Nations Declaration on the Rights of Indigenous Peoples (United Nations, 2012).

First Nations community-controlled sectors often lack funding and resources for self-led research, limiting the sector's ability to produce culturally relevant evidence (Walter & Andersen, 2013).

Limited recognition of First Nations data sovereignty means communities cannot fully use data to address needs and priorities, including Indigenous-led R&D. One critical area for action is health. The 2024 Productivity Commission *Annual data compilation report for Closing the Gap* identifies the lack of First Nations data control as a barrier to implementation (Kukutai & Taylor, 2016).

Figure 24: Participants agreement to the statement 'STEM can benefit my community'



Source: [The Big Mob: STEM it Up](#) report

There are gaps in our R&D infrastructure

R&D infrastructure is crucial for fostering innovation and scientific advancement. Australia has led the world in developing high quality, connected and available research infrastructure.

Different types of R&D infrastructure serve distinct purposes (Department of Education, 2022).

Institutional R&D infrastructure refers to facilities and resources in universities, PFRAs and private companies. These institutions focus on specific research areas and support their scientists and researchers to conduct their work.

National priority R&D infrastructure aims to address national priorities. This helps ensure open access to infrastructure that is beyond the ability of research institutions to fund. This world-class infrastructure meets broad national needs. Host institutions, such as universities, PFRAs and private not-for-profit companies, are expected to be stewards for the nation.

Landmark and global R&D infrastructure represents ultra-high-cost, focused infrastructure characterised by world-leading capabilities. These infrastructures may be based in Australia and open to the global scientific community or located in other countries and accessible to Australian scientists.

The business sector is also increasingly and appropriately leveraging Australia's R&D infrastructure, using it to de-risk technologies and develop testbeds for commercial-ready activity. The number of industry users of National Collaborative Research Infrastructure Strategy (NCRIS) facilities has more than doubled from 2015 to 2023 and is currently around 4000 per year (Department of Education, 2025).

R&D infrastructure needs ongoing funding and renewal to ensure relevance and focus. However, apart from strategic planning for national priority infrastructure through National Research Infrastructure Roadmaps since 2006, there is no coordinated approach or long-term strategy.

The planning patchwork is mirrored in the funding arrangements. The Australian Government allocates funding support through multiple programs designed for different purposes. Illustrative examples are:

- Institutional funding is available from the Australian Research Council's (ARC) Linkage Infrastructure Equipment and Facilities (LIEF) scheme.
- National priority R&D infrastructure funding is allocated through the NCRIS at $4 billion over 2017-18 to 2028–29.
- Landmark and global R&D infrastructure funding can be given by government for specific infrastructure assets such as the Australian Synchrotron and SKA.
- State and territory programs also support strategic investment in R&D infrastructure.

Many R&D infrastructures rely on multiple funding sources. For example, CSIRO operates the Australian Centre for Disease Preparedness, receiving direct funding through appropriations and from NCRIS to facilitate non-CSIRO researcher access.

Current funding arrangements for NCRIS will expire in 2028–29, resulting in a reduction in funding levels to around half of the current level.

Because of this planning and funding patchwork, R&D infrastructure lacks a long-term and coordinated nationwide approach. The result is R&D organisations facing funding gaps and the redirection of internal funding or infrastructure capability.

Figure 25: NCRIS Integrated Marine Observing System

Oceanographic floats calibrate satellite observations to ensure accurate measurements to inform climate models and projections of sea-level rise.

Finding new funding sources to lift R&D intensity is a significant hurdle

A range of stakeholders have called for Australia to lift its R&D intensity to OECD levels or to 3% of GDP. An increase of this scale would need significant increased investment in R&D from all sectors.

To reach the OECD standard of 2.73% of GDP, an extra $25.4 billion a year of R&D investment across sectors would be needed. Similarly, an annual investment of $31.9 billion would be needed to reach R&D intensity of 3% of GDP (Figure 26).

To encourage more business investment, a range of initiatives use public-private models whereby government, higher education, industry and others share financial responsibility for R&D. These include the Clean Energy Finance Corporation (CEFC), the Cooperative Research Centres (CRC) program and RDCs.

RDCs drive agricultural innovation through co-investment between the Australian Government and industry levy payers. Each of the 15 RDCs focus on practical improvements for their industry or commodity sector through targeted R&D and extension investments. Contributions from industry are usually collected through levies on products, and eligible expenditure on R&D is matched by government (up to legislated limits).

Levels of venture capital (VC) investment can be important for startups or early-stage businesses facing higher levels of risk (The Treasury, 2019). Government support of VC through the Early Stage Venture Capital Limited Partnerships (ESVCLPs) and Venture Capital Limited Partnerships (VCLPs) programs has been important in fostering growth of VC in Australia.

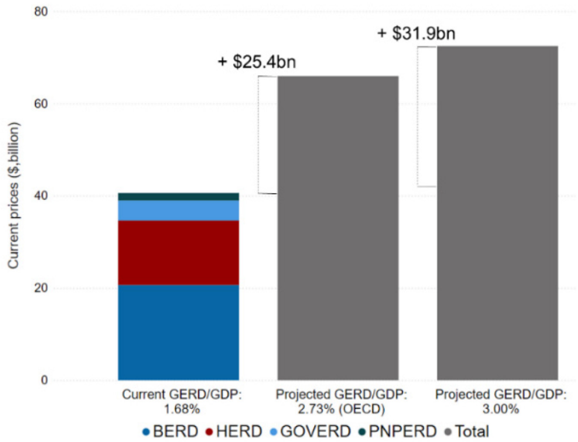
Australia ranks 30th on the Global Innovation Index for amount of VC received as a percentage of GDP (WIPO, 2024). Unlocking capital for high-risk startups needs activation of pools of capital from individual investors and family offices, typically at the very early investment stages. Institutional capital is needed for later stage investments.

Australia's nearly $4 trillion of superannuation assets have been proposed as an underused source of R&D funding. Particularly, for investing in the later stages of development. However, despite some examples such as Canva, this source of funds has not yet featured significantly in investment in early-stage R&D businesses.

Philanthropy may be an under-tapped source of R&D funding in Australia. Available data suggests it is limited compared to other countries.

Data shows that in 2022–23, funds from 'donations, bequests and foundations' added to Government Expenditure on R&D (0.23% of funds), HERD (3.55% of funds) and PNPERD (7.95% of funds) (ABS, 2024). Philanthropy's share of total operating revenue for higher education institutions has declined from a peak of 2.96% in 2011 to 2.24% in 2021. In 2020, public higher education institutions in the United States received an average of 5.5% of their operating revenue from philanthropy (Group of Eight Australia, 2023).

Figure 26: Projected annual levels of expenditure at OECD standard and 3% national R&D intensity



Source: DISR staff estimates; [OECD Main Science and Technology Indicators]

Research collaboration and alignment across sectors is weak

Recent reviews have highlighted a range of factors limiting collaboration between the research and business sectors. Differences in priorities, values and culture between sectors include (Department of Education, 2022):

- researchers lacking the knowledge, interest or capability to translate their research
- differences in timeframes for research outcomes
- misalignment of intellectual property priorities
- undervaluing of researchers by industry and lack of workforce mobility
- current incentives for universities not sufficiently recognising collaboration or commercialisation.

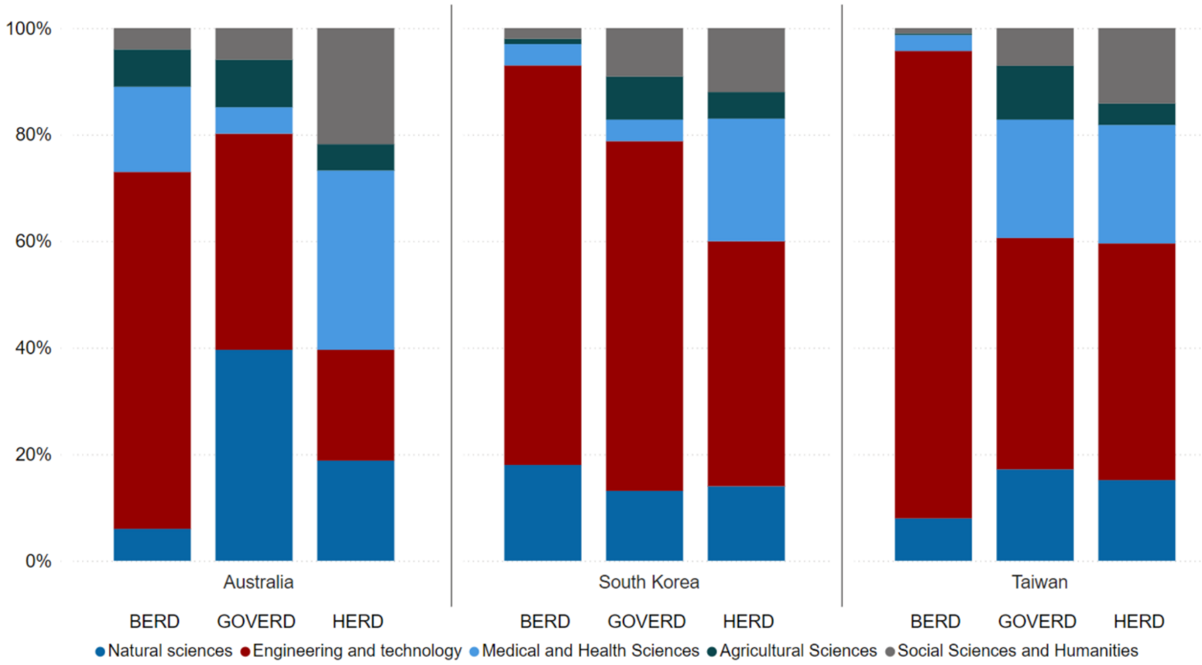
Australia lags on several collaboration indicators:

- 2.93% of Australia's publications have co-authors from industry, which is lower than the OECD average of 3.18% (Clarivate Incites, 2019-2023).
- Compared to South Korea, Germany, the US and Canada, Australia has fewer academics moving to industry and fewer industry researchers moving to academia per 1,000 researchers (Dayton, 2020). Australia has 4.5 R&D personnel per thousand business sector employees, less than the OECD's 6.8. South Korea has 7.8 R&D personnel per thousand business sector employees.

The *Barriers to collaboration and commercialisation* report highlights industry structure, business characteristics and demand side barriers to collaboration (Industry Innovation and Science Australia, 2023). Australia is dominated by small businesses (93% of Australian businesses with between 1-19 employees). Small businesses have low levels of free cash flow and human resourcing limitations. This constrains capacity to invest in R&D, partner with researchers, and adopt and scale innovation.

Countries such as South Korea and Taiwan have a high degree of sectoral overlap, particularly in the fields of engineering and technology (Figure 27). Australia has a more diverse pattern of spending, with the higher education sector spreading its R&D effort more broadly and with limited alignment with business.

Figure 27: Proportion of institutional sector R&D expenditure by field of research



Data sources: OECD Main Science and Technology Indicators; ABS, Research and Experimental Development, Businesses, Higher Education Organisations, and Government and Private Non-Profit Organisations

Our workforce is not aligned to the needs of our economy

A skilled science, technology, engineering and mathematics (STEM) workforce is vital to boosting the effectiveness of innovation. It's also important to meet the needs of an increasingly knowledge intense economy.

The challenges facing the broader innovation workforce demands solutions that build both the research and the industry workforce.

Australia may be facing a lack of skills that are needed for effective translation and commercialisation, including:

- engineering
- commercialisation
- sales and marketing
- product development.

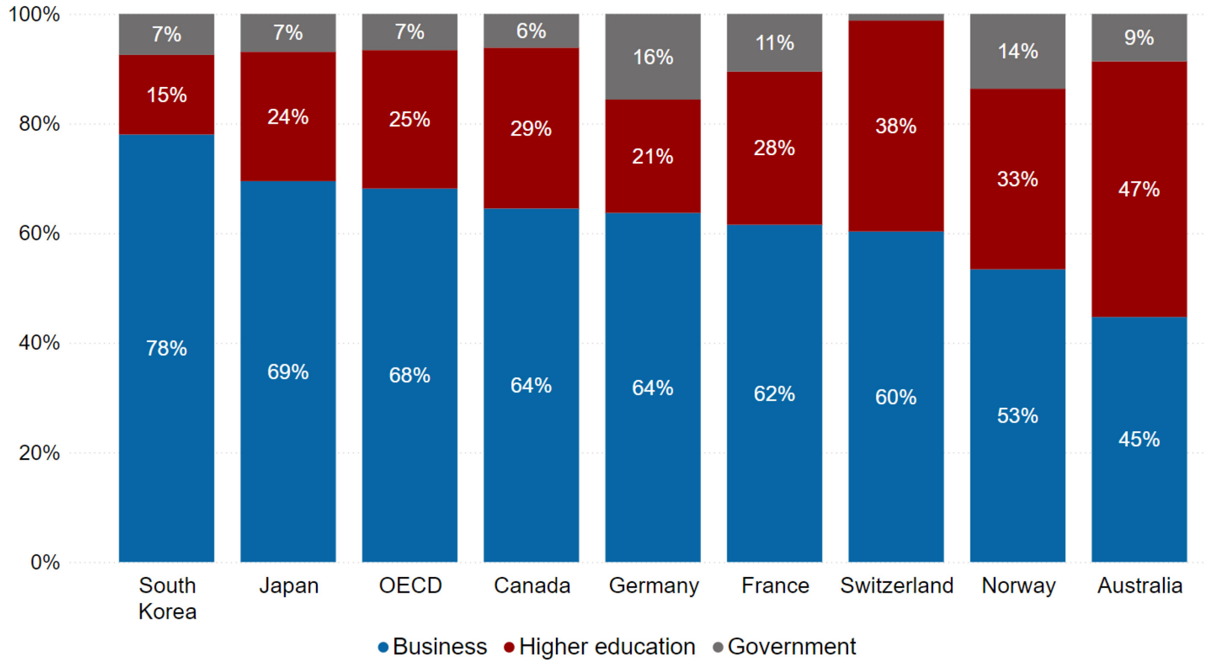
There are also significant 'language' barriers between Australian industry and university sectors. This impacts Australia's commercialisation levels. Industry professionals generally want to promptly find out the commercial viability and profitability of ventures, while academics may prioritise validating concepts or technologies.

Despite the Australian Government's initiatives to promote research translation and commercialisation (Department of Education, 2022), significant challenges persist in aligning the requisite skills and capabilities for achieving effective impact.

In 2019–20, 45% of Australia's R&D workforce was in the business sector (Figure 28). For most countries, including Australia, the distribution of R&D personnel across sectors is consistent with the distribution of R&D expenditure by sector.

There is low diversity in the R&D workforce. Only 15% of the STEM workforce are women, 5% of people studying university STEM subjects are living with a disability, and fewer than 1% of First Nations people hold a university STEM qualification (DISR, 2024).

Figure 28: R&D personnel by sector



Source: OECD Main Science and Technology Indicators, 2019–2020

The way R&D is conducted is changing

Artificial intelligence (AI) is changing the R&D landscape by improving productivity, simplifying complex processes and accelerating innovation. It will support a substantial lift in efficiency across the R&D system by automating routine tasks, accelerating data analysis and improving decision-making (Figure 29).

AI can accelerate research and innovation and is a vehicle for business to be competitive. Estimates suggest that automotive, telecommunications and consumer products have much to gain from new product development. A third of sales, worth $30tn USD over 5 years, are set to come from new products (Colback, 2024). However, the productive impact of AI is also dependent on how well it is diffused and used among businesses. Its effects are likely to take time to impact the economy.

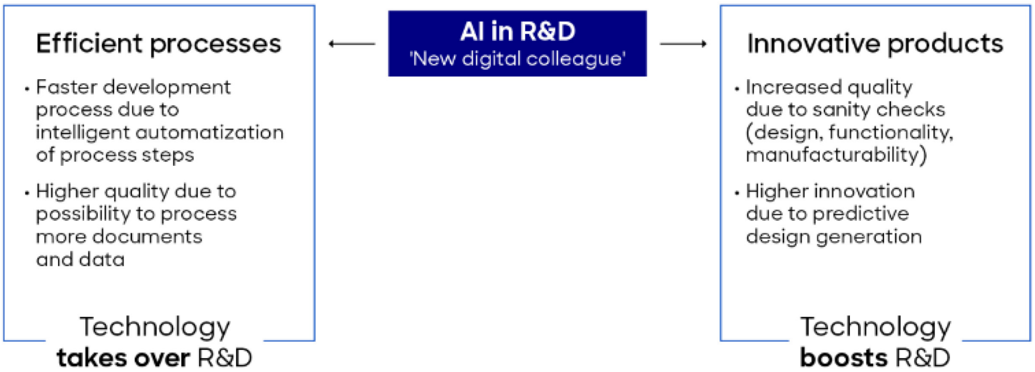
AI can deliver multiple versions of a product and suggest modifications that a human designer might not have considered. Once the concept has been honed, AI can help to plan market-testing strategies and accelerate product testing and design. It can also create and test iterations of a product much faster than a human. AI can suggest materials, sourcing and manufacturing processes. This is helpful for startups and smaller businesses and is therefore relevant to the Australian context.

In the future, humans will carry out R&D with support from AI. Businesses adopting AI now are akin to those who adopted the internet to improve processes, reach and productivity. AI and machine learning creates efficiencies in testing and predictive modelling. AI accurately forecasts and has faster output in distribution centres using computer vision, robotics and simulation. It also improves last-mile delivery, giving retailers more agility.

Austrade estimates that Australia hosts an oversized AI industry, with well over 550 AI companies (Austrade, n.d.). A 2023 AI ecosystem report found year-on-year growth of AI companies was 7.7% over the previous 5 years (CSIRO, 2023). The demand for AI-related jobs in Australia is growing faster than international benchmarks. In 2022, 1.2% of all job postings were AI-related.

There is a growing industry focus on AI applications in new businesses across the country and this will continue to grow. Australia has the potential to become a globally competitive exporter of AI technologies, especially in livestock, medical technology and horticulture.

Figure 29: Benefits of AI in R&D



Source: Roland Berger

Quantum is another upcoming technology likely to transform the way R&D is conducted. Quantum technologies can improve R&D speed and quality. Quantum sensors are used in commercial applications like brain-scanning. They allow for a wider range of diagnostic environments and can perform gravity sensing for subsurface composition in construction. Electric battery researchers use quantum sensors to analyse microcurrents and improve production yields. Quantum technologies aid in material and drug discoveries and model chemical processes. Their demand for power and complexity are barriers to entry. However, this does not preclude commercial usage soon.

Opportunities for AI and quantum will become more evident. Australia must balance the potential risks with the benefits for research and opportunities for business. Leveraging new technologies needs new ecosystems that bring together those who can conduct the research and those who can achieve adaptation and commercialisation.

International examples of R&D reforms

Comparator countries are a reference to benchmark Australia's R&D performance. They are also models of potential pathways to improving investment in R&D and Australia's R&D system to better deliver economic and societal return. While employing different strategies, one constant is the shared understanding of the importance of R&D and a long-term strategy.

United States: Addressing large-scale complex R&D challenges of national interest

The United States Department of Energy National Laboratories and Technology Centers (National Labs) are a group of 17 Federally Funded R&D Centres (FFRDCs). The FFRDCs are a class of research institutions owned by the federal government but operated by contractors, including universities, non-profit organisations and industrial firms. This is the Government-Owned Contractor-Operated model. The National Labs address large-scale, complex R&D challenges in the national interest. The laboratories are suited to do so through government setting missions and allocating funding. The model affords the government the flexibility to direct the overarching aims of these institutions. The contracted operator is granted freedom to use their expertise to decide the best means to achieve them. The managing operators can recruit world-class technical talent and adapt to advances in science and technology through their own processes and expertise.

Germany: Leveraging strengths and comparative advantages

Germany prioritises its R&D investments by leveraging its comparative advantages, focusing on sectors where it possesses strengths to increase innovation and economic growth. The Fraunhofer Society comprises 76 institutes and research units with 30,000 staff. It is prioritised by aligning research with industry needs, government support and global technological trends to foster innovation and economic growth. Fraunhofer institutes focus on applied research in chosen fields, with current focuses on bioeconomy, intelligent medicine, quantum technologies, AI and climate technologies. Around 35% of Fraunhofer's revenue comes from industry contracts, showing the high demand and applicability of its research.

South Korea: Focus to lift R&D intensity

Over the last 3 decades South Korea has significantly lifted its R&D intensity through a long-term policy focus. They formed an innovation authority and investment in public research institutes and R&D infrastructure. South Korea transitioned from importing technology to creating emerging technology, with many of its large technology companies emerging from this period as world-class manufacturers. South Korea's economic transformation relied on the close collaboration between government, industry and the academic community. With R&D intensity at 2.02% of GDP in 1999, South Korea's government adopted several policy reforms, leading to R&D intensity more than doubling to 4.93% by 2021.

France: Building an industry-focused R&D workforce

The French CIFRE (Conventions Industrielles de Formation par la Recherché) scheme is an incentive structure organising the transition of talent from higher education to industry. This is similar to Australia's National Industry PhD Program.

More than 10% of doctoral degrees in France are awarded through CIFRE (around 1,500 students each year), totalling about 34,500 since its inception in 1981.

CIFRE projects are categorised into 3 distinct streams:

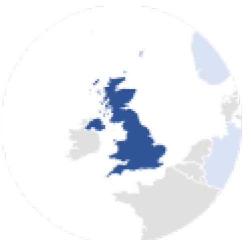
- Disciplinary R&D jobs (60%): Focus on advancing R&D in a specific field.
- Incremental innovation (27%): Develop incremental innovations for a product or service in highly technical fields, often commissioned by specific industries. For example, analytics and simulation for the banking industry.
- Exploratory (13%): Dedicated to building scientific knowledge in emerging fields, interdisciplinary areas or radically innovative industrial contexts. Includes projects that companies lacking internal R&D capabilities commission, such as medical firms without ethics approval for independent research.

The French government streamlines recruitment across these streams with a centralised application and recruitment and networking platform. 90% of CIFRE PhD graduates find employment in industry in 6 months, with 70% remaining in the private sector long-term.

Israel: Developing an innovation economy

The Israeli government funding of R&D is a solution for high-risk R&D investments where the private sector under-invests to develop a flourishing culture of innovation. The Israeli Hub ranks third in the world in the number of active startups that raised funding from investors. Fields of comparative advantage include privacy and cyber information security, agricultural technology, content/ media and information technologies. A feature of Israel's business R&D is also the growth in computer programming research in the last decade. Encouraged by the Israel innovation system assets, corporations such as Intel, IBM, Google, Cisco, Motorola, Apple and Microsoft have set up research centres in Israel. In January 2024, the Israeli government announced a stimulus package aimed at elevating Israel's standing as a global high-tech hub. Directed policy measures such as this have ensured a landscape for long-term creativity in R&D that has led to significant innovation.

United Kingdom: Resource concentration and co-location



The United Kingdom has used clustering of research facilities and industry partners through a network of 'Catapult' centres. These improve business access to technology and expertise, conduct collaborative applied research projects, and create a critical mass of activity between business and research institutes. Since 2013, the Catapult Network has collectively played a lead role in connecting over 5,500 academic collaborations and supported 12,000 organisations in over 18,000 projects. Businesses working with Catapults experienced a 27% increase in turnover compared to their peers. They rose 50% over 6 years, with around 80% reporting that their projects would not have proceeded successfully without Catapult involvement.

Next steps

To meet the challenge of sustainable growth and to mitigate sovereign and international risks, our researchers, governments and business leaders must collaborate to achieve better outcomes.

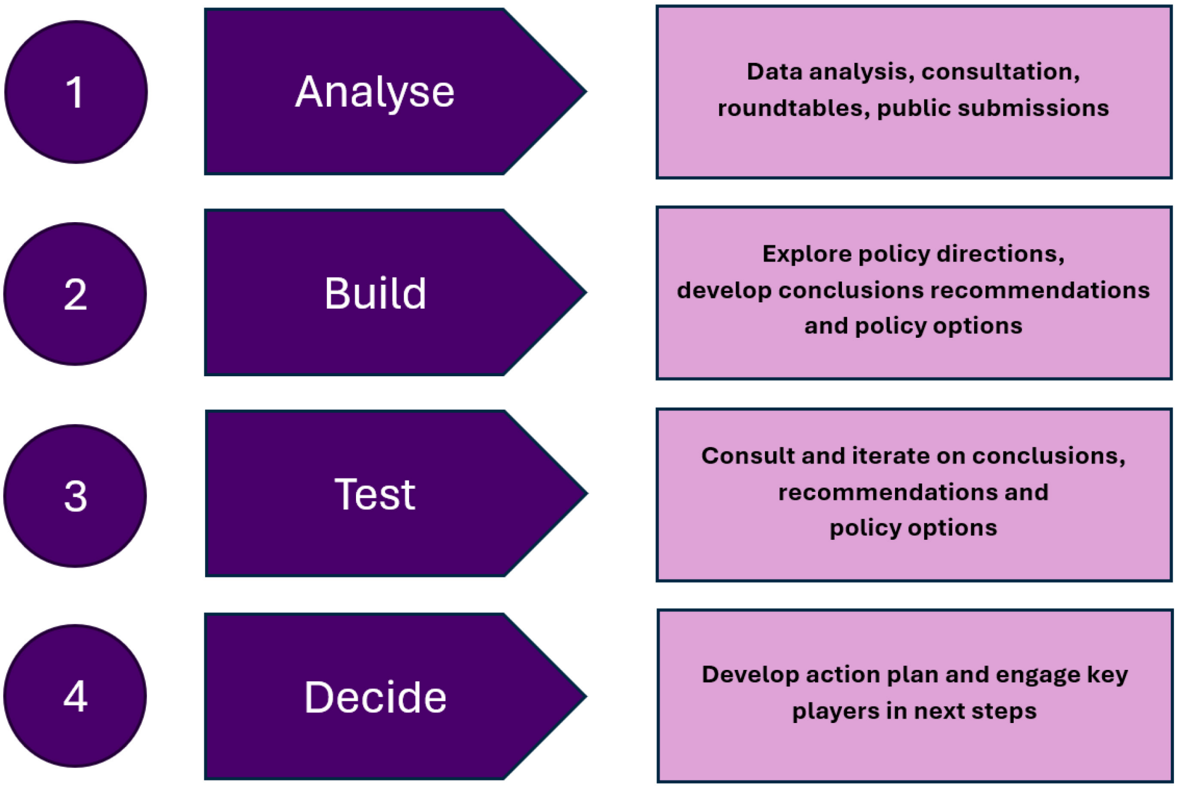
We need to learn from recent experience in Australia and act to develop new ways to secure outcomes for all Australians.

There is a clear need to develop a more purposeful R&D system in Australia. It demands that funding systems, institutional arrangements and incentives align to develop a robust and dynamic Australia.

The expert panel welcomes input of partners interested in a stronger R&D system supporting a better Australia.

You can find the discussion and survey questions on the following pages and the consultation hub. You will be able to upload a submission and supporting research or analysis if you have more to say on this topic.

This is the beginning of a year-long process. There will be more opportunities to input and engage with the debate and discussion this important topic warrants. The panel expects 4 stages to its considerations throughout 2025:



Consultation questions

The consultation hub will ask you to respond to the questions below. You can choose to respond to as many or as few as you would like.

You will also be able to upload a submission if you have more to say.

1. **What should an integrated, sustainable, dynamic and impactful Australian R&D system look like?**
2. **What government, university and business policy settings inhibit R&D and innovation why?**
3. **What do we need to do to build a national culture of innovation excellence, and engage the public focus on success in R&D and innovation as a key national priority?**
4. **What types of funding sources, models and/or infrastructure are currently missing or should be expanded for Australian R&D?**
5. **What changes are needed to enhance the role of research institutions and businesses (including startups, small businesses, medium businesses and large organisations) in Australia's R&D system?**
6. **How should Australia support basic or 'discovery' research?**
7. **What should we do to attract, develop and retain an R&D workforce suitable for Australia's future needs?**
8. **How can First Nations knowledge and leadership be elevated throughout Australia's R&D system?**
9. **What incentives do business leaders need to recognise the value of R&D investment, and to build R&D activities in Australia?**
10. **What should be measured to assess the value and impact of R&D investments?**

Survey questions

The consultation hub will ask you to rate the importance of highlighted topics.

a) **R&D is important for economic diversification.**

b) **Increasing R&D investment by the business sector is the most critical element to improving the economic impact of Australian R&D.**

c) **Maintaining investment in foundational R&D is critical to the overall health of the R&D system.**

d) **Public R&D resources should be more targeted towards national priorities.**

e) **New and alternative sources of R&D funding are needed.**

f) **First Nations knowledge is sufficiently reflected in the R&D landscape.**

g) **Research institutions should be more specialised with more clearly defined roles.**

h) **The current R&D workforce can address Australia's future needs.**

i) **Better coordination is needed to manage R&D infrastructure.**

j) **Government should play a larger role in spurring collaboration and alignment of cross-sector interests.**

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