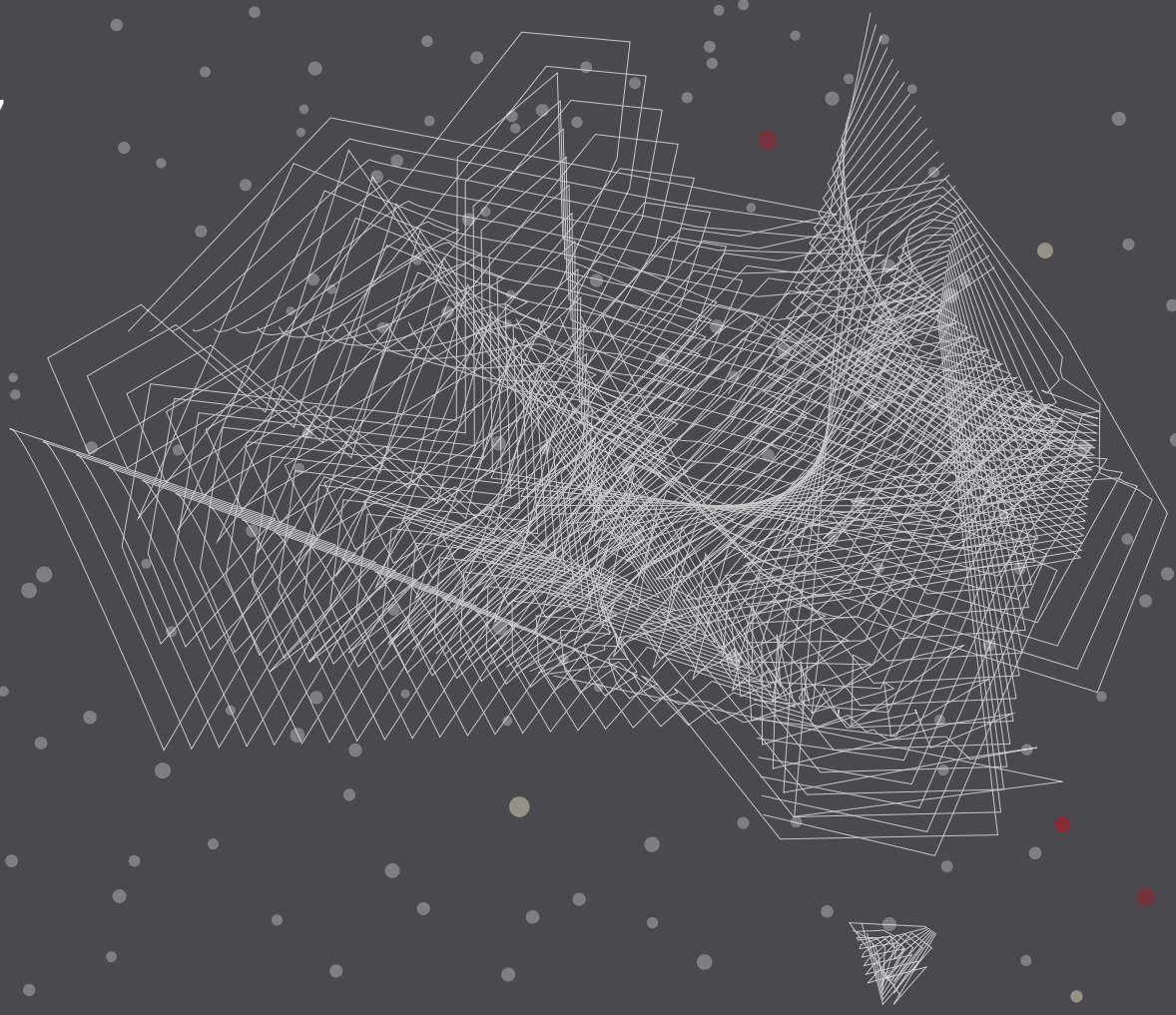
Australian Government

Australia's **National Science** Statement

science.gov.au/NSS

2017



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Introduction

The Australian Government's National Innovation and Science Agenda identified science as one of the critical elements for Australia to deliver new sources of growth, maintain high-wage jobs and seize the next wave of economic prosperity. Science—including the natural, physical and life sciences, medical and health sciences, mathematics, engineering and technology-related disciplines—already plays an important role in today's workforce, and will become increasingly important to job creation opportunities in the future.

Science forms part of the broader research ecosystem that incorporates the humanities, arts and social sciences. Together, this research drives advancements in knowledge and improvements in living standards as discoveries are understood, developed and applied. It makes businesses more innovative and productive, driving economic and jobs growth. It also underpins the social wellbeing of Australians by improving health outcomes, maintaining the quality of the environment, and contributing to solving significant social issues.

Governments and industry will increasingly look to scientific knowledge and skills to meet national and local needs in areas as varied as health care, defence, energy, transport, environmental management, food security and communications. These skills will be needed in Australia and around the world to understand and apply science and the technologies it creates.

Why a National Science Statement?

Australia's science system has many strengths. We have a highly regarded education system, and our universities attract many students from overseas. We have cutting-edge research infrastructure that enables science focused on both discovery and application. We are well connected to global science networks, both in the day-to-day conduct of science and through larger projects.

What Australia has lacked is an explicit framework to bring our collective strengths together and to guide investment and decision making in the longer term. Government decisions in science must build towards future challenges, opportunities and needs that cannot always be anticipated. If science is to be harnessed effectively it must be part of the core mission of government to develop and maintain the nation's science capability. The National Science Statement provides that framework.

The Statement articulates the importance the Australian Government places on having a strong and stable science system and its recognition of the long-term nature of science. It sets out a vision and strategic policy framework for science in Australia, and establishes whole-of-government principles that are intended to guide decision making and provide a secure, stable and enduring foundation for Australian science. It will position Australia to take advantage of our strengths in science over the long term, increasing the return on our investment and driving future prosperity.

The role of the Statement

The government has established Innovation and Science Australia as an independent statutory body with responsibility for providing strategic whole-of-government advice on all science, research and innovation matters. The government tasked Innovation and Science Australia to review the performance of the innovation, science and research system and to develop a strategic plan for the period from now to 2030—called the 2030 Strategic Plan—with recommendations for government, which is expected to be completed in 2017.

In this context, the National Science Statement sets out the government's enduring science objectives and principles. It also positions the government to respond to the science elements of the 2030 Strategic Plan in a considered and targeted manner. The Statement will continue to provide guidance for the government's other science-related policies and initiatives into the future.

Key points from Australia's National Science Statement

The National Science Statement sets a long-term approach to science, providing guidance for government investment and decision making and clarity on strategic aims.

What is meant by 'science'?

Natural, physical and life sciences, including medical and health sciences, mathematics, engineering and technology-related disciplines.

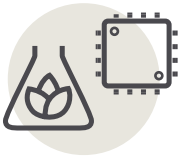
This includes the full spectrum from basic to applied scientific research in both the public and private sectors, and the infrastructure, skills, institutions, knowledge and policies that make it possible.

The government's vision is for an Australian society engaged in and enriched by science

This means achieving four objectives:

engaging all Australians with science

building our scientific capability and skills



producing new research, knowledge and technologies

improving and enriching Australians' lives through science and research

To realise its vision, the government will act in three leadership roles:

- supporting science by providing funding and other resources for the spectrum of basic to applied scientific research, critical scientific infrastructure and equipment, and science and mathematics education, directly investing in Australia's future
- participating in science by producing, using and sharing research, data and information, operating scientific research infrastructure and engaging with science internationally
- enabling science by setting institutional arrangements that shape the science system and its interactions with business and the community, including the translation of research into economic and other benefits.

In supporting science, developing science policies and carrying out science-related activities and decisions, the government will:

- recognise that science is fundamental to the economy and social wellbeing, and core to the mission of the government, as part of a multidisciplinary research ecosystem
- ensure that scientific research investment is focused on high-quality research, Australia's scientific strengths and agreed science and research priorities
- ensure that support across the spectrum of basic to applied research is stable and predictable
- encourage and support collaboration across disciplines, across sectors and across international borders
- ensure that opportunities for all Australians to engage with all aspects of the science process are maximised
- show and promote leadership in actively addressing inequality in science education, participation and employment
- measure and report performance of the science system as a whole and government agencies individually
- seek advice from experts in their respective fields in assessing priorities and research quality and in making policy.

The government has two major advisory bodies in science policy

The **Commonwealth Science Council** connects the leaders of our academic and business communities, including Australia's Chief Scientist, Dr Alan Finkel AO, to the Prime Minister and relevant senior ministers. It advises on the ways that science, research and innovation can contribute to productivity, health and wellbeing, setting priorities for research, and building the evidence base for future areas of science policy development.

Innovation and Science Australia (ISA) is an independent statutory body, chaired by Mr Bill Ferris AC, with the Chief Scientist as deputy chair. It has responsibility for providing strategic whole-of-government advice on all science, research and innovation matters.

ISA has audited the innovation and science system, and this year is developing a **2030 Strategic Plan** with recommendations for government.

The government has introduced a number of strategic science-related initiatives:

The **National Innovation and Science Agenda** is delivering initiatives to support innovation and science, across the full spectrum of science education and engagement, research and research infrastructure, translation and commercialisation.

Innovation and Science Australia's **Performance Review of the Australian Innovation, Science and Research System** has provided a performance baseline ahead of the **2030 Strategic Plan** for innovation, science and research, to be prepared in 2017 in consultation with the community.

The **2016 National Research Infrastructure Roadmap** identifies national priority research infrastructure needs over the next 10 years.

The *Australian Medical Research and Innovation Strategy 2016–2021* and the *Australian Medical Research and Innovation Priorities 2016–2018* will guide decision making for disbursements under the $20 billion **Medical Research Future Fund**, which will commence in 2017.

In partnership with states and territories, the **National STEM School Education Strategy 2016–2026** is taking action to lift foundational skills in STEM learning areas, develop mathematical, scientific and technological literacy, and promote the development of the 21st century skills of problem solving, critical analysis and creative thinking.

1

The past:
a legacy of success

Australia has a proud science history.

From William Farrer's 'Federation' wheat strain, to Howard Florey's work to make penicillin a practical medical treatment, to Graeme Clarke's development of the cochlear implant, Fiona Stanley's work in child health and the CSIRO's invention of Wi-Fi technology, Australian science has changed lives around the world. Australia's dozen Nobel Prize winners in the sciences are a testament to the impact and quality of our science.

Since Federation, the Australian Government has had a central role in Australian science. Along with the states and territories, the Commonwealth has supported and encouraged the growth of a science ecosystem that includes world-famous publicly funded research agencies, internationally competitive universities, independent medical research institutes focused on improving the nation's health, and high-quality research infrastructure.

Over that time, Australia's science system has been transformed and the government's investment has grown considerably. Science itself has also changed—becoming increasingly global, increasingly complex, and more directly touching people's everyday lives. More businesses are dependent on new knowledge and new technologies than ever before, and there is a greater interest in the practical applications and commercial possibilities of science. However, the critical role of science in a modern society has not changed: contributing to building knowledge, solving problems and seizing opportunities, and improving the wellbeing of citizens.

2

The present: Australia's science system

Government, businesses, universities, research institutions, schools, healthcare institutions, state and territory governments, learned academies, museums and science centres, rural research and development corporations and industry associations all play important roles in the science system. Public and private sources of investment are both important, and often complementary. Australia's scientists and science institutions are also connected with individuals and organisations around the world.

Australian businesses are the country's major investors in research. They spent $18.8 billion on research and development in 2013–14, employing nearly 80 000 full-time equivalent (FTE) staff to carry it out.[1] Businesses are also the key players in generating commercial returns from research, and deliver many of the economic benefits from science.

Universities undertake activities along the spectrum from basic to applied research across all disciplines. They also educate and develop the nation's scientific workforce. In 2014, Australian universities spent more than $10 billion on research and development, and were home to nearly 80 000 FTE researchers and support staff, including 24 000 academic staff and almost 45 000 postgraduate students.[2] They are also primarily responsible for the delivery of research workforce training, with over 10 000 postgraduate students completing research degrees in 2015—representing a critical transfer of knowledge and skills from the research sector to the wider economy.[3]

Australia's more than 50 independent research institutes work at the cutting edge of science, and primarily focus on health and medical research. They also have a strong emphasis on delivering improved social outcomes from research, for example through improving clinical practice and treatment, finding new therapies, and contributing to the health and wellbeing of the nation. The private non-profit research sector is growing quickly in Australia and spent more than $1 billion on research and development in 2014–15, an increase of more than 100 per cent over the preceding decade. This investment heavily depends on philanthropic support as well as private sector and government funding.

Australia's publicly funded research agencies also produce world leading research and frequently collaborate with universities, businesses and the community to solve key issues facing the country and the world. They include the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australian Institute of Marine Science, Australian Nuclear Science and Technology Organisation (ANSTO), Geoscience Australia, the Bureau of Meteorology, the Australian Antarctic Division, the Defence Science and Technology Group, and the Australian Centre for International Agricultural Research.

Schools and early-childhood education providers, along with extra-curricular science engagement activities, science centres and museums, are also a key part of the system because they are the first stages in the talent pipeline. They introduce children to science and maths as pursuits of learning and help create a scientifically aware culture. They are vital in building early engagement with science, and sustaining that engagement as students move through the education system.

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1 ABS, 8104.0, Research and Experimental Development, Businesses, Australia, 2013–14.
2 ABS, 8111.0, Research and Experimental Development, Higher Education Organisations, Australia, 2014.
3 Department of Education and Training, www.highereducationstatistics.education.gov.au.

BUSINESS

$18.8 billion on R&D
80,000 researchers

UNIVERSITIES

$10 billion on R&D
24,000 academic research staff
45,000 postgraduate students

PRIVATE NON-PROFIT

$1 billion on R&D
A more than 100% increase over the past decade

Investment in research and development (R&D)

The government's investment in science, research and innovation has grown considerably in recent years, from $6.6 billion in 2006–07 to $10.1 billion in 2016–17 (see Figure 1 below). Key elements of this expenditure in 2016–17 include:

- $3.3 billion to support business innovation, including through R&D tax measures
- $1.8 billion in block grants for universities
- $840 million for the National Health and Medical Research Council
- $744 million for the Australian Research Council
- $787 million for the Commonwealth Scientific and Industrial Research Organisation.

In addition, the government has made a number of significant longer-term commitments, including $2.3 billion over 10 years to support research infrastructure through the National Innovation and Science Agenda and the $20 billion Medical Research Future Fund, which will begin dispersing funding in 2017.

Business has also played a key role in driving increased investment in science, as it contributes more than half of total investment in research and development. Business investment in R&D (BERD) as a percentage of GDP grew from around 0.75 per cent in the mid-1990s to over 1.3 per cent at its peak in 2008–09, before declining to 1.2 per cent in 2013–14. Over the same period, expenditure by government (GovERD) and the higher education sector (HERD) together have remained steady relative to GDP, with a growing share of public investment occurring through the higher education sector. Over recent decades, Australia's overall investment in R&D (GERD) as a percentage of GDP has risen steadily, peaking at 2.25 per cent in 2008–09. Recent investment has declined slightly to 2.12 per cent, mostly driven by decreasing business investment since the Global Financial Crisis.

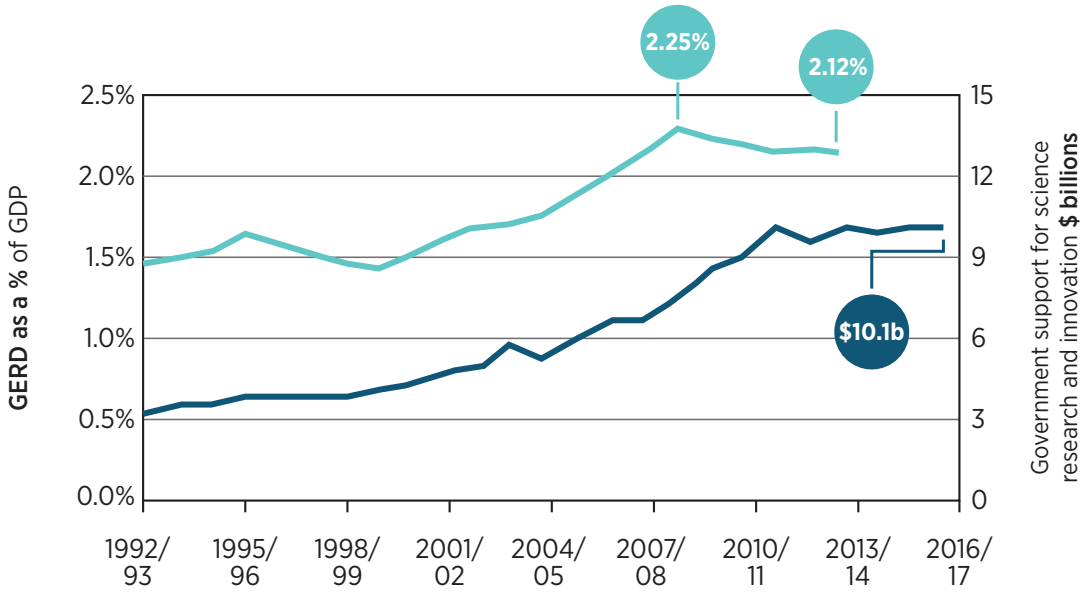

Figure 1: Gross expenditure on R&D (GERD) as a percentage of GDP and Australian Government support for science,

research and innovation, 1992/93– 2016/17

Australia's overall investment in R&D (GERD) as a percentage of GDP ranks 15th out of 33 OECD countries plus China, Taiwan and Singapore (see Figure 2 below). While the government aspires to increase national investment and move up in this ranking, the key consideration is ensuring that the government is making smart investments to get the best value for the Australian public. This will happen where the government supports investment where it would not otherwise be made—social returns on public investment in R&D are highest in basic research, and even in business investment are around twice as high as private returns.

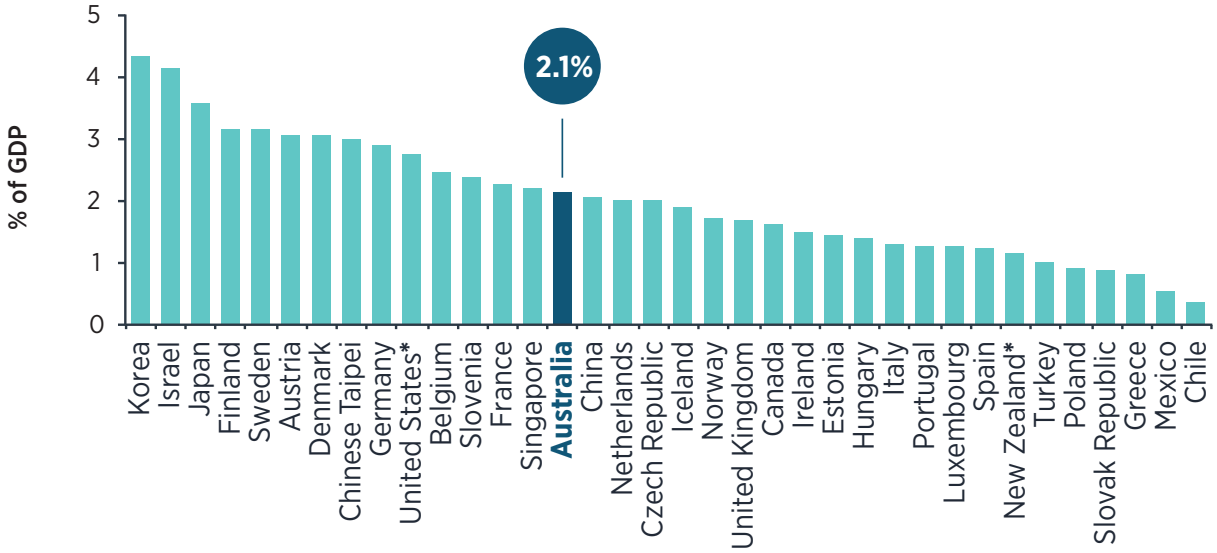

Figure 2: Gross expenditure on R&D (GERD) as a percentage of GDP, OECD+ countries, 2014 or latest available (Australia 2013-14, * indicates 2013)

Australia's strengths and weaknesses

Innovation and Science Australia's *Performance review of the Australian innovation, science and research system* (the ISA Review) found that production of research is a strength of the Australian system. Australia places eighth among OECD+ economies (OECD countries plus China, Taiwan, and Singapore) in terms of share of the world's top one per cent of natural science and engineering publications.[4]

However, Australia has room to improve relative to other OECD countries in the translation of publicly funded research into commercial outcomes.[5] While 22.8 per cent of innovation-active Australian businesses collaborate with competitors and other businesses, only 4.8 per cent collaborate with a university or publicly funded research institution.[6] The ISA Review found that researcher-to-business collaboration is a weakness of the Australian system. However, rates of collaboration vary across industry sectors, and some, notably mining, have much higher levels of collaboration with the research system.

4 Department of Industry, Innovation and Science, *Australian Innovation System Report 2016*, p. 61.
5 OECD, Main Science and Technology Indicators database.
6 Australian Bureau of Statistics, 8167.0 – Selected Characteristics of Australian Business, 2014–15.

Improving collaboration has been a focus of government policy and many research institutions in recent years, and there are numerous examples of research-based success in Australian businesses. Evidence shows that researcher-to-business collaboration drives stronger productivity growth and more novel innovations, meaning it represents an opportunity for greater social and economic value to be obtained from science, particularly in transitioning industries.[7] While Australia has strong rates of researcher-to-researcher collaboration, increased and improved investment in networks for researcher-to-business and business-to-business collaboration and innovation will support further improvements and successes. It also presents an opportunity to increase the degree of novelty of innovations introduced by Australian businesses, which is low in the vast majority of cases.[8]

Participation in science, technology, engineering and mathematics (STEM) subjects in Australian schools is declining, with enrolments in these subjects at the lowest level in 20 years.[9] Australia's performance in STEM subjects is also slipping. In the *Programme for International Student Assessment*, Australia's performance in school-level scientific literacy and mathematics is reported to have declined not only relative to other participating countries but also in absolute terms.[10]

If this decline in participation and performance continues, Australia may be unable to supply the skills required for the future workforce. The ISA Review found that, while Australians are not inherently risk-averse, short-term orientation and lack of learning from failure are also a weakness of Australia's innovation system. This suggests that there are cultural barriers to engaged participation in all aspects of science, from education through to innovation. Despite this, the ISA Review found that Australia's research workforce is world-class. This suggests Australia has strong cutting-edge skills. However, capability gaps and mismatches between the skills taught in schools, the vocational education and training (VET) system and universities and those demanded by industries present an issue that may hold Australia back. The government will work to ensure that Australians have all the skills required to innovate, including STEM skills, business and management capability, and the ability to work across the humanities and social sciences disciplines to achieve solutions to real-world problems.

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7 Department of Industry, *Australian Innovation System Report 2014*, pp. 121–126.
8 ISA, *Performance of the Australian innovation, science and research system*, p. xv.
9 Kennedy, Lyons & Quinn, 'The continuing decline of science and mathematics enrolments in Australian schools', 2014, **http://eprints.qut.edu.au/73153/1/Continuing_decline_of_science_proof.pdf.**
10 Australian Centre for Educational Research, *PISA 2015: A first look at Australia's results*.

3

The government's vision

Building on our previous success and grasping opportunities for improvement will require continued effort from governments, the education and private sectors and the wider community. Consistent and coordinated government action on science requires a clear long-term goal—a vision for Australian science.

The government's vision is for an Australian society engaged in and enriched by science

The government's vision recognises that science is a collaborative, international endeavour, and one that will profoundly transform our economy and society. It recognises that embedding science in Australian society will deliver continuing economic and social benefits, and will be vital to ensure our ongoing prosperity. Realising this vision will require achieving four broad objectives:

➔ Engaging all Australians with science

The benefits of science can be fully realised only when society is fully engaged with science and science actively engages with society. This means that we need to ensure that:

- science and mathematics education are interesting, relatable and valued by parents and teachers, supporting high levels of participation and appreciation at all levels of education
- scientific knowledge and skills are valued by employers and in the workforce
- the general public are engaged by and appreciate science, building support for investment in science
- all Australians have the opportunity to engage with scientists and contribute to scientific processes and discourses
- decision and policy makers use science, draw on expert scientific advice and see science as a contributor to problem solving and evidence-based policy.

➔ Building our scientific capability and skills

Science is advanced through the development of cutting-edge ideas by experts and specialists. However, it is also applied in the workforce and in society by people with varying degrees of scientific knowledge and skills. Not everyone needs highly specialised scientific skills, but everyone does need general science literacy of some kind to make informed decisions about their health, their finances, their career and their lifestyle. This means that we need to ensure that:

- science education is high-quality and work-relevant at all levels of education
- the Australian workforce has strong specialist scientific skills, including the skills to capitalise on our research infrastructure

- all Australians have the basic scientific knowledge and skills to participate as informed members of society
- research training and leadership in science are of high quality
- science training is integrated with other disciplines and skills to maximise impact and increase capacity for multidisciplinary careers
- domestic and international mobility are enabled and supported, including support for flexible career pathways and movement between research and industry sectors.

➔ Producing new research, knowledge and technologies

Social and economic progress requires new ideas and new ways to apply them. New research, knowledge and technologies are the source of new products and services, new methods of tackling problems, and improved understanding of the world around us. Producing these relies on not only our skills but also our equipment and resources. This means that we need to ensure that:

- high-quality, world-leading research takes place across Australia
- Australian scientists have access to research infrastructure and landmark research facilities, at home and around the world
- Australian scientists and organisations participate in and lead globally significant and large-scale scientific research, and are seen as preferred partners in international collaborations
- Australian research organisations transfer high-quality knowledge that produces significant impact across the economy.

➔ Improving and enriching Australians' lives through science and research

The ultimate goal of science is to change the way we live—realising the value and benefits of research by improving our health, building a more productive economy, informing public policy, raising community awareness and preserving our natural environment. This means that we need to ensure that:

- science leads to increased productivity, supporting growth in high-skill jobs and economic opportunities for all Australians
- social, economic, health and environmental outcomes improve as a result of science
- science contributes to solutions to challenges facing Australia, our region and the world.

Australia's performance against these objectives is already very strong, but the objectives recognise that the science system is complex, with a number of elements that perform differing functions and that overlap and interact. Policy making should be informed by the performance of the system against these objectives, but should not be aimed solely at achieving specific targets within them. Instead, it should take a holistic view and recognise that all areas of the system are important for overall performance.

4

The role of government

In realising its vision for Australian science, the government has three key leadership roles

➔ Supporting science by providing funding and other resources for the spectrum of basic to applied scientific research, critical scientific infrastructure and equipment, and science and mathematics education, directly investing in Australia's future.

The government supports and invests in a wide array of science-related activities, including many that the private sector would be unable or unwilling to fund. There are two strong rationales for public support of science and innovation, both highlighted in a 2007 report by Australia's Productivity Commission: the contribution research makes to functions of government (such as environmental management, defence, and health services) and beneficial spillovers from research that cannot be captured by the funder of that research.[11] The commission emphasised that, because of the complex, long-term and uncertain outcomes of scientific research, it is not feasible to determine the return on public investment in science or the optimal amount of funding that should be directed to it. However, it also pointed out that 'there are widespread and important economic, social and environmental benefits' from public investment in science.[12]

➔ Participating in science by producing, using and sharing research, data and information, operating scientific research infrastructure and engaging with science internationally.

The government is an active participant in science. It is directly responsible for publicly funded research agencies, some of Australia's foremost research organisations, which were established to undertake scientific research for the benefit of the nation. These organisations achieve this goal by focusing on particular challenges, both domestic and global, and by building collaboration and sharing data and other information on natural assets. They also operate some of our leading research infrastructure, such as the Synchrotron, and participate in national collaborative facilities and projects under the National Collaborative Research Infrastructure Strategy, such as the National Computational Infrastructure and the Integrated Marine Observing System. Our science agencies help ensure the smooth functioning of business and society by setting and testing standards and measurements and being a trusted source of information. The government is also directly responsible for national cultural institutions that deliver world-class public engagement with science, such as the National Science and Technology Centre (Questacon).

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11 *Public Support for Science and Innovation,* March 2007.
12 *Public Support for Science and Innovation,* March 2007, p. XVI.

The government is also itself a user of science, both in technical solutions to issues in areas such as health, agriculture, environment and defence and in developing policies across all portfolios. It also facilitates the sharing of scientific information with the broader community through its activities.

Science is also a key part of Australia's foreign policy. The government deals directly with international partners and builds connections for international collaboration through bilateral agreements and multilateral forums. In addition, publicly funded research agencies—including the CSIRO, ANSTO, the Bureau of Meteorology and the Australian Centre for International Agricultural Research—play significant leadership roles in helping countries in our region to develop scientific capabilities relevant to their own challenges.

➔ Enabling science by setting institutional arrangements that shape the science system and its interactions with business and the community, including the translation of research into economic and other benefits.

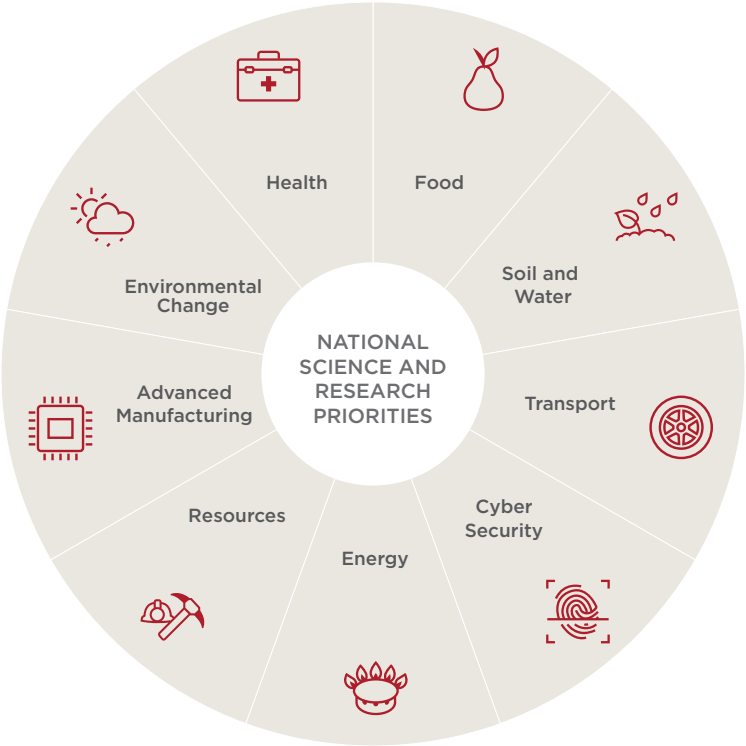
Science outside government does not happen in isolation from it—it is shaped by government policy settings, leadership, institutional arrangements, rules and regulations. Through these, the government ensures that science is carried out in accordance with community expectations and international standards, funding is appropriately used, and the high quality of Australia's science is maintained. The government also enables and facilitates an environment in which science can flourish and contribute to improved social and economic outcomes. Finally, the government articulates national aspirations, setting ambitions and goals for Australian science as a whole.

Policy formulation and coordination

Government science and research activities in Australia follow a hybrid model, whereby responsibility for some elements is distributed across government and located where it is most relevant. Maintaining strategic direction requires good coordination. This occurs both through whole-of-government bodies for advice on specific issues and strategic policy and governance arrangements for individual agencies.

Through coordination and governance arrangements such as the National Science and Research Priorities, the government will continue to set strategic direction and priorities for Australian science. Along with advice from the Chief Scientist and bodies such as the Commonwealth Science Council and Innovation and Science Australia, this coordination will help shape the research that is carried out, delivering the outcomes and applications that tackle national and global challenges and take advantage of Australia's unique opportunities. Coordinated strategic action will also build awareness of systematic strengths and gaps in Australia's scientific capabilities.

Realising the government's vision will require secure, predictable and patient investment in all parts of the science system, with support for the development of knowledge and skills, reliable and accessible enabling infrastructure, and a commitment to sharing and applying new discoveries.



Principles for government science policies and activities

In supporting science, developing science policies and carrying out science-related activities and decisions, the government will be guided by a set of principles.

➔ The government recognises that science is fundamental to the economy and social wellbeing, and core to the mission of the government, as part of a multidisciplinary research ecosystem.

High-quality science and research and the translation of knowledge into applications is vital for a competitive, innovative economy and improved social and environmental outcomes. Interdisciplinary research and integration across science, the humanities and the social sciences is also necessary to address many significant challenges faced by society.

➔ The government will ensure that scientific research investment is focused on high-quality research, Australia's scientific strengths and agreed science and research priorities.

The government's investment in science must be directed to areas in which it will have the greatest national impact, including both current and potential areas of strength. While the government also has a role to play in identifying issues of importance to the country, balance is required across the spectrum of basic to applied research, and between disciplines.

➔ The government will ensure that support across the spectrum of basic to applied research is stable and predictable.

Research timeframes and funding cycles can be lengthy, and excessive uncertainty of funding can lead to suboptimal outcomes, wasted resources and opportunities being missed, and can obstruct clear career paths for young and early career scientists.

➔ The government will encourage and support collaboration across disciplines, across sectors and across international borders.

Science is one component of the research and innovation ecosystem, and there are clear benefits from applying diverse skills and perspectives to problems. Supporting collaboration and mobility across scientific and other disciplines, between and within the business and research sectors and across borders will lead to better outcomes from science. It will also ensure Australia is sought as a key partner in global scientific endeavours.

➔ The government will ensure that opportunities for all Australians to engage with all aspects of the science process are maximised.

Community engagement in science is mutually beneficial. It supports improved research program design and data collection, strong public discourse about science and better use of scientific information in decision making. Open access to research data and findings improves the return on investment in science through increased use, re-use and impact of scientific findings. End users are also often well placed to provide advice and guidance on scientific opportunities and priorities. Education in science, technology, engineering and mathematics at all levels ensures that Australians are able to participate in our increasingly science-driven society, whether through employment or in their everyday lives.

➔ The government will show and promote leadership in actively addressing inequality in science education, participation and employment.

Some groups, including women and girls, Indigenous Australians, and those in rural and regional areas, have lower participation rates in many areas of science. The government cannot address these issues alone. However, it will show leadership in providing Australians with the opportunity to engage in science, develop and use scientific knowledge and skills, and participate in the high-wage careers that depend on scientific knowledge and skills.

➔ The government will measure and report performance of the science system as a whole and government agencies individually.

The government has a responsibility to use public resources efficiently and effectively for the benefit of the country. Transparent, clearly articulated and widely supported performance metrics for the science system will ensure that the government is able to identify opportunities for initiatives to have increased impact. It will also support progress towards realising the government's vision for science and other scientific and policy goals.

➔ The government will seek advice from experts in their respective fields in assessing priorities and research quality and in making policy.

The complexity of science means that leading experts have a vital part to play in informing policy development, implementation and evaluation. Australian scientists will continue to have a central role in helping to set priorities and in providing advice to the government, including through advisory bodies such as the Commonwealth Science Council.

5

Areas of government focus

The National Innovation and Science Agenda (NISA) outlined areas of government action on science and innovation, including the development of the Innovation and Science Australia 2030 Strategic Plan. The government's response to the 2030 Strategic Plan will form an important part of the government's long-term policy for science and innovation.

However, in realising the government's vision for science, government policy in a number of areas will always be of critical importance. These include research support and infrastructure, skills and talent, science engagement, collaboration and translation of research into practical outcomes, and international science engagement.

Research support and infrastructure

High quality research is a core ingredient in a successful science system. The development of new knowledge and new ways of applying it is fundamental to progress and a critical driver of productivity growth. New ideas allow businesses and other organisations, including governments, to provide better products and services. Research also helps to provide solutions to national and global challenges, by improving healthcare and disease prevention and treatment, improving the efficiency of food and energy production and contributing to our understanding of and ability to improve and manage the environment.

While business is the largest source of research and development funding, the government is the key individual funder of research in Australia. It supports most blue-sky and investigator-driven research, and a large amount of more applied research. It also provides funding for research infrastructure—the facilities and equipment required for research to be produced—and supports universities and publicly funded research agencies, the building blocks of our science system. Through competitive grant programs and institutional arrangements such as block grant funding rules, the government also sets incentives for research organisations and researchers.

The government will ensure that Australia continues to produce high-quality research, through institutions such as our universities and publicly funded research agencies. Improvements in Australia's quality of life will be sustained by providing strong, stable and strategic investment in research support and infrastructure. This also includes ensuring appropriate support for 'big science'—those large-scale projects, including international collaborations such as the Square Kilometre Array, which will support significant scientific progress—as well as high-quality smaller projects. Through current initiatives as well as future investment through the Medical Research Future Fund, the government will also support the continuation of Australia's excellent reputation for delivering clinical trials and enhance Australia's competitiveness as a preferred location for trials.

Skills and talent

Ongoing technological and economic change is transforming the nature of work, creating new jobs, making others obsolete, and changing where and how others are performed. This process is being driven by the advance of science and technology, and is at the same time increasing the need for a workforce which is scientifically and technologically skilled. The government has a role to play in facilitating this transition and ensuring Australians have the skills they need.

Science, technology, engineering and mathematics (STEM) skills have value in many different jobs and industries. Science education teaches logical thinking, quantitative analysis and problem solving, but it also instils creativity and an open-minded approach. Research training develops those skills further, as well equipping graduates with the ability to find, analyse, apply and communicate complex information. These skills are all fundamental to the knowledge economy and essential for innovation—businesses that innovate are twice as likely to use STEM skills, while 70 per cent of Australian employers identify STEM-skilled employees as the most innovative.[13]

However, research by the Australian Council of Learned Academies has found that integration of STEM skills is key to the success of leading firms and organisations across a wide range of industries.[14] Innovation requires a wide range of skills, including business and entrepreneurial skills. Skills from other disciplines—such as the humanities, arts and social sciences—are also required to understand how and why businesses grow or fail, how people make decisions, and how individuals, organisations and communities respond or adapt to change.

The government will take a long-term strategic view of skills and talent, ensuring that the Australian education system provides the broad base of STEM skills required for the workforce of the future, while also maintaining the high quality of our cutting-edge skills. This means a strong focus on matching skills taught at all levels of education with those needed by employers.

The government will also ensure that Australia maintains the complementary skills needed to underpin a culture of translation of research into practical applications, developing, retaining and attracting talented individuals through the entire innovation ecosystem. This will include encouraging diversity and mobility, particularly within the science workforce but also in the workforce more generally. All Australians, including under-represented groups such as women, Indigenous Australians and regional communities, must be able to fully participate in science. It also means supporting diverse career paths, including recognising the value of experience gained outside a particular sector—for example, recognising industry or entrepreneurial experience in academia.

70% of Australian employers identify STEM-skilled workers as the *most innovative*

13 Office of the Chief Scientist, *STEM: Australia's Future*, http://www.chiefscientist.gov.au/wp-content/uploads/STEM_AustraliasFuture_Sept2014_Web.pdf, p. 7; Office of the Chief Scientist, *Australia's STEM workforce: a survey of employers*, http://www.chiefscientist.gov.au/wp-content/uploads/DAE_OCS-Australias-STEM-Workforce_FINAL-REPORT.pdf, p. 3.

14 ACOLA, *Securing Australia's Future 10. Skills and capabilities for Australian enterprise innovation*, http://acola.org.au/pdf/saf10/Full%20report.pdf, p. 5.

Science engagement

Maintaining skills in STEM is not only about education and career development but also about engaging the Australian community with science and technology through programmes such as *Inspiring Australia*—the national strategy for engagement with the sciences. A scientifically engaged community will value science and understand its importance to Australia's prosperity and wellbeing, and will participate in public dialogue about science and technology. This can be achieved through maintaining a strong focus on STEM engagement and participation at all levels of society, including within families and communities.

Science engagement is delivered not only by the Australian Government, but also by state and territory governments, many local authorities, the scientific knowledge and outreach sectors, and many parts of the private sector and the community. The government will work with these other key participants in science engagement programme delivery to support activities that communicate science, encourage wide community participation in science and inspire excellence in the sciences.

Collaboration and translation

Collaboration is vital for innovation and the competitiveness of Australia's industries. It also underpins cutting-edge science in many fields. Collaboration of all kinds also reflects that science is a process that should be open and participatory. Government action is fundamentally important in this regard, because the impacts of particular collaborative projects are often uncertain for participants and provide widely spread benefits.

By helping to overcome the barriers between potential collaborators and by supporting increased connections, including through innovation precincts based around universities and/or publicly funded research agencies, the government will facilitate improved production of research, knowledge and technologies. In particular, encouraging deeper collaboration and cooperation between publicly funded research agencies, universities and businesses will help address key scientific challenges facing Australia, building on our strong researcher-to-researcher collaboration. Some of our most notable scientific advances, such as the development of the cochlear implant, are the result of effective collaboration between government, researchers and industry.

Engaging with end-users of science and research through increased communication and better translation of research into commercial, health and social outcomes also builds our capacity for innovation. Increased end-user engagement throughout the research process helps to direct investigation towards areas where it can contribute to increased national prosperity and tackle specific challenges. This includes not only commercial projects but also development of denser connections within the scientific community and among scientists and other parts of society.

Through initiatives such as the redesign of research block grants to encourage industry engagement and measuring the impact of research through the Engagement and Impact Assessment, which will be run as a companion exercise to *Excellence in Research for Australia*, the government will support and incentivise increased end-user engagement. This will drive translation of research into commercial outcomes and into policies and processes that improve social, economic and environmental outcomes.

Business collaboration with research organisations on innovation increases their likelihood of *productivity growth* by 3 times[15]

15 Department of Industry, *Australian Innovation System Report 2013*, p. 54.

International science engagement

New technologies are allowing researchers to work in new and better ways, improving research outcomes and boosting our capacity to develop, share and apply new ideas. They are also facilitating increased international collaboration and allowing Australian scientists to contribute to research programmes that tackle global problems or have applications in diverse locations around the world. Large-scale and cutting-edge research infrastructure is an important part of international engagement in science. International collaboration on research infrastructure provides a better return on investment by minimising duplication and enabling larger-scale projects than would otherwise be possible.

By strengthening and expanding Australia's strategic international science partnerships and programmes through treaties and initiatives such as the National Innovation and Science Agenda's *Global Innovation Strategy*, the government will support increased international engagement in science. This engagement will include collaboration between individual scientists, between groups, and between organisations such as research institutions and businesses. The government will also enable and encourage the mobility of scientists, including supporting our capability development by attracting highly skilled scientists to work in Australia.

International collaboration boosts the citation impact of Australian research by

24%[16]

16 Clarivate Analytics InCites™, Department of Industry, Innovation and Science analysis, December 2016.

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The future: upcoming science, research and innovation initiatives

The government has set in action initiatives that will shape the future direction of science in Australia.

The National Innovation and Science Agenda is continuing to deliver initiatives to support innovation and science, across the full spectrum of science education and engagement, research and research infrastructure, translation and commercialisation. This includes establishing a Committee of Cabinet with a whole-of-government responsibility for innovation and science. This committee is chaired by the Prime Minister and it requires Innovation and Science Australia to report to it through the Minister for Industry, Innovation and Science.

In 2017, Innovation and Science Australia will deliver to the government a 2030 Strategic Plan, which will inform overall innovation and science policy for national prosperity. This will help to shape the government's objectives for our science system in 2030 and influence the medium-term future of innovation and science in Australia. The 2030 Strategic Plan will describe what Innovation and Science Australia considers the innovation and science system should look like in 2030 and determine how Australia can get there, by identifying investment opportunities and strategies, infrastructure priorities and areas for consideration by government. It will also outline how progress against the plan can be evaluated.

Also in 2017, the government will respond to the 2016 National Research Infrastructure Roadmap, which is based on the work of an Expert Working Group chaired by the Chief Scientist. This will address Australia's research infrastructure needs over a 10-year horizon and feed into the 2030 Strategic Plan. In 2017, the Medical Research Future Fund (MRFF) will begin disbursing funding, guided by the *Australian Medical Research and Innovation Strategy 2016–2021* and the *Australian Medical Research and Innovation Priorities 2016–18*. In combination with the $250 million Biomedical Translation Fund, the MRFF will eventually double the amount of government funding for health and medical research.

In partnership with states and territories, the National STEM School Education Strategy 2016–2026 sets out actions to lift foundational skills in STEM learning areas, develop mathematical, scientific and technological literacy, and promote the development of the 21st century skills of problem solving, critical analysis and creative thinking.

These initiatives and the National Science Statement are part of the government's continued long-term plan to increase productivity and job creation through the National Innovation and Science Agenda. They will be important steps in progressing Australia's science system along the path to the government's vision. The strategic framework of the National Science Statement will continue to provide flexible guidance for the government as it makes investment and policy decisions relating to science in the future.