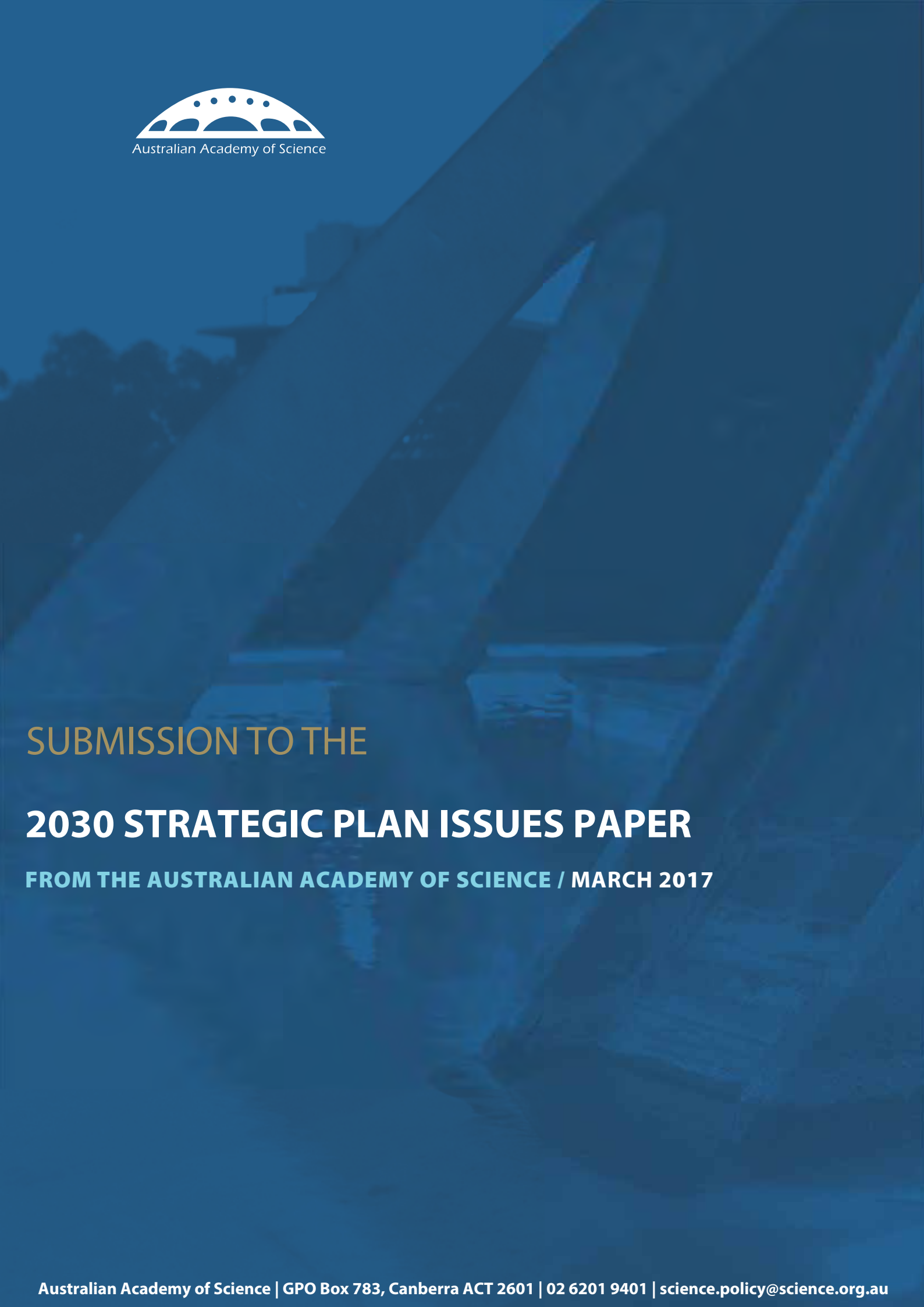

Australian Academy of Science

SUBMISSION TO THE

2030 STRATEGIC PLAN ISSUES PAPER

FROM THE AUSTRALIAN ACADEMY OF SCIENCE / MARCH 2017

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Australian Academy of Science Submission to 2030 Strategic Plan Issues Paper

Overview

The Australian Academy of Science warmly welcomes the Australian Government's commitment to develop a long-term national strategy for science and innovation in through the 2030 Strategic Plan. The Academy is grateful for the opportunity to provide input through this response to the Issues Paper.

As well as responding to the specific questions in the Issues Paper, the Academy has framed its response around the stated goal of the 2030 Strategic Plan, as indicated in the *Innovation Science and Research System Review*:

> The goal of the Plan is to establish what Australia's innovation, science and research system should look like in 2030, and determine how we should get there. Having a long-term strategy will ensure Australia can reach its innovation potential and be a world leader in the knowledge economy of the future.
>
> The Plan will aim to ensure Australia reaches its innovation potential and contributes to global efforts to develop new technologies, protect the environment, and combat illness and disease. It will aim to maintain and enhance Australia's wellbeing, prosperity and economic growth by guiding the government's investment over the medium term.

The purpose of science and innovation in Australia

The Academy believes that the purpose of science and innovation is to make the world a better place. Whether through applied research that solves immediate problems, or basic research that advances human knowledge and understanding, researchers and innovators are fundamentally committed to improving lives. They do this by developing and applying knowledge for new and better products and services, understanding and manipulating human biology for better health outcomes, developing solutions for a more sustainable world, creating technologies and applications for enhanced security, and answering fundamental questions that give us a richer and deeper understanding of the world and the universe in which we live.

Australia has a proud tradition of discovery and innovation. Our ability to harness the power of science and innovation over the last century has allowed us to build a skilled workforce, to compete in global markets, to benefit from international R&D and to capitalise on our natural resources in ways that have delivered economic prosperity, global standing and excellent health outcomes for our comparatively small population.

This is illustrated by a recent report from the Academy and the Office of the Chief Scientist which estimated that Australia's capability to generate, adopt and adapt scientific advances directly and indirectly underpins over 25% of GDP, generates one-third of our exports and employs over 1.1 million Australians.[1]

However, the world is changing quickly. Science and innovation are becoming increasingly globalised, populous countries across Asia and Africa are developing rapidly, and global challenges such as population growth, food and water security and climate change are affecting every nation in the world.

To ensure that future generations of Australians enjoy the economic, health and social privileges most of us share today, it is critical that Australia takes a strategic approach to developing our national STEM capability.

In doing so it will be important to strike the right balance between support for long-term investigator-led research that is strategic but may not lead directly to applied outcomes, and priority-driven research that is directly linked to outcomes and builds on national strengths and comparative advantages to position Australia for the future.

The Academy suggests that a flexible balance between these two approaches will achieve the best and most appropriate outcomes. That is, public support for research and innovation–whether academic or industrial–should embrace high-level national priorities identified and reviewed on a regular basis using rigorous and consultative processes, while also supporting Australia's best and most creative innovators and researchers to address the questions and the challenges that they see as most important to advancing Australia's interests.

Naturally there is overlap–many researchers and businesses are pursuing programs of activity that align directly with national priorities. But there are also distinctions and the Academy firmly believes that, as has been the case throughout Australia's history and in other leading economies, protecting the ability of talented and dedicated minds to access support through peer-review processes to answer fundamental questions and try new ideas, is the best way to ensure a robust innovation pipeline for Australia's future.

The Academy's vision for Australia in 2030

By 2030 Australia's population is estimated to exceed 30 million people, with 6.1 million people living in Sydney, 5.9 million in Melbourne and 3.1 million in each of Brisbane and Perth. 18% of the population will be over 65, an increase of 15% since the mid-2010s.[2] The world's climate will have warmed by more than one degree on pre-industrial levels, with consequent social and economic impacts felt around the globe. However, the world will also be responding, with Australian climate scientists providing significant input into the

[1] The importance of advanced physical, mathematical and biological sciences to the Australian economy (2016). Australian Academy of Science and Office of Australia's Chief Scientist. https://www.science.org.au/support/analysis/reports/physical-mathematical-biological-importance-economy

[2] Population Projections, Australia, 2012 (base) to 2101 (2013). Australian Bureau of Statistics. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/3222.0Main+Features12012%20(base)%20to%202101?OpenDocument

development of iterative mitigation and adaptation measures on a domestic and international scale.

Australia's economy is likely to continue to be structured primarily around SMEs, but the global shift towards renewable energy generation will present an opportunity for renewed investment in Australia's minerals industry, based on surging demand for copper, lithium and other non-bulk commodities.

There will have been modest advances in Australia's manufacturing and services sectors, enabled by the rollout and subsequent improvements in the NBN, as well as widespread adoption of additive manufacturing technologies and significant developments in nanoscale fabrication, machine learning and automation.

Australian industry will remain internationally competitive, and will have expanded its market share in various sectors–from medical devices and biotechnology, to renewable energy and innovative agricultural technologies. However, on current trends our economy will have been surpassed by those of a number of rapidly developing countries and dropped to 23rd largest in the world.[3]

The Academy's vision for Australia in 2030 is for a strong, diverse, equitable and globally connected nation that embraces the solutions and the benefits that science and innovation have to offer.

Through the policy framework of the 2030 Strategic Plan and increased investment in basic and applied sciences and innovation, the Academy believes that all Australians will be able to enjoy:

- **Better health:** Human longevity will be improved and the quality of our extended lives will be enhanced through reduced burden of disease and compressed morbidity. There will be reduced impact from acute and chronic conditions, improved treatments for disease, and more and better ways of managing and treating mental health conditions. We will live in an environment that is conducive to a healthy life, both physically and mentally, with reduced impact of disability reduced through more options to address disabilities and impairments.
- **A better environment:** Agriculture will be more sustainable and our air will be cleaner. There will be more leisure options and enhanced tourism in places of protected natural beauty. Our stewardship of Australia's land and water resources will be sustained and reinforced, the Great Barrier Reef will be stabilised, and our greenhouse gas emissions reduced in line with international agreements.
- **Better jobs:** A greater percentage of Australians will work in highly skilled and highly paid jobs. Industries will be changing, work will be meaningful and there will be work and training available to those who want it. There will be better working conditions enabled by technology and job mobility. There will be economic expansion, with

[3] The world in 2050 (2015). Price Waterhouse Coopers. www.pwc.comgx/en/issues/economy/the-world-in-2050.htm

rapid response to opportunities resulting in new industry sectors and a thriving ecosystem of high-growth start-ups and more Australian global firms. Technology will be smarter, more integrated, and more useful.

- **Better liveability:** Our cities will be more accessible, more socially connected, and more liveable, with reliable and useful transport options. There will be high social mobility, with access to economic opportunity and education, freedom of speech and freedom of association. There will be improved opportunities across different "divides"–gender , race, socioeconomic status, sexuality–and the impact of these "divides" on disadvantaged groups will be declining.
- **Better security:** Australians will enjoy improved food and water security. International engagement and collaboration will have reduced the threat of war, and science and innovation will have enhanced Australia's ability to defend its national interests and play a stabilising role in the region. There will be reduced crime and reduced social conflict. Cultural resilience will be strengthened.

To achieve this near-term future and expand on it over the coming decades, Australia will need a greater proportion of its workforce to be STEM qualified and capable. This means starting now with school and even preschool education. It is imperative to attract and retain highly qualified and skilled science and maths teachers and to support them with excellent training and resources, so that we may inspire our future generations with a belief in what science makes possible.

It means attracting greater numbers of school leavers into high-quality STEM degrees oriented to the technical and problem solving capabilities required by industry.

It means properly supporting our universities and research institutions to maintain a strong research standing that continues to attract international students, that develops and trains great lecturers, and that continues to serve as the incubator of ideas and knowledge that are critical to Australia's future.

Achieving this future will require a step-change in the way Australian science and innovation engages with international partners, moving from predominantly researcher-to-researcher interactions to a greater emphasis on strategic bi-lateral and multi-lateral scientific collaborations.

It will require a long-term strategic outlook for research infrastructure, ensuring new development, enhancement and sustainable operation of facilities that will be used by researchers in academia and industry to drive knowledge and innovation over the next decades and beyond.

It will require an expanded ecosystem of innovative firms–large and small–with better incentives and mechanisms for collaboration with academic researchers across the system.

It will require increased support for the trans-disciplinary and trans-sectoral research needed to develop the transformational solutions to many of Australia and the world's most complex and challenging problems.

This is the vision of the Australian Academy of Science and the leading Australian scientists it represents in 2017. We are committed to working with the Australian Government and community to realise this vision.

Guiding principles

In addition to addressing the challenges and the questions posed in the *Issues Paper*, the Academy wishes to suggest a set of guiding principles for establishing a Strategic Plan for 2030 in science and innovation.

- **Achieving excellence:** The Academy suggests that the Strategic Plan should be informed and reviewed on a regular basis using the best possible information, guided by excellent knowledge, with mechanisms to assess evidence and use it to inform Australia's future directions. Enhancing Australia's standing among the top-ranked innovation nations is a worthy goal. However, the Academy suggests that this should not be a primary target of the 2030 Strategic Plan, but rather an expected outcome of achieving excellence in science and innovation for our own purposes. Achieving such excellence requires long-term, sustained support and infrastructure.
- **Valuing and supporting blue sky and 'public good' research**: It is imperative that Australia does better in translating research discoveries into commercial products and services. However, this priority cannot overshadow the importance of maintaining and building our national capability in basic research aimed at improving the wellbeing of all Australians (social, cultural, health, environmental). While applied research specifically aimed at generating wealth is important, some of Australia's most commercially successful innovations have come from basic research or researched aimed at the public good. This includes Wi-Fi, penicillin, the cochlear implant, polymer bank notes, and many other examples. To achieve the right balance, the Academy suggests that the Strategic Plan must address needs across the innovation system. This is reflected in the National Science Statement and should be part of the 2030 Strategic Plan.
- **A comprehensive, whole-of-system education policy:** Effective education policies and programs are guided by evidence based on a system-wide analysis of needs and opportunities, and an understanding of programs that do and do not result in benefits for students and teachers. Education must be recognised as a continuum that may span a lifetime: the foundations provided in pre- and primary schools should support further learning through secondary, tertiary and lifetime education programs. Scientific, technical and mathematical literacies must be encouraged in a growing proportion of the population at all levels–and the mechanisms for imparting these skills must be examined and tested, with effective methods supported and promoted. Data gathered through methods such as the NAPLAN tests must be interrogated in sophisticated and meaningful ways, and problems identified must be addressed through specifically targeted, proven mechanisms.

  The Academy suggests that, for the Strategic Plan to realise its full potential, it must incorporate a foundational platform for education that supports the role of science and technology, analysis and research in our education systems.

- **Supporting gender equity, diversity, and inclusion:** In order to maximise the effectiveness of Australia's innovation, science, and research workforce, it will be necessary to take a strategic approach to address the structural, systemic, and cultural barriers faced by women and under-represented groups within these disciplines. Removal of these barriers will help to promote an inclusive workplace that attracts, retains, and values diversity. An understanding of best-practice programs and approaches which demonstrate positive impact will allow institutions to apply proven schemes to achieve an inclusive, innovative, and productive workforce culture.
- **The need for clear and connected funding models:** Specific funding mechanisms have not been articulated by the *National Science Statement*, the Infrastructure Roadmap or the *2030 Strategic Plan Issues Paper*. The Academy understands the Australian Government's desire to ensure long-term funding commitments and also understands the challenges inherent in doing so. However, in order to retain the best people in research and in industry, science and innovation require policy and funding certainty at least over medium timeframes. The Academy suggests that to the extent it is able, the 2030 Strategic Plan should suggest models for strengthening and linking the different public research funding streams in Australia. These include the forthcoming Research Infrastructure Investment Strategy, the ARC Discovery, Linkage and Cooperative Research Centre programs, the NHMRC grants program, the Medical Research Future Fund, the Biomedical Translation Fund, the Cooperative Research Centres program, the R&D Tax Incentive program, university Block Grant Funding, CSIRO, defence science and technology funding, and departmental research programs. Increased consistency and connection between these programs will promote productivity and efficiency across the whole of Australia's science and innovation system.
- **Prioritising health:** Medical research is an area of strength for Australia. As the public cost of healthcare and disability care continue to increase, breakthroughs in preventive health will become an increasingly important option for managing health costs, and these will rely on deep understanding of diseases and lifestyle factors that cause health to decline. A positive future is one in which society chooses to support health and medical research—together with social changes in accordance with research findings—to pre-emptively address problems and avoid both the human and financial burdens of late-stage medical care. The fruits of successful research-led preventive health initiatives are likely to be measured in terms of avoided costs as opposed to generated revenue, so it will be important to establish and communicate the counterfactual evidence to retain public support for research into the future–an avoided consequence that is never observed is all too easy to take for granted. The Strategic Plan should make the health of Australians a priority.
- **Valuing environment and sustainability:** Australia has an obligation to protect our future prosperity by taking a leadership role in understanding our impact on the planet that supports us. The UN Sustainable Development Goals provide a mechanism for developed countries such as Australia to demonstrate that a transition to sustainability can be economically beneficial as well as socially and environmentally responsible. Public investment in scientific capability and infrastructure is the only avenue through

which policy makers can arm themselves with knowledge about the state of Australia's environment and its many resources: resource conditions, sizes and sustainable use rates; environmental impacts of development; and the economics of utilisation. Clear and continuing assessment of these factors will enable rational decisions regarding resource use and the ability to optimise the various competing interests for national benefit. A prosperous future, underpinned by sustained investment in the science of our important natural resources such as water, minerals, energy, agriculture and soils, is one in which Australia's leaders have the information, courage and foresight to maximise Australia's resource benefit for the long term. Public good research in climate science delivers the ability to proactively adapt to changes in a planned and fair way. The Academy suggests that the 2030 Strategic Plan should make Australia's sustainable development a priority.

Additional resources and disciplinary strategies

The Australian Academy of Science was founded in 1954 and since that time has played a leading role in contributing to development of science policy and scientific disciplines in Australia. The Academy supports 22 National Committees for Science, which play the dual role of guiding the development of Australia's scientific and research disciplines, and connecting Australian researchers with international scientific associations and unions. Many of these National Committees have produced long-term strategies for their disciplines that have achieved widespread research and industry-sector consensus on priorities, approaches and outcomes (a list is included at Appendix A). The Academy would be pleased to provide more information to the Office of Innovation and Science Australia on any of these strategies and to arrange targeted consultations with committee Chairs and other representatives.

Addressing the Challenges

Challenge 1: Moving more firms, in more sectors, closer to the innovation frontier

Challenge 2: Moving, and keeping, Government closer to the innovation frontier

Challenge 4: Maximising the engagement of our world class research system with end users

While the *ISR System Review* and *National Science Statement* recognises the important role of government in supporting science and innovation, the Issues Paper describes a much narrower, more limited role for government. The Academy suggests that the government's responsibility goes beyond merely being an exemplar. While setting a positive example in driving innovation outcomes is important, government can provide support in many other ways, such as through funding, infrastructure, and reducing barriers for mobility between *all three* sectors: industry, government and research. The *Science Statement* recognises that government can 'produce, use and share research, data and information'; the Academy recommends that this concept be fully developed and realised in the Strategic Plan.

The *Issues Paper* presents Challenge 1 (Industry as beneficiary), Challenge 2 (Government as exemplar) and Challenge 4 (Research and end users) as separate areas of consideration. While there is potential merit in such an approach, the Academy suggests a more holistic and integrated vision for Australia that is based on integration of these three sectors. Rather than distinguishing between 'knowledge creators' and 'end users' with mechanisms for

mobility between the two, the Academy envisages a near future in which industry or public service experience is valued and utilised by research institutions and vice versa; where industry experts and entrepreneurs are enabled to collaborate with researchers and teach in schools and universities and where academics can work in relevant areas of the public service or industry and re-enter academia without fear of jeopardising their careers.

As acknowledged in the *National Science Statement*, Government action will be central to achieving such a vision.

Maximising the effectiveness and impact of our research system will require enhancing the nation's capacity to exploit research. A traditional model of 'taking research discoveries to market' will not be sufficient: we must enhance the ability of industry, government and business sectors to draw on Australian research discoveries, knowledge and expertise, and we must improve the structures and supports that enable firms to draw on research and intellectual capital beyond their own company to innovate and grow. The future likely to yield the greatest return on investment—in the conventional sense—is one in which the research and innovation environment is balanced to support the whole spectrum, from curiosity-driven to application-driven research and translation. Such an innovation system will provide sufficient depth to creatively find and develop the less-expected routes to commercial applications and benefits. Research to adoption is well defined in some areas but not others: in medical research the path from 'bench to bedside' and then to population is relatively well understood, but the same cannot be applied to abstract mathematics, high-energy physics or astronomy.

The Academy suggests that the right combination of intellectual property laws and process to make publicly funded research easily and openly searchable could build a large 'bank' of blue-sky ideas for use by Australian (and other) companies. Such a bank could enable companies to discover and combine new research with new technologies to pioneer new markets, or to become specialists at rapid-follow strategies that bring new ideas to market using existing technologies.

Finding new financial incentives and funding models that encourage translation of research performed in universities and other research institutions is essential. Current venture capital funding models have not been successful in initiating and nurturing start-ups and new ventures arising from original research. The government would do well to examine best practice models in other countries, such as the IP group in UK.

Challenge 3: Delivering high-quality and relevant education and skills development for Australians throughout their lives

The Academy supports a strong, comprehensive education system that includes a thorough grounding in scientific knowledge and provides a solid foundation for students to excel in a range of fields. An effective education system would promote a growth mindset, embracing the idea that failure and trying again is part of the innovation process. It would reflect the needs of the workforce, while being adaptive to changes in technologies and the latest research on best practice. Investment in education is not a luxury. Quite literally, it is our future prosperity.

A strong foundation at primary and secondary level is necessary to provide educated and motivated students for further training at tertiary level, as well as a general population that is scientifically literate. Conversely, deficiencies in early education propagate through the whole system: if a cohort of primary school students receives a substandard education, that cohort will require additional resources at higher levels to reach the desired standard of education, as measured by international benchmarks.

At all levels, the government and the education system should be committed to developing and maintaining a body of knowledge relating to education methods. Effective programs and structures should be identified and championed, and the sector should be open to new methods and new paradigms. A rich professional development stream should be made available to teaching professionals, allowing them to develop their own scientific and teaching skills. Professional scientists should be encouraged to engage with the education system, to confer their knowledge and experience to students and teachers.

With support of the Australian Government, the Academy has been involved in developing and delivering evidence-based school education programs since the 1980s, and its flagship *Primary Connections* and *Science by Doing* programs for students and teachers are known and used by well over half of all Australian primary and secondary schools. Its new school mathematics program *ReSolve: Maths by Inquiry* was launched in 2016 and will deliver an evidence-based, inquiry-focussed approach maths education and teacher professional development in Australian schools from primary to junior middle-secondary levels.

The Academy suggests that in order to secure a pipeline of STEM professionals by 2030, Australia will need to ensure continuation and expansion of evidence-based school science and maths programs that achieve demonstrable benefits to Australian students and teachers. This includes training and educating a strong cohort of well-qualified science and mathematics teachers who are well versed in both pedagogy and scientific knowledge.

Challenge 5: Maximising advantage from international knowledge, talent and capital

The Academy endorses the emphasis on harnessing international knowledge, talent and capital, and notes the findings of the *ISR System Review* pertaining to international collaboration, foreign investment and global value chains. International collaboration is enhanced by reducing the barriers to the free international exchange of knowledge, skills and personnel. Because other nations compete for the same pool of intellectual capability, Australia must ensure that it is attractive to the best scientists and innovators both at home and abroad. This can be achieved by fostering and maintaining an environment that values creativity and intellectual freedom through, for example, the implementation of processes that will enable freedom of scientific exchange of knowledge, such as a specialised visa for researchers, innovators, scientists and knowledge creators.

What is missing from the discussion under this Challenge is the need to retain talented and skilled people in Australian research and industry. Attracting international talent is crucial, and the Academy suggests that Australia must be positioned as a desirable and welcoming destination for researchers, start-up founders, entrepreneurs and highly skilled staff. If incentives and career opportunities in innovative industries remain underdeveloped in

Australia, there is the potential for an 'innovation diaspora' and a risk of losing Australian talent permanently, an economic loss to the country. Distance and scale place Australia at an inherent economic disadvantage in most STEM-based industry sectors and for this reason every effort must be made to encourage entrepreneurs to start their enterprises here, or to encourage them to return if they do start businesses abroad. We cannot allow limited opportunities for investment, capital or resources to push gifted Australians to global innovation hubs such as Silicon Valley or Israel.

Challenge 6: Bold, high-impact initiatives

The Issues Paper correctly identifies that "moon shots"–large, high-impact projects that can capture public imagination and transform the rate of scientific and technological development–are essential to Australia's innovation future. Such projects arise from an environment that supports excellence in research and recognises the benefits provided by such projects extend well beyond their immediate purpose. The Square Kilometre Array cited in the Issues Paper is a well-chosen example: it is a project that will provide large, tangible technological benefits, as well as addressing some of the deepest questions about humanity's place in the universe.

The Academy believes that there are a number of other areas of comparative and competitive strength in which Australia could achieve significant social, health and economic benefits by 2030 if they receive priority investment now. These projects will both increase human knowledge and Australian intellectual capital, and address the issues that the nation will face in coming years.

- **Genomic medicine:** A large number of medical conditions–including physical and mental disabilities, chronic conditions and cancers–have a genetic component. Recent global advances in genetic technology and data storage and analysis technologies have created the opportunity to collect information-rich medical data records that incorporate whole genome sequences at population levels. This in turn provides a phenomenally rich data environment that can be analysed for biomedical discovery, allows for drastically improved diagnostic techniques and provides significant efficiencies in medical treatment and resource allocation. A genomic medicine "moon shot" for Australia could seek to collect whole genome sequences of a significant percentage of Australians, and use this information to achieve world-leading outcomes and efficiencies in Australia's public health system.
- **Brain science and neurotechnology:** We have better scientific models for the creation of the universe than we do for the functioning of the brain, and without this knowledge we will struggle to make progress on devastating mental and neurological conditions such as dementia, depression, substance addiction and intellectual disability, among others. Investing in an Australian Brain Initiative and joining the global effort to crack the brain's code, offers enormous potential for Australians of 2030 to benefit from new treatments for neurological disease and mental health, new approaches to personalised learning, and tens of thousands of high-skilled, high-wage R&D and advanced manufacturing jobs in a thriving high-tech neurotechnology industry sector.

- **Long-term climate prediction:** Australia has stewardship of southern hemisphere climate science and is the most important source of climate information for half of the world. Better long-term climate prediction has enormous potential to improve performance and competitiveness of Australia's agricultural sector, infrastructure planning, mining and tourism sectors, among others, as well as enhancing the value of Australia's climate information services to the rest of the world. To achieve reliable multi-year and decadal climate prediction will require step-change in the science; bringing together and developing expertise across disciplines, investing in new monitoring and observation infrastructure, and incorporating global advances in science to develop truly customised integrated models of Australian and regional climate.
- **UNCOVER initiatives to unlock Australia's mineral wealth:** Global economic development and a shift to renewable energy will require more copper in the coming decades than has been used in all of human history. Australia has vast reserves of high-grade copper, lithium and other non-bulk commodities, but at least half of these reserves are thought to lie beneath Australia's deep-covered continental land-mass and cannot be accessed cost-effectively using conventional smart-prospecting technology. A national geoscience initiative with co-investment from government and industry, involving research organisations, geological surveys and mineral exploration firms, is needed to transform our understanding of Australia's geology and develop new probabilistic prospecting technologies to unlock this mineral wealth.
- **Agricultural innovation future:** Agriculture has been a bedrock of Australia's economy since first settlement and is vitally important to Australia's regional development, national security and sustainability. Australia's unique dry-land and broadacre environment have positioned us as a leader in many aspects of agricultural science and biotechnology. Australian agricultural expertise is widely sought, particularly in the developing world. Yet nature is always encroaching and at least half of agricultural R&D is focused simply on maintaining resilience and yields. Australia has an opportunity to achieve a step change in agricultural productivity by integrating developments in biotechnology, remote sensing, automation, data science and land management to develop new products and services that will be highly sought after in global markets.
- **Data Science and Infrastructure:** Data science and technology infrastructure is central to all branches of science and is vital for business and for government services. Research, development and infrastructure to support long-term data management, including preservation, sharing and re-use, and analysis of data, applied broadly across national data libraries and repositories, will greatly enhance the national capacity for cross-disciplinary data interrogation and research. Greater access to university- and government-generated data will provide countless new avenues for innovation, research and development.

Conclusion: The future of Australian science and innovation

The Australian Academy of Science has a vision of an Australia that embraces science and technology to help retain our place as a leading global economy supporting a high quality of life for all our citizens and residents.

There are other visions of the future. There are futures in which we fail to embrace the opportunities that science and technology can offer Australia. These scenarios are not the product of undirected imagination; they reflect the trends, issues and choices that society currently faces. Analysis of these trends and their historical precedents reveal three important points. First, science is so deeply entwined with economic and human wellbeing that we have a responsibility to prioritise it in future national plans. Second, continuity is critically important for research and innovation. Continuous improvement is much more powerful in the long term than the once-off discoveries that attract headlines and the deeper benefits of science come when society commits to long term support for them. Third, the benefits to society are often under-recognised or hidden in plain sight; health impacts are averted, issues are resolved, barriers are removed. Once a problem no longer exists, we can lose sight of the value of the research that went into providing the solution.

In seeking to secure the best possible future for our society, we must understand the interplay between science and society and the trends that influence public attitudes. We must establish a vision of Australia that Australians desire, and from there, we must address long-term and emerging trends to achieve the future we want.

Appendix A: Decadal and strategic plans for scientific disciplines produced by the Academy's National Committees for Science

1993:

- Physics: a vision for the future
- Chemistry: a vision for Australia

1994:

- Geography: Building Bridges in Australia

1995:

- Australian Astronomy: Beyond 2000—Astronomy decadal plan, 1996-2005
- Mathematical Sciences: Adding to Australia

2001:

- Beyond 2000: The Way Ahead–Mid-term review of the 1996-2000 Astronomy decadal plan

2003:

- National strategic plan for the geosciences: Geoscience—unearthing our future, 2003-2013

2004:

- Nanotechnology benchmarking report

2005

- Decadal Plan for Australian astronomy (2006-2015)

2006

- Critical skills for Australia's future: the national strategic review for mathematical sciences research in Australia

2009

- A national strategy for mathematical sciences in Australia
- An Australian strategic plan for Earth observations from space
- Decadal Plan for Australian Space Science: 2010-2019: Building a National Presence in Space
- Nanotechnology in Australia: trends, applications and collaborative opportunities.

2010

- To live within Earth's limits: an Australian plan to develop a science for the whole Earth system (2010–2020)
- Decadal plan for Australian Space Science (2010-2019)
- Review of: National strategic plan for the geosciences 2003 Geoscience — unearthing our future

2012

- Decadal Plan for Physics (2012-2021)

2015

- Decadal Plan for Australian Astronomy (2016-2025)

2016

- Decadal Plan for Chemistry
- Decadal Plan for Mathematical sciences

2017

- Decadal Plan for Agriculture
- Decadal Plan for Earth Sciences