Australian Academy of Science
Ian Potter House, Gordon Street, Canberra ACT 2601

Ms Sophie Dunstone
Committee Secretary
Senate Legal and Constitutional Affairs Committee
PO Box 6100
Parliament House
Canberra ACT 2600
By email: LegCon.Sen@aph.gov.au

Dear Ms Dunstone,

Inquiry into Nationhood, National Identity and Democracy

The Australian Academy of Science welcomes the opportunity to provide a submission to the Senate References Committee on Legal and Constitutional Affairs *Inquiry into Nationhood, National identity and Democracy*.

The Australian Academy of Science comprises more than 550 of the nation's most distinguished scientific practitioners. It has active groups of Fellows throughout Australia. It is extensively networked and is well balanced within and between the disciplines of science.

Our submission addresses the following Terms of Reference:

(c) social cohesion and cultural identity in the nation state;
(d) the role that globalisation and economic interdependence and economic development plays in forming or disrupting traditional notions of national identity;
(g) comparison between Australian public debate and policy and international trends; and
(h) any other related matters.

To ensure Australian prosperity in the 21st century we need to develop solutions to address declining public trust in key institutions, most notably in government, parliament and business. Attention needs to be paid to the public good value of science and the contribution that science can make to sustaining democracy.

Trust in science and technology to lead to a better future is declining

When the Academy looks forward, the world in which Australians will strive to reach their ideals will be different from anything experienced by past generations. Evidence in Australia and globally suggests that trust in expertise and belief that science and technology will lead to a better future is on the wane, most notably in liberal democracies.

The Wellcome Global Monitor[1] has found that while seven in ten people worldwide believe that science benefits them, there is increasing anxiety, particularly in Europe but to a lesser extent in Australia and New Zealand, about the impact that science and technology will have on local jobs.

This anxiety has been fed, in part, by excessive commentary from some quarters about the impact of science on the future of work.

Similarly, a Pew Research survey of citizens in ten nations found that the belief that "in the next 50 years robots and computers will probably or definitely do much of the work currently done by humans" was widespread in the nations that were surveyed. [2]

Science and technology are changing our industries, and the way we live, work and interact with each other – a process often called the fourth industrial revolution or Industry 4.0. While technology is changing the skills that will be needed in the workforce of tomorrow, it does not follow that this will lead to a "jobs apocalypse" as has often been claimed.

Evidence for this claim is often pointed to a 2013 study, The Future of Employment, by Professors Karl Frey and Michael Osborne of the Oxford Martin School at the University of Oxford in the UK[3], which claimed that 47 percent of work was at risk. The Committee for the Economic Development of Australia did similar work in a 2015 report Australia's Future Workforce to reach a figure of 40%[4]. By contrast, work by Jeff Borland and Michael Coelli of the University of Melbourne have found that the "total amount of work available in Australia has not decreased" from IT and that the "pace of change has not accelerated"[5]

As noted by the CSIRO National Outlook Report, "The World Economic Forum's latest jobs report stresses that if adaptation strategies are in place, embracing technology can have a net positive outlook for jobs, with job creation outweighing displacement."[6]

Science is the answer to the challenges of an uncertain world

Science and the capacity to make judgements and policies informed by scientific evidence are of paramount importance. Indeed, other comparable countries have already developed long-term strategic plans that build on national capacity in science, technology, engineering and mathematics (STEM) to deliver high-value industries and jobs for the future.

---

[1] Wellcome Trust, (2018) 'Wellcome Global Monitor 2018', Accessed at https://wellcome.ac.uk/reports/wellcome-global-monitor/2018/chapter-4-science-and-society

[2] Pew Research Centre, (2018), 'In Advanced and Emerging Economies Alike, Worries About Job Automation', accessed at https://www.pewresearch.org/global/2018/09/13/in-advanced-and-emerging-economies-alike-worries-about-job-automation/

[3] Frey, C and Osborne, A, (2013), 'The Future of Employment: How susceptible are jobs to computerisation?', accessed at https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

[4] Committee for the Economic Development of Australia (2015), 'Australia's Future Workforce?', accessed at https://www.ceda.com.au/CEDA/media/ResearchCatalogueDocuments/Research%20and%20Policy/PDF/26792-Futureworkforce_June2015.pdf.

[5] Borland, J and Coelli, M, (2017) 'Are Robots Taking Our Jobs?', *Australian Economic Review,* 50 (4), pp. 377 – 397, accessed at https://minerva-access.unimelb.edu.au/handle/11343/197535

[6] CSIRO (2019), 'Australian National Outlook 2019', p. 9, accessed from https://www.csiro.au/en/Showcase/ANO.

GPO Box 783, Canberra ACT 2601 Australia | Tel +61 (0)2 6201 9400 | Fax +61 (0)2 62019494 | Email aas@science.org.au | www.science.org.au

Their plans are accompanied by resources to ensure that the personnel, the infrastructure, and the partnerships are in place to drive innovation and build prosperity. They include concerted approaches to extend capacity and basic understanding of science across the population, and to overcome barriers to participation in STEM resulting from outdated practices and cultures.

To compete internationally and ensure continued prosperity, health and wellbeing, Australia must plan for and invest in STEM on par with the best in the world.

Without stable support for research infrastructure and for basic and applied science, Australia risks losing knowledge and expertise and damaging the training pipeline of high-skilled STEM professionals. Lack of stable support for science also risks creating an 'innovation gap', where the pipeline of people and ideas falls short of the skills, the capability, and the collaboration needed to feed the development of new products and services for domestic and international markets.

A well-planned and well-resourced STEM education and research capability is necessary to drive innovation and growth into the future.

Strong Science and healthy democracy

Countries that have stronger science sectors, have stronger democracies[7]. This is not a causational relationship, but a correlational one. Countries with stronger democracies tend to foster scientific endeavor, likely an effect of high literacy and prosperity that is coincidental with democracy. By the same logic, scientific countries help foster their democracies[8].

Science, and namely, scientific literacy and understanding of the scientific method can strengthen democracy. Scientific literate citizens are more likely than not to be healthy, engaged citizens.

[7] The exceptions here are notably China and Russia, which both claim to have democratic elements, but tend not to be described as democratic.

[8] Kuhn, R.L, (2013), 'Science as a Democratizer', American Scientist, Volume 91

GPO Box 783, Canberra ACT 2601 Australia | Tel +61 (0)2 6201 9400 | Fax +61 (0)2 62019494 | Email aas@science.org.au | www.science.org.au

Science & Engineering articles in all fields, by country or economy: 2016

(Number and percent)

Rank	Country or economy	Country or economy economic status	2016	2016 world total (%)	2016 world population (%)	Political System
-	World	na	2,295,608	na		
1	China	Developing	426,165	18.6	18.94	One party state
2	United States	Developed	408,985	17.8	**4.33**	**Democracy**
3	India	Developing	110,320	4.8	**17.75**	**Democracy**
4	Germany	Developed	103,122	4.5	**1.10**	**Democracy**
5	United Kingdom	Developed	97,527	4.3	**0.89**	**Democracy**
6	Japan	Developed	96,536	4.2	**1.71**	**Democracy**
7	France	Developed	69,431	3.0	**0.87**	**Democracy**
8	Italy	Developed	69,125	3.0	**0.81**	**Democracy**
9	South Korea	Developed	63,063	2.8	**0.68**	**Democracy**
10	Russia	Developing	59,134	2.6	1.95	Autocratic democracy
11	Canada	Developed	57,356	2.5	**0.49**	**Democracy**
12	Brazil	Developing	53,607	2.3	**2.76**	**Democracy**
13	Spain	Developed	52,821	2.3	**0.62**	**Democracy**
14	Australia	Developed	51,068	2.2	**0.33**	**Democracy**
15	Iran	Developing	40,974	1.8	1.07	Islamic Republic
16	Turkey	Developing	33,902	1.5	**1.07**	**Democracy**
17	Poland	Developed	32,978	1.4	**0.51**	**Democracy**
18	Netherlands	Developed	29,949	1.3	**0.23**	**Democracy**
19	Taiwan	Developed	27,385	1.2	**0.32**	**Democracy**
20	Switzerland	Developed	21,128	0.9	**0.11**	**Democracy**

na = not applicable.

Source(s):
National Science Foundation, National Center for Science and Engineering Statistics; SRI International; Science-Metrix; Elsevier, Scopus abstract and citation database, accessed July 2017.

United Nations World Population Prospects 2019. Accessed October 2019

Science and Trust in Democracy

In a post-truth world of many 'truths' and 'alternative facts', science and scientific knowledge should be held in high esteem as the most reliable source of information that is closest to an objective truth, alongside other forms of knowledge and rationality such as that embedded in the social sciences and humanities. Scientific knowledge is grounded in empirical inquiry - an approach to discerning fact that uses a model to predict and calculate the probability of a specific event, while referring to an entire body of evidence and experience as an arbiter for truth. Because it must have regard to established evidence, scientific knowledge is sceptical, considered and careful in its claims.

For more information on the nature of science and peer review the Academy recommends that the committee consults:

GPO Box 783, Canberra ACT 2601 Australia | Tel +61 (0)2 6201 9400 | Fax +61 (0)2 62019494 | Email aas@science.org.au | www.science.org.au

- National Innovation and Research Alliance statement, "Australia cannot afford to compromise the principles underpinning scientific research"[9]
- Reef 2050 Plan Independent Expert Panel, communique 13 August 2019[10].

Science is part of Australia's national identity

Science and scientific achievement play an important role in Australian national identity. Breakthrough scientific achievements are well-known sources of national pride. Australian honours such as the Australian of the Year are increasingly awarded to scientists, creating a notion of modern Australia which prides itself on its scientific achievements, and those in pursuit of scientific discovery.

Recommendations

The Committee may wish to explore ideas for strengthening the role of science and research, and increasing trust between scientists, the parliament, government and the community, some of which are found in the document "Earning Our Future – The platform of the Australian Academy of Science" produced by the Academy in 2018.[11]

To thrive in an increasingly uncertain world, the future economy and workforce will be underpinned by science of the highest quality and intensity. The three pillars of *Earning Our Future are:*

1. **That the mutual obligations of scientists and government should be made clear.** To this end there should be formal structures to produce independent, timely and relevant science advice to government, parliament and through these bodies to the Australian public.
2. **Australia's capacity in science must have the breadth and depth that will allow our community to make rational decisions about our future** when given choices, while making a valuable contribution to the search for effective solutions to great global challenges. This needs to include investments in STEM education, a sustainable base of funding for research, global connectivity and a continuing commitment to diversity and inclusion.
3. **The Australian community has a right to expect that it will benefit from its investment in science**. The Australian research system needs to nurture integrity and diversity along with a sense of national purpose, giving clarity to the sector and confidence to Australians.

Recommendation 1: That the mutual obligations of scientists and government should be made clear

In other countries science and technology advice is more integrated into the activities of government and parliament. While the government has a Chief Scientist and has had iterations of a peak scientific advice council over the past decade there has been frequent changes to these advisory structures, leading to the current National Science and Technology Council.

[9] Australian Innovation and Research Alliance (2019), 'Australia cannot afford to compromise the principles underpinning scientific research', accessed at https://www.science.org.au/news-and-events/news-and-media-releases/australia-cannot-afford-compromise-principles-underpinning

[10] Reef 2050 Plan Independent Expert Panel, communique 13 August 2019, accessed at https://www.environment.gov.au/system/files/pages/abff0d5e-b94d-4495-b79b-90dc52274f69/files/expert-panel-communique-13-aug-2019.pdf

[11] Australian Academy of Science (2018), 'Earning Our Future – The platform of the Australian Academy of Science', accessed at https://www.science.org.au/files/userfiles/support/position-statements/earning-our-future-platform-austacademyscience.pdf

GPO Box 783, Canberra ACT 2601 Australia | Tel +61 (0)2 6201 9400 | Fax +61 (0)2 62019494 | Email aas@science.org.au | www.science.org.au

In 2018 the Academy advocated for a Charter to be developed between scientists and the Australian Government that articulates the expectations and obligations of each to the Australian people.

Such a document would clarify the reciprocal responsibilities and obligations: scientists to conduct their work ethically and in a manner consistent with a social license that is reviewed and refreshed as circumstances change; and the Australian people through their government will ensure that Australian science is supported to play its full role in national development, culture and national prosperity while securing Australia's position as a contributing and respected global citizen.

It would also outline the obligations on both researchers and government to ensure that scientific advice is provided, and that decisions are made, in accord with the expectations and the requirements of the Australian community.

Recommendation 2: The Parliament should establish its own formal advisory mechanisms on science and technology

The Academy believes scientific advice to the Parliament could be strengthened by establishing some form of office that would work with the learned academies to provide dispassionate, impartial and bipartisan advice on science and technology issues to MPs and Senators.

There are a number of possible models such as a formal office like the Parliamentary Library or the Parliamentary Budget Office modelled on the UK Parliamentary Office for Science and Technology (POST), an in-house source of independent, balanced and accessible analysis of public-policy issues related to science and technology. Variations on POST exists in France (OPECST – Parliamentary Office for Scientific and Technological Assessment), the Panel for the Future of Science and Technology (STOA) in the European Parliament, or the former US Office of Technology Assessment (OTA) attached to the US Congress which operated from 1972 to 1995.

Alternatively, such an office could be embedded in the Parliamentary Library.

Recommendation 3: Build science literacy and trust in science through education

Steps have been taken to reverse the decades-long downward drift in enrolments and performance in STEM subjects in schools. In December 2015, Australia's Education Ministers endorsed the National STEM School Education Strategy 2016-2026.[12] This strategy has two goals:

a) all students finish school with strong foundational knowledge in STEM and related skills, and
b) students are inspired to take on more challenging STEM subjects.

The strategy must now be implemented comprehensively, at scale and in all regions of Australia: metropolitan, regional and remote.

The Australian Academy of Science can facilitate this implementation: it has national reach together with a track-record in developing and delivering proven programs to support science and mathematics teachers and students in schools[13].

[12] Education Council (2015), 'National STEM School Education Strategy', accessed at www.educationcouncil.edu.au/site/DefaultSite/filesystem/documents/National%20STEM%20School%20Education%20Strategy.pdf

[13] Hackling, M. W. & Prain, V. (2008). Stage 3 Interim research and evaluation report on the impact of Primary Connections on students' science processes, literacies of science and attitudes towards science.

GPO Box 783, Canberra ACT 2601 Australia | Tel +61 (0)2 6201 9400 | Fax +61 (0)2 62019494 | Email aas@science.org.au | www.science.org.au

The Academy can deliver:

- A single consolidated STEM program that will target all schools in Australia
- Guided inquiry-based approaches across all years of schooling
- Effective digital delivery of contemporary, content-rich resources.

An adequately supported program could reach more than 200,000 students and 20,000 teachers across Australia.

Recommendation 4: Invest in science and research

Direct Australian Government investment in research (i.e., grants and program allocations; excluding tax concessions) has declined as a percentage of Gross Domestic Product (GDP) from 0.41% in 1992-93 ($1.56B) to 0.19% in 2016-17 ($3.3B); at the same time business spending increased from 0.64% of GDP to a peak of 1.37% in 2008-09. By 2016-17 that had fallen to 0.9%[14]

This long-term decline in public funding for research in Australia – keeping pace with inflation over the 25 years to 2015-16 and no more – stands in contrast to sustained increases in countries such as the US, China and Korea[15]. It also reflects a shift away from support for 'public good' research – the patient capital that supports research in the pursuit of knowledge or research that will *create an environment for the inspired risk-taking that is essential to technological discovery*[16]. In other words, there is a transfer of emphasis towards using intellectual capital and away from generating it. The long-term public interest is not well served by this approach.

Not only is there a downwards drift in the funds available '*…successive governments' practice of funding long-term [research] investments on short-term funding cycles'*[17] compounds the issues facing both researchers and industry investors. Public support is both decreasing as a proportion of GDP, and is dominated by short funding cycles.

This makes research careers in STEM less attractive at the very time we need more and different skills and perspectives. The implications for the pipeline are obvious: early-and mid-career researchers leave universities and publicly-funded research institutes for more secure careers, with only 27% of Australia's 151,000 employed PhD graduates remaining in academic and other research professional roles over time[18]. This is further complicated by the weight given to' track-record' in the assessment of grant applications.

Research in Australia is not funded fully. Indirect costs of maintaining and sustaining research program are covered by most research grant programs, meaning that research organisations have to meet these costs from other revenue streams[19].

---

[14] Australian Bureau of Statistics (2017), "Research and Experimental Development, Businesses, Australia, 2017-18"; and Australian Bureau of Statistics (2018), "Research and Experimental Development, Government and Private Non-Profit Organisations, Australia, 2016-17".
[15] OECD Main Science and Technology Indicators. www.oecd.org/sti/msti.htm
[16] A moment of truth for America: An open letter to Congress from the executives of some of America's leading technology companies. (1995). Accessed at https://homes.cs.washington.edu/~lazowska/cra/ceo.letter.html
[17] Research Infrastructure Review, 2015. p.viii.
[18] ABS Census Data. Occupation and highest educational attainment, 2016
[19] Allen Consulting Group (2008), Recognising the full cost of university research.

GPO Box 783, Canberra ACT 2601 Australia | Tel +61 (0)2 6201 9400 | Fax +61 (0)2 62019494 | Email aas@science.org.au | www.science.org.au

The Academy acknowledges that there are no simple solutions. But without some understanding of the impact of compounding problems, the hard questions can't even be framed.

In the absence of a comprehensive national strategy for STEM, the profile of STEM research is heavily influenced by funding models rather than a strategic positioning.

For Australian research to be able to play an effective role addressing our own challenges as well as being a valued contributor to global solutions, the level of investment should be consistent with that in other developed countries.

The Academy stands ready to work with Government to identify the means by which a set target could be achieved, the time-frame for its achievement and the ways it could be used to provide incentives to researchers and business to co-operate better than at any time in our history.

Recommendation 5: Strengthen and maintain a commitment to a global community of scholars and scientists

Australian researchers must be globally connected to draw from the best in the world, while actively participating in the search for solutions to global problems where we have capability.

STEM is a global enterprise and many of the existential challenges are too complex for any one country to undertake alone.

There are very few nations that do not contribute in some way to the global effort in STEM. Australia's contribution is reasonable given our population size: some 3% of global research output. In terms of highly cited work, Australia fares even better, ranking 8th of 36 OECD+ countries in the top 1% of highly- cited publications per million population[20]

A key to further advancement of Australian STEM is to build global connectivity – links to the other 97%. This requires strategic and sustained investment. It provides Australia with the opportunity to contribute to the search for solutions to the large and complex problems that require multilateral effort. But it is not only external influence; the return is substantial: a valued contributor with early insights into new developments can benefit the Australian community.

Governments around the world have recognised the benefits of international research collaboration. It benefits individuals, institutions and nations–and people's lives.

Australia cannot be a supplicant or wait until something can be bought off-the-shelf. It must be a contributor to earn the right to be part of the international STEM community.

In addition, Australia's national interest is well served when scientific collaborations open doors and broker dialogue with other nations, especially where geopolitical issues might slow positive cooperation. Science diplomacy is powerful and must be formally recognised an soft power asset.

[20] OECD (2016) Main Science and Technology Indicators, 2016-1, accessed at https://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB 332; and Thomson Reuters (2016) InCites, accessed at https://incites.thomsonreuters.com/

GPO Box 783, Canberra ACT 2601 Australia | Tel +61 (0)2 6201 9400 | Fax +61 (0)2 62019494 | Email aas@science.org.au | www.science.org.au

Recommendation 6: Australia's STEM sector must be supported to draw from all the talent available to the nation.

Australia is characterised as a culturally diverse community. The demographic profile of STEM in Australia is not: there are fewer women in key STEM subjects (physics, chemistry, advanced mathematics) in senior school[21], for example, and regional and remote students too often do not have access to the well-supported teachers and facilities that are enjoyed in the metropolitan areas[22]. Even in metropolitan areas there are differences in participation between suburbs[23]. The effect is a STEM demographic profile that is the consequence of barriers to access rather than interest or capacity.

It is inexcusable for Australia to continue to accept that it is tolerable to exclude large sections of the community from full participation in STEM because of what they are, who they are or where they are.

The barriers to participation are well known, and improvement is being made slowly. If Australia is to draw from all the talent available, however, barriers to participation, such as those related to diversity of background, gender, indigenous, disability or geography, must be eliminated.

Recommendation 7: Government and Parliament should champion science, not act to undermine it

Recent inquiries set up in the Senate into the science of the Great Barrier Reef and seismic testing are of concern to the Academy. The benefits to the nation of science and the advancement of knowledge are best served by a culture where researchers can put forward views and present data for discussion and scrutiny free from interference and without fear of reprisal.

In return for scientific freedoms, researchers must ensure they conduct their work responsibly and ethically, respecting regulations and laws. Researchers recognise they have a duty to contribute to the public good by placing societal benefits ahead of personal gain, acknowledging risk and uncertainty, and being accountable for responsible and honest communication of their work.

Principles that guide the scientific enterprise include posing testable and refutable hypotheses; designing studies that test competing counterhypotheses, using transparent methods that enable other scientists to verify their accuracy, and recognising the importance of independent replication across studies.

Research knowledge forms the basis of innovations and advances that serve the well-being of society; however, it is acknowledged that they can also do harm. Given this, researchers take seriously their obligation to critically reflect upon how their expertise is used, particularly when asked to support decision-making and policy processes.

---

[21] Justman, M. & Mendez, S. (2016). Gendered selection of STEM subjects for matriculation. *Melbourne Institute Working Paper No. 10/16.*

[22]. Australian Council for Educational Research (2018), 'Challenges in STEM learning in Australian schools: Literature and policy review', accessed at. https://research.acer.edu.au/policy_analysis_misc/28/

[23] Public Education Foundation (2018), 'What price the gap? Education and inequality in Australia', accessed at https://publiceducationfoundation.org.au/wp-content/uploads/2018/04/Issues-Paper_What-Price-The-Gap.pdf

GPO Box 783, Canberra ACT 2601 Australia | Tel +61 (0)2 6201 9400 | Fax +61 (0)2 62019494 | Email aas@science.org.au | www.science.org.au

The Committee should reject propositions that argue for the establishment of some form of political body to check the validity of scientific findings or calls to audit science that impacts on contentious areas of public policy. Alternatively, the establishment of an Australian Parliamentary office of science and technology (as proposed in recommendation 2) could be considered in this context, as a body that is able to provide an independent, rigorous evaluation of the evidence base underpinning legislative instruments.

If you would like to discuss any aspect of this submission, please contact Mr Christopher Anderson, Director of Policy, Australian Academy of Science (chris.anderson@science.org.au).

GPO Box 783, Canberra ACT 2601 Australia | Tel +61 (0)2 6201 9400 | Fax +61 (0)2 62019494 | Email aas@science.org.au | www.science.org.au