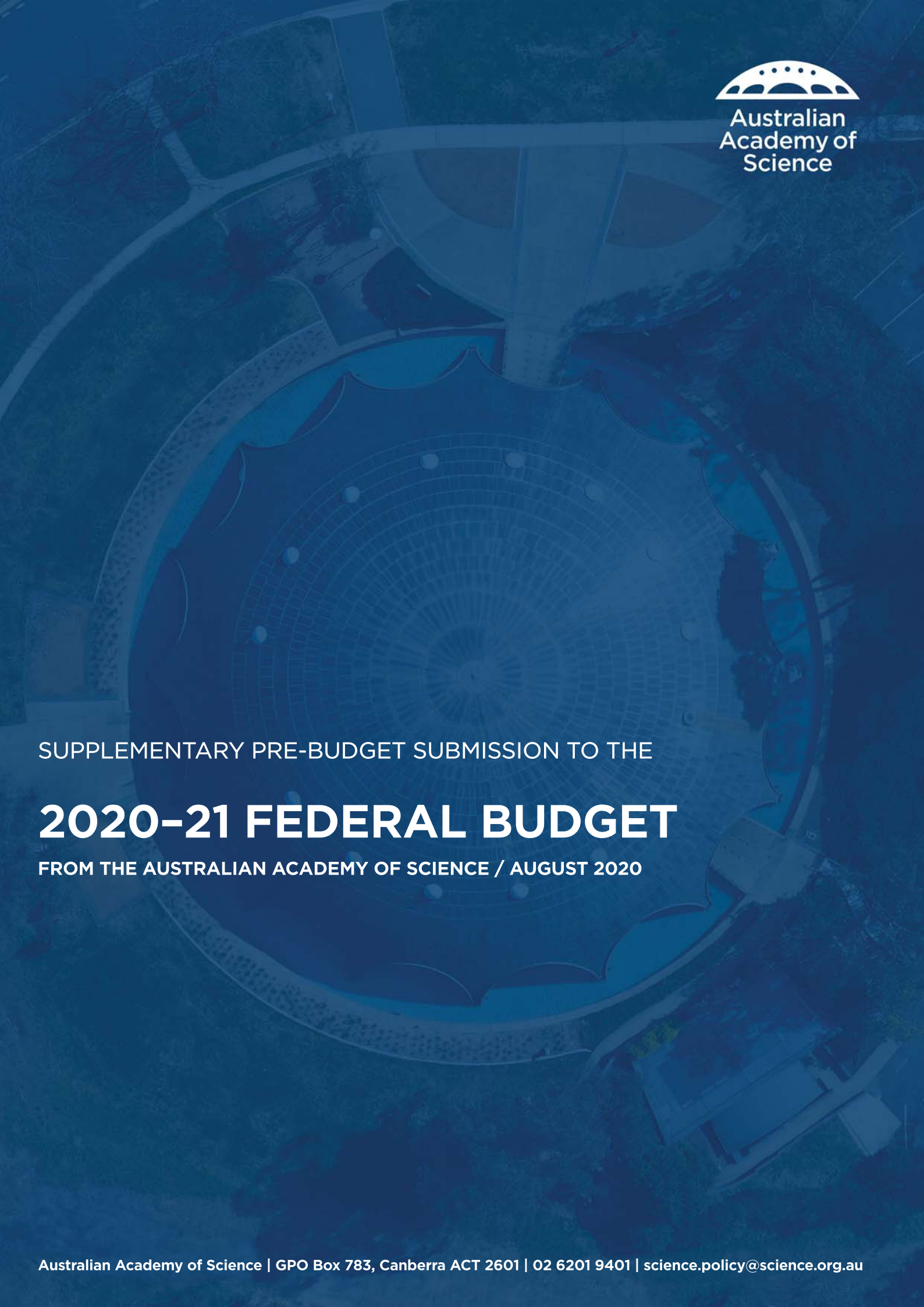

Australian Academy of Science

SUPPLEMENTARY PRE-BUDGET SUBMISSION TO THE

# 2020–21 FEDERAL BUDGET

**FROM THE AUSTRALIAN ACADEMY OF SCIENCE / AUGUST 2020**

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# Supplementary submission to the 2020-21 Federal Budget

## Executive Summary

Science and our scientific capabilities have served Australia well – both in response to the pandemic and in our efforts to find a solution. However, the scientific workforce is facing significant disruption, retrenchment, and dislocation. The impact of COVID-19, particularly the reduction in discretionary university income from international revenue and industry co-investment, has led to this crisis. The research workforce is particularly impacted because of the interdependencies between teaching and research funding within universities. Initial estimates of the loss of between 4,600 and 7,000 FTE across the university research sector in the next six months are being borne out.[1,2]

The Australian Academy of Science acknowledges and welcomes targeted government investments in epidemic-related research and the broader long-term investment by the Australian Government in scientific excellence and capability. However, it would be inimical to Australia's national interest for our young scientists and research capability to be the collateral damage of the pandemic. Australia can ill-afford to lose billions of dollars of Australian Government investment and should identify alternatives pathways to retain research talent in Australia, and at the service of the nation.

The actions the Academy proposes are aimed at supporting researchers, especially early and mid-career researchers (EMCR) who are most vulnerable because of COVID-19.

The Academy recommends that:

- The research workforce be supported through targeted schemes to transition to areas of national need, or into industry, where appropriate. This could include providing emergency one off funding to the research councils (ARC and NHMRC) to provide targeted support to early and mid-career researchers.
- The Australian Government undertake a review of research funding arrangements in Australia given the vulnerabilities associated with the current system which have been brought into sharp focus because of COVID-19
- In the national interest, sufficient research funding be made available across the research ecosystem to have near 50 per cent of their R&D activities at the fundamental end of the research spectrum.
- Specific and targeted action be implemented to preserve recent equity gains for women and other groups in the STEM workforce
- The Australian Government invests in STEM Education to replenish the STEM workforce and maintain a healthy pipeline
- The Australian Government implement a program that harnesses science as a soft power asset by leveraging science diplomacy as a strategic capability for realising foreign policy objectives and advancing Australian interests.
- Build and maintain sovereign scientific capability to support knowledge generation

# Science in a post-pandemic world

Scientific research has rapidly improved our understanding of COVID-19. Scientists around the world have directed their efforts to this global priority, working collaboratively across countries and disciplines, and sharing findings openly and quickly. Rapid and ad-hoc innovation has enabled connections between researchers and policymakers, to clarify and tackle pressing questions and to enable businesses to collaborate in new ways to address national needs.

However, COVID-19 has exposed a looming crisis for science and research. Much of the growth of Australia's research capacity over the past decade has been funded from discretionary university funds – or, more precisely, income generated from international student fees.[3] Estimates of the loss of 7,000 FTE research positions at universities arising from financial losses associated with the pandemic will damage Australian research capability for the long term if left unaddressed.[1] For the previous decade, universities developed alternative sources of revenue to fund the Australian research sector adequately. This funding was required because of inadequate government funding to support the full costs of research, including the absence of adequate funding for research infrastructure at universities.

Australia and the world are looking to science to solve the COVID-19 crisis. For a recovery from this pandemic that propels our society to a better future, we must look to science to solve it. Now is not the time to trim or cut scientific investments – particularly cuts to our research workforce pipeline– that have served Australia and our region so well.

## Workforce – retrenchment and redeployment

Many scientists and researchers are facing the economic impacts of necessary public health actions to address the pandemic. These effects include job loss, loss of hours, less grant activity, cancellation of research projects.

To better understand these impacts, the Early and Mid-Career Researcher (EMCR) Forum of the Australian Academy of Science, surveyed scientists in May 2020.[4] Findings include:

- 91 per cent said COVID-19 disrupted the way they work
- 57 per cent were uncertain about the continuation of their employment
- EMCRs experienced higher stress levels and mental health impacts.

Many scientists and researchers, including those in the early stages of their careers, are employed on casual contracts or are term limited. Their positions depend on grants from both government and industry, as well as funding from discretionary university income streams, which include revenue from international education.

Much of the impact to date has fallen upon casual teaching staff, but as 2020 has progressed, casual and term-limited scientists are also negatively affected in their employment circumstances. This will be exacerbated as grant- and industry-funded projects conclude towards the end of 2020 and in 2021.

At an individual level, every job loss, project cancelled, or contract not renewed is a tragedy. At a national level, the sum represents a loss of essential research expertise and capacity and the consequent economic loss. This expertise does not grow overnight. Scientists who have led Australia's response to COVID-19 are scientists in whom we have invested for decades.

The potential loss of scientific capability is a matter of concern to the Academy. It takes 10 to 15 years of intensive post-secondary education and training to produce a qualified researcher. We expect that as challenging economic conditions develop, we risk losing valuable scientific capability that will be required to meet national priorities and fuel new sources of innovation and growth beyond the crisis.

## Redeployment of the scientific workforce

In the face of the disruption and dislocation of the research workforce, the government has several possible options. Inaction is not a viable or desirable choice.

In 2020 the Australian Government invested $1 billion annually in the training of higher degree by research (HDR) candidates, mostly PhDs. The Australian Government provides financial support to candidates by subsidising the cost of tuition for all domestic candidates. Cost of living assistance is provided for outstanding candidates through scholarships funded by the government, and through university and industry scholarships. A high proportion of doctoral candidates have had their PhDs disrupted by COVID-19. Many of these candidates will have to extend their period of candidature. Increased government investment in the Research Training Program over the next three years would enable universities to support these candidates to successful completion.

The skills gained from HDR training are readily transferrable to a range of industries and occupations beyond academia, including business, government, community, and not-for-profit sectors.

***Australian Qualification Framework level 10 (Doctoral) Skills:***

*Graduates at this level will have **expert**, specialised **cognitive**, **technical** and **research** skills in a discipline area to independently and systematically:*

*- engage in **critical reflection, synthesis and evaluation***

*- develop, adapt and implement **research methodologies** to extend and redefine existing knowledge or professional practice*

*- disseminate and promote new insights to peers and the community*

*- generate **original knowledge** and understanding to make a substantial contribution to a discipline or area of professional practice*

The reduction in research staff that is occurring across Australian institutions must not be allowed to waste this investment in training and talent.

As a nation, we should grasp this opportunity to enrich and develop a new high-tech industrial workforce. One consequence of the decrease in income caused by the pandemic will be a cohort of talented researchers able to move into the non-university sector, if the required pathways and incentives are provided. This is an opportunity that cannot be wasted, and measures that can be adopted to grasp this moment include:

- initiatives to encourage researchers to move into industry, such as internships or investment incentives for the private sector to hire people with PhDs. This could involve implementing a recommendation of the 2016 Review of the R&D Tax Incentive, which argued that incentive should also apply to the cost of employing new STEM PhD or equivalent graduates in their first three years of employment.[5]

- initiatives to encourage researchers to start up their own companies (such as some version of JobKeeper for scientists who establish a new company)
- reforms of intellectual property laws to reduce barriers for researchers starting their own companies and capitalising on their research discoveries and inventions.

Another important option for keeping researchers within the research sector is a one-off increase in fellowships or grants targeted at early and mid-career researchers through the Australian Research Council and the National Health and Medical Research Council. For example, the Australian Research Council could be funded to offer additional fellowships targeted at retaining EMCRs in the system in 2021. Additional funding for the Industrial Transformation Research Hubs or Training Centres in areas of defined national priorities would also assist in retaining EMCRs. This could be one-off funding until the composition of the 2021 international student market is known.

### Recommendation

**The research workforce be supported through targeted schemes to transition to areas of national need, or into industry, where appropriate. This could include providing emergency one off funding to the research councils (ARC and NHMRC) to provide targeted support to early and mid-career researchers.**

## Retaining sovereign scientific capability

Notwithstanding initiatives that will aid in the redeployment of the research workforce, currently predicted funding shortfalls in research institutions will inevitably lead to the retrenchment of scientists. This will harm national scientific capability. Australia depends on science for essential research which only we do – for example, our universities and scientific institutions run key climate science monitoring stations and climate models for the Southern hemisphere that would be lost to the world if we abandoned that field of research.[6]

Internationally advanced economies are deepening and directing their investments in science and research. For instance, during the pandemic, the UK has released a Research and Development Roadmap outlining an ambitious plan to take the lessons from COVID-19 and address the whole of system (including government) challenges and opportunities that will underpin new sources of economic and societal growth.[7]

The Academy is of the view that there is a need for strategic direction around the retention of research capability, to guide institutions and others in decisions around necessary fiscal choices.

### Recommendation

**The Australian Government undertake a review of research funding arrangements in Australia given the vulnerabilities associated with the current system which have been brought into sharp focus because of COVID-19.**

## Essential research must be maintained

Australia stands in good stead to respond to the pandemic because of the decades of substantial investment in science and research capability.

Researchers in a wide range of disciplines including those outside of medical research are involved in the pandemic response. The expertise our nation is relying on to chart a way through this pandemic goes across the discipline boundaries and includes researchers involved in fundamental (also called basic), applied and translational research. Much of the research that sits behind public health responses to the disease, the clinical response and vaccine development, is fundamental research.

Australia must invest in its research capacity along the entire 'value chain' from fundamental to applied research, through to commercialisation. Fundamental research across the spectrum of research fields gives the research and innovation system its core capacity. It provides the platform for multidisciplinary approaches to problem-based research. It ultimately enables Australia to identify emerging opportunities in its global engagements and to prepare for and respond to unforeseen economic, health, environmental, and societal challenges. Fundamental and applied research are deeply linked; both flourish when all parts of the research and development ecosystem are valued and supported.

The future economic success of the nation relies on breakthrough discoveries that are primarily the products of fundamental, curiosity-driven research. Australian success through the 21st century relies on our ability to make investments in science and research along the entire innovation value chain.

However, over the past decade, the level of the research effort particularly at universities has been steered away from fundamental research. In 2008 fundamental-type research represented 49.6 per cent of total R&D activity at universities. By 2018 it had decreased to 40.6 per cent. This represents a structural weakness in the national innovation value chain, as our policy settings rely on universities as the engines of knowledge generation.

Additionally, over the past 20 years, the burden of responsibility for fundamental research has shifted. As universities have shifted focus, industry has become a more significant funder of the discovery of new knowledge.[8] A significant 87 per cent of this funding is concentrated in ICT (38.7 per cent), engineering (27 per cent), medical sciences (11.2 per cent) and technology (10.3 per cent).[8] However, this shift does not, and cannot, compensate for the change in focus by universities.

Overall, business investment in R&D (BERD) as a proportion of GDP has been falling for over a decade. In 2008 BERD was 1.27 per cent of GDP. In 2018 it had dropped to 0.9 per cent. The impact of the recession is that business investment, absent policy change, is expected to slip further.

The Academy is concerned about this trend because it is from university research activities that many of the fundamental discoveries are made that underpin innovation and international competitiveness. Policy drivers are leading universities to do more mission-oriented research because of the applied nature of directed funding and the low levels of business investment Australian R&D.

### Recommendation

**In the national interest, sufficient research funding be made available across the research ecosystem to have near 50 per cent of their R&D activities at the fundamental end of the research spectrum.**

## Maintaining and advancing STEM equity

The 2020 Australia's STEM Workforce report, released by the Chief Scientist, finds women with STEM qualifications remain underrepresented since the first report in 2016.[9] While women with university qualifications have increased their earnings since the first report in 2016, there has been little change in the number of women with STEM university and VET qualifications. The report also found only 0.5 per cent of the Aboriginal and Torres Strait Islander population had a STEM qualification, compared to 5 per cent of the non-Indigenous population.

The Academy's recent rapid research brief synthesises the evidence on the impact the COVID-19 pandemic is having on women in the STEM workforce. It found women are more vulnerable to economic and social shocks, based on disparities in the distribution of domestic workloads and reduced career opportunities compared to men. The COVID-19 pandemic will disproportionately hinder women's STEM careers. Job insecurity is emerging as an even more troubling issue for women in STEM than for men due to the high proportion of women employed in short-term contract and casual jobs - jobs that are likely to be threatened by cuts to research and teaching jobs.

The EMCR survey found 61 per cent of part-time EMCR staff were concerned about the continuation of employment, compared to 42 per cent of full-time staff. 25 per cent of women were part-time, compared to 6 per cent of men.[4]

### Recommendation

**The Academy recommends the Australian Government take specific and targeted action to preserve recent equity gains for women and other groups in the STEM workforce, including:**

- **formally monitoring of the impact of COVID-19 on gender equity in STEM and analysing current threats to achieving the vision of the Women in STEM Decadal Plan**
- **funding a review of the Women in STEM Decadal Plan, in view of the impact of the pandemic, and develop a full implementation strategy for the plan**
- **extending support for gender equity and other diversity programs in the STEM sector, including Science in Gender Equity (SAGE) Ltd, which may be at risk from income losses in the university sector**
- **supporting the efforts underway by the Australian Academy of Science and Science & Technology Australia to support the development of an Indigenous STEM Professionals network, and consider ways it can support the initiative in view of the government's commitment to a new Closing the Gap framework**
- **supporting other diversity and inclusion initiatives in STEM, including the Queers in Science network, established with the support of the Australian Academy of Science.**

# Supporting Australia's Recovery

Science can play a crucial role in Australia's recovery from COVID-19. This ranges from supporting STEM education investments, developing international scientific collaborations, and targeting investments in scientific capabilities to support critical Australian industries.

## Solving tomorrow's problems starts here – STEM education in Australia

With the world looking to science to chart our path out of the pandemic, now is not the time to put the brake on Australia's ambition to be a top science, technology, engineering and mathematics (STEM) education nation.

We need an education system that creates the problem solvers of tomorrow: science, technology and innovation will play an increasingly important role in resolving challenges and creating prosperity.[10] Navigating the future effectively and sustainably requires imagination, critical perspectives and foresight. Science, technology, engineering and mathematics, the STEM learning areas, underpin the knowledge generation and problem-solving essential for this navigation.

Good STEM education fosters curiosity, collaboration, critical and creative thinking, and evidence-based decision making. Good STEM education policy interventions help develop great STEM teachers. STEM education provides students with multiple ways of learning and thinking that extend understanding and support the development of solutions to the complex problems and issues we face nationally and internationally.

The Australian Academy of Science has a proven track record and unparalleled experience in developing and delivering evidence-based education programs to support **effective science and mathematics teaching and learning** in Australian schools from Foundation to Year 10.

Over 2020 to 2024, the Academy proposes to build on its exemplary record, extensive collaborations and Australian Government investment to date to deliver the next phase of what is necessary to transform and advance science, mathematics and STEM education in Australia.

### Recommendation

**Given the Australian Academy of Science's national reach, strong track record in developing and delivering proven programs, and substantial depth and breadth of experience and resources to draw on, the Academy is ideally positioned to continue its successful partnership with the Australian Government. This should involve continuing the high performing NISA national STEM education programs, including those in partnership with the Australian Academy of Science.**

## Science as a strategic capability and securing Australia's place on the global stage

As the health and economic impacts of the COVID-19 pandemic continue to permeate societies across the world, successful response and recovery strategies are underpinned by robust, evidence-based science and modern technology.

Our progress in the development of effective treatments and vaccines underscores the global nature of the scientific endeavour. Progress is made possible by cutting-edge, data-driven science and information sharing.

Science and international scientific collaboration are at the forefront of policy and public discourse. There is a critical role for scientifically informed decision making as a driver of effective responses to

present and ongoing global challenges, including emerging diseases, disaster resilience and climate change.

Australia contributes some 3 per cent of the global research output, with outsized impact, ranking 8th of 36 OECD+ countries in the top 1 per cent of highly cited publications per million population. The continued advancement of Australian science, and its contributions to the international effort, depend critically on global connectivity – linking to the other 97 per cent – which is made possible only by strategic, sustained investment.

Science diplomacy is a potent diplomatic and soft power asset deployed by governments across the world. It has great potential to enhance the impact and realisation of Australia's soft power diplomacy and foreign policy priorities.

Investing in science diplomacy as a strategic capability will enable Australia to establish international leadership and expertise in this reliable diplomatic asset, and forcefully advance national interests.

The Academy's broad spectrum of bilateral, multilateral, and global engagement provides a ready-made infrastructure for mobilising resources, knowledge, and experience to aid the government in realising this opportunity. Advancing a program would:

- boost worldwide visibility and influence through participation in peak international science bodies
- demonstrate regional leadership by facilitating scientifically informed decision-making
- build capacity to address critical challenges including COVID-19 recovery, disaster resilience and sustainability
- enhance bilateral and multilateral scientific relationships
- support emerging research and researchers.

### Recommendation

**Implement a program that harnesses science as a soft power asset by leveraging science diplomacy as a strategic capability for realising foreign policy objectives and advancing Australian interests.**

## Retaining and investing in scientific capability for a prosperous future

Even before the pandemic, CSIRO's National Outlook highlighted the role that new technologies, such as artificial intelligence, automation and life sciences, are playing in transforming established industries and creating new ones.[11]

The Academy has identified key opportunities for Australia in several critical areas over the years. Some that are worthy of mention are:

- Delivering Australia's major new mines by locating and unlocking future mineral wealth and positioning Australia as the global leader in exploration beneath post-mineral cover rocks. **The UNCOVER Australia initiative aims to mobilise and target scientific investment to identify the mineral deposits that lie beyond the surface** through new sensors, new technology, computing power and training the scientists to uncover Australia's mineral wealth.[12]

- The pandemic has brought to our attention the risks that come from the interactions between humans and the natural world. However, most Australian species have not yet been discovered. An estimated 420,000 taxa, or 70 per cent of species thought to exist on our megadiverse

continent, remain unknown. **The taxonomy sector, through Taxonomy Australia, is planning a mission to discover and document all remaining species in Australia in a generation.** [13]

- There is a major investment in the **recovery from the bushfires** from all levels of government. However, previous bushfire recovery efforts have fallen short as the economic and social investment required for long term recovery and wellbeing has not been sustained. The Academy is producing a series of bushfire expert briefs bringing scientific knowledge to a range of issues. To date expert briefs have been released on soil condition after bushfires, and wildlife monitoring. Both reinforce the need for more **cross-government investment in baseline monitoring and data collection,** which is lacking across our nation.

### Recommendation

**Work with the Australian Academy of Science and other stakeholders to identify how targeted scientific investments can support key national challenges.**

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