EXECUTIVE SUMMARY

Innovation is a primary driver of sustainable productivity growth and social wellbeing. Conscious of this, in May 2009 the Australian Government set out a ten-year vision for strengthening innovation and increasing productivity in *Powering Ideas: An Innovation Agenda for the 21st Century*.

Part of that strategy, which is supported by an increase of almost 25 per cent in science and innovation investment in 2009-10 over the previous year, is a new series of annual reports on the performance of Australia's national innovation system. The *Australian Innovation System Report 2010* is the first of that series.

This report provides metrics and baseline indicators as a platform to compare Australia's innovation performance with other OECD countries and track progress against the Government's priorities and targets in the coming years. While it cites the most recent and comprehensive data available, most of this data dates back to 2007-08 or earlier. Our understanding of recent developments must depend on more qualitative evidence until new metrics become available in the years ahead. This data gap is a global problem and the report itself discusses national and international efforts to develop more timely and sensitive metrics of innovation performance. Notwithstanding these limitations, the data available can still serve as a yardstick against which efforts to meet the priorities and targets in *Powering Ideas* can be measured in the future. Each chapter also provides case studies of world-class innovation achievements by Australian researchers, businesses, and governments.

The Australian innovation system: key features and trends

The Australian innovation system is an open network of organisations interacting to produce and use new knowledge and technology to create economic and social value.

Some features of Australia's innovation system and performance include:

- Innovation drives productivity improvements, and hence economic growth. Sixty-five per cent of economic growth per capita in Australia over the last four decades can be attributed to increases in multi-factor productivity (MFP). Nevertheless, Australia's MFP growth over the long term is slightly below the median of nineteen OECD countries.
- Australia's gross expenditure on research and development (GERD) has grown consistently over the last few decades, and a significant amount of this is due to business investment in R&D. GERD has grown at an annual rate of 6.1 per cent over the last twenty-two years in real terms, and businesses contributed two-thirds of the absolute GERD increase over this period.
- In 2007-08 the number of innovating firms increased to 39.1 per cent, up 6.4 percentage points from 2006-07. In 2007-08, the top three innovation sectors were wholesale trade, retail trade and manufacturing, with 51.4 per cent, 50.9 per cent and 45.6 per cent of businesses in those sectors innovating.
- The Australian innovation system consistently underperforms on most measures of collaboration and networking; however, disaggregated data by firm size, sector and type of collaborator reveals marked differences. For example, while 84 per cent of innovation-active businesses had no collaborative arrangements in 2006-07, 60 per cent of large innovation-active mining firms undertook collaboration.
- Information technology, marketing and business management were the most frequent skills used for innovation. The largest shortage of skills required for innovation was in the trades professions. Considerable differences in skills needs arise when data is analysed by industry sector or firm size.

- Eco-innovation is an important driver of renewal in the innovation system. Low-carbon and renewable-energy innovation received 32 per cent or $1.05 billion of the grant funding allocated for science and innovation programs in the 2009-10 Commonwealth Budget, an increase of 290 per cent from the previous year.[1]

Research capacity and skill base

Australia's innovation performance is underpinned by its research capacity and skills base. Research in the public and private sectors creates new ideas which fuel innovation, while skilled workers drive innovation by turning ideas into new products, services and processes for the benefit of the economy and society.

In *Powering Ideas*, the Australian Government set priorities and targets for improving Australia's research capacity and skill base:

Priority 1: Public research funding supports high-quality research that addresses national challenges and opens up new opportunities.

Target: The Australian Government's ambition is to increase the number of research groups performing at world-class levels, as measured by international performance benchmarks.

Priority 2: Australia has a strong base of skilled researchers to support the national research effort in both the public and private sectors.

Target: The Australian Government's objective is to significantly increase the number of students completing higher degrees by research over the next decade.

In respect of research capacity, the number of research fields with higher than world average citations is applied as a proxy indicator of progress against the Government's target to increase the number of research groups performing at world-class levels.

Over the period 2004-08, Australia recorded higher than world average citation rates by field in nineteen out of twenty-two research fields.

As for higher degree completions, in 2008, 7,478 students completed a higher degree by research in Australia. This provides a baseline for the Government's target to significantly increase the number of students completing higher degrees by research over the next decade.

Australia is placed in the top third of OECD countries in terms of R&D expenditure in the public sector and number of scientific publications.[2] On the other hand, Australia ranks only in the middle third on GERD relative to GDP and population, and on the quality of its scientific publications.

With regard to skill base, Australia is among the top third of OECD countries in terms of gross investment in tertiary education, population with a tertiary qualification, new PhDs, and professionals and technicians in total employment. Australia's performance is moderate however, when compared to other OECD countries on indicators of public investment in tertiary education, new graduates with science and engineering qualifications, R&D personnel as a proportion of total employment, and researchers as a proportion of the labour force.

The Australian Government has strengthened its efforts to support high-quality public research and build a strong base of skilled researchers. Major initiatives have been implemented to improve research quality and accountability in the higher education sector, to increase investment in research infrastructure, to boost funding for research training, and to support researchers at different stages of their careers. State and territory governments have also made significant contributions to strengthening Australia's research capacity and skill base through funding for high-impact research facilities, initiatives to create knowledge hubs, and support for talented researchers.

Business innovation

Technological innovation by businesses involves the creation of new knowledge that leads to the development of a product or service; it also includes process innovation which leads to improved production or delivery methods. Non-technological innovation covers changes in organisational and managerial processes to improve a firm's performance or efficiency. In *Powering Ideas*, the Australian Government set the following priorities and targets for innovation in business:

1 The total of $1.05 billion includes all programs related to low-carbon and renewable-energy innovation listed in Table 3 of the *Australian Government's 2009-10 Science and Innovation Budget tables.*

2 R&D expenditure in the public sector is composed of higher education expenditure on R&D (HERD) and government expenditure on R&D (GOVERD).

Priority 3: The innovation system fosters industries of the future, securing value from the commercialisation of Australian research and development.

Target: The Australian Government aims to see a continuing increase in the number of businesses investing in R&D.

Priority 4: More effective dissemination of new technologies, processes, and ideas increases innovation across the economy, with a particular focus on small and medium-sized enterprises.

Target: The Australian Government's goal is to achieve a 25 per cent increase in the proportion of businesses engaging in innovation over the next decade.

The number of companies registered for the R&D Tax Concession is a primary indicator of progress against the Government's target of a continuing increase in the number of businesses investing in R&D. In 2007-08, 7,754 businesses were registered for the R&D Tax Concession, providing a baseline for that target. The proportion of innovation-active businesses provides a measure of progress against the Government's target of achieving a 25 per cent increase in the proportion of businesses engaging in innovation over the next decade. In 2007-08 innovation-active businesses accounted for 44.9 per cent of all businesses in Australia.

Australia ranks in the middle third of OECD countries on most indicators of innovation activities, including business expenditure on research and development (BERD), generosity of tax treatment for business R&D, patenting and non-technological innovation. Australia is relatively lowly ranked on the proportion of firms that develop product innovations which are new to the market.

With respect to innovation outputs and outcomes, Australia is in the top third of OECD countries for knowledge-intensive market services, GDP per capita, and human development, and in the middle third on indicators of labour productivity and global competitiveness. On measures of high and medium-high technology manufacturing, high-technology manufacturing exports, and environment performance, Australia is ranked in the bottom third.

To foster industries of the future in Australia and increase support to innovative firms, the Australian Government will replace the existing *R&D Tax Concession* with a new, streamlined *R&D Tax Credit*. The Government is providing commercialisation assistance and driving eco-innovation through a number of new initiatives (including Clean Business Australia, Commercialisation Australia and the Clean Energy Initiative). It is acting to increase innovation across the economy by improving business access to ideas, technologies and venture capital, improving the intellectual property (IP) system, and fostering an innovation culture in industry. State and territory governments have also introduced initiatives to support the development of new products, services, processes and business models through the provision of venture capital, commercialisation services and business advice.

Links and collaboration

Collaboration and networking between industry and the research community enables business to tap into ideas and expertise to resolve ongoing challenges, create new products and services, and become more competitive and profitable. Collaboration within the research community enables us to build capacities that are greater than the sum of their parts. International collaboration gives Australian researchers and scientists access to new knowledge and opportunities to leverage domestic investments in research and infrastructure.

In *Powering Ideas*, the Australian Government set priorities and targets for links and collaboration:

Priority 5: The innovation system encourages a culture of collaboration within the research sector and between researchers and industry.

Target: The Australian Government's ambition is to double the level of collaboration between Australian businesses, universities and publicly-funded research agencies over the next decade.

Priority 6: Australian researchers and businesses are involved in more international collaborations on research and development.

Target: The Australian Government has adopted the long-term aim of increasing international collaboration in research by Australian universities.

The proportion of innovation-active businesses collaborating with universities and public research agencies is a measure of progress against the Government's target to double the level of collaboration between Australian businesses, universities and publicly funded research agencies (PFRAs) over the next decade. In 2006-07 around 1.6 per cent of innovation-active businesses collaborated with universities and 7.2 per cent collaborated with PFRAs.

The share of university R&D financed from abroad and the number of formal agreements on academic and research collaboration between Australian universities and overseas institutions are primary indicators of progress against the Government's target of increasing international collaboration in research by Australian universities. In 2006, around 2.9 per cent of higher education expenditure on research and development (HERD) was financed from abroad, and there were 3,493 formal agreements on research collaboration between Australian universities and overseas institutions in 2009.

With regard to knowledge exchange, Australia is in the top half of OECD countries for business-financed R&D performed by universities and government agencies (business-financed HERD and government expenditure on research and development) and patents owned by universities and government agencies. Australia ranks in the mid-range of OECD countries in terms of small and medium enterprises collaborating in innovation with higher education institutions and government institutions. For large firms, Australia ranked towards the bottom of the group of OECD countries on innovation collaboration with higher education institutions and government institutions.

On global integration, compared to other OECD countries, Australia has a relatively low rate of international collaboration on R&D and innovation measured by gross expenditure on R&D financed abroad, co-authored scientific publications, patents with foreign co-inventors, total international technology payments and receipts, and firms involved in foreign cooperation on innovation.

In contrast, Australia records one of the highest inflows of human capital from overseas among OECD countries, measured by the proportion of foreign-born people in the total employed population having a tertiary qualification (second highest in the OECD). Australia also has the sixth highest proportion of international students enrolled in advanced research programs among OECD countries.

The Australian Government supports collaboration between Australian researchers and their counterparts at home and abroad, and between researchers and industry through a wide range of programs. The Government has explicitly internationalised research programs to promote the transfer of skills and the dissemination of new ideas and technologies. The new R&D Tax Credit will be available to foreign firms and firms conducting R&D activities for which the intellectual property rights are held offshore.

State and territory governments also fund initiatives and partnerships to support public and private sector collaboration and international collaboration. These projects build national and international industry partnerships and research collaborations that provide opportunities for each state in the development of new skills, industry capabilities or research capacity.

Public sector innovation

The public sector accounts for approximately 29 per cent of GDP in Australia. Improving policy and program development through innovation is therefore a priority for the Government. Public sector innovation involves the "creation and implementation of new processes, products, services, and methods of delivery which result in significant improvements in the efficiency, effectiveness or quality of outcomes". [3]
In *Powering Ideas*, the Australian Government set the following priority:

Priority 7: The public and community sectors work with others in the innovation system to improve policy development and service delivery.

The Government has a multi-pronged approach to improving public sector innovation.

- The Review of the Australian Government Administration includes a focus on public sector innovation.
- The Australian Public Service Management Advisory Committee has undertaken a cross-agency project to examine how innovation can be encouraged in the public sector and to identify issues inhibiting innovation in the public sector.
- The Australian National Audit Office has released a *Better Practice Guide to Innovation in the Public Sector* to provide a practical framework to assist public sector agencies in their management of innovation, and to further promote an innovation culture within the public sector.
- The Government 2.0 Taskforce has identified the use of collaborative tools and approaches in *Engage: Getting on with Government 2.0*, to achieve a more open, accountable, responsive and efficient government.

3 Mulgan, G and Albury, D (2003), *Innovation in the Public Sector*, Cabinet Office Strategy Unit, London.

- The Australian Centre of Excellence for Local Government, supported by the Australian Government, aims to increase professionalism, showcase innovation and build research and development capacity to achieve better policy formulation.
- The development of metrics and data collection on public sector innovation is critical to benchmarking Australia's performance against other OECD countries and monitoring progress against the Government's goals. Australia is a member of the OECD taskforce which is examining options for measurement in this area.

This report illustrates a number of achievements and actions from the Australian Government and state and territory governments to promote innovation in the public sector.

Opportunities and challenges

In a 21st century characterised by increasing global economic competition, rapid development of knowledge and technology, and pressing social and environmental issues, Australia must continuously address these opportunities and challenges to create a more effective and efficient national innovation system.

In *Powering Ideas*, the Australian Government signalled several initiatives to support a more innovative Australia, including implementing a new foresight model, producing a research workforce strategy, and developing a measurement and analytical framework for the Australian innovation system.

The Prime Minister's Science, Engineering and Innovation Council (PMSEIC) has adopted a new model incorporating foresight methodology to support long-term, whole-of-government policy development. PMSEIC's foresighting aims to identify gaps in evidence and activity to inform decision-makers of potential future impacts of current choices and focus policy engagement with future challenges. The methodology outlines possible futures and assists in developing a strategy to reach a preferred future by systematically examining the longer-term future of science, technology, the economy, the environment and society.

Australia's research workforce is a crucial part of our skills base. Australia must therefore focus on maintaining the quality and reach of its research training system, meeting research workforce needs and building attractive career pathways for its researchers. The Research Workforce Strategy will explore and address potential shortfalls in the future supply of research-qualified people in Australia. It will also support Australia in meeting the targets for the national innovation system outlined in *Powering Ideas*. Work on the strategy is expected to be completed in the second half of 2010.

Understanding the dynamics of the innovation process is important in determining the effectiveness of government expenditure on innovation and improving policy coordination across government. In 2009, the Government commissioned the development of a measurement and analytical framework for the national innovation system. The Innovation Metrics Framework aims to develop guidelines for innovation measurement and program data collection and analysis. It evaluates limitations of current measures, identifies principles for developing new indicators and determines methods for achieving consistent program data collection.

INNOVATION SYSTEM PERFORMANCE INDICATORS

The indicators highlighted in orange will directly measure progress against the Australian Government's *Powering Ideas* innovation targets.

Research capacity and skill base

Indicators	Latest Figure	Reference Year	OECD Ranking	Gap from the Top Five OECD Performers
Target 1: Increase the number of research groups performing at world class levels				
Target 2: Increase the number of students completing higher degrees by research over the next decade				
Number of fields with higher than world average citation rate by field	19 out of 22 fields	2004-08		*Target 1 & 2*
Number of students completing higher degree by research in Australia	7,478	2008		
HERD as a % of GDP	0.52%	2006	9th	24.6%
Publications per thousand researchers	413.8	2008	9th	31.2%
Public expenditure on tertiary education as a % of GDP	1.13%	2006	15th	43.2%

Business innovation

Indicators	Latest Figure	Reference Year	OECD Ranking	Gap from the Top Five OECD Performers
Target 3: Increase in the number of businesses investing in R&D				
Target 4: 25 per cent increase in the proportion of businesses engaging in innovation over the next decade				
Number of businesses registered for the R&D Tax Concession	7,754	2007-08		*Target 3 & 4*
Proportion of innovation-active businesses in Australia	44.9%	2007-08		
BERD as a % of GDP	1.27%	2007	14th	51.8%
Patent applications filed under PCT per million population	66.9	2007	15th	64.3%
Total investment in early stage venture capital as a % of GDP	0.054%	2008-09	-	-
Proportion of non-technological innovators in manufacturing sector	31.7%	2004-06	15th	47.1%
Proportion of non-technological innovators in services sector	28.2%	2004-06	17th	52.7%

Links and Collaboration

Indicators	Latest Figure	Reference Year	OECD Ranking	Gap from the Top Five OECD Performers
Target 5: Double the level of collaboration between Australian businesses, universities and publicly funded research agencies over the next decade				
Target 6: Increasing international collaboration in research by Australian universities				
Proportion of innovation-active businesses collaborating with publicly funded research agencies	**7.2%**	**2006-07**		*Target 5*
Proportion of innovation-active businesses collaborating with universities	**1.6%**	**2006-07**		
Number of formal agreements on academic/ research collaboration between Australian universities and overseas institutions	**3,493**	**2009**		*Target 6*
Share of HERD financed from abroad	**2.9%**	**2006**		
Proportion of Australian Science & Engineering publications co-authored with foreigners	38.9%	2003	25th	34.1%
Proportion of SMEs collaborating in innovation with higher education institutions	3.1%	2004-06	13th	62.6%
Proportion of large firms collaborating in innovation with higher education institutions	10.0%	2004-06	20th	75.8%