



Australian Government
Chief Scientist

STRATEGIC SCIENCE AND RESEARCH PRIORITIES

At the inaugural meeting of the Commonwealth Science Council, members strongly supported the need and value of establishing science and research priorities, at the same time emphasising the critical importance of investigator-led research.

The Council noted that only a proportion of public investment would be directed to science and research priority areas leaving scope to support research in other areas of science along with research in the humanities, arts and the social sciences. The Council agreed the Chief Scientist would lead further consultation on the priorities, and the practical challenges underpinning them, to inform advice to be considered at the Council's next meeting in the first half of 2015.

The proposed priorities will align areas of research excellence with Australia's industrial strengths, comparative advantages, community interests and global trends.

Implementing the priorities will result in the direction of appropriate levels of support for areas of critical importance within the total Commonwealth investment in science, research and innovation.

The proportion of support for priority research will not be predetermined, but will be sufficient to build critical mass and scale in areas vital to Australia's future.

The following research priorities were discussed by the Science Council:

1. Food

Optimising food and fibre production and processing; agricultural productivity and supply chains within Australia and global markets

2. Soil and Water

Improving the use of soils and water resources, both terrestrial and marine

3. Transport

Boosting Australian transportation: securing capability and capacity to move essential commodities; alternative fuels; lowering emissions

4. Cybersecurity

Improving cybersecurity for individuals, businesses, government and national infrastructure

5. Energy and Resources

Supporting the development of reliable, low cost, sustainable energy supplies and enhancing the long-term viability of Australia's resources industries

6. Manufacturing

Supporting the development of high value and innovative manufacturing industries in Australia

7. Environmental Change

Mitigating, managing or adapting to changes in the environment

8. Health

Improving the health outcomes for all Australians

Government policy context

On 14 October 2014, the Government released the *Industry Innovation and Competitiveness Agenda* which focuses on providing the right economic incentives to enable the growth of Australian businesses. The Agenda states that the Government will align Australia's research priorities with our comparative advantages and foster collaboration between researchers and business; stimulate the growth of high-technology start-ups in Australia; and create a culture that is conducive to the commercialisation of good ideas.

On 29 October 2014, the Government released the *Boosting the commercial returns from research* paper which stated the Government would articulate national science and research priorities and identify corresponding practical challenges to direct research effort within each priority area. The challenges will reflect the practical problems faced by research and business communities.

In response to these documents and as part of a shift to a more strategic approach, Australia should adopt, like many countries, a collection of science and research priorities that would be the focus of a proportion of government support for research.

Science and Research Priorities in Australia

More than a decade ago, Australia developed National Research Priorities. It was essentially a model in which a researcher ticked the priority box closest to their field of research. In the end there were more than 20 very broad priorities and a review recommended increasing the number because a few researchers did not see where their activities fitted.

They were not seen as serious; they had little if any effect on funding.

As a consequence it was recommended that Australia develop a smaller set of priorities that were more strategic and that would have an effect on the profile of expenditure by the Commonwealth on research and development.

The Chief Scientist took responsibility for developing the science and research priority areas.

Since Australia was one of few countries with an embedded science and research culture that did not have a strategic approach to science and prioritising investment, the Chief Scientist investigated the models in the United States, the United Kingdom and the European Union. The key elements of interest in international approaches include:

- identifying the big challenges communities face to provide an overarching direction;
- identifying broad research (and development) priorities within each;
- directing a proportion of government investment to the agreed priorities, to encourage action;
- funding projects within each broad priority;
- funding 'basic' research to ensure the continuous flow of new ideas either within or unrelated to the priority areas;
- requiring government departments and agencies to account for part of their investment in research and development in the priority areas; and
- reviewing the priorities regularly (in the US, a new letter is issued to federal departments at two yearly intervals).

The approach adopted by the Chief Scientist began with identifying areas where we need to be certain that we have activity in an appropriate quantity and of high quality, and that addresses matters of national interest or concern. Competitive advantage was also considered. The priorities were expected to influence the distribution of Commonwealth financing of research and development.

The Chief Scientist identified five of the most important societal challenges drawing extensively from their international equivalents. They were:

- Living in a Changing Environment;
- Promoting Population Health and Wellbeing;
- Managing Our Food and Water Assets;
- Securing Australia's Place in a Changing World; and
- Lifting Productivity and Economic Growth.

These challenges are global in nature, self-evident and broadly align with those of the US, EU and many other countries. The detailed priorities and areas underneath the challenges will change over time to reflect changes to the Government's priorities.

They have had an extended public airing and were not seen to be controversial by the research or business communities.

The Chief Scientist convened a workshop to assist with developing priority areas within the five broad challenges. The workshop comprised over 100 industry representatives and other end-users of research, leading experts, senior Government officials, researchers; and the Chief Scientists of the States and Territories.

Attendees were asked to identify the three most important areas under each challenge in which research could make a difference to Australia's future. Attendees were asked to consider where we had competitive advantage and which would make maximum impact.

The 15 areas that were identified have been distilled down to eight areas after overlaps and redundancies were removed.

This draft set of eight priorities align areas of research excellence with Australia's industrial strengths, global trends and community interests. The priorities also align with the five key sectors that were recently announced as the initial focus of the *Industry Growth Centres Initiative*:

- manufacturing;
- food and agriculture;
- oil and gas, including petroleum;
- mining and mining services; and
- medical devices and biotechnology.

Implementation Overview

The development of research challenges is part of a broader process to better align Australia's research effort with our competitive advantages. The research challenges will provide the basis for identifying capability gaps and identifying solutions as outlined below.

1. Agreement by the Commonwealth Science Council

At the first meeting on the Commonwealth Science Council, members acknowledged the need for science and research priorities and agreed that further consultation on the priorities, and the practical challenges underpinning them, would inform Government advice.

2. Identify practical challenges

The Chief Scientist, assisted by the National Science, Technology and Research Committee (NSTRC), will conduct expert consultations. Informed by evidence, working groups of experts from industry, research organisations and government will identify corresponding practical challenges to direct research effort within each priority area. The challenges will reflect the problems that need to be faced by the research and business communities as Australia shifts its capacity in each area from where it is to where it needs to be.

3. Announce the Priorities and corresponding practical challenges

Following endorsement of the practical challenges by the NSTRC and the Commonwealth Science Council, the Government will articulate the priority areas to the research sector and the wider community. Endorsement and publication of the Government's research priorities will send a clear signal to the research sector about how to align its effort and to increase the level of scale and focus to meet national needs.

4. Assess research activity

The NSTRC will assess existing research activity against the priorities and practical challenges. It will analyse current capabilities, capacity, investment and activities in order to provide an evidence base for each identified practical challenge. This process will also assess the capacity of the system to address gaps or capitalise on opportunities.

5. Address gaps

Identified gaps in research activities within a priority area will be addressed through the development of tailored strategies and targeted interventions. The nature of the tailored strategies will be determined by the circumstances of a particular priority area and, where common challenges are identified across priorities, system wide strategies will be considered.

6. Whole-of-Government response

Possible interventions will be considered by the Government.

The NSTRC will ensure appropriate consultation and articulate any new policy or funding initiatives to support the research priorities and practical challenges.

7. Evaluation and review

The science and research priorities and practical challenges will be reviewed on a biennial basis to allow for new initiatives to take effect. Data collected through the process will be used to monitor performance and assess activity against the priorities. These measures will include a requirement for all departments and agencies to report research activity against the priorities.

Proposed Science and Research Priorities

PRIORITY 1: FOOD

Optimising food and fibre production and processing; agricultural productivity and supply chains within Australia and global markets.

Agricultural productivity, sustainability and supply chains are important to our long-term competitiveness and our capacity to get food to market reliably.

In 2011–12 the food value chain in Australia had a combined worth of \$270 billion. In that period, Australia exported \$30 billion and imported \$11 billion worth of food and beverages. Furthermore, the food industry, including farm production and manufacturing to retail food service, employed 1.6 million people.¹

The growing global population, changing dietary preferences, the environment and natural resource constraints create challenges for food production. To maintain globally competitive agriculture industries and to meet food supply demands, Australian agriculture will need to boost its output, efficiency and ecological sustainability.

Research will identify and address issues that span the value chain for Australia's food production, from optimising animal and plant production to food processing and access to global markets. It will enable Australia to increase output and efficiency, using new technologies and knowledge to contribute to healthy Australian lifestyles and global food security.

¹ Australian Food Statistics 2011-12, Department of Agriculture, Fisheries and Forestry, Commonwealth of Australia.

PRIORITY 2: SOIL AND WATER

Improving the use of soils and water resources, both terrestrial and marine.

Managing Australia's soil and water resources is vital to the productivity of our agriculture, resources, manufacturing, fisheries, forestry and energy industries. Sustainable use of these resources is dependent on understanding complex interactions between the natural and human environments.

Australia faces many challenges to soil and water management, including population growth encroaching on arable agricultural land; old soil that has been further degraded; impact of irrigation on aquifers and salt degradation; and over-exploited river systems. As the driest inhabited continent with variable rainfalls, Australia must aim to achieve sustainable water use.

Using water from our environment is fundamental to the Australian economy. Each year, industries add about \$1.2 trillion of gross value for the water we use. In 2008–09, the gross value added per gigalitre of water consumed was \$4 million for agricultural production, \$226 million for the mining industry and \$164 million for the manufacturing industry.²

In 2001 soil acidity was estimated to be costing around \$1.585 billion per year in lost agricultural productivity, about eight times the estimated cost of soil salinity at that time.³ Threats to soil quality will increasingly affect Australia's productivity unless they are better understood and carefully managed.

Research will develop a better understanding of the importance of our soil and water resources in improving the productivity and health of the landscape while maximising the large scale efficiency of our soil and water usage to meet Australia's needs.

² State of the Environment 2011 Committee. Australia state of the environment 2011. Independent report to the Australian Government. Minister for Sustainability, Environment, Water, Population and Communities. Chapter 4: Inland Water.

³ State of the Environment 2011 Committee. Australia state of the environment 2011. Independent report to the Australian Government. Minister for Sustainability, Environment, Water, Population and Communities. Chapter 5: Land.

PRIORITY 3: TRANSPORT

Boosting Australian transportation: securing capability and capacity to move essential commodities; alternative fuels; lowering emissions.

Australia is heavily dependent on transport for private and commercial purposes. Importantly, transport services reach almost every part of the economy, as consumer products reach businesses and households through the logistics chain. Transport and storage services contribute almost 5 per cent of gross domestic product annually and provide critical services to other industries including mining, construction and manufacturing. In 2011, the transport sector directly employed over half a million people.⁴

Total freight volumes in Australia have quadrupled over the past four decades, predominantly due to significant growth in road freight and in mining-related rail freight volumes. In 2011-12, rail transport accounted for approximately 49 per cent of total domestic freight, and road freight about 35 per cent.⁵ Forecasts estimate that the total freight task will nearly double by 2030, which will have the greatest impact on road and rail transport.⁴

With 91 per cent of its fuel imported Australia's transport system is heavily reliant on overseas supply chains. There are limited alternative energy sources available in the immediate to medium term.^{4,6}

Ensuring road, rail, air and water vehicles and transport systems are efficient, secure and reliable will be essential to increasing Australia's access to domestic and international markets, for economic growth, job creation and for everyday quality of life. Research into new technologies will develop low cost, reliable, resilient and efficient transport systems that meet the needs of businesses and enable more sustainable transportation for all Australians.

⁴ National Land Freight Strategy - A place for freight, Standing Council on Transport and Infrastructure, 2013 Commonwealth of Australia.

⁵ Freightline 1 – Australian freight transport overview, Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2014, Commonwealth of Australia.

⁶ Australia's Liquid Fuel Security Part 2, A report for NRMA Motoring & Services, Prepared by John Blackburn AO, February 2014.

PRIORITY 4: CYBERSECURITY

Improving cybersecurity for individuals, businesses, government and national infrastructure.

Australia is increasingly dependent on cyberspace for its national wellbeing and security. Cyberspace is an environment vulnerable to exploitation by malicious actors. Cybersecurity requires application of research to anticipate vulnerabilities, strengthen cyber systems to ward off attack and enhance national capacity to respond to and recover from cyber-attack.

Cybercrime has a major impact on the world economy, with an estimated annual cost of US\$110 billion globally. In 2012 it is estimated to have cost Australians AU\$1.65 billion, affecting over 5 million victims.⁷ In 2012, Australia's Cyber Security Operations Centre identified 1,790 cyber security incidents. Of those, 685 required a 'heightened response' from the Centre, with 65 per cent of all cyber intrusions targeting commercial information. Common commercial targets included energy, mining and resources; banking and finance; defence capability; telecommunications; and technology.⁸

Research will strengthen the information and communication systems in our utilities, businesses and government agencies against attack or damage. Investment will deliver cyber security enhancements, infrastructure for prototype assessment and a technologically skilled workforce.

⁷ Organised Crime in Australia 2013, Australian Crime Commission, Commonwealth of Australia.

⁸ Australian National Audit Office Audit Report No.50 2013–14, Cyber Attacks: Securing Agencies' ICT Systems, Commonwealth of Australia.

PRIORITY 5: ENERGY AND RESOURCES

Supporting the development of reliable, low cost, sustainable energy supplies and enhancing the long-term viability of Australia's resources industries.

The energy and resources sector is one of Australia's most significant economic contributors. In 2013-14 the value of Australia's resource and energy exports is estimated to have increased by 11 per cent to \$196 billion.⁹ Sustainable development of the nation's mineral and energy resources will optimise long-term economic, social and environmental benefits to the community.

The growth in energy exports as well as domestic use has driven recent increases in demand for energy products. Australia is the world's seventeenth largest consumer of non-renewable energy resources which represent 96 per cent of our total energy consumption. Renewable energy consumption, which accounts for the remaining 4 per cent of consumption, has been growing strongly in recent years.¹⁰

Research will support the exploration, production, distribution and end-use systems of Australia's mineral and energy resources to meet growing demands and support Australia's economic growth.

⁹ Resources and Energy Quarterly, June Quarter 2014, Bureau of Resources and Energy Economics, Commonwealth of Australia.

¹⁰ Energy in Australia 2013, May 2013, Bureau of Resources and Energy Economics, Commonwealth of Australia.

PRIORITY 6: MANUFACTURING

Supporting the development of high value and innovative manufacturing industries in Australia.

Australia needs to understand how to develop better manufacturing, how to identify the areas on which to focus, how to build relationships between the research sector and the business world, how to engage with risk management rather than avoidance, and how to decrease environmental impact of manufacturing.

The manufacturing industry contributed 7 per cent to Australia's gross domestic product and accounted for 8 per cent of employed Australians in 2013-14. The industry also accounted for 35 per cent of the value of merchandise exports in 2012–13, and 25 per cent of business R&D in 2011-12.¹¹

While manufacturing has long been a significant part of Australia's economy, competitiveness of the sector has been declining in recent decades. Changes across the international economic landscape require Australia to improve our position in global supply chains through the development of new innovative manufacturing industries in areas of competitive advantage.

Research will support the development, commercialisation and industrialisation of innovative, high value advanced manufacturing activities and improve efficiency and performance across the sector.

¹¹ Manufacturing data card, June 2014, Department of Industry, Commonwealth of Australia.

PRIORITY 7: ENVIRONMENTAL CHANGE

Mitigating, managing or adapting to changes in the environment.

The Australian environment is a living system in a constant state of change and with a highly variable climate. To be resilient towards the changing environment, communities need to adapt to new conditions and be prepared to withstand and respond to extreme events.

Australians are experienced in confronting the impacts of drought, heatwaves, bushfires, cyclones and floods. In recent years, insurance claims, infrastructure repair, and lost productivity have cost the economy tens of billions of dollars. For example, the cost of the 2009 Black Saturday bushfires to Victoria was estimated to be about \$4.4 billion, the Queensland floods of 2010-11 cost in excess of \$5 billion, and the Sydney hailstorm of 14 April 1999 was Australia's most costly storm in terms of insured losses, totalling \$4.3 billion.¹²

Due to the global dimension and ongoing nature of environmental changes, there is a growing need to improve our understanding of the processes, impacts and the mitigation and adaptation strategies required.

Research will increase our understanding of environmental change, and support the development of options for change management.

¹² The Critical Decade: Extreme Weather, The Climate Commission, Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education 2013, Commonwealth of Australia.

PRIORITY 8: HEALTH

Improving the health outcomes for all Australians.

As the world changes and people move, the way in which populations secure health and well-being will become ever more important.

In 2011–12, Australia's national expenditure on health was estimated at over \$135 billion, or around 10 per cent of gross domestic product (GDP). Of this, the Australian Government provides about \$50 billion. Over the decade from 1999–00 to 2009–10, for each year Australia's expenditure on health grew in real terms at an average of 5.3 per cent, compared with average real growth in GDP of 3.1 per cent.¹³

Health and Medical Research is estimated to deliver a return on investment of around 117 per cent. This means that each dollar invested in Australian health research and development is estimated to return an average health benefit of \$2.17.¹⁴ One of the largest contributors to this return is the medicines industry which has been the Australian manufacturing sector's biggest hi-tech export earner in recent years, contributing more than \$4 billion worth of exports a year. Australia also has a highly advanced medical device industry which, in 2010, was estimated to be worth US\$4,027 million.¹⁵ Total ASX investment in Pharma, biotech and life sciences companies is around \$50 billion.

Research under this priority will examine how health problems and diseases affect individuals and populations, and will develop treatments, solutions and preventative options to improve the physical and mental well-being of Australians.

¹³ Strategic Review of Health and Medical Research, Department of Health and Aging, February 2013.

¹⁴ Strategic Review of Health and Medical Research, Department of Health and Aging, February 2013.

¹⁵ Medicines Australia - ABS catalogue 5368.0 International Trade in Goods and Services, Australia, Table 12a. MERCHANDISE EXPORTS, Standard International Trade Classification (1 and 2 digit), FOB Value, June 2012.