Australian Research & Innovation

A Whitepaper

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Background

The Industry Growth Centres Initiative outlined by the Australian government identifies the top five priority industries for the country. As part of its Industry Innovation and Competitiveness Agenda, this initiative aims to foster productivity and growth by focusing on the innate strengths of the region, enabling Australia to transition to delivering more exports-centered industries for its ongoing prosperity.[1]

With a $188.5 million investment by the government, Industry Growth Centres will be established for the following five areas in which Australia already has a position of strength:

- Advanced Manufacturing
- Food & Agribusiness
- Medical Technologies & Pharmaceuticals
- Mining Equipment, Technology & Services
- Oil, Gas & Energy Resources

One of the main pillars of this initiative is to improve the engagement between research and industry, strengthening coordination and collaboration between research and commercialization in the growth sectors. To support this goal, and to identify the current state of research and innovation across the five main areas, analysts from Thomson Reuters explored the scientific research and innovation activity of each sector. The following is a summary of the findings, and a benchmark for progress as the initiative gets traction and unfolds.

Methodology

Thomson Reuters analysts studied scientific literature volume and citation impact using the Web of Science and InCites, two flagship solutions for the research and evaluation of scholarly literature trends. They also used Thomson Innovation and Derwent World Patents Index to study patent activity; patents are used as a proxy for innovation.

Scientific research typically precedes any investment in patent protection and innovation by a few years. A field of study needs to be identified, explored, and to undergo evolution before it is commercialized. This report looks at the scientific research landscape in Australia first, followed by innovation activity across the five growth sectors.

[1] http://www.business.gov.au/advice-and-support/IndustryGrowthCentres/Pages/default.aspx

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Scientific Research Landscape

Australia is a nation with a rich history in scientific research.

There are two principal means by which to measure the performance of its research. One is by sheer volume, meaning the number of research papers produced, collectively as well as individually, by Australia-based institutions. The other is by impact, meaning the influence of research according to how frequently the work is cited by peers in the worldwide scientific and scholarly community.

In terms of volume, and after institutions with a general focus, Australian universities are prolific in these areas:

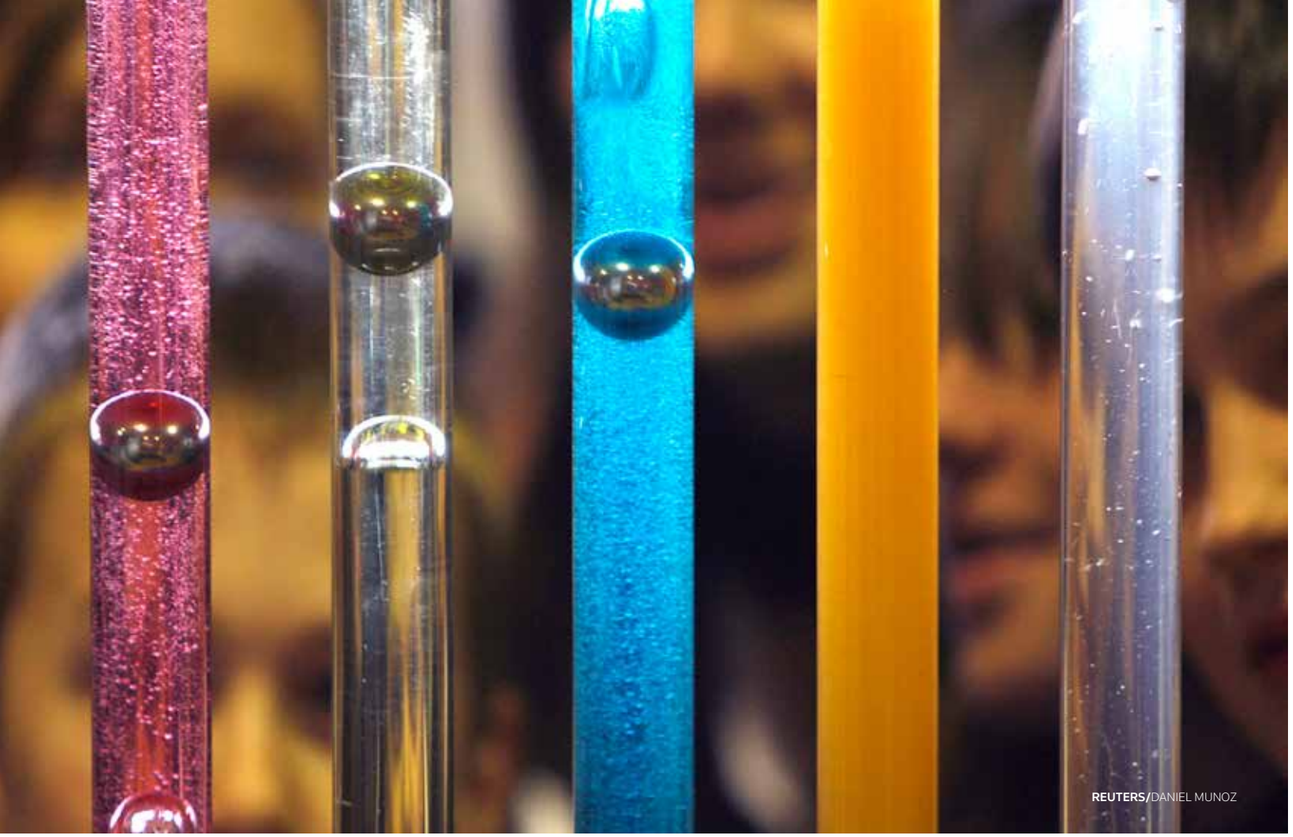
- Agriculture
- Minerals/Energy
- Oceans, Water, Land

The most prolific organizations in the nation are shown in Figure 1. Where applicable, the organization's areas of concentration have been listed, despite the imprecision in designating a "general" university as opposed to one that offers a broad range of curricula while also demonstrating strength or prominence in a given field.

Figure 1:
Top 20 Most Prolific Australian organizations (2010–2014, articles and reviews)

Rank	Institution	Concentration (where applicable)	Papers (2010–2014)
1	University of Sydney	General	30,857
2	University of Melbourne	General	29,319
3	University of Queensland	General	26,989
4	Monash University	General	24,775
5	University of New South Wales	General	22,627
6	University of Western Australia	General	17,279
7	Commonwealth Scientific & Industrial Research Organisation (CSIRO)	Objective driven research including agriculture, energy, land, water	15,032
8	Australian National University	General	14,920
9	University of Adelaide	General	12,471
10	Curtin University	General	7,875
11	Griffith University	General	7,842
12	Queensland University of Technology	General	7,328
13	Macquarie University	General	7,031
14	University of Newcastle	General	6,932
15	Deakin University	General	6,766
16	University of Wollongong	General	6,475
17	University of Tasmania	General	6,380
18	University of South Australia	General	5,742
19	James Cook University	General	5,307
20	Flinders University South Australia	General	5,244

Source: Thomson Reuters Web of Science & InCites



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Most Influential Research Organisations

Measurement on the basis of output favors large institutions that produce a high volume of research. An assessment of citation impact, on the other hand, frequently allows smaller institutions to come to the fore. Although their production of papers may be comparatively small, their influence , as measured by how frequently their research is cited by the scientific community, often outstrips that of larger producers, resulting in a different list of prominent players. Such is the case with Australian organisations..

A specific indicator available through Thomson Reuters InCites, measuring normalized citation impact, controls for different fields, document types and age of publications. This allows for an overall, multidisciplinary assessment of an institution's impact, against a baseline measurement set at 1. Based on this measure of influence, the roster of prominent Australian institutions proves to be quite distinct from the listing of the most prolific. Particularly visible on the list are institutions specializing in health and medical research. Similar trends in favor of smaller specialized organizations, notably in medical research, are frequent in most countries. The notably recurrent areas in terms of impact are:

- Cancer Research
- Cardiovascular & Diabetes
- Biomedical Research

Eleven of the top 22 organizations are in the category of health and medicine.

Figure 2 shows the most impactful organizations across Australia.

Figure 2:
Top Institutions in Australia by Relative Impact (2010–2014)

Rank	Institution	Concentration (where applicable)	Normalized Impact (versus baseline of 1.00), 2010–2014)	Papers (2010–2014)	Size class (in AUS)
1	Peter Maccallum Cancer Center	Oncology Research, Treatment	2.35	1,769	small
2	Ludwig Institute for Cancer Research	Oncology Research, Clinical Trials	2.30	1,480	small
3	Walter & Eliza Hall Institute	Biomedical Research	2.21	1,315	small
4	QIMR Berghofer Medical Research Institute	Oncology & Infectious Disease	2.15	2,376	medium
5	Garvan Institute of Medical Research	Biomedical Research	2.10	1,028	small
6	Baker IDI Heart & Diabetes Institute	Cardiovascular, Diabetes	2.03	1,364	small
7	Australian Institute of Marine Science	Oceanography, Environmental	1.99	824	small
8	Murdoch Children's Research Institute	Cell Biology, Genetics, Immunology	1.70	2,808	medium
9	Howard Florey Institute	Neuroscience	1.66	4,976	medium
11	Austin Research Institute	Biomedical Research	1.62	2,360	medium
11	St Vincents Hospital Sydney	Medical Translational Research	1.62	1,647	small
13	University of Melbourne	General	1.57	29,319	large
13	Bureau of Meteorology–Australia	Weather, Climate, Water	1.57	533	small
15	Government of Western Australia*	Food, Agriculture, Biology	1.56	539	small
17	NSW Trade & Investment*	Agriculture, Land, Water, Fisheries	1.53	1,198	small
17	Commonwealth Scientific & Industrial Research Organisation (CSIRO)	Objective driven research	1.53	15,032	large
19	James Cook University	General	1.51	5,307	medium
19	Children's Medical Research Institute–Australia	Biomedical Research	1.51	4,833	medium
21	Charles Darwin University	General, biomedical Research	1.48	1,820	small
21	University of Queensland	General	1.48	26,989	large
21	University of Sydney	General	1.48	30,857	large
21	University of Western Australia	General	1.48	17,279	large

*Source: Thomson Reuters Web of Science & InCites(*other State agencies were not included in the analysis).*

Leading Universities By Reputation

Thomson Reuters annually performs its Academic Reputation Survey of more than 800 institutions evaluated by upwards of 20,000 people around the world. Figure 3 shows the top institutions in Australasia (Australia and New Zealand) based on data from 2010 – 2014. The University of Melbourne and Australian National University are in the top 50 institutions globally based on reputation.

Figure 3:
Top 10 Institutions in Australasia by Reputation

Rank (local)	Rank (global)	University	Country/Region
1	35	University of Melbourne	Australia
2	50	Australian National University	Australia
3	51	University of Sydney	Australia
4	88	Monash University	Australia
5	92	University of Queensland	Australia
6	109	University of New South Wales	Australia
7	183	University of Western Australia	Australia
8	201	University of Auckland	New Zealand
9	217	RMIT University	Australia
10	225	University of Newcastle	Australia

Source: Thomson Reuters Web of Science and InCites

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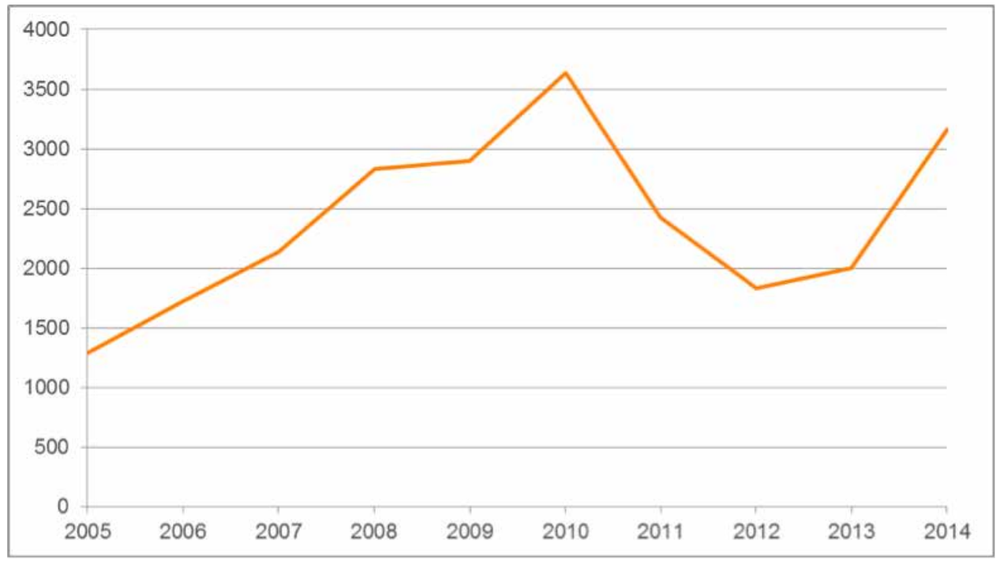
Innovation In Australia

Using patents as a proxy for innovation, Thomson Reuters analysts studied the unique patent inventions with Australian assignees from 2005 – 2014 using the Derwent World Patents Index and Thomson Data Analyzer.

The results of this effort are showcased across the five focal areas for the Australian government. Overall, as Figure 4 illustrates, innovation activity peaked in 2010, however it is making a comeback and has nearly reached the same level as that year.

Figure 4:
Overall Innovation Activity by Australian Assignees (2005 – 2014)

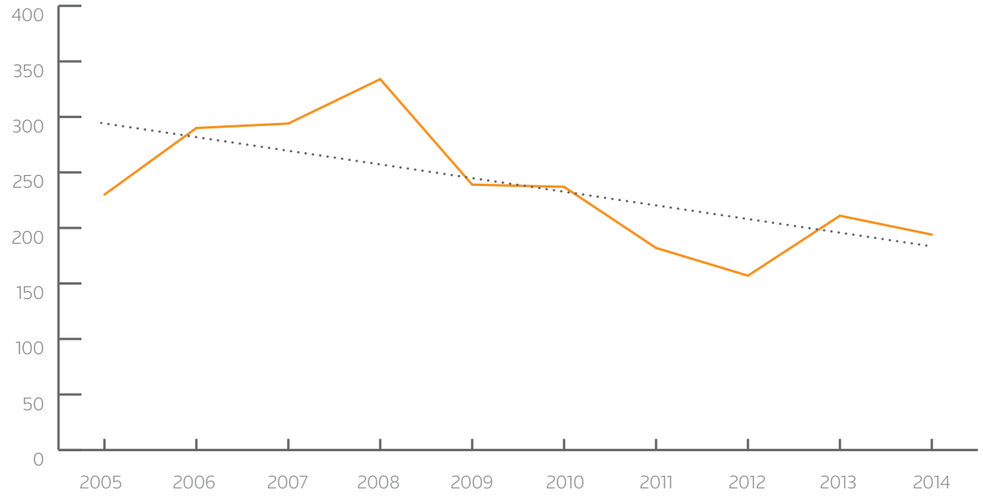


Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

Advanced Manufacturing

Advanced Manufacturing, according to the CEDA, comprises areas such as information /communications technology and industrial internet technology. For the purposes of this report, these sectors are isolated and analyzed. Figure 5 shows the overall trend line of innovation activity in Advanced Manufacturing over the last decade.

Figure 5:
Australian Innovation Trend Line for Advanced Manufacturing (2005–2014)



Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

Innovation in this area reached its peak in 2008, followed by a precipitous drop through 2012 and only a slight increase to reach its 2014 level. The top assignees innovating in this area are shown in Figure 6.

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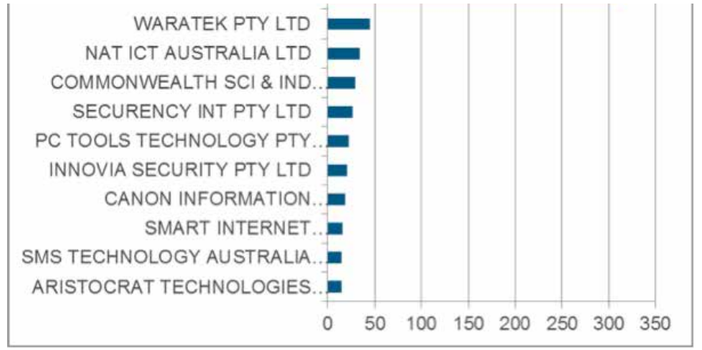
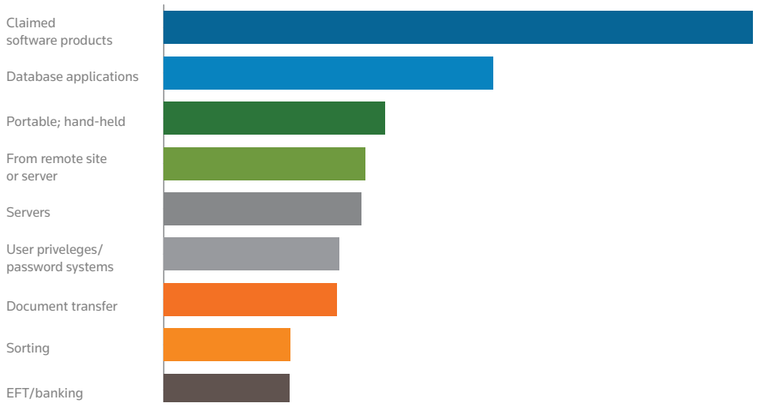
Figure 6:
Top Australian Assignees Innovating in Advanced Manufacturing (2005–2014)



Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

The type of inventions being produced by the top innovators include local memory classifying method for multiple computer systems (Waratek), and a public encryption key sending process used in a communications network for secure communications (CSIR). A breakdown of innovation across all assignees is show in Figure 7; the top areas overall are claimed software products, database applications and portable, hand-held devices.

Figure 7:
Top Areas of Australian Innovation in Advanced Manufacturing



Food & Agribusiness

Innovation in the Australian food and agribusiness sector has been bumpy over the last decade, the end result being almost a 20% decline in activity from 2005 to 2014. Figure 8 shows the peaks and valleys in Australian innovation across this sector.

Figure 8:
Australian Innovation Trend Line for Food & Agribusiness (2005–2014)

Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

The top three innovators in Food & Agribusiness comprise Australia's national scientific research agency, CSIRO; a veterinary pharmaceutical manufacturer, Jurox Pty; and a university, University of Queensland (as shown in Figure 9).

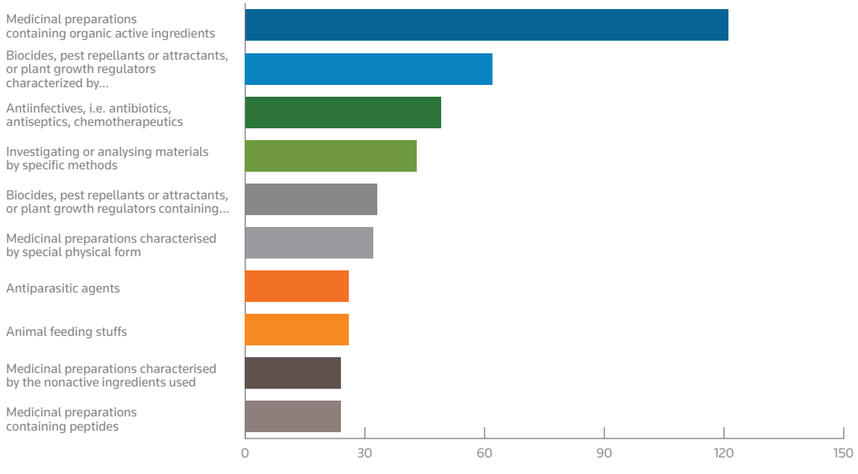
CSIRO is about 100% more active than its nearest competitor in the field. Its focus is on new, transgenic plants (such as wheat) and an encapsulated emulsion useful in food products such as yoghurt. Meanwhile, Jurox is innovating to control or prevent insect and acarid infestations, as well as in the area of parasiticidal suspension compositions. And, the University of Queensland is focused on fertilizer compositions and controlling the growth of weeds.

Figure 9:
Top Australian Assignees Innovating in Food & Agribusiness (2005–2014)

Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

Across all of the assignees in this field the main areas of innovation include medicinal preparations containing organic ingredients; biocides and pest repellants or attractants for plant growth; and anti-infectives, such as antibiotics and antiseptics, among other things (as shown in Figure 10).

Figure 10:
Top Areas of Australian Innovation in Food & Agribusiness

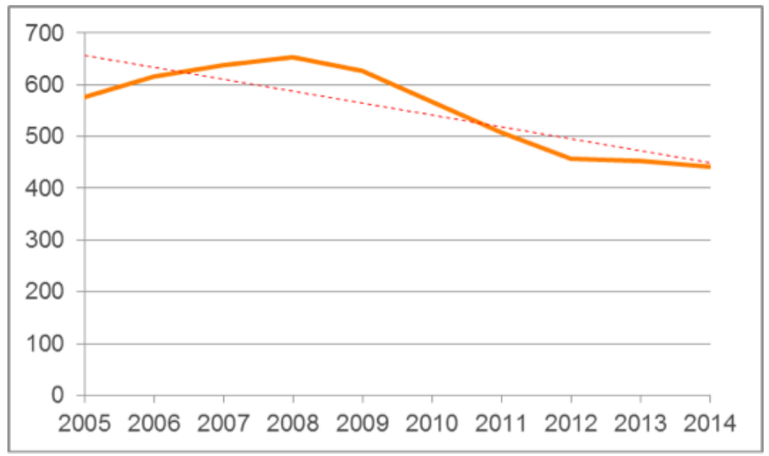


Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

Medical Technologies & Pharmaceuticals

After peaking in 2008, Australian innovation related to medical technologies and pharmaceuticals has been on a precipitous decline over the past six years, as shown in Figure 11.

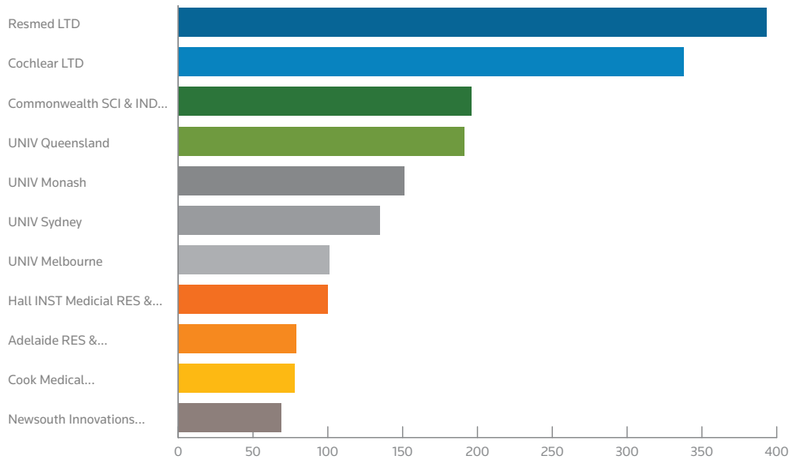
Figure 11:
Australian Innovation Trend Line for Medical Technologies & Pharmaceuticals (2005–2014)



Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

The top three innovators in this space are Resmed, Cochlear and CSIRO, as shown in Figure 12. Resmed is focused on a nasal mask for providing breathable gas and a method for managing data associated with home medical equipment. Cochlear is innovating to fit totally implantable implants in a user and bone conduction for hearing prosthesis. And, CSIRO is focused on disease detection, specifically a method for characterizing the state of brain diseases like Alzheimer's.

Figure 12:
Top Australian Assignees Innovating in Medical Technologies & Pharmaceuticals (2005–2014)



Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

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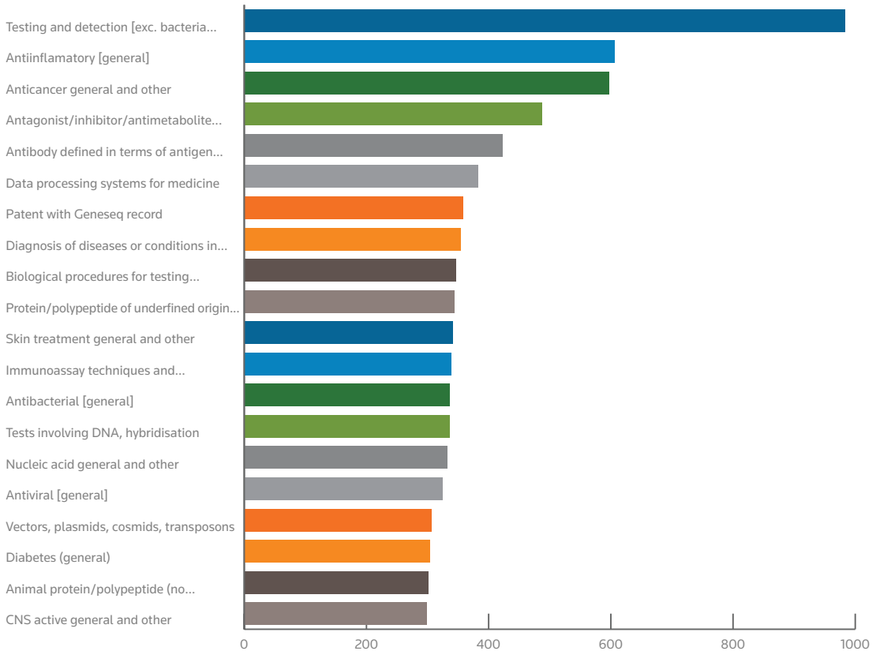
Looking across all the Australian innovators in this space, the key focal areas are around testing and detection of bacteria, anti-inflammatories and anticancer inventions, as shown in Figure 13.

Figure 13:
Top Areas of Australian Innovation in Medical Technologies & Pharmaceuticals



Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

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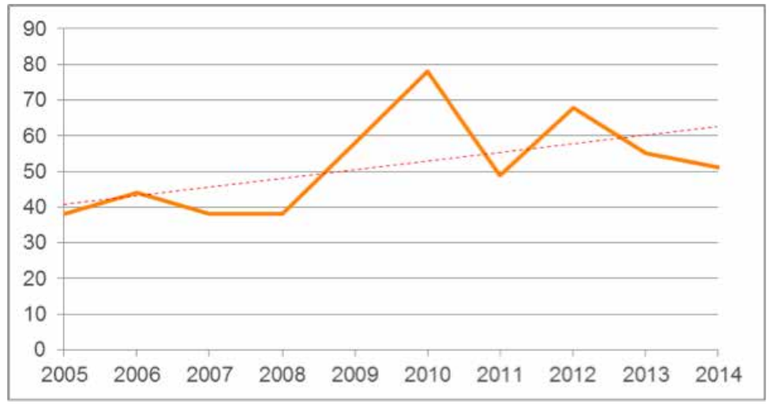
Mining Equipment, Technology & Services

Australian innovation related to mining equipment, technology and services has also had a bumpy ride over the last decade, however it finishes the 10-year-period about 25% higher than where it started, as shown in Figure 14.

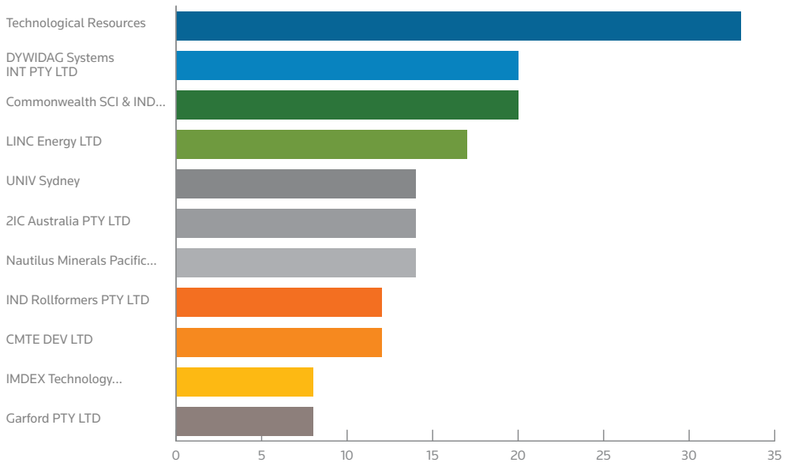
Figure 14:
Australian Innovation Trend Line for Mining Equipment, Technology & Services (2005–2014)



Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

The top innovators in this space include Technological Resources, Dywidag Systems and CSIRO, as shown in Figure 15. They are focused on methods for sorting mined material and a system for hoisting conveyance from a mineshaft; a cable-bolt manufacturing apparatus for use in mines and a method for stabilizing rock; and a mining operation controlling method for longwall mining, respectively.

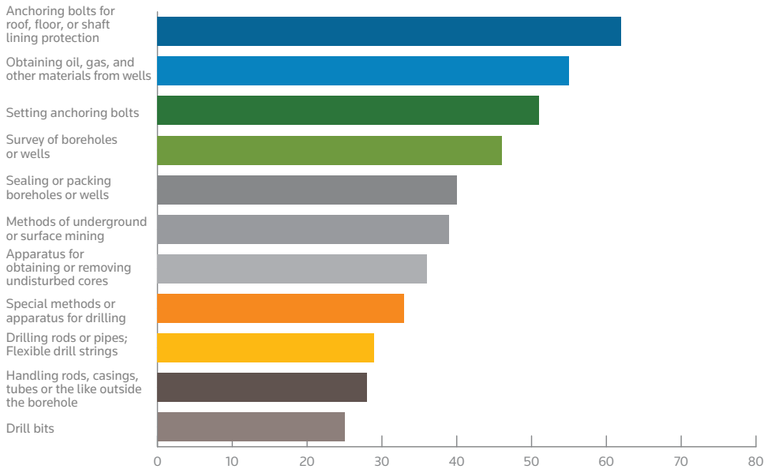
Figure 15:
Top Australian Assignees Innovating in Mining Equipment, Technology & Services (2005–2014)



Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

Looking across all of the innovators in this space, the main areas of concentration are around anchoring bolts for roof, floor or shaft-lining protection; obtaining oil, gas and other materials from wells; setting anchoring bolts; and survey of boreholes or wells, as shown in Figure 16.

Figure 16:
Top Areas of Australian Innovation in Mining Equipment, Technology & Services

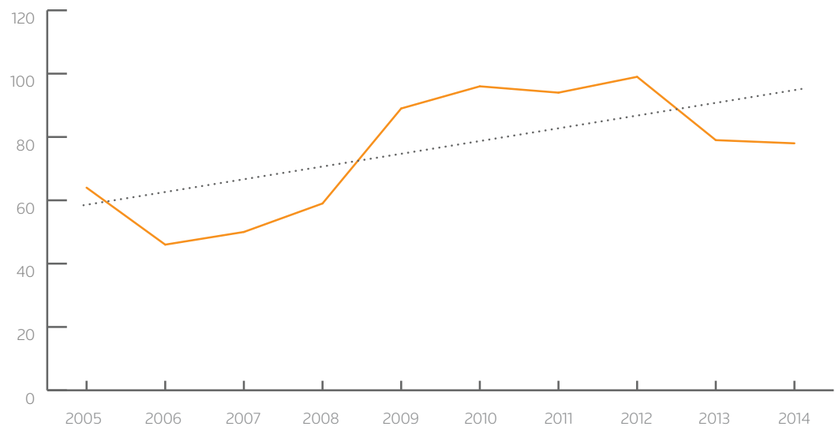


Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

Oil, Gas & Energy Resources

Oil, gas and energy resources innovation has also experienced somewhat tumultuous activity over the last decade, ending up about 27% higher in 2014 than in 2005, as shown in Figure 17.

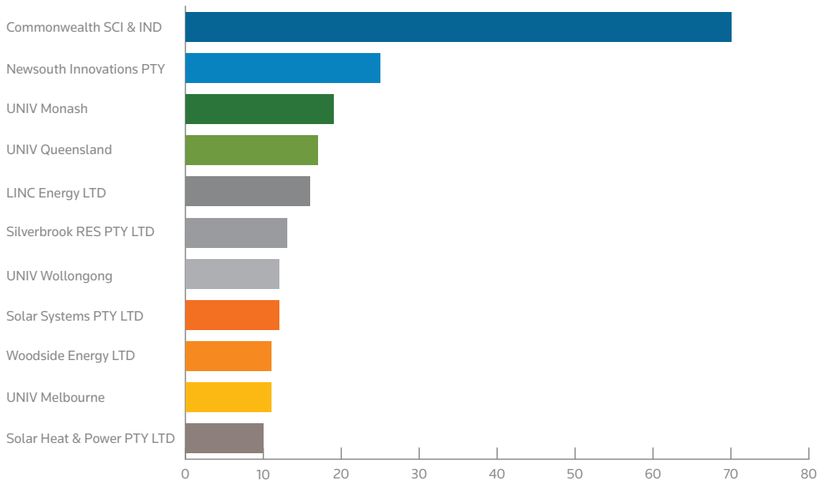
Figure 17:
Australian Innovation Trend Line for Oil, Gas & Energy Resources (2005–2014)



Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

CSIRO is once again in the top three assignees for this field, followed by Newsouth Innovations and the University of Monash, as shown in Figure 18. CSIRO's focus here is on processes for producing hydrocarbon products from plants; Newsouth Innovations on processing silicon for use in the fabrication of photovoltaic devices; and, the University of Monash on electrolytic cells for gas synthesis, batteries and fuel cells. CSIRO is nearly 200% more active than the nearest innovator in this space.

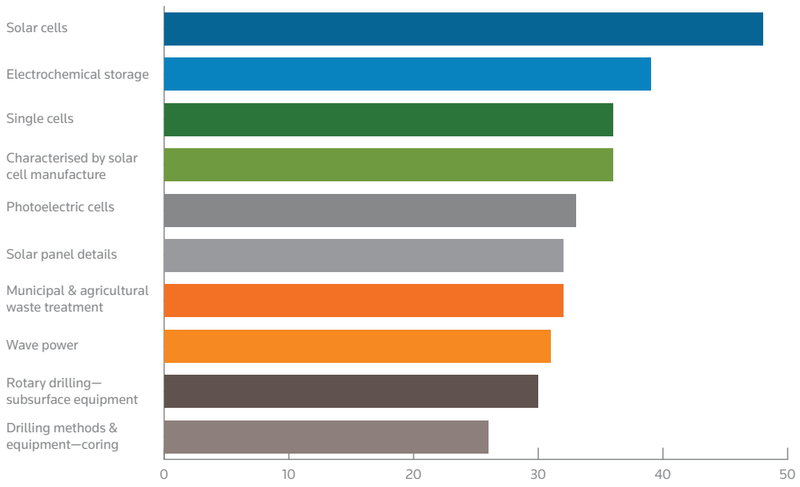
Figure 18:
Top Australian Assignees Innovating in Oil, Gas & Energy Resources (2005–2014)



Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

When looking across all of the assignees in this area, the top inventions are around the use of solar cells, electrochemical storage and single cells, as shown in Figure 19. There is a strong push for renewable sources of energy in Australia.

Figure 19:
Top Areas of Australian Innovation in Oil, Gas & Energy Resources



Source: Thomson Reuters Derwent World Patents Index & Thomson Data Analyzer

Conclusion

When taking into account the scientific research and innovation activity originating in Australia, it is clear to see that the country is making strides to support the five main growth areas: Advanced Manufacturing; Food & Agribusiness; Medical Technologies & Pharmaceuticals; Mining Equipment, Technology & Services; and, Oil, Gas & Energy Resources. However, there is room for growth, as the volume across all areas has not reached its peak, despite a recent upward trend, in most areas.

Stay tuned for additional updates on the science, research and innovation landscape across the continent, as Thomson Reuters brings you the current state of innovation at stateofinnovation.com.

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