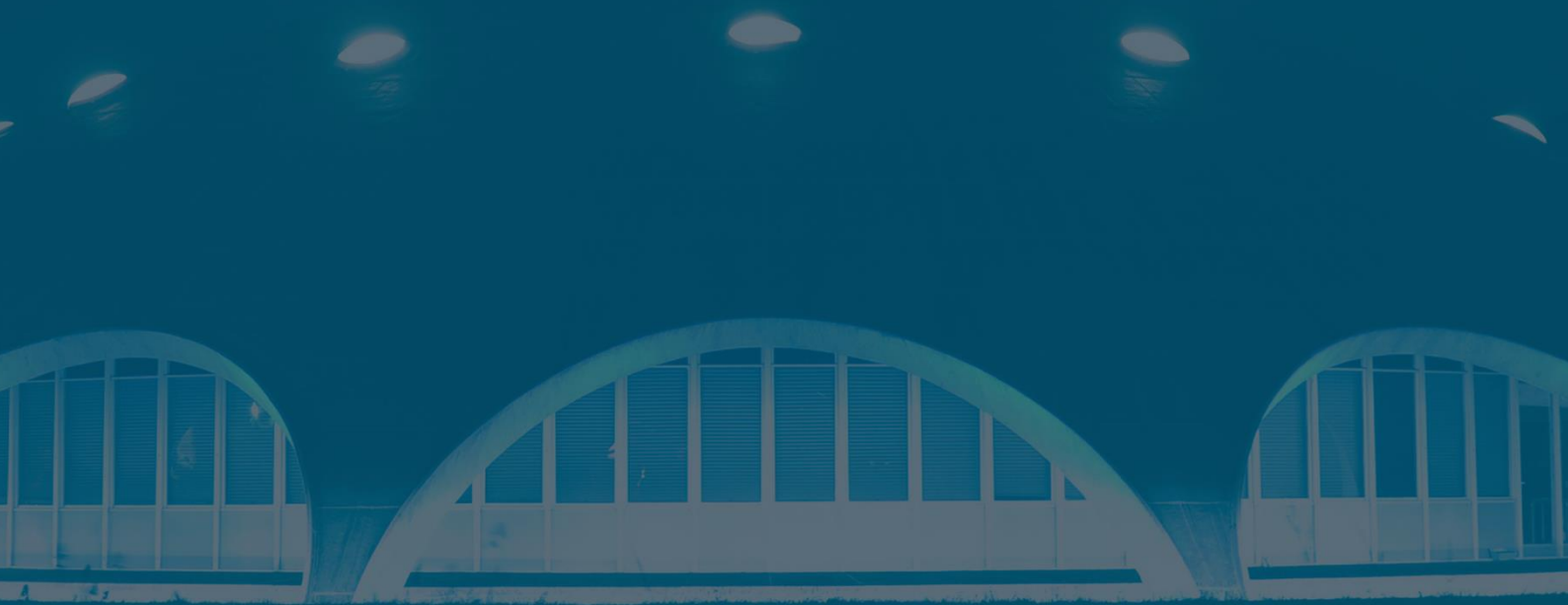
Australian Academy of Science

2024-25 Pre-Budget Submission

January 2024



2024-25 Pre-Budget Submission: In a time of risk and opportunity, science is critical.

The world is in a time of flux, between crisis and opportunity, that requires science to inform the decisions we need to make to secure our future.

Our nation is experiencing the pressures of an uncertain world – rising extreme weather and natural hazards, a pressing need to decarbonise, stagnant productivity, a workforce with inadequate skills for a digital world, a cost-of-living crisis, a growing and ageing population, threats to global food security and water supply, and national security risks.

The challenge for the Australian Government is to address these pressures and build a stronger, more resilient nation.

The Productivity Commission and the Government's draft National Science and Research Priorities recognise the value of science and technology – the deep and fundamental link between science and economic development – but this cannot be realised with a science system that is stagnant and relies on decades-old settings.

The Academy recommends that the Australian government commissions a review of the Australian research and development (R&D) system in order to create a roadmap to secure Australia's economic future through strategic development of scientific capacity and capability.

Science addresses the problems of a challenging world – and underpins productivity growth

A poorly functioning science system has wide-ranging impacts.

Australia's productivity growth is declining: in the decade to 2020, Australia's productivity growth was the slowest in 20 years, and so was our investment in R&D.[1]

Australia has one of the world's least differentiated economies, ranking 93rd of 132 countries on the Harvard Economic Complexity Index, well below Japan, South Korea, China, the UK and the USA, which are amongst the top 20.[2] This reflects a services and resource-focused economy and highlights our vulnerability to volatile international conditions.

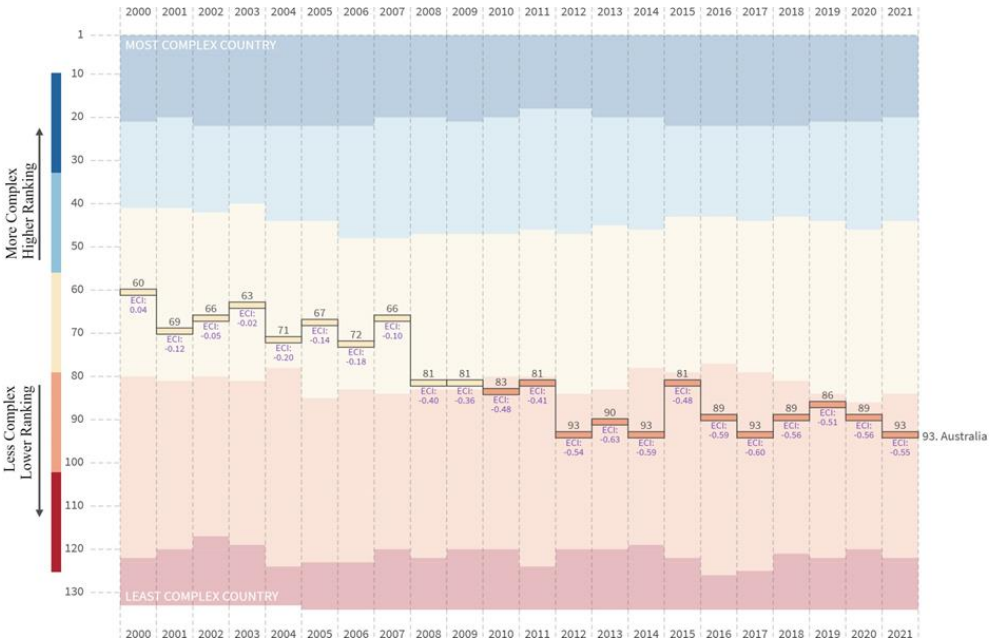


Figure 1. Australia's economic complexity compared to other countries has declined, with Australia now ranking 93rd of 132 countries on the Harvard Economic Complexity Index. Credit: Harvard Growth Lab.

Australia's falling productivity is in part caused by under-investment in and the under-utilisation of science and research.

R&D is a driver of productivity, economic growth, and improved sustainability. Investment in research leads to innovation, which in turn drives productivity and stimulates industry growth.

While R&D investment carries inherent risks, there is a clear, quantifiable economic return on investment in R&D - the CSIRO estimates that every dollar invested in R&D

[1] Source: Measuring What Matters - Productivity

[2] See Harvard Economic Complexity Index.

returns $3.50.[3] In the agricultural sector, estimates of economic return are even higher at $7.82 per dollar.[4]

Science supplies the aggregate knowledge developed by many years of investment of the 'patient capital' central to discovery and technological development: the rapid development of mRNA vaccines was founded on work overseas that began around 40 years ago, not in 2020.

"People sometimes think that I and the others worked on penicillin because we were interested in suffering humanity. I don't think it ever crossed our minds about suffering humanity. This was an interesting scientific exercise, and because it was of some use in medicine is very gratifying, but this was not the reason that we started working on it." Howard Florey, 1970

Australia was able to attract mRNA manufacturing facilities to our shores because of our scientific capability in fundamental and applied mRNA science decades in the making.

Our pandemic response, national security, capacity to mitigate and adapt to the destructive forces of climate change, and our recovery from extreme events such as floods and bushfires depend on science.

The pandemic showed that we cannot rely on supply chains, including in science. We need a talent pool not only to develop new knowledge, but to utilise, adapt and interpret overseas innovations.

Without a foundation of knowledge and expertise, Australia will be unable to respond to domestic or global challenges or capitalise on international developments. A robust science sector will drive Australia's response to immediate and future challenges, such as:

- Economic and social transformation driven by AI
- Energy transition to meet national and global decarbonisation targets and to live sustainably
- Innovation to mitigate and adapt to the impacts of climate change
- Robotics and developing advanced manufacturing capability on shore, including semiconductors and RNA products
- Maintaining national security in multiple fields, including cybersecurity
- The priorities under Pillar 2 of the AUKUS partnership
- Defence capability acceleration in the Defence Strategic Review

Science capability protects Australia's national interests. There are uniquely Australian problems that only we have the motivation to solve, such as limiting climate change impacts on the Great Barrier Reef and increasing water security in the Murray-Darling Basin.

As identified by Treasury,[5] five major factors will shape our future economy:

- An ageing population
- Rising demand for care and support services
- A technological and digital transformation requiring digital inclusion and a digitally literate population
- Climate change and the net zero transformation
- Increased geopolitical risk and fragmentation.

These are factors that can only be addressed by a society with a powerful science sector capable of generating, attaining, and applying new knowledge.

[3] Source: Quantifying Australia's returns to innovation, CSIRO 2021

[4] Source: Agricultural research and development investment in Australia, ABARES 2023

[5] See Intergenerational Report 2023

However, we lack the understanding of whether Australia has the right scientific capacity and capability to meet these challenges. Without a strong foundational expertise base, our responses to these challenges will be partial, weak, uninformed, and wrongly focused: Australia will be forced into suboptimal responses to challenges we can see coming, let alone those we have not anticipated.

Further, meeting our national challenges requires addressing global skill shortages, particularly in the transition to a carbon-neutral economy.

Towards meeting these challenges, the Government's policy agenda includes decarbonisation, creating jobs, skills reform, environmental law reform, and delivering cheaper medicines, groceries and energy bills. Ongoing scientific research and development are required to achieve these goals and support a high quality of life for Australians.

Science is essential to Australia's future economic growth and can unlock our potential to meet Australia's national ambitions. However, we are yet to unlock that potential because we are not investing strategically and efficiently as a nation in research and development.

There is a mismatch between Australia's aspirations and its strategy for science.

There is a fundamental mismatch between Australia's national aspirations and its approach to science. Individually, scientists are working harder than ever and are expected to do more than ever, but the science system is not working to leverage this effort, to support the modern scientific enterprise, and to maximise the benefit for Australians. Instead, Australia's performance against key indicators of science and innovation performance has declined.

Fragmentation and distortion

The base for Australia's existing system is more than 30 years old.

Over time, ad-hoc interventions, various departmental initiatives and overlapping state and Commonwealth priorities have led to a system that is spread over 176 programs and 14 federal portfolios, with multiple ministers and departments having key responsibilities.

The result: an overly bureaucratised and inefficient system lacking scale.

This is made worse because few programs, if any, fund the actual cost of research: scientists must secure multiple grants for the work that a single grant would cover in a fit-for-purpose system.

This, in turn, has led to a distorted research funding model, where universities rely heavily on international student fee revenues to meet the real costs of research. This places much of Australia's scientific capacity at the mercy of highly contested international student markets and is vulnerable to national security measures.

Since the mid-2000s, policy focus has placed greater emphasis on knowledge diffusion (translation or commercialisation). The onus has been on universities to seek collaborations with businesses – with marginal effect on business collaborations with science but with negative structural consequences for knowledge creation.

And as government investment falls, the incentive for business investment falls with it.

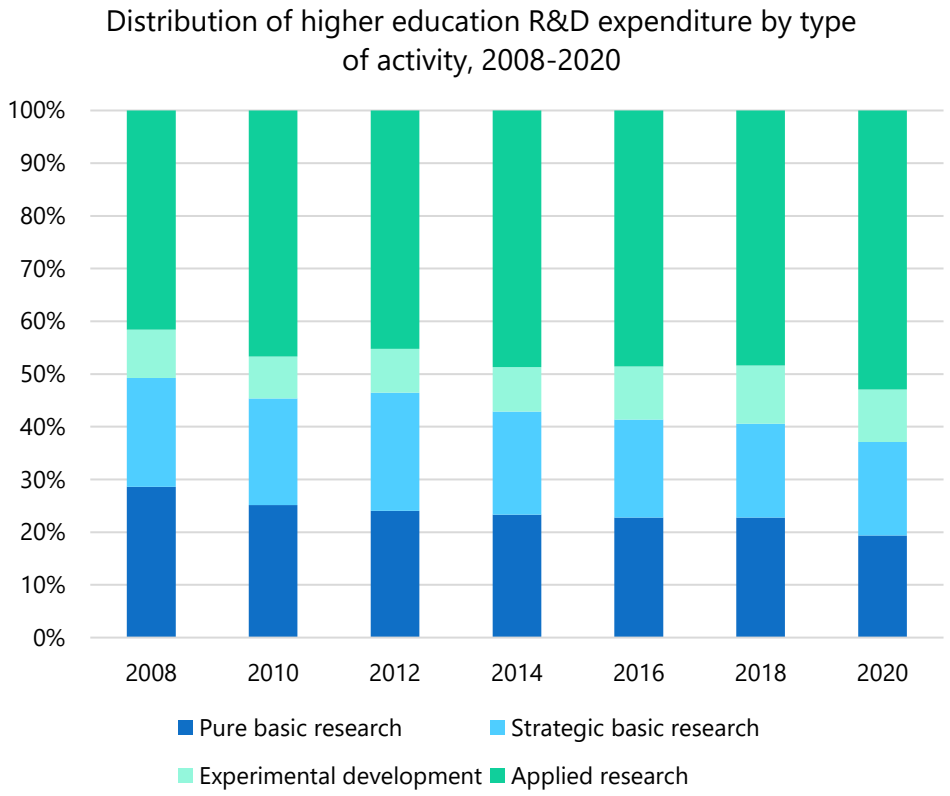


Figure 2: The proportion of higher education expenditure on R&D towards applied research has increased, while the proposition of expenditure on pure basic research has declined. Source: Australian Bureau of Statistics.

The fragmentation of current R&D governance and distribution is symptomatic of a system that needs transformative change.

Workforce gaps and workforce needs

After increasing steadily between 2000 and 2014 to a peak of 119,000 researchers (FTE), numbers have plateaued in recent years. In 2020, there were 117,000 researchers (FTE) across business, government, private non-profit and higher education. Of these, 59% worked in higher education, 30% in the business sector, 7% in government and 4% in the private non-profit sector. Postgraduate students are a significant portion of the science workforce, making up 38% of researchers (FTE) in Australia in 2020.

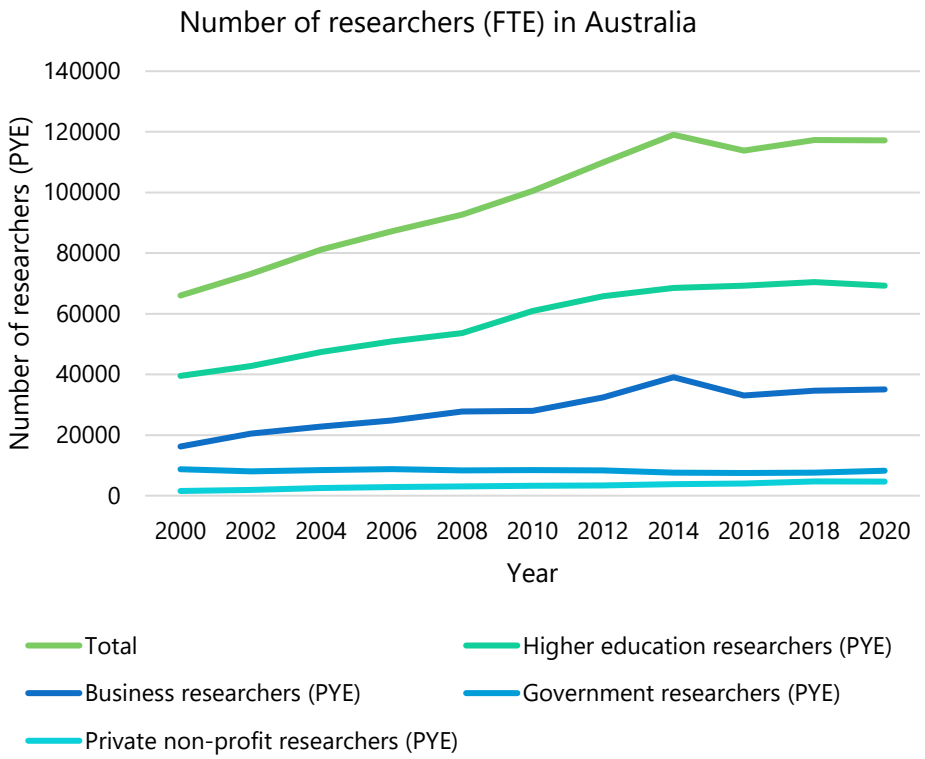


Figure 3. The number of researchers (FTE/Person Years of Effort (PYE)) in Australia has plateaued since 2014. Source: Australian Bureau of Statistics.

Science has become an overly challenging career path. Early and mid-career researchers report high levels of job insecurity, unsustainably high workloads, and bullying. A high rate of attrition from the university sector (the 'leaky pipeline') disproportionately affects researchers from underrepresented backgrounds, perpetuates the shortage of highly skilled scientists, and limits the government's return following years of investment to train these highly skilled Individuals.

Scientists are asked not only to advance frontiers of knowledge but to train the next generation, inspire the public, commercialise their research, protect national security, and solve global challenges.

Yet many of these tasks are not supported by the system and are not captured by the metrics used to assess performance.

Australia has a system of research assessment that focuses on individuals performing against metrics which do not capture what they are trying to achieve. The focus on individualistic metrics does not reflect the team-based, collaborative practice that defines current research, nor does it reflect the capacity of the research sector to deliver on science priorities and national research missions.

A robust, diverse, innovative and rewarding research sector is critical for Australian productivity and industrial capability.

If the system doesn't work for researchers, then it doesn't work for Australia.

Australia needs a long-term strategic roadmap for science.

A long-term strategic plan of coordinated strategic R&D investment is necessary to build Australian scientific knowledge at scale, create economic benefits, boost productivity, and de-risk our vulnerabilities.

A strategy for science will help to secure the scientific knowledge and discovery needed to underpin future technologies and commercial opportunities.

The solution lies in how we focus the limited resources we have and how we grow those resources over a ten-year period.

Reversing the downward trend of government R&D is not the work of any single budget. The Federal Government alone cannot solve this. It must be a national effort: all levels of government, industry, universities, the research sector, and philanthropy must all play their part.

This needs a national strategy: a roadmap and a decade of commitment to boost government investment in R&D and to stimulate expenditure by other sectors.

An Australian R&D roadmap setting out the Government's approach to R&D investment will strategically stimulate R&D expenditure by other sectors. It will show leadership and create coherence and certainty by producing focused R&D targets and opportunities to scale up and expand cross-cutting R&D programs, bringing together transdisciplinary expertise, Indigenous Knowledge, and knowledge creation.

The strategy will ensure meaningful, efficient investment of government research and development funding – while developing our own national scientific capability in key areas rather than relying on imported expertise, knowledge, skills, technology, and goods.

There have been many recent reviews looking into aspects of the science and research sectors, but none that treat it as a whole system.

A more innovative, productive, sustainable, and resilient nation

The strategic development of Australia's scientific capacity will have dividends throughout the economy. Government investment in R&D will stimulate cross-economy investment. Cultivating Australian science will lead directly to economic development, increased productivity, and industrial growth.

It will lead to greater resilience to global and regional challenges. It will improve the quality of life for all Australians.

Contact

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