



Australian Academy of Science

SUBMISSION TO THE

2016-17 FEDERAL BUDGET

FROM THE AUSTRALIAN ACADEMY OF SCIENCE / FEBRUARY 2016

OVERVIEW

The Australian Academy of Science welcomes the opportunity to make a submission in advance of the 2016-17 Federal Budget. This submission is made in the context of the Government's welcome announcement of the National Innovation and Science Agenda and its renewed focus on science and innovation as drivers of long-term economic growth.

Economic importance of science and research

In framing the 2016-17 Budget, the Academy urges the Government to consider the improvements in future prosperity that investment in science, research and innovation will bring. A [recent report](#) commissioned by the Australian Academy of Science and the Australian Chief Scientist shows that global advances in physical and biological sciences over the past 20-30 years **directly and indirectly underpin 25.5% of Australia's economic output**. While Australian science is responsible for only a small proportion of these global scientific advances; our domestic science capacity is critical for:

- understanding and finding solutions to Australia's unique needs and challenges;
- adapting international scientific advances for application in Australia;
- gaining timely access to international advances in science as a contributor to the global scientific enterprise.

A time for stability

The Academy welcomes the additional investment into science and research foreshadowed in the National Innovation and Science Agenda, and urges the Government to provide a **stable policy and funding environment** to allow these new initiatives to gain traction and deliver their intended outcomes. Reforms to the funding of university research will present challenges for researchers and university administrators, and ongoing variability in policy or funding will further undermine confidence and limit the success of these initiatives in a stressed research system. The Academy also urges the Government to **protect Australia's future competitive advantage** in science and innovation **by maintaining adequate education and research funding**.

PROMOTING AND ENHANCING AUSTRALIAN INNOVATION

The Academy's enclosed policy statement, *Science Priorities for Australian Innovation*, suggests three priorities and seven objectives for enhancing Australia's performance in science, research and innovation, for the economic and social benefit of the Australian community, and is provided to Government for consideration in the Budget development process.

In this context the Australian Academy of Science recommends consideration of two specific budget measures:

School science and maths education

1. **\$10 million over four years to provide pre-service and in-service professional learning for maths and science education in indigenous communities, disadvantaged, regional and remote schools.** This level of funding would allow delivery of professional learning opportunities to over 5,000 primary and secondary teachers in the areas of highest need, helping to reduce disparity in education outcomes and, over the longer-term, helping to close the gap in social and economic outcomes for some of Australia's most vulnerable communities.

Ensuring global connection of Australia's science and innovation community.

2. **\$10 million over four years to maintain and expand long-standing and strategically important bi-lateral science partnerships with Indonesia, Japan, the EU, Brazil and the US.** This could also extend participation in the Lindau Nobel Laureates Meeting to promote industry-research collaboration. Funding at this level would allow Australia to leverage significant additional funding and mutual benefit from these regionally significant countries, complementing the welcome commitment to new multilateral science partnerships with 17 priority nations outlined in the National Innovation and Science Agenda.

Science priorities for Australian innovation

Australia's future economic and social prosperity depend above all else on science, technology, engineering and mathematics (STEM). From solving our grand challenges in agriculture, environment and health, to basic research that will deliver unexpected but transformative breakthroughs, science is the engine room of innovation. All Australians depend on a vibrant, well-planned and well-resourced science education and research capability with the capacity to drive innovation and prosperity into the future.

SCIENCE PRIORITIES

To deliver this future and continue driving innovation, Australian science needs three things:

- 1. A society with the understanding and skills to use and apply STEM in their lives and careers.** To achieve this, Australia needs world-class science and mathematics education available to every student in every school and every tertiary institution.
- 2. The best and brightest scientists solving Australia's current and future challenges.** Systemic barriers prevent many women and diverse groups from achieving their full potential in science. These barriers must be dismantled to ensure more of Australia's best science minds can focus on solving our most pressing problems.
- 3. A strong, secure and globally connected research capability** that provides stability in funding, a long-term commitment to national research infrastructure, and a suite of international engagement programs that link Australian science to the region and the world.

WHY SCIENCE?

Australia is at a crossroads. Our economy is in transition as demand for natural resources plateaus, as global manufacturing consolidates in Asia, and as international competition for our services intensifies.



More than three decades of exponential growth in Australia's per-capita GDP is tapering and, if nothing changes, Australia will fall out of the G20 within 15 years.

The only way in which Australia can maintain its long-term prosperity is to follow the lead of comparable nations in Europe, North America and Asia and foster a world-class science and innovation system to drive new and advanced services and high-tech and transformative industries that deliver continued prosperity and solve grand challenges.

WHEN AND HOW?

The innovation pipeline from scientific discovery to social and economic benefit takes decades and, while Australia has benefited hugely from its commitment to science since the 1950s, investment is needed now to ensure continued prosperity in the future. The Australian Government's National Innovation and Science Agenda¹ lays the foundation for this investment, and the Australian Academy of Science and members of Australia's science and innovation community look forward to working with all levels of government to ensure **a continued strategic approach to science and innovation in Australia and sustainable growth in research investment in the medium term.**

PRIORITY ONE: A SOCIETY WITH THE UNDERSTANDING AND SKILLS TO USE AND APPLY STEM IN THEIR LIVES AND CAREERS

Demand for STEM skills in the workforce is higher than at any time in history, with 75% of the fastest-growing occupations requiring STEM skills.² To succeed in tomorrow's economy, the majority of school leavers will need a high level of science and maths literacy, and a growing pipeline of university graduates with specialist training in STEM will be required.

OBJECTIVE 1: HIGH-QUALITY SCIENCE AND MATHS EDUCATION FOR EVERY STUDENT IN EVERY SCHOOL

CURRENT SITUATION: High-school enrolments in science and mathematics are decreasing, with these subjects often taught by out-of-field teachers. Primary students are taught on average 45 minutes of science each week, and Australian school science and maths performance is static and falling behind many other countries on international rankings. Early disengagement with science means fewer STEM-literate school leavers entering the workforce and a declining proportion of university enrolments in STEM disciplines.

SOLUTIONS:

- Ensure **each student in every Australian school** is taught by appropriately qualified teachers with access to the best resources and support, regardless of postcode.
- Teach **science as a core subject in primary school**, in the same way as maths and English.
- Have **specialist teachers lead high school science and maths** programs in core curriculum areas.
- Embrace the principles of **inquiry-based learning** that foster curiosity and innovative thinking from an early age.
- **Support science and maths teachers** to provide the best possible education to students.

Appropriate professional learning opportunities and ready availability of high-quality and engaging curriculum materials support these goals, such as those provided through the Academy's Australian Government-funded *Primary Connections*, *Science by Doing* and *Mathematics by Inquiry* programs.³

OBJECTIVE 2: UNIVERSITIES PRODUCING CREATIVE, WORK-READY STEM GRADUATES

CURRENT SITUATION: Australia's university sector is globally respected and attracts students from around our region to participate in education and research, but mismatches remain between education outcomes and workforce needs. To retain higher education as a significant and growing export industry, Australian universities need to provide world-class training in STEM through appropriate funding and increased incentives for quality teaching.

SOLUTIONS:

- **Recognise and reward excellence in university teaching.** Active, inquiry-based learning for undergraduates contextualises education and results in better outcomes. However, few academics have the resources or appropriate incentives to overhaul their teaching materials or style, particularly given the competing demands of research.
- **Create work placement opportunities for STEM students** to better tailor university education to workforce needs. Much can be learned from the tradition of work-integrated learning that exists in engineering, medicine and allied health.
- **Incentivise both industry and universities to collaborate.**

PRIORITY TWO: THE BEST AND BRIGHTEST SCIENTISTS SOLVING AUSTRALIA'S CURRENT AND FUTURE CHALLENGES

Australia has world-leading scientists across a wide range of disciplines, but science also has a serious gender and diversity imbalance. Fewer than one in five women hold senior STEM roles, and science is not representative of many diverse

groups. To address the magnitude of the social, economic, health and environmental challenges facing Australia we need *all* of Australia's best minds to be working on the solutions, regardless of gender or background.

OBJECTIVE 3: EQUAL OPPORTUNITIES FOR PEOPLE OF ALL GENDERS AND ALL BACKGROUNDS TO LEARN, WORK AND ACHIEVE THEIR FULL POTENTIAL IN SCIENCE

CURRENT SITUATION: Securing a career in science is challenging. The path from research student to established scientist is paved with short-term contracts, intense competition for funding, long hours, and low tolerance for career breaks or disruptions. There are also significant barriers to mobility between research and industry; a move from academia to the private sector is almost always a one-way trip. As a result, too many talented and promising young scientists—particularly those with family and other responsibilities—are forced to abandon their passion for science in favour of international opportunities or more forgiving careers outside of science. As a result, Australia loses their talent, their potential, and the significant investment in their training.

SOLUTIONS:

- Change the **culture, research funding practices, and incentives and workplace practices** that favour men in science.
- Create **visible and achievable career pathways** for Australia's early- and mid-career scientists, who will secure Australia's future.

The Australian Academy of Science and the Australian Academy of Technology and Engineering are piloting a gender equity accreditation and quality improvement program⁴ in 32 Australian universities and research

institutions and, with support from the Australian Government, will roll this program out more broadly in the coming years.

PRIORITY THREE: A STRONG, SECURE AND GLOBALLY CONNECTED RESEARCH CAPABILITY

To drive innovation and prosperity and provide solutions to our many complex challenges, Australia needs a world-class research capability underpinned by stability in funding, a commitment to research infrastructure, targeted support for industry–research engagement and a suite of global scientific engagement programs.

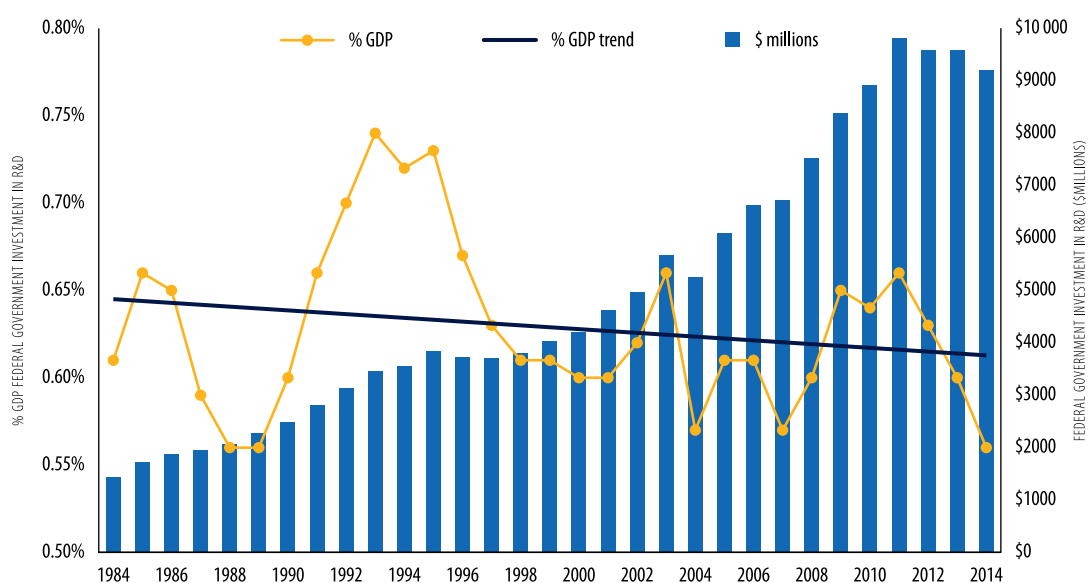
OBJECTIVE 4: STABILITY IN FUNDING FOR RESEARCH, INCLUDING SUPPORT FOR INDIRECT COSTS

CURRENT SITUATION: As research challenges get harder, science in Australia and around the world is becoming more sophisticated, connected and costly. However, public funding for science has been declining as a proportion of GDP for 30 years (Figure 1). Furthermore, limitations on research grant provisions (which exclude lead research salaries, infrastructure and on-costs) leave Australian universities forced to use teaching income to cross-subsidise billions of dollars of indirect costs of research. As the engine room of innovation, it is vital that stability is returned to science funding, and that policies and strategies are put in place to ensure growth in funding in the longer term.

SOLUTION:

- A **national research investment strategy** to ensure a long-term plan for investment growth.

Figure 1: Federal Government investment in science, research and innovation⁵



Source: Australian Parliamentary Library

OBJECTIVE 5: A LONG-TERM STRATEGY FOR NATIONAL RESEARCH INFRASTRUCTURE

CURRENT SITUATION: Australia has a \$3 billion suite of 27 major research facilities, from ocean observation systems to big-data supercomputing centres and a flagship particle accelerator that probes the molecular structure of matter. Almost every researcher in Australia uses government-supported research infrastructure in some way: these facilities enable vital research that would otherwise not be possible in Australia. The 2015 National Innovation and Science Agenda made a welcome 10-year commitment to supporting the operational costs of these facilities, and to working with the Australian Chief Scientist to review Australia's future infrastructure requirements. For Australia to remain at the leading edge of research in identified priority areas, it will be critical to ensure adequate capital is available to create and upgrade necessary research infrastructure.

SOLUTION:

- Create a **capital investment fund to support new and upgraded research infrastructure** as needs arise.

OBJECTIVE 6: TARGETED FUNDING FOR INDUSTRY-RESEARCH ENGAGEMENT

CURRENT SITUATION: Australia ranks near the bottom on international measures of engagement between research and industry, and while this failure is often attributed to reticence on the part of the research sector, it is also true that only a small proportion of Australian businesses engage in the type of new-to-world innovation that can benefit from collaboration with universities. The National Innovation and Science Agenda introduced welcome measures to encourage industry to collaborate with researchers and flagged changes to research funding arrangements to place a greater emphasis on industry collaboration.

SOLUTIONS:

- Continue to foster a culture of close ties between researchers and business through a multifaceted approach involving **incentives and intervention on the side of both supply and demand**.
- Build **new programs and interventions** on the success of the cooperative research centres, the ARC Linkage program, and new initiatives such as industry growth centres.
- Ensure **new engagement measures are not introduced at the expense of funding for basic research**, which feeds the pipeline of future innovation.

OBJECTIVE 7: A GLOBALLY CONNECTED SCIENCE COMMUNITY

CURRENT SITUATION: Science is a global enterprise, and Australian scientists and innovators need to be closely connected to the rest of the world if Australia is to realise the benefits of the latest discoveries and innovations. While universities and research grants provide some support for individual scientists to collaborate internationally, Australia needs to participate more extensively as a nation in scientific exchanges, bilateral and multilateral partnerships, and networks of science and innovation attachés and counsellors. With the exception of isolated programs targeting India and China, Australia has not had an international science engagement program since 2011, and has missed significant opportunities for scientific and innovation exchange and leveraged funding as a result.

SOLUTION:

- Provide rapid access to the rest of the world's science, opportunities for training early career researchers in the latest technologies, and unique possibilities for diplomatic engagement, through an **international science and innovation strategy** emphasising international science engagement and diplomacy programs.

1 <http://www.innovation.gov.au/>

2 Office of the Chief Scientist (2014), *Science, technology, engineering and mathematics: Australia's future*, Australian Government, Canberra. Available at: http://www.chiefscientist.gov.au/wp-content/uploads/STEM_AustraliasFuture_Sept2014_Web.pdf

3 <https://www.science.org.au/node/2699>

4 <http://www.sciencegenderequity.org.au/>

5 Australian Parliamentary Library (2014), *Australian Government support for R&D, 1978-79 to 2014-15*. Available at: <https://www.documentcloud.org/documents/1310652-parliamentary-library-australian-government.html>

ABOUT THE AUSTRALIAN ACADEMY OF SCIENCE

The Australian Academy of Science was established by Royal Charter in 1954 to champion, celebrate and support excellence in Australian science, to promote international scientific engagement, to build public awareness and understanding of science and to provide independent, authoritative and influential advice. The Academy comprises more than 500 of Australia's leading scientists, each of whom is elected for their outstanding contribution to science.

<http://www.science.org.au/science-priorities>