



Australian Government
Australian Research Council

INQUIRY INTO TECHNOLOGICAL SERVICE INNOVATION IN WESTERN AUSTRALIA

SUBMISSION BY THE AUSTRALIAN RESEARCH COUNCIL

CONTACT

Organisation: Australian Research Council
Name: Leanne Harvey
Position: Acting Chief Executive Officer

INTRODUCTION

The Australian Research Council (ARC) is a Commonwealth entity that provides advice to the Government on research matters and administers the National Competitive Grants Programme (NCGP) and Excellence in Research for Australia (ERA). The ARC's mission is to deliver policy and programmes that advance Australian research and innovation globally and benefit the community. In seeking to achieve its mission, the ARC supports the highest quality fundamental and applied research and research training, through national competition across all disciplines.

The ARC welcomes the opportunity to provide input to this inquiry. This submission provides brief comments on:

- the support provided by the ARC under the NCGP for research conducted in Western Australia (WA) universities (with a particular focus on support for collaboration and for research in the areas that are targeted under this inquiry)
- the profile of research conducted in WA universities as indicated by the results of ERA 2012.

Additional information on the funding awarded to WA under the NCGP is provided in Attachment A.

NATIONAL COMPETITIVE GRANTS PROGRAMME

The NCGP supports the highest quality fundamental and applied research, research training and collaboration, including industry partnerships and infrastructure. It comprises two programmes—Discovery and Linkage:

- Discovery provides funding for investigator-initiated research projects, fellowships and awards
- Linkage provides funding for research projects, hubs, centres and infrastructure that foster collaboration among researchers and research teams in Australia, internationally and with research end-users (such as industry).

In the past five years the ARC has awarded approximately \$302.3 million under the NCGP for 575 research projects administered by WA universities. This is approximately 7.7 per cent of the total funding awarded by the ARC during this period.

The funding awarded is helping to maintain WA's research capacity by supporting:

- development of Australia's research workforce
- acquisition of and access to research infrastructure
- development of research partnerships (both national and international).

It is also helping to build scale and scope of research in priority areas through support for:

- research centres and hubs
- research in areas of Australian Government priority.

Research Collaboration

The ARC is committed to maximising the benefit of ARC-funded research through support for collaborative research and research training and provides a range of opportunities for collaboration between universities and industry, government and other partner organisations.

The Linkage Programme in particular is aimed at promoting national and international research partnerships. By supporting the development of partnerships under the Linkage funding schemes the ARC aims to encourage the transfer of skills, knowledge and ideas as a basis for securing commercial and other benefits of research.

In the past five years, WA universities have been the administering organisation on 192 proposals funded under the Linkage Programme, comprising 142 Linkage Projects grants, 45 Linkage Infrastructure grants, three Industrial Transformation Research Programme Centres/Hubs and two ARC Centres of Excellence. These grants indicate a strong level of engagement across all sectors and across all states.

Linkage Projects scheme

The Linkage Projects scheme provides funding to Eligible Organisations to support research and development projects which are collaborative between higher education researchers and other parts of the national innovation system. Proposals for funding must include at least one Partner Organisation and Partner Organisations must make a contribution in cash and/or in kind to the project.

Research projects awarded funding under the Linkage Projects scheme have involved 317 Partner Organisations of which 27 per cent were industry partners, 28 per cent were government partners, 18 per cent were other universities, 14 per cent were international partners and the remainder were community partners. The five most common partner organisations on Linkage Projects grants awarded to Western Australian universities are:

- WA Botanic Gardens and Parks Authorities (13)
- CSIRO (11)
- Woodside Energy Ltd (8)
- Geological Survey of Western Australia (5)
- Rio Tinto (5).

Industrial Transformation Research Programme

The ARC introduced the Industrial Transformation Research Programme in 2012 to develop scale and research capacity in Industrial Transformation Priority research areas. The priority areas identified and supported under the programme to date are: food and agriculture (since 2012); manufacturing (since 2013); oil and gas, including petroleum (since 2014); mining and mining services (since 2014); and medical devices and biotechnology (since 2014).

The Programme consists of two funding schemes, Industrial Transformation Research Hubs and Industrial Transformation Training Centres. Industrial Transformation Research Hubs provide funding to support collaborative research activity between Australia's higher education sector and industry that focuses on strategic outcomes not independently realisable. Industrial Transformation Training Centres foster partnerships between the higher education sector and industry to provide innovative research training within industry for higher degree by research students and postdoctoral researchers, improving and expanding the skills relevant to these industries into the future.

To date the ARC has awarded a total of 18 Research Hubs and 16 Training Centres, including one Hub and two Training Centres to WA universities:

- ARC Research Hub for Offshore Floating Facilities (The University of Western Australia)
- ARC Training Centre for Liquefied Natural Gas Futures (The University of Western Australia)
- ARC Training Centre for Mining Restoration (Curtin University).

WA universities are collaborators on two other research hubs and one other Training Centre:

- ARC Research Hub for Basin Geodynamics and Evolution of Sedimentary Systems (GENESIS)
- ARC Research Hub for Legumes for Sustainable Agriculture
- ARC Training Centre for Advanced Manufacturing of Prefabricated Housing.

The three WA-led centres and hubs involve 27 partner organisations including 13 from industry.

ARC Centres of Excellence

The ARC Centres of Excellence scheme is aimed at building critical mass in areas of research priority. Funding rounds are conducted periodically and successful Centres receive between \$1 and \$4 million per annum for seven years.

ARC Centres of Excellence funded in WA in the past five years include the ARC Centre of Excellence for the History of Emotions in 2011 and the ARC Centre of Excellence in Plant Energy Biology, initially funded in 2005, had its funding renewed in 2014.

ARC Centres of Excellence collaborating with Western Australian universities include:

- ARC Centre of Excellence for Core to Crust Fluid Systems (Macquarie University)
- ARC Centre of Excellence for All-sky Astrophysics (The University of Sydney)
- ARC Centre of Excellence in Cognition and its Disorders (Macquarie University)
- ARC Centre of Excellence for Geotechnical Science and Engineering (Newcastle)
- ARC Centre of Excellence for Engineered Quantum Systems (The University of Queensland)
- ARC Centre of Excellence for Environmental Decisions (The University of Queensland)
- ARC Centre of Excellence for Integrated Coral Reef Studies (James Cook University)

- ARC Centre of Excellence for Children and Families over the Life Course (The University of Queensland)

Fields of Research

Under the NCGP the ARC funds research across all disciplines excluding clinical medicine. Research disciplines achieving the highest levels of ARC funding in Western Australia include plant biology (\$47.1 million for 42 projects), civil engineering (\$15.0 million for 34 projects), ecology (\$9.1 million for 23 projects), psychology (\$8.7 million for 24 projects), and chemical engineering (\$7.7 million for 20 projects). More information of the number of projects and funding awarded to WA universities by field of research and socio-economic objectives can be found in Attachment A.

Agriculture and food

The ARC has awarded approximately \$257.1 million in funding for 347 research projects relating to agriculture and food over the last five years. WA has received approximately 17.7 per cent of this funding, the most notable being \$26.0 million for the ARC Centre of Excellence in Plant Energy Biology administered by The University of Western Australia (funding commencing in 2014 over seven years).

Mining and energy

The ARC has awarded approximately \$390.3 million in funding for 773 research projects relating to mining and energy over the last five years. Western Australia has received approximately 16.3 per cent of this funding, the highest proportion of any state or territory. The WA funding includes \$5.0 million awarded under the Industrial Transformation Research Program for the ARC Research Hub for Offshore Floating Facilities.

Advanced manufacturing

The ARC has awarded approximately \$516.4 million in funding for 745 research projects relating to advanced manufacturing over the last five years. Western Australia has received less than three per cent of this funding.

EXCELLENCE IN RESEARCH FOR AUSTRALIA

The ARC is responsible for administering Excellence in Research for Australia (ERA), Australia's national research evaluation framework. ERA identifies and promotes excellence across the full spectrum of research activity in Australia's higher education institutions.

ERA is a comprehensive quality evaluation of all research produced in Australian universities against national and international benchmarks. The ratings are determined and moderated by committees of distinguished researchers, drawn from Australia and overseas. The unit of evaluation is broadly defined as the Field of Research (FoR) within an institution based on the *Australia and New Zealand Standard Research Classification (ANZSRC)*.

The ERA 2015 evaluations are underway and the outcomes will be published in the ERA 2015 National Report in December. The most recent ERA results from ERA 2012 provided a nationwide stock take of discipline strengths and areas for development of research in Australian universities.

Data from ERA 2012 confirmed that the overall size and quality of Australia's university research sector increased from previous years—with more researchers and more outputs, than in the ERA 2010 round. The ratings achieved by universities were higher overall in ERA 2012 than in ERA 2010. Importantly ERA 2012 demonstrated that world standard research performance occurs at Australian universities of all kinds, in all states and territories.

All five Western Australia (WA) universities participated in ERA 2012 (Curtin University, Edith Cowan University, Murdoch University, the University of Notre Dame Australia and the University of Western Australia). There was significant breadth in good performance by WA universities as each broad discipline (2-digit FoRs) assessed in ERA 2012, from basic sciences through to the arts and humanities, had at least one WA university performing at world standard or better.

WA universities also showed particular strength in a number of fields of research that are the focus for this inquiry, including:*

- Agricultural biotechnology
- Business and management
- Classical physics
- Crop and pasture production
- Earth Sciences*
- Ecology
- Environmental science and management
- Geochemistry
- Geology
- Optical physics
- Physical chemistry
- Physical Sciences*
- Resources engineering and extractive metallurgy
- Technology*

* By identifying key research strengths such as those listed above, ERA has the capacity help promote research that is of benefit for industry and the wider economy. The results for all universities and disciplines are published in the ERA national reports following each ERA round, which can be a valuable source of information for industry to identify opportunities for collaboration with universities.

ATTACHMENT A

NATIONAL COMPETITIVE GRANTS PROGRAMME FUNDING AWARDED TO WA UNIVERSITIES

Table 1: Total funding, by scheme, 2011 to 2015

Scheme	Funding commencing in				
	2011	2012	2013	2014	2015
Discovery Projects (1)					
\$	\$20,019,963	\$14,286,085	\$19,408,832	\$21,730,682	\$16,436,731
No.	60	45	54	55	44
Discovery Indigenous (2)					
\$	\$399,982	\$1,467,224	0	\$ 610,000	0
No.	1	3	0	1	0
Discovery Early Career Researchers Award (3)					
\$		\$ 9,375,000	\$ 5,247,736	\$ 4,614,345	\$5,058,013
No.		25	15	12	14
Future Fellowships (4)					
\$	\$10,257,032	\$7,403,724	\$9,819,236	\$6,164,801	
No.	14	10	13	8	
Australian Laureate Fellowships (5)					
\$	\$2,627,006	\$3,229,566	\$3,204,762	\$2,800,000	\$2,917,436
No.	1	1	1	1	1
Super Science Fellowships (6)					
\$	\$1,670,400				
No.	3				
Linkage Projects (7)					
\$	\$13,780,671	\$9,765,447	\$7,763,585	\$9,007,553	\$8,350,568
No.	46	28	22	25	21
Linkage Infrastructure, Equipment and Facilities (8)					
\$	\$5,070,000	\$3,495,000	\$3,540,000	\$ 3,351,000	\$4,650,916
No.	12	9	10	6	9
Industrial Transformation Research Programme (9)					
\$				\$4,997,672	\$9,533,419
No.				1	2
ARC Centres of Excellence (10)					
\$	\$24,250,000			\$26,000,000	
No.	1			1	
Total (11)					
\$	\$78,075,054	\$49,022,046	\$48,984,151	\$79,276,053	\$46,947,083
No.	138	121	115	110	91

Notes

- (1) The Discovery Projects scheme provides funding for research projects undertaken by excellent individual researchers and research teams.
- (2) The Discovery Indigenous scheme supports the development of Indigenous researchers' skill and expertise.
- (3) The Discovery Early Career Researcher Award scheme (DECRA) was first introduced in 2012 and aims to develop and support early career researchers. Each year 200 awards are made under this scheme (with the exception of the inaugural year where an extra 77 awards were made).

- (4) The Future Fellowships scheme supports mid-career researchers awarding 200 fellowships a year between 2009 and 2013, 100 in 2014 and an expected 50 in 2015.
- (5) Australian Laureate Fellowships aim to attract and retain outstanding researchers to build research capacity and excellence in Australia, providing project funding as well as salary support and on-costs. It is considered the ARC's most prestigious fellowship or award with up to 17 awarded each year. Five Australian Laureate Fellowships have been awarded to researchers at Western Australian universities in the last five years:
 - Philip Bland from Curtin University of Technology exploring what meteorites can tell us about how our solar system came into being
 - Malcolm McCulloch from the University of Western Australia determining the future of coral reefs and marine calcifiers in response to rising carbon dioxide and ocean acidification
 - Mark Cassidy from The University of Western Australia engineering the future of Australia's offshore gas infrastructure
 - Ian Small from The University of Western Australia controlling gene expression in living organisms with synthetic RNA-binding proteins
 - Zheng-Xiang Li from Curtin University of Technology building a new tectonic paradigm.
- (6) In addition to the ongoing funding schemes described above, in 2010 and 2011 the ARC conducted two selection rounds under the Super Science Fellowships scheme. The aim of this scheme was to attract and retain early career researchers in Australia in three key areas (space science and astronomy, marine and climate science, and future industries research such as bio- and nanotechnology). A total of 100 Super Science Fellowships were awarded under the scheme.
- (7) The Linkage Projects scheme supports collaborative research and research training between universities and partner organisations.
- (8) Funding for infrastructure is provided under the ARC's Linkage Infrastructure, Equipment and Facilities scheme which encourages universities to develop collaborative organisational arrangements for building and using research infrastructure.
- (9) In 2012 the ARC introduced a new programme, the Industrial Transformation Research Programme to build scale and capacity in industries vital to Australia's future prosperity. The programme consists of two schemes—Industrial Transformation Research Hubs, which support collaborative research activity between the higher education sector and industry; and the Industrial Transformation Training Centres scheme which fosters partnerships between university and industry-based researchers with the goal of providing innovative research training for postdoctoral researchers and postgraduate students.
- (10) The ARC Centres of Excellence scheme is aimed at building critical mass in areas of research priority. Funding rounds are conducted periodically and successful Centres receive between \$1 and \$4 million per annum for seven years.
- (11) In the past five years the ARC has awarded over \$3.9 billion to new research projects commencing in those years. Approximately 7.7 per cent of the total funding was awarded to WA universities.

Table 2: Funding and number of projects, by field of research (1), 2011 to 2015

Field of Research	Total ARC funding		ARC funding for WA		
	Projects (no.)	Funding	Projects (no.)	Funding	% of ARC total
Biological Sciences	436	\$552,472,885	39	\$74,196,566	13.4%
Engineering	506	\$511,867,780	60	\$56,554,146	11.0%
Language, Communication and Culture	179	\$138,802,540	19	\$29,846,379	21.5%
Earth Sciences	179	\$233,737,309	24	\$27,675,556	11.8%
Technology	156	\$172,693,369	17	\$14,719,992	8.5%
Physical Sciences	209	\$409,042,825	20	\$13,312,082	3.3%
Chemical Sciences	280	\$248,321,737	18	\$10,697,579	4.3%
Psychology and Cognitive Sciences	136	\$168,277,324	12	\$10,128,488	6.0%
Environmental Sciences	136	\$140,628,745	10	\$9,441,176	6.7%
Mathematical Sciences	184	\$180,281,195	14	\$8,924,663	5.0%
History and Archaeology	126	\$119,908,768	11	\$7,840,382	6.5%
Medical and Health Sciences	271	\$308,647,931	14	\$7,297,934	2.4%
Studies in Human Society	315	\$193,565,804	17	\$7,210,369	3.7%
Information and Computing Sciences	216	\$174,677,395	11	\$6,990,909	4.0%
Agricultural and Veterinary Sciences	77	\$55,960,970	11	\$4,376,531	7.8%
Education	127	\$68,026,445	15	\$4,222,014	6.2%
Commerce, Management, Tourism and Services	115	\$48,796,631	10	\$3,747,977	7.7%
Economics	88	\$71,763,228	6	\$2,349,785	3.3%
Studies in Creative Arts And Writing	76	\$28,925,795	5	\$1,307,115	4.5%
Built Environment and Design	54	\$21,562,443	4	\$1,284,744	6.0%
Law and Legal Studies	61	\$49,909,611	1	\$180,000	0.4%
Philosophy and Religious Studies	68	\$38,139,493	0	\$0	0.0%
TOTAL	3995	\$3,936,010,223	338	\$302,304,387	7.7%

Notes

- (1) Field of Research codes are a hierarchical classification system maintained by the Australian Bureau of Statistics to categorise research and development activity by the techniques and methodology used. The three levels within the classification system are Divisions (broad discipline level or two digit), Groups (discipline level or four digit) and Fields (specific discipline level or six digit). Researchers applying for ARC funding are asked to identify the Fields of Research most relevant to their proposal at the six digit level, which can be amalgamated into two digit and four digit levels.

At the 2-digit level, the highest levels of funding awarded to WA universities are recorded for research nominated as falling within the FoR codes of: biological sciences (\$74.2 million for 39 projects), engineering (\$56.6 million for 60 projects), language, communication and culture (\$29.8 million for 19 projects), earth sciences (\$27.7 million for 24 projects), and technology (\$14.7 million for 17 projects).

At 4-digit level disciplines achieving the highest levels of ARC funding in WA include: plant biology (\$47.1 million for 42 projects), civil engineering (\$15.0 million for 34 projects), ecology (\$9.1 million for 23 projects), psychology (\$8.7 million for 24 projects), and chemical engineering (\$7.7 million for 20 projects).

Table 3: Funding and number of projects, by socio-economic objectives (1), 2011 to 2015

Socio-Economic Objective	All ARC funding		ARC funding for WA		
	Projects (no.)	Funding	Projects (no.)	Funding	% of ARC total
Defence	51	\$19,515,202	10	\$4,123,128	21.1%
Energy	334	\$167,886,317	59	\$33,375,178	19.9%
Mineral Resources (excl. Energy Resources)	85	\$ 4,089,577	14	\$7,158,274	16.2%
Education and Training	200	\$67,905,124	23	\$10,510,601	15.5%
Cultural Understanding	572	\$261,409,315	38	\$37,702,108	14.4%
Commercial Services and Tourism	55	\$15,778,304	5	\$1,789,678	11.3%
Animal Production and Animal Primary Products	59	\$31,280,560	7	\$3,031,193	9.7%
Plant Production and Plant Primary Products	117	\$105,162,697	24	\$9,198,561	8.7%
Expanding Knowledge (2)	2931	\$1,688,457,520	214	\$126,641,756	7.5%
Construction	145	\$55,284,252	14	\$4,145,588	7.5%
Environment	822	\$446,513,501	68	\$29,512,684	6.6%
Economic Framework	205	\$82,339,908	14	\$3,713,393	4.5%
Manufacturing	397	\$193,248,540	18	\$7,495,564	3.9%
Health	797	\$416,048,409	41	\$14,981,628	3.6%
Law, Politics and Community Services	384	\$138,578,900	14	\$4,499,763	3.2%
Information and Communication Services	328	\$168,169,216	11	\$4,203,000	2.5%
Transport	93	\$34,342,881	1	\$222,290	0.6%
TOTAL	7575	\$3,936,010,223	575	\$302,304,387	7.7%

Notes

- (1) Socio-Economic Objective (SEO) codes are a hierarchical classification system maintained by the Australian Bureau of Statistics to categorise research and development activity according to the intended purpose or outcome of the research. The Socio-Economic Objective classification is a four level hierarchy including Sectors (letter level), Divisions (two digit level), Groups (four digit level), and Objectives (six digit level). Researchers applying for ARC funding are asked to identify the Socio-Economic Objectives most relevant to their proposal at the six digit level, which can be amalgamated into two digit and four digit levels.

At the 2-digit level, the highest levels of funding awarded to WA universities are recorded for research nominated as falling within the SEO codes of: expanding knowledge (\$126.6 million for 214 projects), cultural understanding (\$37.7 million for 38 projects), energy (\$33.4 million for 59 projects), environment (\$29.5 million for 68 projects), and health (\$15.0 million for 41 projects).

At the 4-digit level, groups achieving the highest levels of ARC funding since 2011 include: expanding knowledge (\$126.6 million for 214 projects), understanding past societies (\$30.0 million for 14 projects), mining and extracting of energy resources (\$19.6 million for 20 projects), flora, fauna and biodiversity (\$10.6 million for 20 projects), and clinical health (\$6.6 million for 16 projects).

- (2) Expanding knowledge is the categorisation of research and development used for pure basic or strategic basic research.