

Senate Economic References Committee
Inquiry into Australia's Innovation System
Submission by the Australian Research Council

Contents

INTRODUCTION.....	2
AUSTRALIA'S DUAL FUNDING MODEL	2
NATIONAL COMPETITIVE GRANTS PROGRAM (NCGP)	3
Funding excellent research across all disciplines.....	3
Promoting excellence in basic research.....	5
Supporting a sustainable research workforce	5
Supporting Partnerships	8
International Collaboration.....	8
Open Access and Open Data.....	10
Promoting Benefits of Research	11
EXCELLENCE IN RESEARCH FOR AUSTRALIA.....	12
Quality Assurance for Australia's University Research	12
ERA Data and the Benefits for Universities, Government and Industry	13
Research Quality Underpinning Research Impact—Evidence from ERA	15
Appendices.....	17

INTRODUCTION

The Australian Research Council (ARC) has a unique and important role in Australia's innovation system. It funds and evaluates research excellence across all research disciplines in Australian universities. The ARC promotes national and international collaboration in the research sector and also makes a major contribution to building Australia's research capacity. ARC funded projects drive social, economic, environmental and technological advances arising from the innovative research undertaken.

The ARC welcomes the opportunity to provide a submission to the Senate Economic References Committee Inquiry into Australia's Innovation System (the Inquiry). The terms of reference provided for the Inquiry cover a broad range of issues relating to Australia's innovation system including the role of industry, the education sector, the research sector, government, and broader social and economic impacts of innovation. The submission addresses the terms of reference by providing an overview of the ARC and its role in Australia's dual funding model for university research, and the policies and benefits arising from the ARC's two key programs: National Competitive Grants Program (NCGP) and Excellence in Research for Australia (ERA).

The NCGP provides grants for research and researchers and makes a fundamental contribution to the innovation system by:

- funding research across all disciplines areas
- promoting excellence in basic and applied research
- supporting researchers across all career levels
- supporting partnerships between university-based researchers and researchers in other sectors in Australia and overseas
- promoting international collaboration.

In addition, the ARC's policies regarding open access, open data and promoting the benefits of research (in conjunction with other publicly funded research agencies), ensures that the NCGP's contribution to innovation in Australia will be sustained into the future.

ERA is Australia's national evaluation of the quality of research conducted by Australia's universities. It makes a strong contribution to the innovation system by:

- providing quality assurance of Australia's university research
- providing a valuable information resource for universities, government and industry to make strategic investments that promote research and innovation
- showing that there is growing evidence that research quality underpins the wider benefits of research.

AUSTRALIA'S DUAL FUNDING MODEL

Australia has a dual funding model for higher education research (and research training), which funds research through competitive grants and block grants for universities. Australia awards substantial research funding on the basis of competitive grants which are provided to researchers based on the evaluation of research proposals for future research.

The ARC has a major role in awarding competitive grants through the NCGP and the ARC's grants represented a 10.2 per cent share of total Commonwealth investment in research and development over 2013–14.¹

The other main form of university funding for research is the Government's allocation of block grants to universities to support research and research training. In Australia, the overall research block funding to universities is expected to be \$1.72 billion for 2014. The two sources of funding are not independent of each other, though, since university income from Australian Competitive Grants (HERDC category 1 income, predominantly ARC and NHMRC funding), is used as a performance index for awarding Research Infrastructure Block Grants and Sustainable Research Excellence (SRE) funding. This income is also used to inform calculations for funding through the Australian Postgraduate Awards, Research Training Scheme and International Postgraduate Research Scholarships. Furthermore, the performance of universities in ERA moderates the apportionment of 60 per cent of the funding available under the Threshold 2 element of SRE funding. For 2014, the total SRE (Threshold 2) funding was \$116.4 million, which means that ERA is used to moderate the apportionment of \$69.8 million of funding. This represents only 4 per cent of the total research block grant funding for the year.

NATIONAL COMPETITIVE GRANTS PROGRAM (NCGP)

The NCGP provides funding for research and research training across all discipline areas including some health and medical research. The ARC's CEO makes funding recommendations for grants or fellowships to the Minister for Education following a process of expert review. The NCGP comprises two programs of funding (Discovery and Linkage). In 2013, the ARC's funding covered more than 5500 research projects and more than 8000 individual researchers.

The Discovery Program supports the growth of Australia's research and innovation capacity, which generates new knowledge resulting in the development of new technologies, products and ideas, the creation of jobs, economic growth and an enhanced quality of life in Australia.² The ARC's Discovery funding schemes totalled \$551.4 million in 2013–14.

The Linkage Program focuses on promoting research partnerships (national and international) between researchers and business, industry, community organisations and other research agencies. As a result, the Linkage funding schemes encourage the transfer of skills, knowledge and ideas to develop commercial and other benefits or research.³ The Linkage funding schemes totalled \$332.4 million in 2013–14.

Funding excellent research across all disciplines

The ARC contributes to innovation by funding excellent research across all disciplines. Due to the competitive process that the ARC uses to distribute funding, it focusses on supporting researchers and research projects that are of the highest quality.

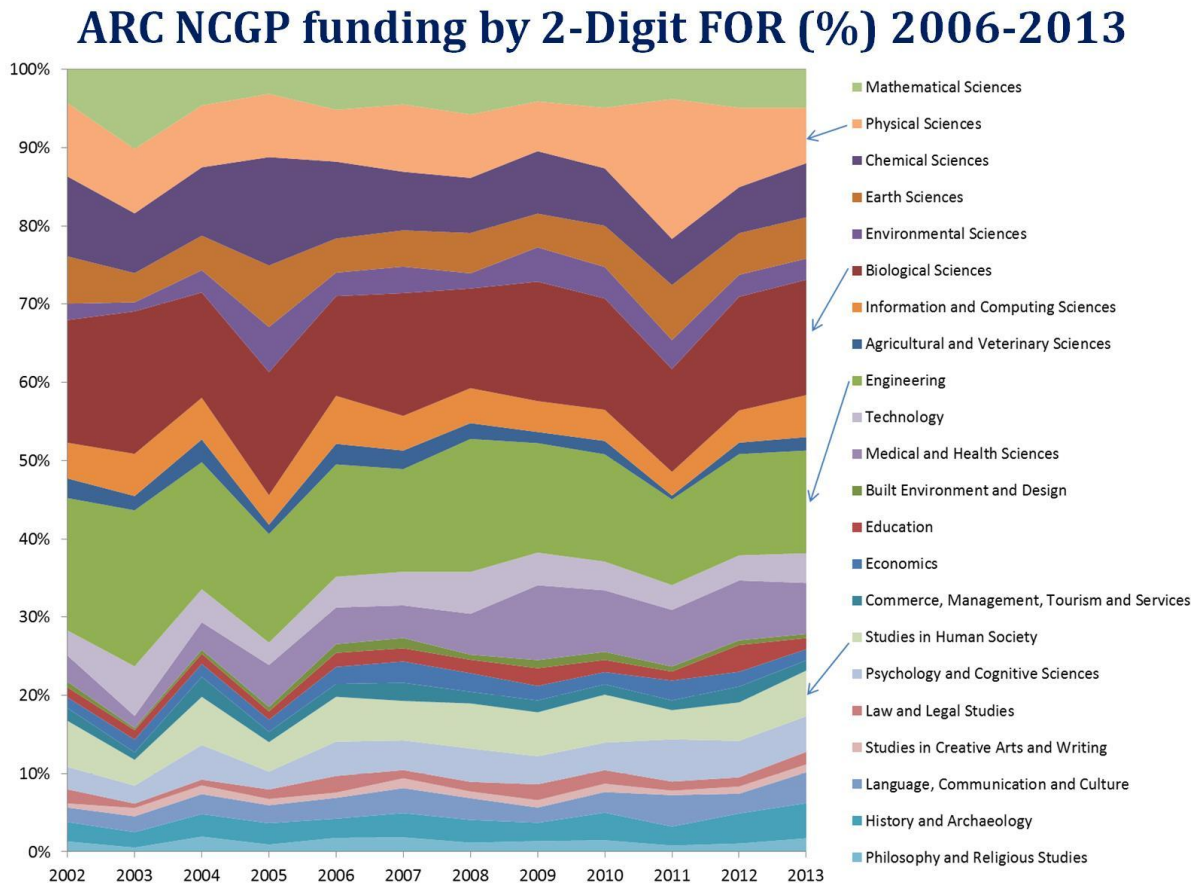
¹ A graph of the sources of commonwealth funding of research and development for 2013–14 is available at appendix 1.

² The main Discovery schemes are: Discovery Projects, Discovery Early Career Researcher Award, Future Fellowships, Australian Laureate Fellowships and Discovery Indigenous, for further detail, see http://www.arc.gov.au/about_arc/arc_profile.htm#discovery.

³ The main Linkage schemes are: Linkage Projects; Linkage Infrastructure, Equipment and Facilities; ARC Research Centres; and Special Research Initiatives, for further detail, see http://www.arc.gov.au/about_arc/arc_profile.htm#linkage.

At an aggregate level, the success of the NCGP in targeting the highest quality research is demonstrated by the ERA 2012 results showing that 72.4 per cent of Category 1 research income was associated with assessed units of evaluation rated above or well above world standard.⁴ The breadth of the ARC's research funding through the NCGP is illustrated in the following graph. It shows the proportions of the ARC's investment in university research across two digit fields of research over the period of 2007 to 2013.

Figure 1: Funding profile as a function of discipline



Maintaining a strong research capacity across the disciplines is a key feature of nurturing innovation in the Australian economy into the future. Multi-disciplinary research plays an important role in creating solutions to a range of complex economic and social challenges. Furthermore, a number of the most promising emerging skilled industries, such as nanotechnology, draw from a variety of disciplines. For example, the \$23 million awarded to the ARC Centre of Excellence for Nanoscale BioPhotonics at the University of Adelaide for funding commencing in 2014, will undertake research boundaries of biology, lasers and nanoscience, to use light-based sensors to probe molecular processes within living systems.

⁴ Category 1 research income includes all research income universities receive from Australian Competitive Grants. The funds awarded by the ARC and the NHMRC form the bulk of this income. See page 14 of this submission for a graphical representation. The ERA rating process is discussed later in this submission.

In describing the value of the interdisciplinary approach the Centre Director Professor Tanya Monro noted:

Our understanding of the processes of life is limited by constraints imposed by studying cells and biological systems outside the body...

We will use nanomaterials and photons to serve as an interface between organisms and artificially engineered systems. By bringing these fields together we will transform our understanding of nanoscale events in living systems.

We will create a window into the body, with tangible outcomes from our research in areas such as reproductive health, the immune system, and cardiovascular health.⁵

Promoting excellence in basic research

Over the years, breakthroughs in basic research have resulted in many of the social, economic, medical and technological innovations that have transformed well-being and standard of living throughout the world. Australian examples of these breakthroughs are numerous but include: the application of research on communications technologies such as those embedded in mobile phones and other mobile devices (noting Australia's contribution to WIFI is well documented); and contributions to worldwide disease control, for example, through the research of Professor Frank Fenner.

Despite its importance, there is little incentive for private investment in basic research as risks (in terms of financial benefit derived from specific projects) may be high and the time lags for financial gains can take decades. In Australia, the vast majority of basic research is undertaken in universities and in 2010 basic research constituted 45.2 per cent of higher education expenditure on research and experimental development (according to the Australian Bureau of Statistics). The ARC, therefore, particularly through the Discovery Program, has a pivotal and significant role in supporting Australia's capacity for basic research.

The ongoing capacity of Australia to deliver high quality basic research depends on maintaining long-term stability in overall government funding, and the utilisation of the ARC's flexibility to deliver funds through mechanisms that respond to the specific needs of the highest quality proposals. Having a mix of grants, through fellowships, project funding or special initiatives of varying duration lengths allows the ARC to fund basic research that can respond to the areas of strategic importance to Australia and its national interest. It is also fundamental to maintaining the research capacity that drives future innovation and knowledge based economic growth.

Supporting a sustainable research workforce

Attracting and maintaining a strong research workforce is essential to the ongoing success of Australia's universities and the wider innovation system. There are a variety of ARC fellowship schemes available across all career levels and discipline areas that help promote excellence in the research workforce in Australian universities.

The Australian Laureate Fellowships, for example, focus on attracting world class researchers and research leaders, and also includes the provision for fellowships to be allocated to exceptional female researchers who will also undertake an ambassadorial and mentoring role to promote women in research. The Discovery Indigenous scheme supports research and research training for Indigenous Australians, and there are significant schemes to support early and mid-career researchers. In addition to direct fellowships much of the research support provided through our awards goes to support for post-doctoral and post-graduate researchers.

⁵ See http://www.arc.gov.au/media/feature_articles/dec13_New_centres_announced.html

The research environment provides significant challenges for early and mid-career researchers. The term of reference at point (g) notes the importance of 'research pathways' for early and mid-career researchers to the innovation system. Although early-career researchers are highly trained in comparison to other professions, they may have limited financial and career development prospects. Furthermore, attracting and maintaining mid-career researchers in Australian universities in the face of competition from international universities and other sectors, is a challenge for Australian universities.

Through the NCGP, the ARC has provided opportunities for early and mid-career researchers under the various discovery and linkage schemes. The DECRA scheme is a separate element of the Discovery Program. It provides focused support for researchers and for early-career researchers (for teaching and research positions and research-only positions) and improved opportunities for diverse research career pathways. Researchers may be eligible to apply for the DECRA scheme if they have been awarded a PhD within five years of the closing time of submission of proposals—this eligibility criterion may be extended to nine years post PhD if taken together with periods of significant career interruption.⁶ The DECRA scheme provides three-year awards, for up to 200 researchers per year.

As part of the 2014–15 Federal Budget, the Government announced that the Future Fellowships would be an ongoing scheme, with 100 fellowships available per year for the forward estimates. The *Future Fellowships* scheme supports research in areas of critical national importance by giving outstanding researchers incentives to conduct their research in Australia. Many highly qualified mid-career researchers further their careers overseas due to lack of opportunities in Australia. Future Fellowships address this by providing four-year fellowships to outstanding Australian mid-career researchers.

ARC Centres of Excellence and Linkage Projects schemes allow eligible researchers and research teams to apply for project support for themselves, research assistants, research technicians and postgraduate students. Postgraduate and postdoctoral stipends are also awarded under the Industrial Transformation Research Program. In particular, the *Industrial Transformation Training Centres* scheme is aimed at fostering close partnerships between university-based researchers and other research end-users to provide innovative Higher Degree by Research (HDR) and postdoctoral training for the end-user focused research industries vital to Australia's future. Across 11 centres established to date, opportunities were created for 115 HDR and 33 postdoctoral researchers across a range of industry areas including food to manufacturing.

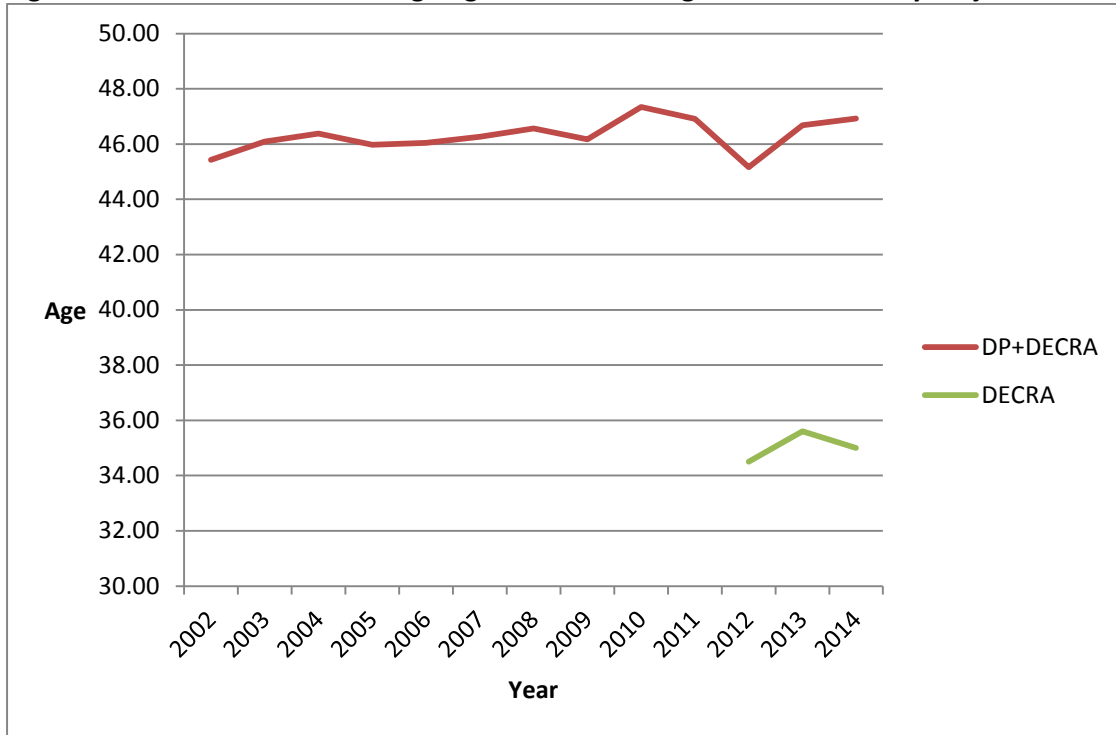
Overall, ARC trend data shows that the average age of chief investigators in one of the ARC's primary schemes (ARC Discovery Projects) has remained stable over the past decade. As the graph demonstrates (Figure 2), the average age of chief investigator's for Discovery Projects (including DECRA since 2012, which was formerly part of Discovery Projects as Early Career Researcher-Only Proposals) has changed very little since the inception of the scheme in 2002. Trend line analysis indicates a slow increase of just three weeks a year).

In this regard, it is also worth noting that researchers in the early stages of their career may be older than in many other professions. The average age in 2014 for DECRA recipients (a scheme that is normally only open to researchers up to five years after the award of PhD⁷) was 35.

⁶ See <http://www.arc.gov.au/ncgp/decra/fundingrules.htm> for the definition of significant career interruptions.

⁷ For example, see the criteria for eligibility criteria for the ARC's DECRA scheme noted above (the eligibility criteria can be extended to 9 years post PhD depending on career interruptions).

Figure 2: Trend Data of the Average Age of Chief Investigators for Discovery Projects and DECRA



Supporting Partnerships

The ARC also makes a major contribution to innovation in Australia by supporting partnerships between universities and research users, such as industry. As a key element within the NCGP, Linkage Projects encourages the formation of long-term alliances between university researchers and industry, government and community organisations (otherwise known as partner organisations). The scheme has been in operation in one form or another since 1990. In that time the size of the program and the level of partner organisation commitment to it has grown significantly and today, demand continues to be strong. In the most recent year of funding under the scheme (for funding commencing in 2014), for example, 699 applications were received of which 251 were successful, involving 415 partner organisations.

Approximately 51 per cent of the total partner contributions pledged in the 2014 funding round was provided by industry partners. This is important given that the level business expenditure on research and development as a proportion of Australia's gross domestic product has decreased in recent years.⁸ The industry partners included a range of large multinational firms, as well as a host of small to medium-sized enterprises.

To some extent, the Linkage Projects scheme is unique among the suite of programs offered by the Australian Government to encourage universities to work with industry, government and community organisations. Although it does not provide funding directly for commercialisation activities, it enables the parties involved to take a first step towards working together.

Large-scale collaborative research programs are funded under the ARC Centres of Excellence scheme and Industrial Transformation Research Program (ITRP). Similar initiatives exist in countries around the world to provide a focus for collaborative cross-cutting activities.

In 2014, the ARC is funding about 50 research centres including ARC Centres of Excellence, Industrial Transformation Research Hubs and Industrial Transformation Training Centres. All centres involve the participation of collaborating organisations, which bring with them cash and in-kind contributions to the research being conducted.

The hubs and centres funded under the ITRP are unique in that they are focused specifically on building collaborative research activity between the Australian higher education sector and industry. For example in June 2014, the Government announced the establishment of seven new industry research hubs (under the Industrial Transformation Research Hubs scheme) that will support collaborative research and development that will address industry challenges across areas including, mining, grain improvement, aquaculture and manufacturing. The ARC funding for these hubs is \$23.9 million with more than \$36.4 million being contributed (in cash and in-kind) by 26 partner organisations (which range from multinational companies including BHP Billiton Iron Pty Ltd to regional businesses such as Intrepid Geophysics).

International Collaboration

Australia's economic, social and environmental well-being depends on having a world-class science and research sector that is globally engaged. The ARC has a long established reputation internationally for supporting outstanding research, researchers and research facilities. At the same time, the ARC considers that future improvements in innovation in Australia will require continued efforts to attract international investment in Australian based research.

⁸ See <http://www.abs.gov.au/ausstats/abs@.nsf/mf/8104.0/>

International research collaboration can provide substantial leverage of Australia's domestic research investment by providing access to knowledge, expertise and infrastructure that is not available in this country, and can greatly increase the citation impact of Australian research. It also supports the delivery of broader Australian Government objectives in aid, trade and diplomacy. In a recent survey of ARC-funded researchers, contributions mentioned included:

- increased visibility of research and accompanying advantage including improvements in Australia's research reputation, attraction of students and visitors to Australia and identification of new opportunities for research collaboration
- increased uptake of research (including government uptake)
- increased Commercialisation
- improved quality of research (through access to researchers/equipment).

All NCGP schemes provide funding for international research collaboration, to enable Australian researchers to effectively engage with other world-leading researchers. There is evidence of significant levels collaboration between Australian and international researchers in ARC funded schemes. For example, in 2012–2013 ARC funding rounds, over 60 per cent of applications indicated an intention to collaborate internationally, amounting to over 7500 instances of intended international collaboration.⁹ Given that the vast majority of research undertaken globally is conducted outside of Australia, the international collaboration from ARC supported research of significant importance to the innovation system.

Furthermore, ARC supported researchers are collaborating with researchers in countries that are well recognised for having strong research performance. Data collected regarding international collaboration on ARC grant applications over the period 2010 to 2014 show that the United States was a country for collaboration (accounting for 24 per cent of the intended instances to collaborate internationally collaboration), followed by the United Kingdom (15%), Germany (8%), France (6%), Canada (5%), China (5%), and Japan (4%).¹⁰ A key focus for the ARC is maintaining high levels of international collaboration and promoting the benefits it provides for the Australian research sector.

The ARC also participates in research forums, and liaises with comparable funding agencies overseas, to ensure that ARC is abreast of international developments and best practice standards. The ARC also uses these opportunities to communicate the strength and accomplishments of Australian research, and promotes opportunities for international participation and engagement in NCGP supported research.

However, the ARC also looks to identify further mechanisms that can promote international opportunities for Australian research, including accessing and leveraging funding from overseas. In this regard it is worth noting that the funding bodies in other countries, such as the National Science Foundation in the United States, account for a major share of global funding of basic research. Furthermore, major international initiatives such as the European Union's €80 billion research and innovation program—Horizon 2020—which is open to the participation of researchers from across the world, provides opportunities for deeper research cooperation between Australia and other countries. Pursuing deeper engagement with such overseas funding bodies and programs, and promoting the related international investment opportunities they provide, will help achieve the best outcomes for Australian research and the innovation system more broadly.

⁹ See appendix 2 for more information.

¹⁰ Appendix 2 (Table 1) provides a further breakdown of international collaboration in ARC-funded research.

Open Access and Open Data

ARC's open access policy and practices towards open data also ensure that the results of ARC funded research are available to all parts of the innovation system. Open access publishing is the practice of providing unrestricted, free access to peer-reviewed scholarly research. The two most common ways to provide open access are through self-archiving, also known as 'green' open access (where material typically becomes available after an embargo period), and open-access journals, known as 'gold' open access (which typically have upfront charges for authors). The move towards Open Access is a worldwide trend and currently there are more than 250 academic institutions or research funding organisations mandating Open Access for publications across the world.

Open access to scholarly research is important in that a large percentage of research is paid for by taxpayers through government grants, who therefore have a right to access the results of what they have funded. Additionally, researchers and research users (including industry) may benefit from the open and free accessibility of research results.

The ARC Open Access for ARC-funded research took effect from 1 January 2013. The policy requires that any publications arising from an ARC supported research project must be deposited into an open access institutional repository within a 12 month period from the date of publication. The requirements of the policy have been incorporated into all new ARC Funding Rules and Agreements released after 1 January 2013. Throughout 2013–14 the ARC continued to roll-out its *Open Access Policy (January 2013)* for ARC-funded research.

Open data is the idea that publicly funded data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control. The goals of the open data movement are similar to those of Open Access publishing. There is a global trend towards facilitating broader and easier access to the data generated from publicly funded research.

While the ARC has not mandated an Open Data policy, the ARC is committed to maximising the benefits from ARC-funded research, including encouraging greater access to research data. In line with its responsibilities outlined in the Australian Code for Responsible Conduct of Research (2007) and international best practice, since 2007 the ARC has encouraged researchers to deposit data arising from research projects in publicly accessible repositories. In January 2014, the ARC continued to foster a culture of good data management and practices by clarifying its data management expectations. A requirement for researchers to outline how they plan to manage research data arising from ARC-funded research was added to the funding rules and supporting documentation of Discovery Program schemes for 2014 and 2015. The requirement forms part of the application process to receive funding.

Promoting Benefits of Research

The ARC's support of high quality research across all disciplines through the NCGP have provided important and long lasting benefits for Australia and its innovation system. Its policies towards international collaboration, open access, open data and support for researchers across all career stages, is ensuring that ARC supported research continues to provide the widest possible benefits to Australia and facilitate the development of this research by industry, government and other stakeholders in the innovation system.

However, there is an increasing focus on showcasing or measuring the societal benefits from research, and a need for better coordination in reporting and promoting the impact of these research outcomes. This will become increasingly important in a tight fiscal government environment where returns on investment in research will need to be demonstrated in terms of environmental, economic and social impact.

In this regard, the ARC has taken an active role in collaborating with other Publicly Funded Research Agencies to develop a common understanding of approaches, terminology and reporting of research impact.¹¹ Since August 2012, the working group has met a number of times and focussed its attention on issues including:

- understanding current arrangements for planning, monitoring and evaluating research impact within the above mentioned agencies
- demonstrating to key stakeholders (government, industry and community) the return on investment from Australian research activities (both retrospective and prospective);
- establishing a common understanding of the latest developments, nationally and internationally in research impact assessment
- establishing a set of overarching principles and a common understanding of language that underpins the measurement of research impact, and achieves a common use of terminology
- identifying possible common data requirements that can be used to verify research impact outcomes
- considering new data as measures of impact
- identifying cost effective and efficient methodologies for reporting
- sharing experiences in communication strategies to promote research impact to key stakeholders.¹²

As a result, the working group has developed Impact Measurement Principles and Operational Principles for implementing and reporting research impact (these are provided at Appendix 3).

¹¹ The agencies involved in the working group are: Australian Institute of Aboriginal and Torres Strait Islanders Studies, Australian Institute of Marine Science, Australian Nuclear Science and Technology Organisation, Australian Research Council, Commonwealth Scientific and Industrial Research Organisation, Defence Science and Technology Organisation, National Health and Medical Research Council and National Measurement Institute.

¹² See <http://www.arc.gov.au/general/impact.htm>

EXCELLENCE IN RESEARCH FOR AUSTRALIA

ERA is Australia's national evaluation of the quality of research conducted by Australia's universities. It is a comprehensive evaluation that considers the entire output of Australian universities' research efforts. This is in contrast to exercises undertaken by other countries where only a selection of work is considered. ERA uses committees of experts to determine the ratings for university research in institutions by discipline area. Background to the ERA process and the rating system is at Appendix 4.

ERA's contribution to the innovation system is by:

- providing quality assurance of Australia's university research
- providing a valuable information resource for universities, government and industry to make strategic investments that promote research and innovation
- showing that there is growing evidence that research quality underpins the wider benefits of research.

Quality Assurance for Australia's University Research

Research is only of value to the innovation system and Australia more broadly, if it is high quality. Although the rigorous selection processes used for the NCGP provides confidence about the quality of the research that the ARC funds, ERA through its comprehensive evaluation of university research provides a quality assurance mechanism for the entire university research sector.

ERA's value as a quality assurance mechanism depends on its rigorous, yet highly efficient, methodology. Its rigour is due to the use of expert interpretation of citation metrics, peer review and other indicators to make judgements about research quality. Using metrics alone would be an inadequate evaluation of research that could actually lead to perverse behavioural outcomes as the sector responds to requirements of an evaluation system. On the other hand, relying heavily on peer review across all disciplines to evaluate research in all universities creates significant burden for the sector. Achieving the best balance of expert review and metrics is a key strength of ERA. It is a view reinforced by an OECD review of national research evaluation systems across the world, which noted:

...departmental level performance-based research funding systems using peer judgment based on indicators seems to be the state of the art and is being implemented in ERA.¹³

The cost effectiveness is also clearly demonstrated in monetary terms. The financial cost of ERA to government, to January 2014, has been \$48.1 million. This has funded the initial trial of ERA in 2009, the full rounds of ERA in 2010 and 2012, and the preparations so far for the upcoming ERA 2015 round. ERA is clearly a cost effective measure of research quality when the enormous amount of research activity and research over this period is taken into account. For example, universities reported for ERA 2012 that they received \$8.77 billion in research income between 2008 and 2010 (\$3.75 billion in Australian Competitive Grants (HERDC category 1), \$2.38 billion in other public sector income (HERDC category 2), \$2.26 billion in industry and other research income (HERDC category 3), and \$372 million in Cooperative Research Centre income (HERDC category 4)). Based on the cost of ERA to date, it was about 0.5% cost to verify that investment alone. As universities receive significant other funding through Research Block Grants and that ERA 2010 and ERA 2012 evaluated all Australian university research from 2003 to 2010, the real cost to investment ratio is likely to be much smaller.

¹³ OECD, 2010, *Performance-based Funding for Public Research in Tertiary Education Institutions - Workshop Proceedings*, OECD Publishing.

There is also evidence to indicate that the quality of research outputs in the sector has risen since the development of ERA and the quality assurance that it provides. ERA 2010 results show that universities produced 333 467 unique research outputs in the six year reference period (2003 to 2008). For ERA 2012 the number of unique research outputs for the six year reference period (2005 to 2010) was 413 477.

The ratings for Units of Evaluation (UoE) (i.e. assessed discipline areas in universities) also improved from ERA 2010 to ERA 2012. When comparing ERA 2010 to ERA 2012 results, fewer university discipline areas were performing below world standard and more were performing at or above world standard (see table below). Importantly, there has been a marked increase in UoE receiving the highest ERA rating, demonstrating the depth of world-leading research conducted by Australia's universities. In ERA 2012 there were 308 UoE (18.3 per cent of assessed UoE) that received an ERA rating of five (i.e. well above world standard) compared to 239 UoE (13.8 per cent of assessed UoE) for ERA 2010.

Table 1: Comparison of ERA Ratings (by four-digit UoE) from ERA 2010 to ERA 2012

	Rating of 1 (well below world standard)	Rating of 2 (below world standard)	Rating of 3 (at world standard)	Rating of 4 (above world standard)	Rating of 5 (well above world standard)	Total Units of Evaluation Assessed
ERA 2010 (No of UoEs Assessed and % of total)	170 9.8%	389 22.4%	547 31.5%	393 22.6%	239 13.8%	1738 100%
ERA 2012 (No of UoEs Assessed and % of total)	67 4.0%	266 15.8%	583 34.7%	457 27.2%	308 18.3%	1681 100%

ERA Data and the Benefits for Universities, Government and Industry

ERA is providing opportunities for universities to invest in research strengths and areas of development. This will further drive Australia's research performance and capacity for innovation. It is achieving this by providing information to universities that facilitates strategic planning and investment in infrastructure, and human and financial resources. An ACIL Allen review of ERA, published in 2013, examined the influences, benefits and impacts of ERA for Australia's university research. The report found, among other things, that the information from the ERA evaluations was assisting universities in making informed human resource decision making through:

- enhanced skills utilisation, productivity and innovation
- increased efficiency of resources
- enhanced collaboration.

As part of the review, ACIL Allen surveyed universities about ERA. Of those surveyed, 75 per cent of universities said that ERA influenced decisions about recruitment and 56 per cent said it informed staff retention decision making.

The report noted that this was supported by specific comments made by stakeholders, including:

Recruitment and retention has been a specific focus in areas where the university either performed well in ERA or where the university has aspirations to perform well in the future.

...

Far greater attention is being given to developing staff research capacity, and in finding ways to provide research time and funding for them.¹⁴

There is also growing recognition that ERA has the capacity to provide the information for research users (including industry) that identify opportunities for developing university research for economic or societal benefit. Each round of ERA includes a comprehensive data set that covers university research output across a six year period. It also includes collections of a number of other measures for universities including research income and esteem measures. The ERA ratings are provided at a fine-grained level that develops a detailed map of where Australian university strengths lie across many disciplines and sub-disciplines (ratings are provided at the two-digit and four-digit Australian and New Zealand Standard Research Classification (ANZSRC) Fields of Research (FoR) classifications for each university). These results are published in the ERA national reports, which are made available on the ARC website following each ERA round, and provide valuable information for research users to identify opportunities for collaboration with universities.

ERA also provides a good mechanism for international engagement with research in Australia's universities. One of the key objectives of ERA is to allow for comparisons of Australia's university research nationally and internationally across all research disciplines. Furthermore, establishing the quality of research in the discipline areas of each university against a world benchmark is a fundamental feature of the ERA methodology. As a result, the international community has access to detailed information (through the ERA results) about areas within institutions and disciplines that are internationally competitive, as well as highlighting emerging areas where there are opportunities for further investment and international collaboration. International parties can also use ERA results to guide research investment and have confidence that their decisions are based on a transparent assessment of research quality within Australia.

The importance of ERA for international engagement was confirmed by the ACIL Allen review of ERA (Benefits Review Report (BRR)), which noted its role in improving international research recognition.

Specifically, the report stated:

Stakeholders consulted for this BRR reported that ERA has assisted universities in receiving greater international and national recognition for their research. Additionally, stakeholders also noted that, over time, ERA will enhance Australian universities' international profile. This was supported by the survey results, with approximately 61 per cent of universities agreeing that ERA led to greater international recognition of research conducted at their institutions.¹⁵

Finally, the longitudinal data available as a result of ERA is a valuable resource in tracking the performance of research in Australia's universities. From ERA 2015, the ARC will have a data set that covers the research output and performance for the 11 years from 1 January 2003 to 31 December 2013. The trend data and analysis will only improve following the future rounds of ERA. It will greatly assist in developing policies and strategies to support emerging industries and identifying competitive advantages that can be developed from research conducted in Australia's universities – a theme identified in the inquiry's terms of reference at point (j).

¹⁴ ACIL Allen Consulting, 2013, *Benefits Realisation Review of Excellence in Research for Australia*, pp 27-28.

¹⁵ ACIL Allen Consulting, 2013, *Benefits Realisation Review of Excellence in Research for Australia*, p. 36.

In addition, for ERA 2015, gender data is being collected to improve the ARC's ability to understand issues relating to gender and equity in relation to Australia's university research landscape and workforce.

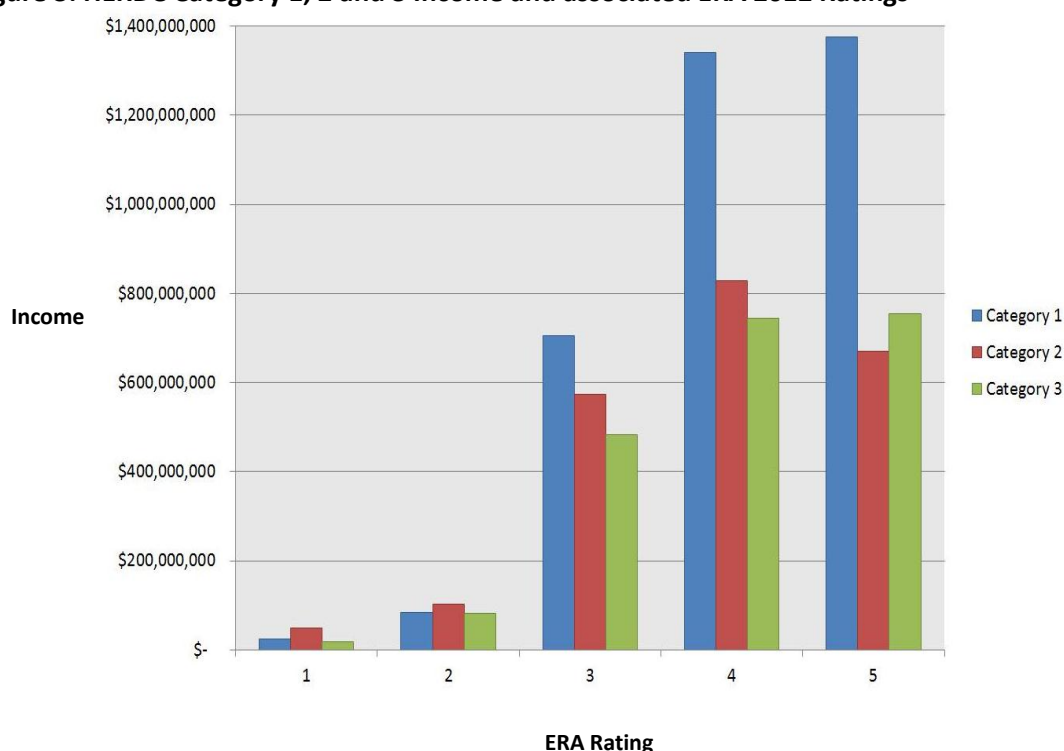
Research Quality Underpinning Research Impact—Evidence from ERA

The NCGP has long supported high quality research that has significant benefits for Australia. As noted above, the ARC and other Public Funded Research Agencies have also developed an important framework for promoting the benefits of the research they support. In addition to this, there is evidence from ERA data that research of significant benefits and impact is underpinned by high quality research.

ERA collects data about a number of measures that are indicators of industry, economic, and social impact of university research: industry collaboration; government sector collaboration; university research commercialisation; and patents generated from university research.¹⁶ ERA ratings can be associated with these proxies for research impact. It shows that quality and impact often coincide.

For example, as shown in the following graph (Figure 3), in ERA 2012 the research income that universities received (by HERDC Categories 1, 2 and 3) was associated with higher ERA ratings. As noted earlier in this submission, the graph shows that income from HERDC category 1 income (i.e. Australian Competitive Grants) is associated with high ERA ratings, confirming that ARC and other competitive grant income is going to high quality research. However, the results for HERDC category 2 and 3 income (see below) also provide evidence about the association between research quality and research impact.

Figure 3: HERDC Category 1, 2 and 3 Income and associated ERA 2012 Ratings



¹⁶ Industry collaboration with universities is measured through university receipt of industry income for research and government collaboration with universities for research is measured through public sector income excluding Australian Competitive Grants.

HERDC Category 3 'Industry and other income' identifies university links outside of the Australian public sector. It can be considered an indicator of the benefits of research as it represents the willingness of industry to invest in university research. ERA 2012 shows that the category 3 income universities received from 2008 to 2010 totalled \$2.26 billion. In ERA 2012, 95.2 per cent of category 3 income from assessed units of evaluation was associated with research areas rated at or above world standard in research quality—with 36.3 per cent of category 3 income was associated with an ERA rating of five (i.e. well above world standard).

HERDC category 2 income presents a similar picture. Category 2 income is income that universities receive from local, state, or federal governments and government enterprises that is not awarded through the Australian Competitive Grants schemes. In ERA 2012, 93.2 per cent of category 2 income (worth \$2.38 billion from 2008 to 2010) from assessed units of evaluation was associated with research at or above world standard—with 30.2 per cent of category 2 income was associated with an ERA rating of five.

In addition, research commercialisation reflects the tangible financial benefits of research. There was \$274 million in income for universities from research commercialisation reported in ERA 2012. The ERA 2012 results show that 95.6 per cent of research commercialisation income from assessed units of evaluation was associated with research rated at or above world standard—49.6 per cent of commercialisation income was associated with an ERA rating of five. The ERA evidence also points towards a link between high quality research and patenting activity. In the Australian context, 781 patents were submitted as part of ERA 2012. The ERA 2012 data shows that 97.3 per cent of university patents from assessed units of evaluation were associated with research rated at or above world standard—with 39.4 per cent of patents associated with an ERA rating of five.

International studies reach similar conclusions about the link between research of high quality and the wider impact of research. A major review of the academic studies on university and industry collaboration found, for example, that higher quality researchers tend to collaborate with industry more than lower quality researchers. The same review also pointed towards a positive link between research quality and research commercialisation, wherein higher quality researchers are more likely to commercialise their research outputs than lower quality researchers.¹⁷

The evidence above shows that the research of high benefit is associated with research of good quality. In addition, the focus on quality does not appear to be driving universities away from research of social, economic and industry benefit. Two of the three proxies of impact discussed above increased from ERA 2010 to ERA 2012. Industry and other income (HERDC category 3) increased from \$2.07 billion reported in ERA 2010 to \$2.26 billion reported in ERA 2012. 671 patents were report in ERA 2010 and 781 patents were reported in ERA 2012.

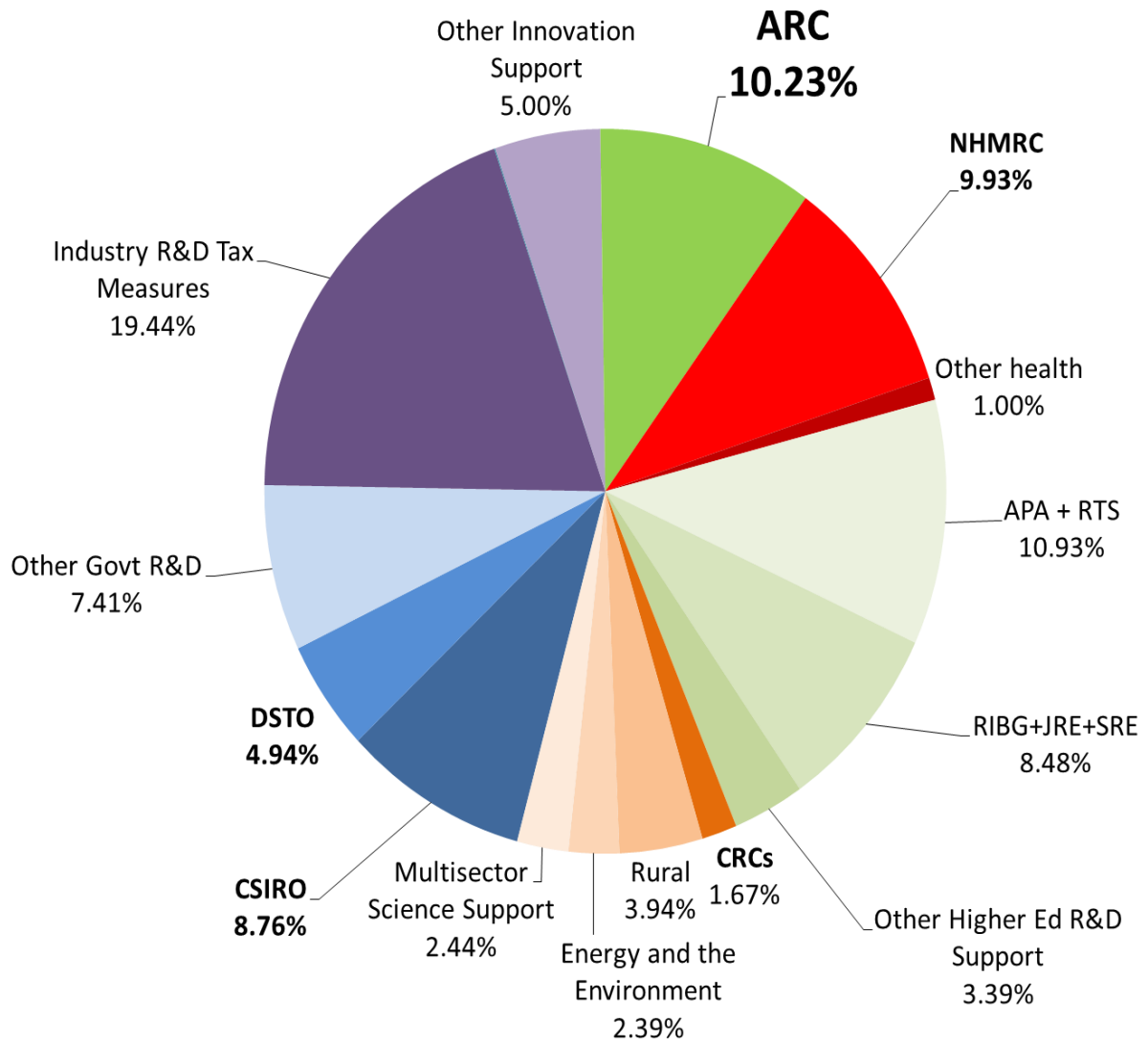
Overall, this evidence from ERA supports a key Impact Measurement Principle developed by a working group from Publicly Funded Research Agencies that acknowledges that excellent research underpins impact (see above and appendix 3 for information on the working group).

¹⁷ For these studies, the quality of a researcher is considered as their scientific productivity in relation to their colleagues. See: Perkmann, M. et al., 2013. "Academic engagement and commercialisation: A review of the literature on university-industry relations", *Research Policy*, Volume 42, pp. 423-442.

Appendices

Appendix 1

Commonwealth Investment in R&D 2013–14



Source: Budget 2013–14 Industry and Innovation tables.

Appendix 2

Collaboration in recent years

Since the inception of the NCGP, the ARC has actively supported international collaboration through its various schemes. The information below provides insight into the ARC's previous international collaborations, including overall statistics from the commencement of the NCGP, and more recent examples of scheme-specific collaboration.

Percentages of collaboration with countries on ARC grants from 2010 to 2014

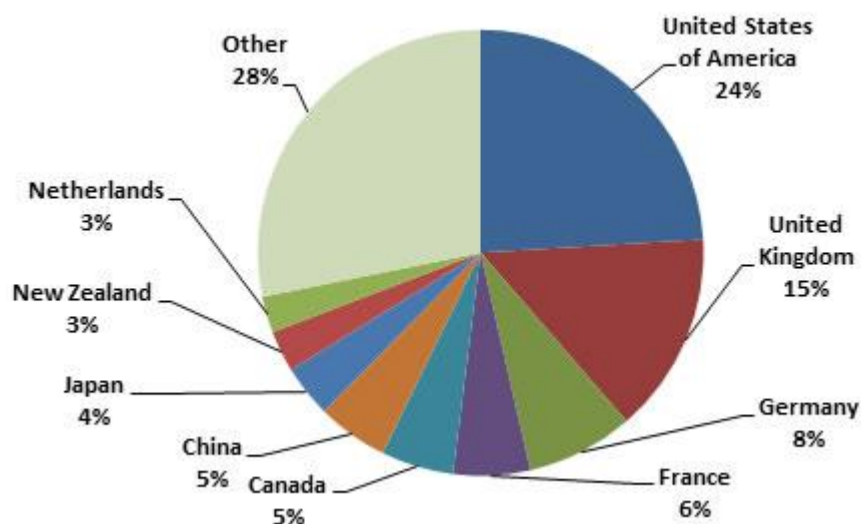


Table 1—Instances* of international collaboration in ARC-funded research since 2010, by funding allocation year**

Country of intended collaboration	2010	2011	2012	2013	2014***
United States of America	1653	1752	1807	1827	1596
United Kingdom	983	1061	1081	1114	994
Germany	525	572	596	584	510
France	394	418	423	417	351
Canada	382	391	390	392	332
China	338	376	385	398	351
Japan	272	291	280	279	243
New Zealand	192	220	226	240	200
Netherlands	159	188	200	214	184
Italy	154	178	172	183	154
Switzerland	151	164	166	171	162
Sweden	131	140	146	145	130
Singapore	99	115	117	125	122
Spain	73	99	117	120	120
Denmark	95	100	109	106	101

India	92	95	81	87	78
Belgium	74	82	70	82	72
Indonesia	69	67	68	69	66
South Africa	69	70	65	60	57
Norway	63	64	62	70	61
Other	831	940	930	968	887
Total	6799	7383	7491	7651	6771

**The data in this table refers to instances of collaboration and represents all new and ongoing projects that have a funding allocation in a given year. Some projects involve collaboration with more than one country and therefore are represented more than once in these figures*

*** The information shown is limited to that which was current at the time research proposals were approved for funding and accordingly excludes any post-award variations that may subsequently have been approved.*

**** The table does not include projects that may have been funded under the Special Research Initiatives scheme and the Linkage Learned Academies Special Projects scheme. For allocation year 2014, the data does not include the ARC Future Fellowship scheme, Laureate Fellowship Scheme, Linkage Projects Scheme and Industrial Transformation Research Partnership scheme.*

Appendix 3

Research Impact Principles and Framework

The Definition of Research Impact

Research impact is the demonstrable contribution that research makes to the economy, society, culture, national security, public policy or services, health, the environment, or quality of life, beyond contributions to academia.

Impact Measurement Principles

The working group developed the following principles to underpin the measurement of research impact.

- Acknowledge that excellent research underpins impact.
- Promote understanding through use of common language and terms associated with research impact.
- Respect the diversity in research disciplines/sectors in demonstrating research impact.
- Cooperate in developing a set of common, cost effective and efficient parameters for data collection and reporting.
- Adopt a consultative approach with stakeholders in regards to implementing impact reporting in support of future research investments.
- Encourage, recognise and reward positive behaviour in planning, monitoring and evaluating research impact.

Operational Principles

These principles offer high level guidance on operational considerations for implementing the measures and reporting of research impact.

Plan

- Set early and clear expectations on research impact against which progress can be monitored.
- Develop capability to effectively collect data and undertake impact monitoring and evaluation.
- Identify appropriate data elements for effective assessment of research impact.

Report

- Set up reporting requirements that are appropriate to the scale of investment.
- Accommodate multi-disciplinary and collaborative research through flexibly designed impact reporting appropriate for its intended outcomes.

Assess

- Utilise planned performance data elements and metrics to monitor and evaluate outcomes.
- Consider any learnings from retrospective case study analyses, evaluations and reviews.

Promote

- Appreciate and value both intended and serendipitous research outcomes.
- Regularly communicate research impact to stakeholders.
- Be aware of Whole of Government agendas for example Open Access and Open Data.

Appendix 4

Background Information about ERA

There are 41 higher education providers that participate in the ERA evaluations. ERA uses expert review of based on comprehensive information about a broad range of indicators of research in universities including: research outputs (such as books, journal articles and non-traditional outputs), research income, esteem measures, and applied measures (such as patents, registered designs and research commercialisation income). Committees of experts use the information to provide ratings of discipline areas in each university (known as units of evaluation). The committees assigned a rating of 1 to 5 where:

- A rating of 1 represents research well below world standard;
- A rating of 2 represents research below world standard;
- A rating of 3 represents research at world standard;
- A rating of 4 represents research above world standard; and
- A rating of 5 represents research well above world standard.

The first full round of ERA was held in 2010, the second round in 2012 and the next round will be conducted in 2015.