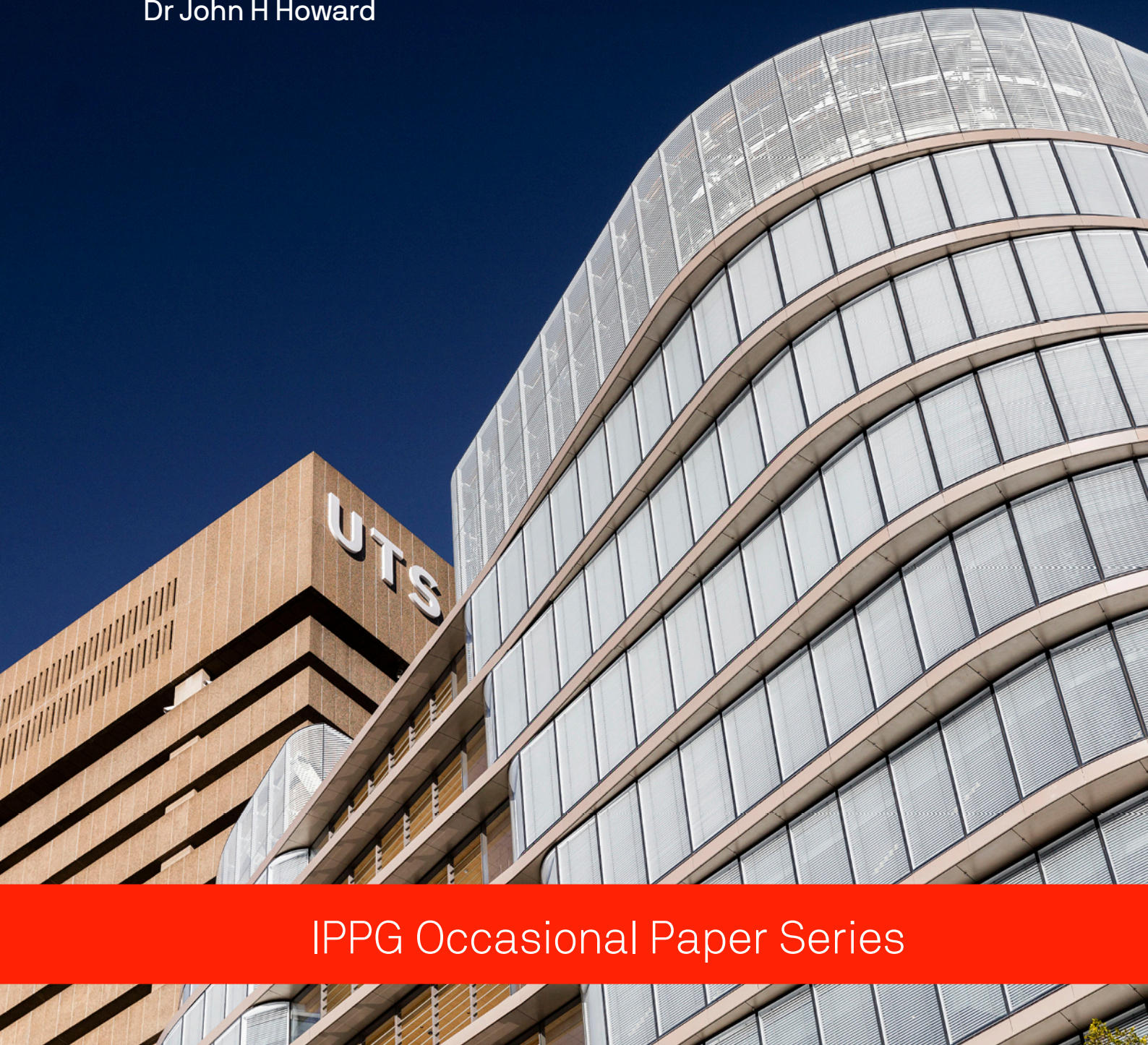
Institute for Public Policy and Governance

Science, Research and Innovation in Australia: What the Data Tells Us

Dr John H Howard



IPPG Occasional Paper Series

About this publication

This paper has been produced as part of IPPG's Occasional Paper series which is dedicated to bringing relevant issues of public policy and governance to a broad audience.

The Institute for Public Policy and Governance is an independent institute of the University of Technology Sydney (UTS) focused on driving excellence in public policy. Excellence in public policy, governance and public administration. Explore our work.

Science, Research and Innovation in Australia: What the Data Tells Us

Dr John H Howard

Visiting Professor at the University of Technology Sydney

Published by University of Technology Sydney,
Acton Institute for Policy Research and Innovation
PO Box 123 Broadway NSW 2007 Australia

ISBN 978-1-64786-073-8

Contents

List of Figures

Introduction

On 15 February 2024, the Department of Industry, Science and Resources published the 2023-24 *Science, Research, and Innovation Budget Tables*[1].

A covering Message from the Minister of Industry and Science (The Hon. Ed Husic MP) included some perfunctory remarks on the content of the Tables—

> *The 2023–24 Science, Research, and Innovation (SRI) Budget Tables show the Government will invest an estimated $12.6 billion in R&D in 2023–24, an increase of 2.7 per cent compared with 2022–23. This government is sending all the right signals ...*
>
> *The Government is investing in priority industries that will support an uplift in R&D investment over the longer term, including through the $15 billion National Reconstruction Fund, the $392 million Industry Growth Program, and the National Quantum Strategy*[2]*.*

The Minister considers that "these investments collectively provide the right frameworks so that business will be confident to invest in new research and innovations, supporting them to translate new knowledge into practical opportunities that drive economic growth and competitiveness". Other announcements have been made concerning the defence industry and sovereign capability.

The Tables contain a wealth of information about the performance and (implied) priorities of Australia's investment in R&D and what are termed "Other Innovation Programs". The material is rich in detail and is a credit to the Departmental Officers responsible for compiling it and improving the data quality over the years.

The SRI Budget Tables do not represent a "budget" in the strictest sense of the term. However, there is potential to use them as an instrument to guide decision-making and resource allocation across portfolios in the future. Ideally, the SRI Budget should be presented to Parliament as a Budget Paper accompanying the Treasurer's Budget Speech.

But will the investments foreshadowed by the Minister support an uplift in R&D investment over the longer term? Will they be enough?

The disappointing aspect of the Budget Tables is that they do not show a material improvement in the Commonwealth Government's investment in R&D since 2011-12. In fact, the investment has been going backwards.

This Paper delves into the content of the SRI Budget Tables to find out what they mean for building Australia's R&D capacity and capability.

[1] Department of Industry Science and Resources (2024), *Science, Research, and Innovation (SRI) Tables*, 2023-24 https://www.industry.gov.au/publications/science-research-and-innovation-sri-budget-tables

[2] The National Reconstruction Fund and the Industry Growth Program are not R&D investment programs, although they will potentially "pull through" existing, additional, or new R&D. In the SRI Tables, they are classified as *Government investment in science, research & innovation (not including R&D*). They are, therefore, not included in the $12.6 billion R&D investment. The National Quantum Strategy has not yet been funded, and no budget or forward estimates are included in the *SRI Budget Tables*.

Policy background

The *Australian Universities Accord—Final Report*

The *Australian Universities Accord—Final Report*[3] has raised the issue of whether the distribution of R&D investment among programs reflects the most appropriate allocation of resources to "maximise Australia's R&D competitiveness for economic gain, and environmental, cultural, and social good".

For example, questions are often asked about why the RDTI should take up 27% of the R&D Investment in the absence of any direction to targeted priority areas, and Health should take up 15% at the expense of areas of more interest to Australia's high potential micro firm and SME population.

In this context, the *Accord Final Report* recommends that "the Australian Government develop a multi-agency government strategy that sets medium and long-term targets for Australia's overall national spending on R&D as a percentage of GDP, requiring a significant increase to ensure Australia fully utilises the potential of its research sector … The strategy should also undertake a root and branch consideration of the suitability and sustainability of the national research funding and governance architecture".

This project would be expected to recommend substantial increases in Government support for R&D, particularly in new areas and areas currently underfunded or not funded at all. Attempting to shift resources from programs that currently appear generously funded (such as the RDTI, Health, and University Block Grants) might not be appropriate in the context of the systemic decline in Government support for R&D.

The Department of Industry, Sciences and Resources, through the Chief Scientist, is currently seeking feedback on a draft set of National Science and Research Priorities that cut across traditional discipline and sector boundaries—

1. Ensuring a net zero future and protecting Australia's biodiversity
2. Supporting healthy and thriving communities
3. Enabling a productive and innovative economy
4. Building a stronger, more resilient nation.

The Chief Scientist is also working on several other projects, including refreshing the National Science Statement and strengthening Australia's dialogue and cooperation with priority countries on research collaboration and skills for critical and emerging technologies.

The finalisation of the priorities might be expected to impact the distribution of Government R&D investment programs.

The target of 3% of R&D expenditure as a proportion of GDP

In November 2022, the Minister for Industry, Science and Resources announced a target of 3% of expenditure on R&D as a proportion of GDP[4].

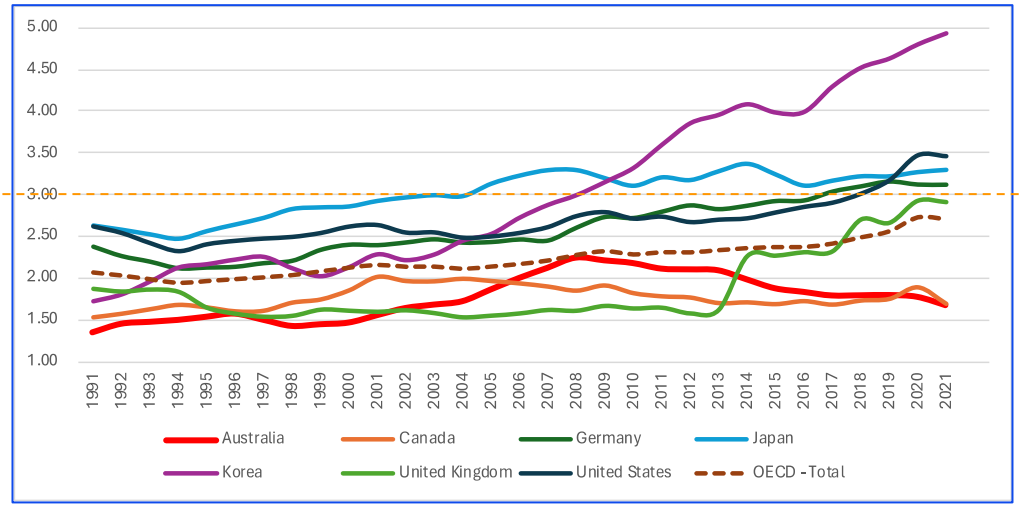
We are a long way off that target, and since 2008 and the Global Financial Crisis (GFC), Australia has been falling further behind relative to what we consider our R&D investing peers, as shown in Figure 1 (red line). In 2021, Australian R&D expenditure as a proportion of GDP stood at 1.68%, a decrease of 0.12% since 2019-20.

This compares with 4.93% in Korea, 3.46% in the USA, 3.13% in Germany, and 3.3% in Japan. The OECD average is 2.72%. The UK has lifted its R&D effort since 2013 and now spends 2.91% of GDP on R&D.

[3] Australian Government, *Australian Universities Accord Final Report*, 2024. https://www.education.gov.au/accord-final-report

[4] The Hon Ed Husic MP, 2022. Speech at the UTS Vice-Chancellor's Innovation Showcase, 3 November 2022, University of Technology Sydney https://www.minister.industry.gov.au/ministers/husic/speeches/speech-uts-vice-chancellors-innovation-showcase

Figure 1: Gross Expenditure on R&D as a percentage of GDP—Australia and peer nations



Source: OECD Dataset: Main Science and Technology Indicators, ABS, Research and Experimental Development, Businesses, Australia, 2021-22, Section on GERD and Gross Domestic Product (GDP).

Most of the countries represented in Figure 1 used the GFC as a call to *step up* their investment in R&D, but Australia did not.

While the 3% target is widely acknowledged internationally, its achievement requires a comprehensive policy framework, collaboration between government, academia, and industry, and a conducive environment for research and innovation to flourish.

For Australia to make the 3% target more than a rhetorical aspiration, serious investments are required by the business and government sectors.

A possible bright light is higher education investment in R&D, where the Australian investment as a proportion of GDP is among the highest in the world. Many have observed that higher education is doing the "heavy lifting" in Australia's national R&D effort, enabled by fees paid by international students and the R&D recorded by overseas PhD and postdoctoral candidates[5].

Others would argue that the higher education sector is not appropriate for leading Australia's transformation from a commodity-based economy to a modern, vibrant, and dynamic industrial ecosystem. It is the business and government sectors that are not pulling their weight. All have distinct but complementary roles in the "triple helix" of business-higher education-government collaboration.

[5] Almost 55% of human resources devoted to R&D (person-years of effort (PYE)) in Higher Education Organisations are PhD students. Source: ABS, 2020 Research and Experimental Development, Higher Education Organisations, Australia, 2020. Only 32% of human resources are academic staff. In 2022, 49.6% of the 47,349 PhD students were from overseas. In Engineering and related technologies, 72.6% were from overseas, and 70.6% in Information Technology were from overseas. Source: https://www.education.gov.au/higher-education-statistics/student-data/selected-higher-education-statistics-2022-student-data, sections 4 and 7.

Why 3%?

The aspiration for countries to allocate 3% of their Gross Domestic Product (GDP) to Research and Development (R&D) expenditure is a widely recognised benchmark and policy goal. This objective is founded on the belief that a higher investment in R&D contributes significantly to economic growth, innovation, and overall competitiveness.

Several reasons support the pursuit of this 3% target:

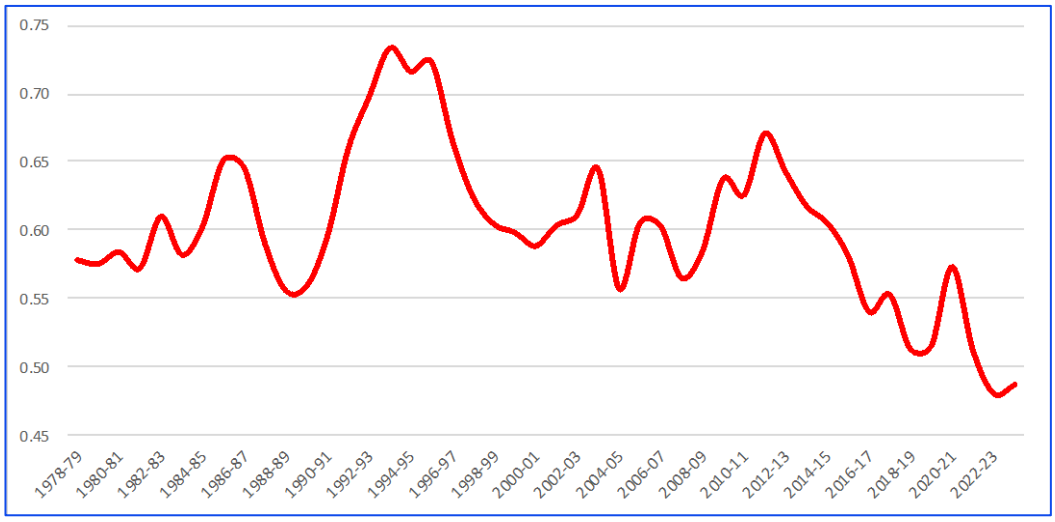
- Innovation and Technological Advancement: Increased R&D spending fosters innovation, leading to the development of new technologies, products, and services. This, in turn, enhances a nation's competitiveness on the global stage.
- Economic Growth and Productivity: R&D investment is linked to economic growth and increased productivity. It fuels the development of cutting-edge technologies, which can have widespread applications across various industries, driving economic expansion.
- Job Creation: A thriving R&D sector generates employment opportunities. The development of new technologies and industries often requires skilled workers, contributing to job creation and economic development.
- Global Competitiveness: Nations with a robust R&D sector are better positioned to compete globally. The 3% target reflects a commitment to staying at the forefront of technological advancements, ensuring that a country remains competitive in the international arena.
- Quality of Research Output: Setting a specific percentage of GDP for R&D encourages countries to focus not only on the quantity but also on the quality of research. This can lead to more impactful discoveries and advancements.
- Scientific and Technological Leadership: Achieving the 3% goal is seen as a pathway to establishing leadership in science and technology. It enables countries to take the lead in critical areas, influencing global standards and developments.
- Addressing Societal Challenges: R&D investment is instrumental in solving pressing societal challenges, such as healthcare, climate change, and energy. The 3% target signals a commitment to leveraging research for the betterment of society.
- Knowledge-Based Economy: Emphasizing R&D expenditure aligns with the transition toward a knowledge-based economy. Countries investing in research and innovation are better positioned to adapt to rapid technological changes and capitalize on intellectual capital.
- Long-Term Economic Resilience: R&D is an investment in the future. Countries allocating 3% of GDP to research are better equipped to navigate economic uncertainties, as innovation becomes a driver of resilience and adaptability.

1 Trends in Australian Government R&D investment

Investment as a proportion of GDP

The *SRI Budget Tables* report that Australian Government Investment in R&D now stands at 0.49% of GDP. It peaked at 0.73% in 1993-94, then trended down and up again to a new peak of 0.67% in 2011-12. It then trended down again to where it is today. The trends are shown in Figure 2.

Figure 2: Total Government Investment in R&D as a proportion of GDP (current prices)



Source: SRI Budget Tables

Research has consistently shown that public (government) investment in R&D generates a large multiplier effect and positively impacts business expenditure on R&D—much greater than the effect produced by generic public expenditures[6]. However, in Australia, that commitment has been allowed to dissipate.

The fall in Government investment in R&D, particularly since 2012-13, is a major contributor to the overall fall in Australia's R&D effort as a proportion of GDP. This downward trend is a serious concern and does not augur well for building strong R&D collaborations among actors in the national innovation system—industry, higher education, government research, and the broader community.

Government-funded research is often expected to take a lead role in—

- Creating and maintaining national scientific research facilities, expensive instruments (analytical, measurement, calibrating), equipment (scale up and testing, for example), and developing treatments for human, animal, and plant diseases.
- Reducing technical uncertainty and risk in adopting and applying new technologies in the industries of the future, including advanced manufacturing, Quantum Information Sciences, AI and Machine Learning, 5G and advanced communication, and biotechnology.
- Updating and extending the stock of useful knowledge underpinning the education and training of the research workforce recruited to work on business R&D projects.
- Solving economic, societal, and environmental problems, mitigating climatic, biological, chemical, and physical risks.

[6] Giovanna Ciaffi, Matteo Deleidi, Mariana Mazzucato, Measuring the macroeconomic responses to public investment in innovation: evidence from OECD countries, *Industrial and Corporate Change*, 2024. https://doi.org/10.1093/icc/dtae005

- Leveraging participation in international R&D networks
- Supporting high-risk early-stage venture capital investment in new technology-based firms.
- Maintaining prescience and preparedness about the future impact of events we may face.

Successive Governments have achieved a great deal in these areas, but much more can be done.

Inflation-adjusted R&D expenditure

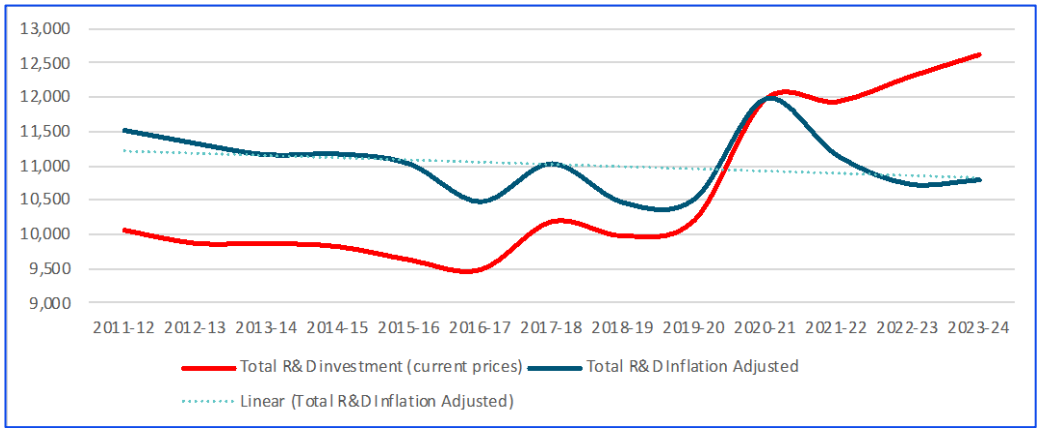
Overall trend

The *SRI Budget Tables* estimate an inflation-adjusted increase in R&D expenditure in 2023-24 of 2.9% (based on 2020-21 dollars). This arises because of the assumption in the Budget that the GDP deflator (generally used to calculate the effect of inflation in the National Accounts) would *fall* by something in the order of 0.25%.

The *Mid-Year Economic and Financial Outlook* (MYEFO), published six months after the Budget, revised the GDP deflator to an *increase of 2.5%* (page 37, Table 2.2). This gives an inflation-adjusted increase of only 0.6% in the Australian Government's 2023-24 R&D investment.

Notwithstanding this marginal increase, there has been a continuous downward trend in inflation-adjusted Government R&D investment since 2011-12—by 6.3% to 2023-24 (Figure 3 below).

Figure 3: Government Investment in R&D ($m, current prices and inflation-adjusted) 2011-12—2023-24



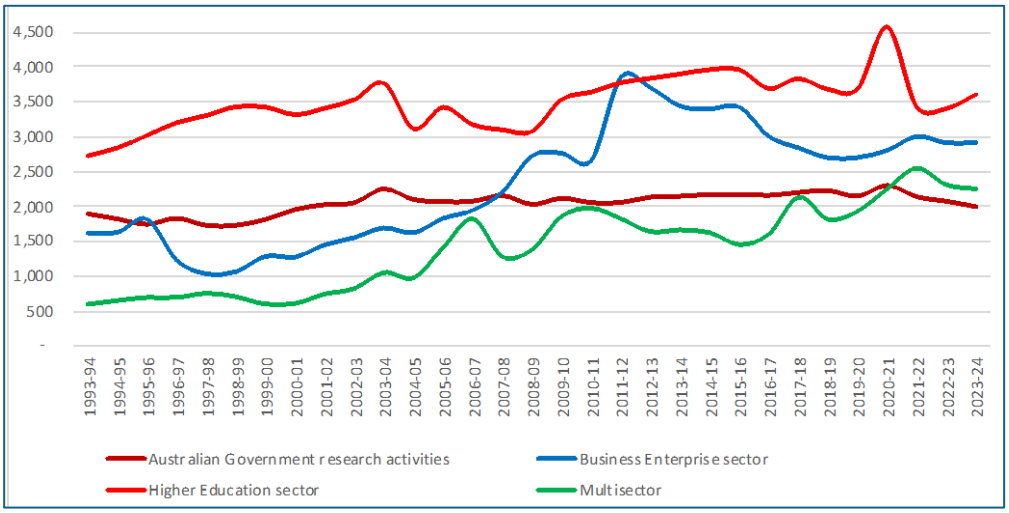
Source: SRI Budget Tables

The spike in 2020-21 is due to the *one-off* COVID-related $2 billion payment to universities under the Research Support Program. However, over the four years since 2020-21, there has been an inflation-adjusted reduction in Government R&D investment of 9.9%.

Investments by sector

The long-term trends in Government inflation-adjusted R&D sectoral investment since 1993-94 are shown in Figure 4.

Figure 4: Australian Government investment in R&D by sector 1993-94 to 2023-24 ($m, inflation-adjusted)



Source: SRI Budget Tables

Figure 4 shows that from 1993-94, there had been a substantial increase in business R&D investment. However, since 2012-13, the level of investment has been falling mainly due to changes in eligibility for the R&D Tax Incentives (RDTI) program. There was some increase from 2021-22, reflecting measures to improve access to the program by small to medium businesses.

Figure 4 also shows wide fluctuations in the level of Government investment in the higher education sector. In 2023-24, the investment will be equivalent to the level reached in 2003-04. Higher Education institutions are deeply concerned about this level of commitment.

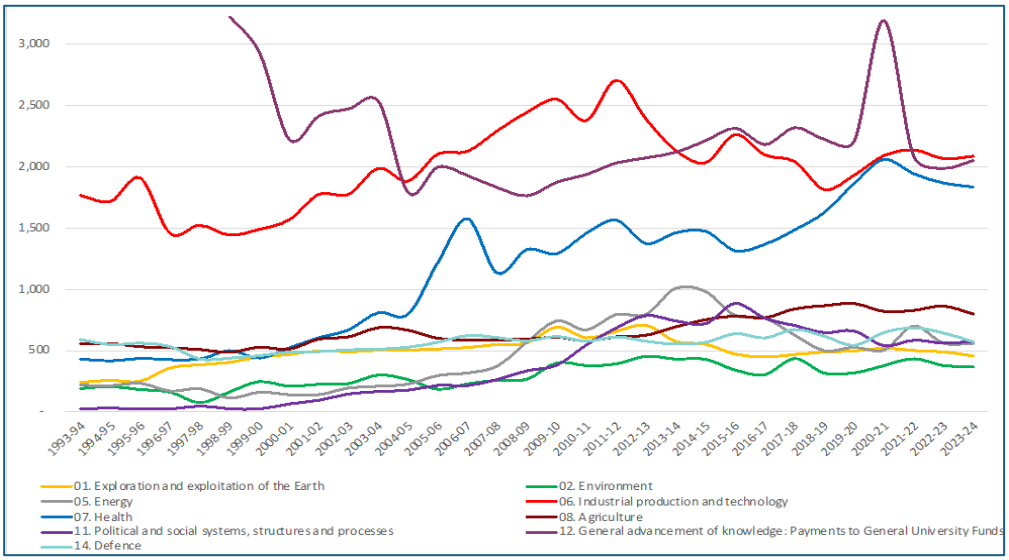
Investment by the Government in its own research activities (principally CSIRO, ANSTO and the DST Group) has barely moved over the period. Internationally, government research institutes and laboratories are important partners in industrial research, as indicated by the 72 Fraunhofer Institutes in Germany and the 42 Government research laboratories in the USA. The Catapult Centres in the UK perform an important role.

There has been a very large increase in what is termed “multi-sector” investment since 2019-20. This covers the NHMRC, the MRFF, the CRCs, Rural R&D, and Energy and Environment investments.

Investments according to socio-economic objective

Substantial investments in health show up in calculations of the Australian government's investment in R&D according to socioeconomic objectives. This is revealed in Figure 5.

Figure 5: Total Australian Government investment in R&D by socioeconomic objective 1993-94 to 2023-24 ($m, inflation-adjusted)



Source: SRI Tables. Smaller SEOs are not included in the Chart.

Figure 5 shows the extent to which Government investment in R&D in 1993-94 was dominated by Industrial production and technology (red line) *until 2011-12* and how investment in Health research (blue line) has increased since 2005-06. By 2021-22, Health R&D was equivalent to Industrial production and technology R&D.

Investments in Political and social systems, structures and processes (purple line) peaked in 2015-16 and have fallen away rapidly since then.

The ups and downs in General University funds, sourced principally from performance-driven block grants (the Research Support program and the Research Training program), are particularly significant in the SEO profile.

.

2 The structural allocation of R&D investment

Section 64 of the Constitution provides that—

> *The Governor-General may appoint officers to administer such departments of State of the Commonwealth as the Governor-General in Council may establish.*
>
> *Such officers shall hold office during the pleasure of the Governor-General. They shall be members of the Federal Executive Council, and shall be the Queen's Ministers of State for the Commonwealth.*

The *Administrative Arrangements Order*[7] (AAO) determines the allocation of responsibilities among Ministers. It specifies the names of departments, the principal matters they deal with, and the legislation administered within each portfolio. A Minister appointed to administer a department is responsible for the performance of functions and duties and the exercise of powers relating to legislation listed in the AAO.

The AAO specifies the following Matters to be dealt with by the Department of Industry, Science and Resources.

THE DEPARTMENT OF INDUSTRY, SCIENCE AND RESOURCES

Matters dealt with by the Department

- Administration of export controls on rough diamonds, uranium and thorium
- Anti-dumping
- Biotechnology, excluding gene technology regulation
- Business entry point management and business services coordination
- Civil space issues Analytical laboratory services Science policy Science engagement and awareness
- Co-ordination of science research policy Commercialisation and utilisation of public sector research
- Co-ordination of supply chain resilience policy
- Collaborative research in science and technology
- Construction industry, excluding workplace relations
- Country of origin labelling
- Critical technology policy development and coordination of information and communications technology industry development
- Economy-wide digital policy and co-ordination
- Enterprise improvement
- Facilitation of the development of service industries generally
- Food and beverage processing industry policy
- Geoscience research and information services including geodesy, mapping, remote sensing, groundwater and spatial data co-ordination
- Industrial research and development, and commercialisation
- International science engagement

[7] Department of Prime Minister and Cabinet, Administrative Arrangements Orders, https://www.pmc.gov.au/government/administration/administrative-arrangements-orders The current Administrative Arrangements order was made on 13 October 2022 (amended 3 August 2023)

- Major projects facilitation
- Manufacturing and commerce including industry and market development
- Marketing of manufacturers and services
- Mineral and energy resources, including oil and gas, extraction and upstream processing
- Minerals and energy resources research, science and technology
- Provision of B2G and G2G authentication services
- Radioactive waste management
- Technology policy, development and diffusion
- Trade marks, plant breeders' rights and patents of inventions and designs
- Weights and measures standards

There are similar lists of "Matters dealt with" for all Departments. The matters dealt with by the Department of Education cover—

- Higher education policy, regulation and programmes
- Policy, coordination and support for international education and research engagement
- Co-ordination of research policy in relation to universities
- Creation and development of research infrastructure
- Research grants and fellowships

The Department of Agriculture, Fisheries and Forestry has specific responsibility for primary industries research, including economic research; The Attorney General's Department for criminology research; DCCEEW for environmental information and research, co-ordination of climate change science activities, and renewable energy technology development; The Defence for defence scientific research and development; The Department of Employment and Workplace Relations for co-ordination of labour market research; The Department of Foreign Affairs and Trade for international agriculture research; The Department of Health and Aged care for health research and ageing research.

A department's responsibilities are executed through a range of policy and program *instruments*, including regulations made under legislation and managing expenditure programs.

During the annual Budget process, Ministers agree, collectively, through Cabinet, the amounts that will be allocated from the Consolidated Revenue Fund to expenditure programs. Subsequently, funding is legislated in the Appropriation Acts. The Annual Budget sets out detailed funding allocations for each department and expenditure program[8].

There is no provision for Ministerial responsibility for expenditure programs to be shared with other Ministers or overseen by a superior body, except in the situation where the previous Prime Minister asked the Governor General to appoint him as Minister to several departments where there was already an incumbent Minister.

In aggregate, the Ministerial "owned" expenditure programs reflect a *de facto* implementation of a science, research, and innovation policy without an overarching strategy. These programs are loosely connected to the Government's nine Science and Research priorities.

Ministers may have a *collective responsibility* when the Cabinet adopts and implements *cross-portfolio* or government-wide strategies.

SRI Investment among portfolios

The SRI Budget Tables show that in 2023-24, the Government's $12.6 billion investment in R&D programs is distributed across 14 (out of 16) government portfolios. However, most investment is made within six portfolios: Industry Science and Resources, Education, Health and Aged Care, Climate Change, Energy,

[8] See for example, Budget 2023-24, Budget Documents https://budget.gov.au/content/documents.htm

the Environment and Water, Defence, and Agriculture. Proportions for each portfolio, together with gains and losses in the 2023-24 Budget, are documented in Table 1.

Table 1: Australian Government investment in R&D by government portfolio

Portfolio	Estimated Actual 2022-23 ($m)	Budget Estimate 2023-24 ($m)	Increase (%)	Percent of Total
Agriculture, Fisheries and Forestry	532.79	469.73	-0.1%	3.7%
Attorney-General's	5.24	4.54	-13.3%	0.0%
Climate Change, Energy, the Environment and Water	679.91	673.14	-1.0%	5.3%
Defence	632.23	561.10	-11.3%	4.4%
Education	3,503.98	3,902.60	11.4%	30.9%
Foreign Affairs and Trade	103.87	116.26	11.9%	0.9%
Health and Aged Care	1,680.01	1,684.30	0.3%	13.4%
Home Affairs	8.61	7.50	-12.9%	0.1%
Industry, Science and Resources	5,036.22	5,081.71	0.9%	40.3%
Infrastructure, Transport, Regional Develt, Comms & Arts	38.95	46.49	19.3%	0.4%
Prime Minister and Cabinet	1.87	2.05	9.5%	0.0%
Social Services	49.33	53.37	8.2%	0.4%
Treasury	1.94	1.98	2.5%	0.0%
Veterans' Affairs	7.45	6.04	-18.9%	0.0%
Total	**12,282.40**	**12,610.80**	**2.7%**	100.0%

Source: SRI Budget Tables

The *SRI Budget Tables* simply report an aggregation and classification of the expenditure decisions made on a portfolio-by-portfolio basis through the Budget processes.

There are no formal arrangements for science, research and innovation policy coordination and collaboration across these portfolios, such as through a Science, Research, and Innovation Committee of Cabinet. Industry, Innovation and Science Australia does not have that role. The National Science and Technology Council is an advisory body only. This process differs from other countries with National Science/Research Foundations, such as the US, Germany, and Korea.

In 2023-24, the Education portfolio was a clear winner in this resource allocation framework, with budgeted expenditures up 11.4% on $3.5 billion in 2022-23. The Industry, Science, and Resources portfolio had a small increase of 0.9% on $5.1 billion, and the Health portfolio secured a marginal increase of 0.3% on $1.7 billion. Defence was a significant loser, with a reduction of 11.1% on an expenditure of $632m in 2022-23. Other portfolios had gains and losses, but the amounts were relatively small.

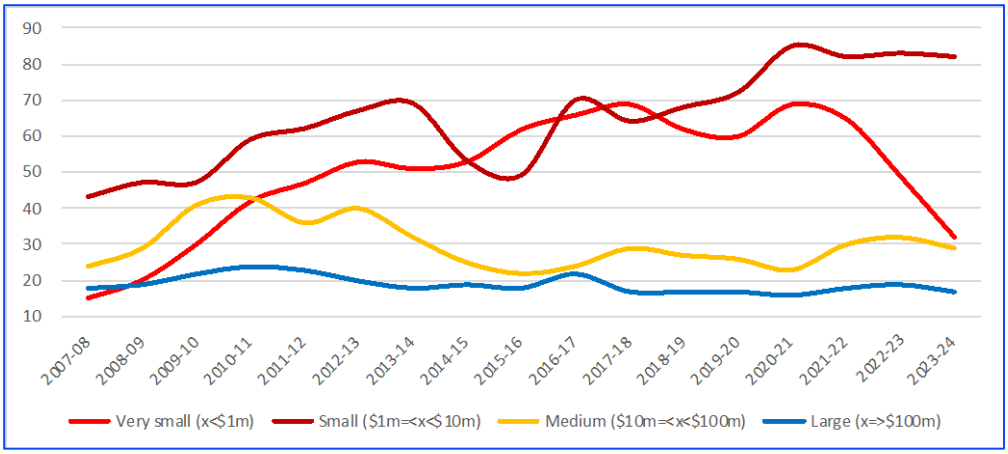
Frequent machinery of government changes and reallocation of ministerial responsibilities have introduced substantial instability into the system. *Fourteen* Ministers have had portfolio responsibilities for industry, science, and innovation functions since 2008[9]. Program responsibilities have been shuffled between portfolios—particularly between Industry and Education. Newly appointed Ministers have different priorities impacting program design, continuity, and funding commitment.

Investment among programs

The *Science Research and Innovation (SRI) Budget Tables* show that in 2023-24, the Government will be delivering 160 R&D programs. This is down from the 182 reached in 2016-17. Longer-term trends in the number of programs are shown in Figure 6.

[9] The Ministers were Kim Carr (twice), Greg Combet, Chris Evans, Chris Bowen, Craig Emerson, Ian Macfarlane, Christopher Pyne, Greg Hunt, Arthur Sinodinos, Karen Andrews, Christian Porter, Angus Taylor, Melissa Price, and Scott Morrison.

Figure 6: Count of Government R&D programs/activities (number)



Source: SRI Budget Tables

The *SRI Tables* also report that in 2023-24, the proportion of large programs accounted for 90% of total investment, the medium ones seven per cent, the small ones three per cent and the very small ones only 0.2%.

Within this overabundance of programs, the *SRI Budget Tables* indicate what would appear to be a very uneven distribution of resources among investment priorities, with some showing very substantial increases in 2023-24. The distribution of investment in programs is shown in Table 1. Also shown is the proportion of each program in the total investment.

Table 2: Australian Government R&D programs and activities valued at over $100 million in 2022-23 to 2023-24 ($m current prices)

Program / Activity	Estimated Actual 2022-23	Budget Estimate 2023-24	Increase 2022-23 to 2023-24	Percent of Total 2023-24
Research Tax Incentives	3,276	3,365	2.7%	26.7%
University Block Grants	2,044	2,160	5.7%	17.1%
CSIRO	991	1,009	1.8%	8.0%
NHMRC Research Grants	898	946	5.3%	7.5%
Australian Research Council (ARC) - National Competitive Grants	832	900	8.2%	7.1%
Medical Research Future Fund	598	650	8.7%	5.2%
Defence Science and Technology Group (DST Group)	513	483	-5.7%	3.8%
National Collaborative Research Infrastructure Strategy	286	402	40.6%	3.2%
Australian Renewable Energy Agency (ARENA)	312	319	2.2%	2.5%
Australian Nuclear Science & Technology Organisation (ANSTO)	264	267	1.0%	2.1%
National Institutes Program - ANU Component	217	229	5.7%	1.8%
Cooperative Research Centres (CRC) Program	199	201	0.6%	1.6%
Australian Antarctic Division	207	192	-7.0%	1.5%
Australian Centre for International Agricultural Research (ACIAR)	102	113	10.6%	0.9%
Meat and Livestock Australia Limited	98	104	6.0%	0.8%
Australia's Economic Accelerator	10	100		0.8%
Total over $100m	10,848	11,439	5.5%	90.7%
Other programs	1,435	1,172	-18.3%	9.3%
Total	12,282	12,611	2.7%	100.0%

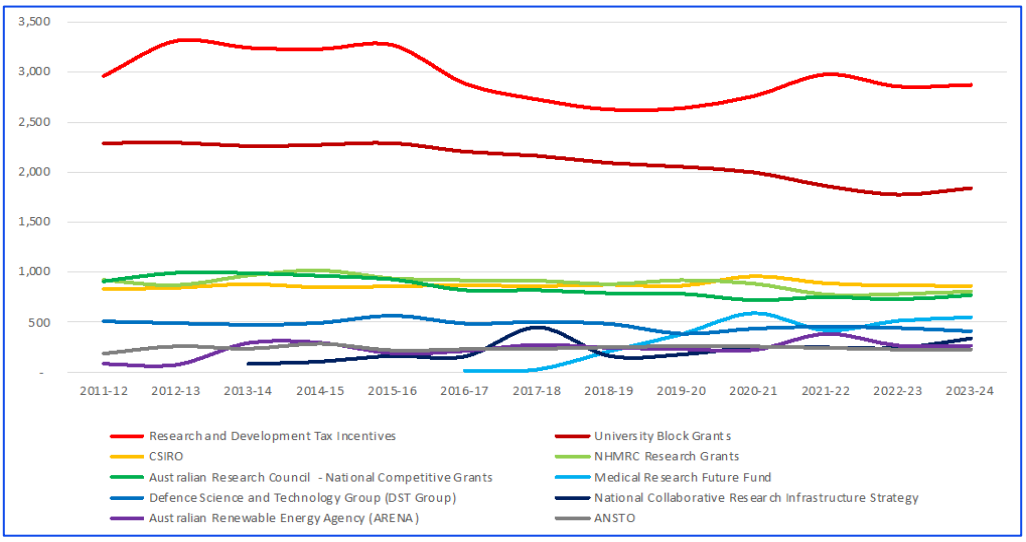
Source: SRI Budget Tables.

The *SRI Budget Tables* report that 173 of the 602 programs (29%) meet at least one of the nine Science and Research priorities: Seventy-three meet two or more—Food (14 programs), Soil and Water (50), Transport (13), Cybersecurity (9), Energy (28), Resources (31), Advanced Manufacturing (21), Environmental Change (61) and Health (22). Six programs meet all nine—including the ARC, CSIRO, the CRC program, and the Research and Development Tax Incentive (RDTI).

The largest 10 of the R&D programs in Table 1 comprise over 83% of the total investment. The longer-term trends in these programs are shown in Figure 7 below. The R&D Tax Incentives have continued to

dominate the distribution of investment and are virtually the same in 2023-24 as in 2011-12. Payments had been trending down from 2013-14 following changes in eligibility arrangements but started trending up from 2020-21 with new arrangements that expanded access to SMEs.

Figure 7: Australian Government R&D programs and activities valued at over $100 million in 2023 24 the ten largest programs—trend from 2011-12, ($m inflation-adjusted)



Source: SRI Budget Tables.

Investments in university block grants have also been trending downwards and have effectively "made room" for the Medical Research Future Fund and the Australian Renewable Energy Agency (ARENA).

Socio-economic (SEO) investments in major programs

The *SRI Budget Tables* provide detailed information about the allocation of R&D investment according to socio-economic objectives for several of the large programs listed in Table 2 above. Trends are shown from 2007-08, the onset of the Global Financial Crisis (GFC) and the collapse of business expenditure on R&D.

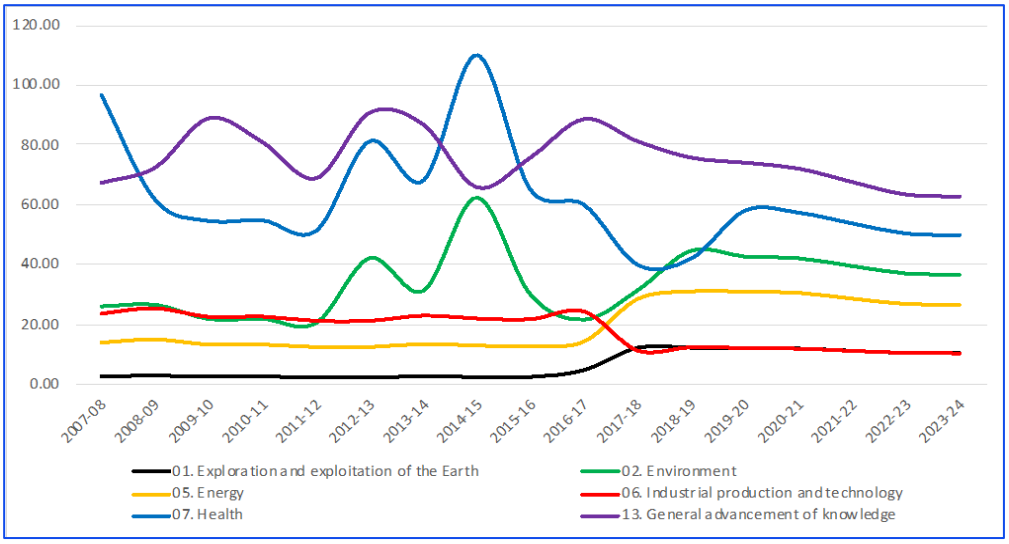
These allocation investment decisions reflect decisions made by Ministers, program advisory councils, and the management of each organisation, and in this way, become embedded in the *de facto* Science, Research and Innovation policy referred to on page 9 above.

In some cases, such as the current Research and Tax Incentive (see page 16 below), the allocations are *demand*-driven by program applicants. In other situations, such as the ARC and the Health programs, allocations are also application-driven, although guided by internal processes and grant criteria.

Australian Nuclear Science & Technology Organisation (ANSTO)

The SRI Budget Tables reveal that over the period 200-08 to 2023-24, the inflation-adjusted Budget allocation to ANSTO (base year 2020-21) fell by 6.4%. The trends in investment over the period are shown in Figure 8.

Figure 8: Investment in R&D by SEO for ANSTO, 2007-08 to 2023-24, ($m inflation-adjusted)



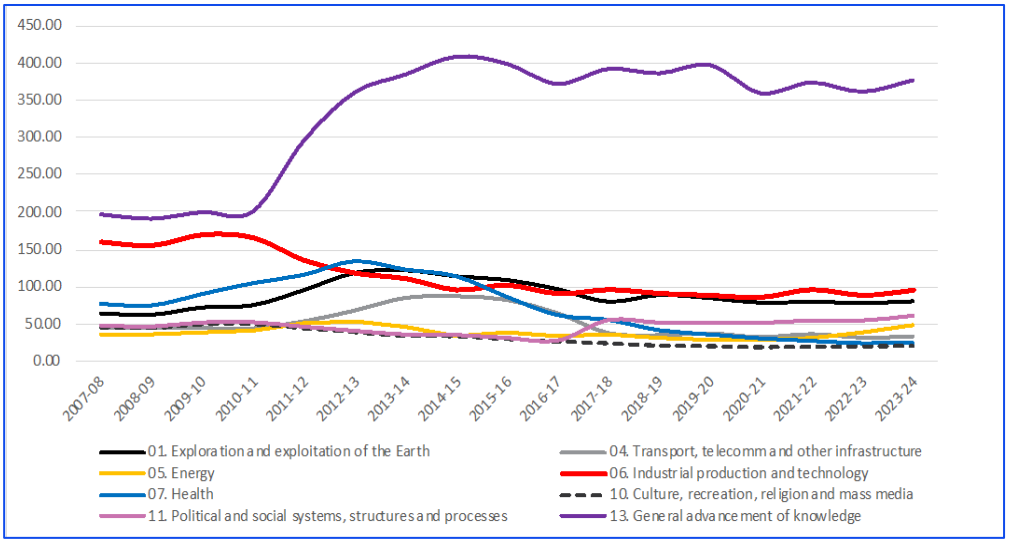
Source: SRI Budget Tables.

Figure 8 reveals that the largest proportion of ANSTO expenditure is for General advancement of knowledge. Over the years, only a small amount has been allocated to Industrial production and technology. This has fallen further since 2016-17.

Australian Research Council (ARC)

Over the period 2007-08 to 2023-24, the inflation-adjusted payments to the ARC have increased by 2.2%. Investment trends are shown in Figure 9.

Figure 9: Investment in R&D by SEO for the ARC, 2007-08 to 2023-24 ($m inflation-adjusted)



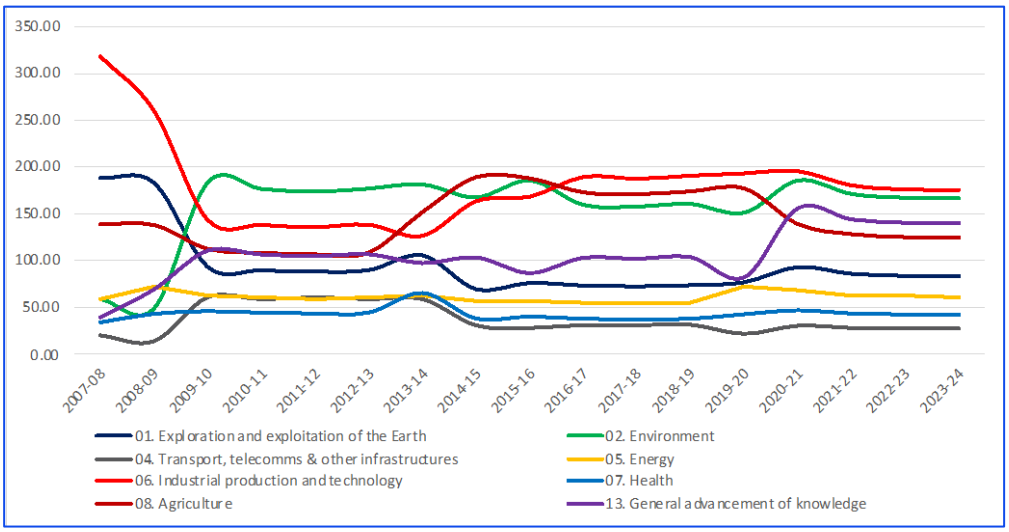
Source: SRI Budget Tables.

Figure 9 reveals that the greater part of ARC expenditure is for General advancement of knowledge, increasing substantially from 2011-12. The commitment to Industrial production and technology has fallen considerably since that year.

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Over the period 2007-08 to 2023-24, the inflation-adjusted investment in CSIRO decreased by 0.9%. The changing distribution of investment is shown in Figure 10.

Figure 10: Investment in R&D by SEO for CSIRO, 2007-08 to 2023-24, ($m inflation-adjusted)



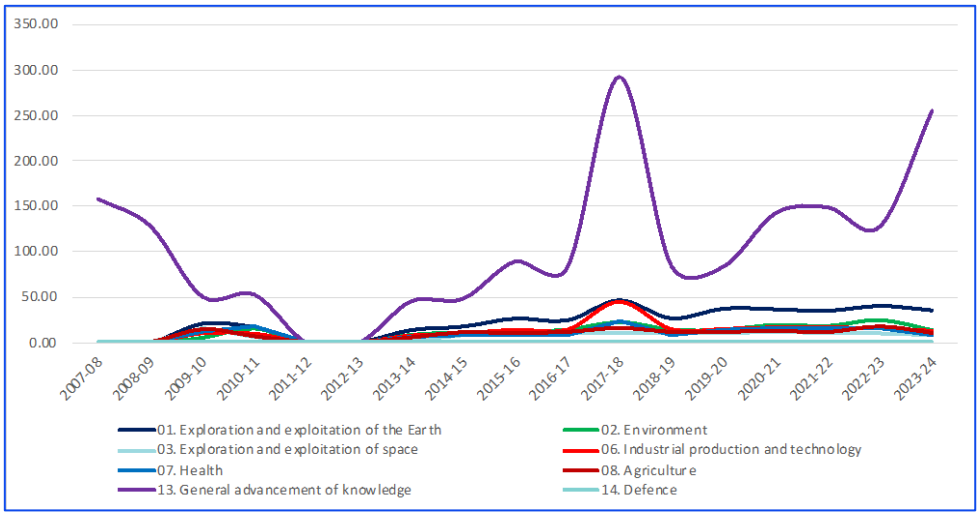
Source: SRI Budget Tables.

Figure 10 shows that the commitment to Industrial production and technology had fallen quite rapidly since 2007-08, although it started to recover in 2014-15. Investments in other areas have fluctuated widely.

National Collaborative Research Infrastructure Strategy (NCRIS)

The Government's inflation-adjusted investment commitments to NCRIS have increased by 177.3% since 2007-08, although there have been significant fluctuations over the period, as illustrated in Figure 11.

Figure 11: Investment in R&D by SEO for NCRIS, 2007-08 to 2023-24, ($m inflation-adjusted)



Source: SRI Budget Tables.

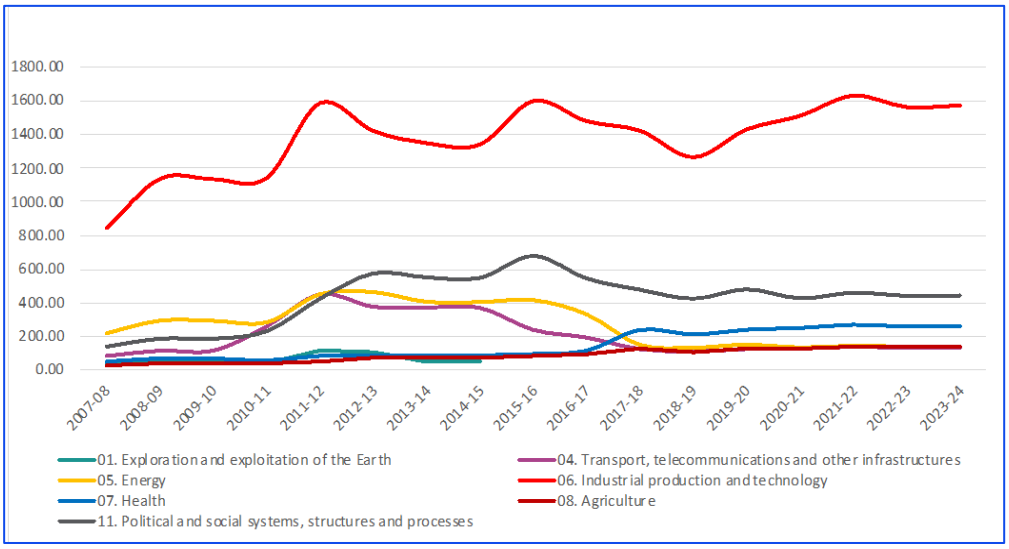
The investment commitment increased substantially between 2016-17 and 2017-18, the period of the National Innovation and Science Agenda. The commitment also increased substantially in the 2023-24 Budget.

Investments have been classified principally as General advancement of knowledge.

R&D Tax Measures

Between 2007-08 and 2023-24, the inflation-adjusted investment in R&D Tax Measures has increased by 77.3%. The Increase has been predominantly in Industrial production and technology, as shown in Figure 12.

Figure 12: Investment in R&D by SEO for R&D Tax Measures, 2007-08 to 2023-24, ($m inflation-adjusted)



Source: SRI Budget Tables.

Figure 12 also shows significant fluctuations in other investment areas, including Political and social systems, structures and processes, Energy, and Health.

As indicated earlier, these investments are *demand-driven,* with the program guidelines being agnostic about the sector where the investments are made[10].

Distribution by program lifespan

Just under half of the current R&D programs have been operating between one and four years.

The *SRI Budget Tables* report that in 2023-24, of the 602 programs/activities contained in the R&D database—

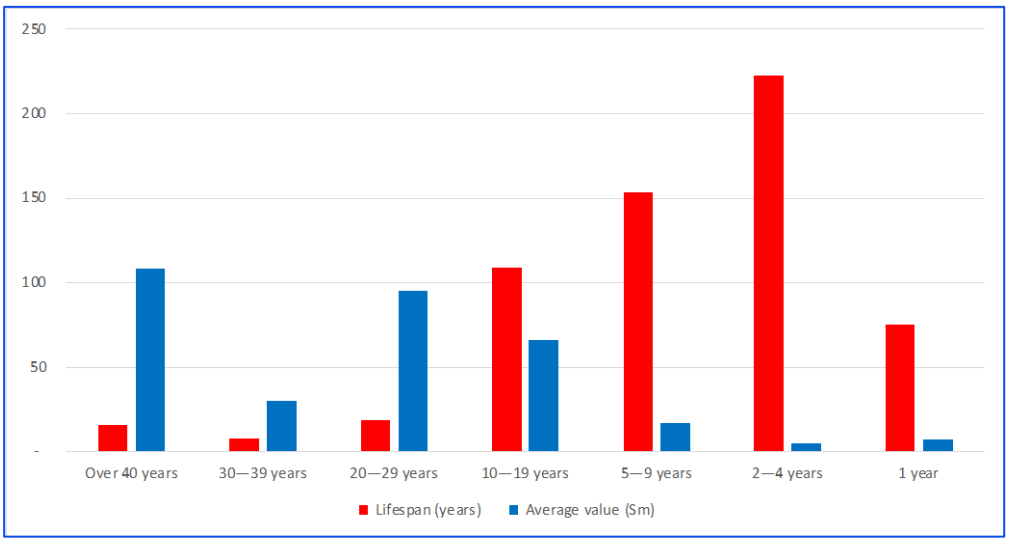
- 16 (2.7%) have been present for over 40 years. They include CSIRO, NHMRC grants, ANSTO, DST Group, GRDC, the Antarctic Division, and the National Institutes Program at the ANU.
- 8 (1.3%) have lasted between 30 and 39 years, including the CRC program, Horticulture Research, Meat Research (ceased 2015-16), RIRDC (Agrifutures), Land and Water Research (ceased 2009-10) and the former 125% R&D Tax Concession.
- 19 (3.2%) have operated between 20 and 29 years, including the ARC, the ACIAR, the Institute of Criminology and NCRIS. Seven of those 19 programs are no longer operating.
- 109 (18.1%) have lasted between 10 and 19 years, including the RDTI, the university Research Training and Research Support Programs and the MRFF. Just under half of the programs in this grouping no longer operate due to the termination of funding agreements, absorption into other programs, or budget decisions not to continue.
- 153 (25.4%) programs have operated between 5 and nine years
- 222 (36.9%) have operated between two and four years

[10] See Howard, J, January 2024, Taxation deductions available for R&D expenditure in Australia: Past and present, paper no: Policy Brief 1 /2024

- 75 (12.5%) were in existence for one year. These later programs are predominantly for one-off payments.

A profile of the life span of programs/activities and the average value in each category is provided in Figure 13.

Figure 13: The comparative lifespan of R&D investment programs



Source: SRI Budget Tables

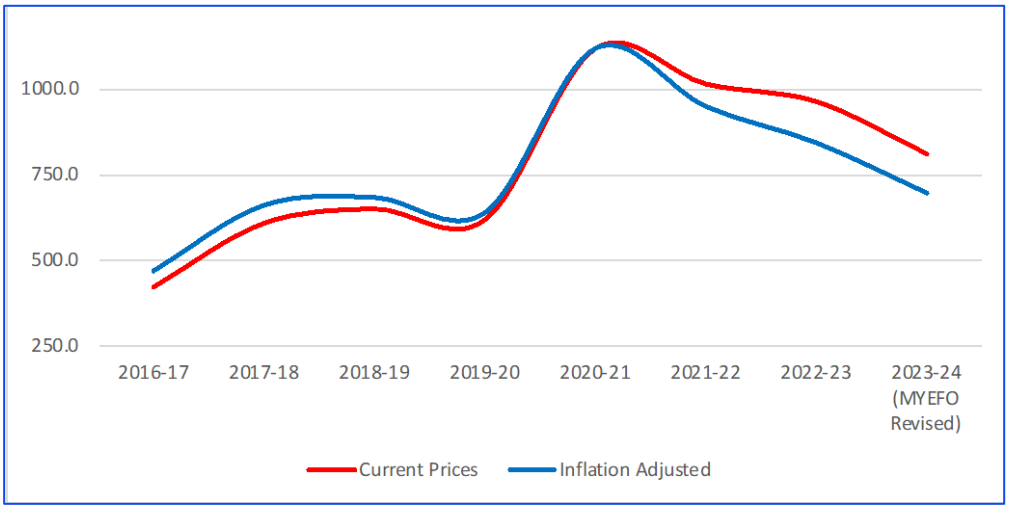
Figure 13 indicates several programs are firmly embedded in the profile of R&D investment. However, there has been a transitory element of small, short-term activities.

Investment trends in other SRI programs

An important component of the *SRI Budget Tables* is investment in *Other (non-R&D)* programs. These include the Industry Growth program, the Moon to Mars initiative, the Business Research and Innovation Program, Questacon, and the previous Entrepreneurs program. It does not include estimates of expenditures or loans relating to the National Reconstruction Fund. Geoscience Australia was added to the tabulation in 2021-22.

Total investment peaked in 2020-21. Trends are shown in **Error! Not a valid bookmark self-reference.**.

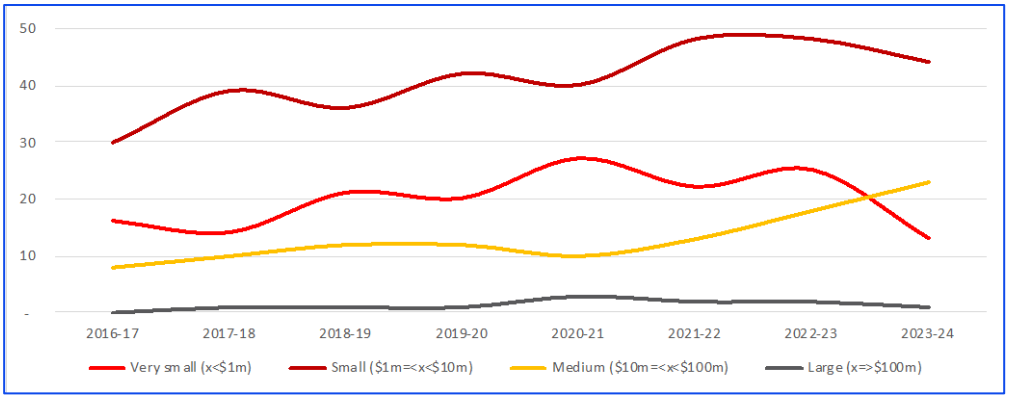
Figure 14: Investment Other SRI Programs 2016-17—2023-24. $m (current prices, inflation-adjusted)



Source: SRI Budget Tables; Includes Geoscience Australia expenditure of $218.3m 2021-22, $279.6m in 2022-23, and $289.5m in 2023-24

The SRI data indicates that there has been an increase in the number of *Other (non-R&D)* programs—from 54 in 2016-17 to 81 in 2023-24. The trends since 2016-17 are illustrated in Figure 15.

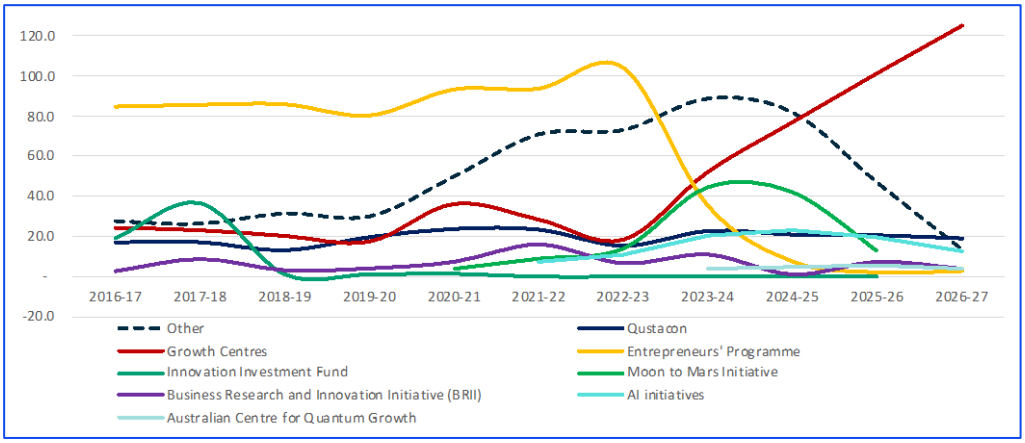
Figure 15: Count of Other Innovation programs/activities (number)



Source: SRI Budget Tables

These numbers have been impacted by the shuffling of the funding deck and the loss of a few cards since NISA in 2016. As we all know, there was no new funding for NISA, and there hasn't been for the latest iteration of the Industry Growth Program. Trends in program expenditures are shown in Figure 16.

Figure 16: Trends in program items in Other SRI Programs $m (current prices)

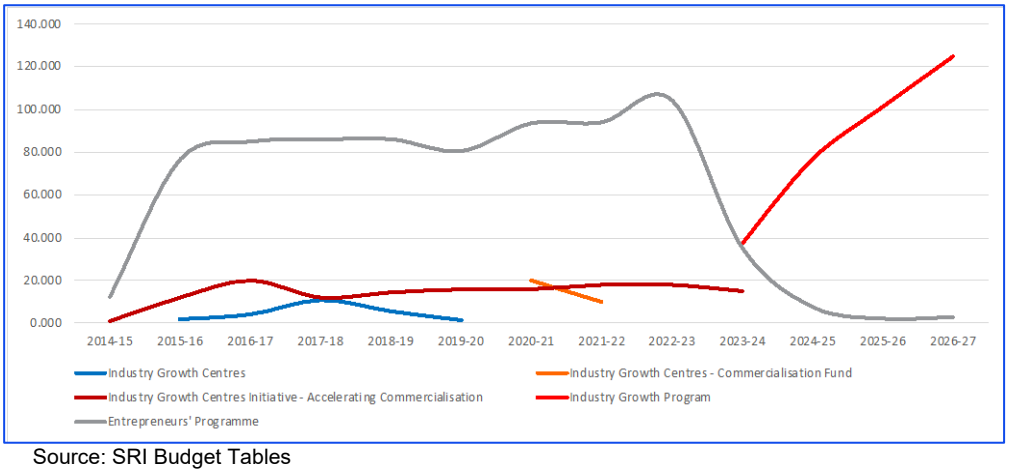


Source SRI Tables. This does not include Geoscience Australia's expenditure of $218.3m in 2021-22, $279.6m in 2022-23, $289.5m in 2023-24, $ 264.5m in 2024-25, $272.7m in 2025-26, and $346.7m in 2026-27.

Included in the Other Category are relatively small amounts for: Automotive Innovation Lab Access Grants, Boosting Female Founders Initiative, Cyber Security Skills Business Connect and Protect, Daintree Microgrid Program, Data Integration Partnership for Australia, Digital Careers, Digital Directors, Digital Skills Finder Platform, Empowering Business to Go Digital ,Industry 4.0 Testlabs for Australia, Industry Innovation and Science Australia (IISA) Board, Inspiring Australia | Science Engagement Programme, International Science Council Asia Pacific Regional Office Program, International Space Investment Initiative, Local Industry Grants - Flinder's University Factory of the Future, National Quantum Strategy ($28m over 4 years), the National Science and Technology Council, Open Geocoded National Address File, Protecting Australia's National Interest in Critical ad Emerging Technologies Standards, Resources Methane Abatement Fund, Soil Carbon Measurement Innovation Challenge, Space Infrastructure Fund, Using blockchain technology to reduce business compliance costs, and Women in STEM initiatives.

Commitment to industry growth programs has been particularly unstable, as indicated in Figure 17.

Figure 17: Investment commitment to growth programs 2014-15—2026-27 $m (current prices)



Source: SRI Budget Tables

3 Tourism or Technology: Where to from here?

Should the expenditure trends described in this Paper continue, and in the knowledge of the complementarity of government and business research investment, the 3% target would appear to be a little more than a rhetorical ambition.

Substantial increases in both public and business investment in R&D are required to reach 3% of GDP. Continuing to rely on universities through their international student fee income and overseas PhD students as the major component of national R&D investment is very high risk in the intensely competitive global higher education market and unlikely to deliver the 3% outcome. It is even more risky as governments impose tighter visa requirements[11].

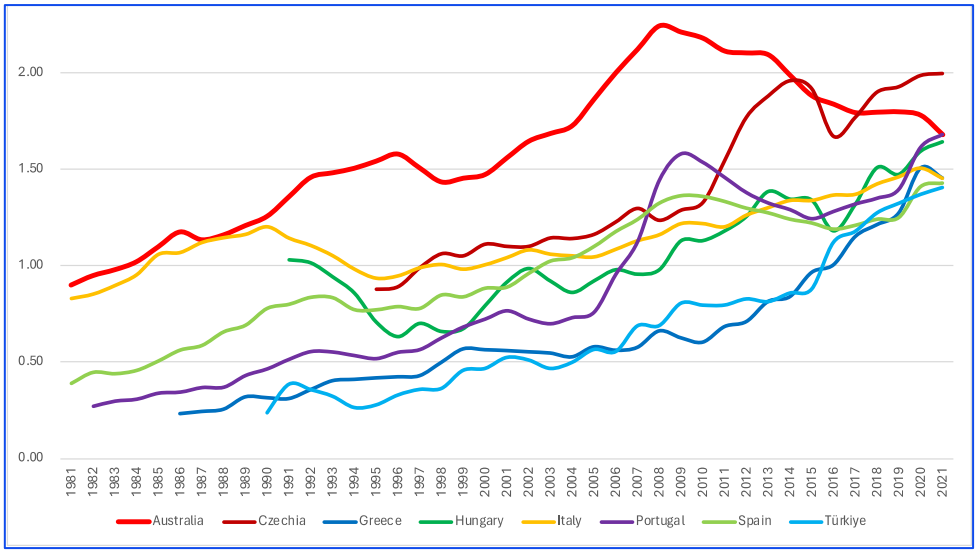
Tourism—the easy pathway to growth

Growing the tourism industry is a high priority for the Australian and state/territory governments and is driven hard by the tourism operators and lobbies, and the higher education sector. Governments provide extensive support for the industry through various subsidies, infrastructure and facilities development, and fast-track development approvals.

Tourism, including educational tourism, is a significant contributor to the Australian economy and accounted for 2.5% of GDP in 2022-23, below the pre-COVID level of 3.1%[12]. Deloitte has reported that tourism accounts for nearly 15% of total exports[13].

Based on trends in the OECD data (Figure 18), Australia is heading into the league of the European tourism, sport, and entertainment-driven economies. This is suggested in the trends indicated in Figure 18.

Figure 18: Gross Expenditure on R&D as a percentage of GDP: Australia and European tourism-oriented nations, 1981-2021



Source: OECD Dataset: Main Science and Technology Indicators

[11] Hans de Wit and Philip G Altbach, 2024. "Chaos as headwinds hit international student recruitment", *University World News*, 20 Feb 2024. https://www.universityworldnews.com/post.php?story=20240220125648569

[12] ABS, 2023. *Australian National Accounts: Tourism Satellite Account.* https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-tourism-satellite-account/latest-release#:~:text=Data%20downloads-,Key%20statistics,%2D19%20level%20of%203.1%25.

[13] Deloitte, 2021. *The Value of Tourism: Exploring the challenges and optimism of Australian tourism as it embarks on the recovery journey. https://www.deloitte.com/au/en/services/economics/perspectives/value-of-tourism.html*

However, Figure 13 also suggests that many historically tourism-oriented countries (or countries devasted by war) have committed to increasing their R&D investment—albeit from a very low base. Australia, Spain, and Portugal are distinguished in the grouping as the only countries that reduced their R&D commitment from 2008. Turkiye's commitment to R&D since 2005 and Czechia's from 2011 is particularly impressive. *Horizon Europe* funds have been important in driving these changes[14].

The legacy of tourism in Australia's industrial policy is indicated by its placement alongside industry and science functions, such as the Minister for Industry, Science and *Tourism* (John Moore, March 1996—October 1998, which was associated with a *substantial decline* in R&D as a percentage of GDP (Figure 18). Nick Minchin was the Minister for Industry, Science and Resources from 1998 to 2001, but the situation did not improve.

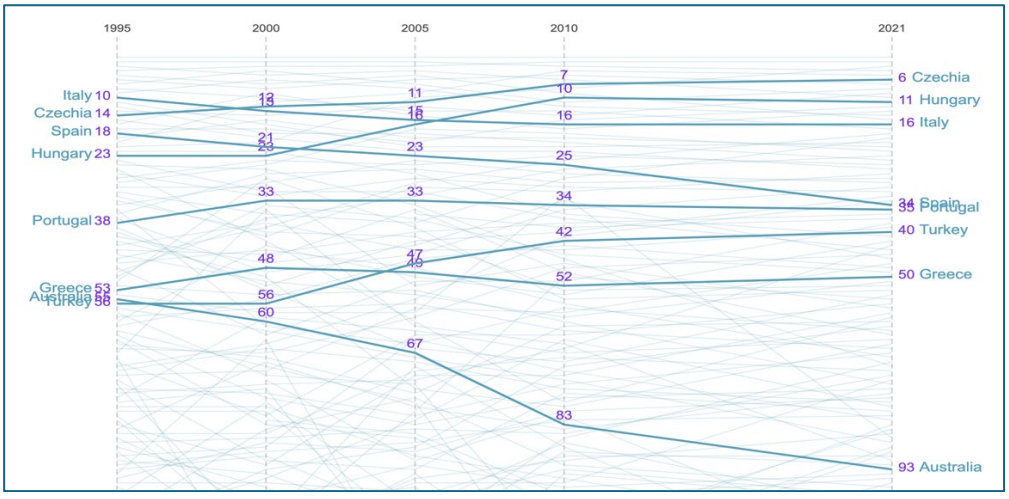
Ian McFarlane was Minister for Industry, *Tourism* and Resources (2001-2007), which was associated with a substantial increase in R&D as a percentage of GDP—principally in the mining sector. In 2008, after the government change and the GFC's onset, Gross Expenditure on R&D as a proportion of GDP collapsed. That year also marked the beginning of a period of sustained political instability, badly impacting the business investment climate. Unlike overseas governments, Australia did not prioritise R&D investment as a response to the GFC.

The current Minister for Trade *and Tourism* (The Hon. Don Farrell MP) is the 6th in seniority in the Albanese Cabinet; the Minister for Industry and Science (The Hon. Ed Husic MP) is 22nd out of 23[15].

Perhaps Australians and many of our political leaders are comfortable with this. However, tourism is unlikely to be a sustainable pathway to economic prosperity, social cohesion, higher living standards, and social equity, particularly with the limitations on economic development posed by Australia's narrow trade and industrial structure[16].

Australia's place at number 93 on the *Harvard Atlas of Economic Complexity*, measuring the diversity and research intensity of our export mix, has been widely noted[17]. Figure 19 shows how far Australia's economic complexity ranking has deteriorated in comparison to what we often perceive as the European tourism-oriented nations.

Figure 19: Australia's Economic Complexity Ranking compared to European tourism-oriented nations



Source: Harvard Atlas of Economic Complexity. https://atlas.cid.harvard.edu/rankings

[14] See https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

[15] *Current Ministry List*, https://www.aph.gov.au/about_parliament/parliamentary_departments/parliamentary_library/parliamentary_handbook/current_ministry_list

[16] At the same time, tourism is becoming increasingly technology-intensive, with smart hotels, AR/VR experiences, contactless solutions, AI-powered personalisation and a revolution in the integration of back-office booking, reservation, and pricing systems. This calls for high-level skills in software engineering, AI, visualisation, biometrics, and AR/VR

[17] https://atlas.cid.harvard.edu/rankings

Australia also ranks poorly in the Location Quotient (LQ)—an international benchmark indicator of industries' share of the economy compared to its share of the global economy. Robert Atkinson and Roy Green reported in April 2023—

> *In 1995, Australia's advanced industries' LQ was 0.56, meaning it had 44 per cent less advanced industry production as a share of its economy than the world. But by 2018, its LQ had fallen to 0.41, ranking 51st of 74 nations, just ahead of Costa Rica and behind Iceland. To compare, America's LQ is 0.94, China's 1.34, and Germany's 1.74. Even the UK and Canada, which have also deindustrialised, lead Australia with 0.80 and 0.60 scores*[18].

Atkinson and Green raised the question about how to reverse the slide towards a third-world natural resources, tourism, and international student-driven economy. They pointed to three initiatives, all of which rested on the need to lift R&D investment and how it is allocated.

The R&D imperative

In contrast to tourism, the Manufacturing industry currently contributes 5.7% to GDP but only 7.4% to exports[19]. To secure its transformation and growth and a place in the global competitive environment, the industry requires substantial investment in R&D. But apart from the support that flows through the R&D Tax Incentive, the level of support is minimal.

Substantial investments by government and business are required to leapfrog into the future: digital infrastructure, AI and machine learning, robotics, virtual and augmented reality, cyber security, and green technologies. Commitments are being made, but progress is serpentine. A sense of urgency is absent.

The current Minister now assures us that the Government is investing in priority industries supporting an uplift in R&D over the longer term, including the National Reconstruction Fund, the Industry Growth Program, and the National Quantum Strategy. These are *innovation* programs with strong diffusion and commercialisation objectives, not R&D delivery. Nonetheless, these programs will require strong R&D capability to draw upon to succeed.

Lifting R&D is not a matter of trying to shift existing funding allocations from one portfolio to another. It requires genuinely new and sustained public and private investment commitment of all Ministers and business leaders to see what is at stake.

These are matters for the Prime Minister to take the lead, with the support of his Cabinet colleagues, through a Cabinet subcommittee. But suggestions often miss the mark, overlooking the realities of constitutionally determined institutional settings.

Current Vice-Chancellor and former Chair of the Australian Research Council, Professor Margaret Shiel, observed in a recent opinion piece that the whole-of-government coordination of science and research effort is not addressed by the structure of the proposed Australian Tertiary Education Commission (whatever its final form)[20]. Professor Sheil added—

> *To achieve that goal we need not only a comprehensive review (Recommendation 24) but arguably a new mechanism that addresses and strengthens cross-portfolio co-ordination without the need for structural reform.*
>
> *For example, a ministerial research council could be convened that comprises the ministers with responsibility for significant science and research activities – education, science, health, defence, industry, environment, agriculture, energy and climate change, and foreign affairs.*
>
> *It would be supported by a standing inter-agency committee of their secretaries and the relevant agency heads within those portfolios – for example, the ARC, the National Health and Medical Research Council, the CSIRO, the Australian Institute of Marine Science, the Defence Science and Technology Group, the Australian Antarctic Division, et cetera – and an advisory group of representative peak bodies such as the learned academies, Universities Australia, Science and Technology Australia, Co-operative Research Australia,*

[18] "Can Australia catch up in the race for advanced industries?" InnovationAus, Sourced from Inf*ormation Technology and Innovation Foundation, The Hamilton Index of Advanced-Industry Performance*: Data Visualisation Tool, https://itif.org/publications/2022/06/08/hamilton-index-of-advanced-industry-performance/

[19] Reserve Bank of Australia,2024. Composition of the Australian Economy SNAPSHOT. https://www.rba.gov.au/education/resources/snapshots/economy-composition-snapshot/#:~:text=Mining%2014.3%25%2C%20Finance%207.4%25,5.7%25%2C%20Construction%207.1%25.

[20] Shiel, Margaret, 2004. "A note of caution on the Universities Accord's approach to research policy", The Australian, March 7 2004. https://www.theaustralian.com.au/higher-education/a-note-of-caution-on-the-universities-accords-approach-to-research-policy/news-story/8519d46a31971abcfafa8f326eb06119

and so on. There are precedents such as the Council for International Education and earlier versions of the Prime Minister's Science, Engineering and Innovation Council that can demonstrate the effectiveness of such bodies when officials work together on complex cross-portfolio issues.

The Business Council of Australia, the Australian Investment Council, and other financial institutions must be seriously on board as part of a national joined-up strategy. It cannot be a lobbying exercise to be orchestrated by the broad-based industry associations whose major purpose is to extract favour, concessions, and subsidies from the Government. State/Territory Governments with significant R&D investment programs should also be involved.

We can no longer rely on the "bottom-up" aggregation of the decisions and submissions of six (and possibly 14) individual Ministers and their portfolio advisers to "coordinate" Australia's science, research, and innovation investment policy.

There must be "top-down" leadership in policy direction and resource allocation, as seen in several of our "peer" countries—for example, Germany, Israel, Korea, and the USA – combined with a national network of place-based innovation ecosystems. Their success is based on the engagement of large global knowledge-driven companies, local SME supply chains, universities, and public research institutions.