Australian Government

Department of Innovation
Industry, Science and Research

RESEARCH SKILLS FOR AN INNOVATIVE FUTURE

A RESEARCH WORKFORCE STRATEGY TO COVER THE DECADE TO 2020 AND BEYOND

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MESSAGE FROM PRIME MINISTER

An innovative Australian economy is critical to our nation's future.

Success in the 21st century belongs to those societies that value qualities such as creativity, innovation and problem-solving. Societies that invest in the intellectual capacity of their people.

At the heart of that capacity lies our research workforce, because it is they who underpin so much of our nation's innovation effort by pioneering the ideas, applications, products and services of tomorrow.

In that spirit, I am delighted to present the Australian Government's research workforce strategy – *Research Skills for an Innovative Future* – a pioneering and comprehensive examination of this important field.

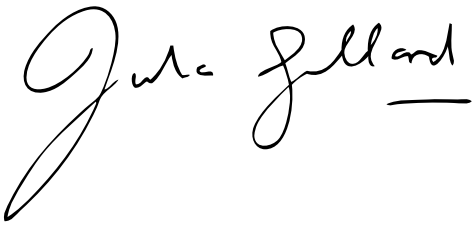
Our strategy reflects the Government's aspirations for education and innovation to develop and support a prosperous nation that offers opportunity to all its people.

Through the strategy, we not only aim to ensure that Australia has the quantity of researchers required to meet our future needs. We also seek to provide a research training experience of world-class quality and to ensure our researchers are supported and fulfilled in their careers.

Realising these goals will require sustained commitment and collaboration of industry, government and the higher education sectors if we are to achieve Australia's potential as an innovative economy.

I therefore commend this strategy to all the stakeholders who play a role in sustaining Australia's research workforce, and sincerely thank my colleague, Senator the Hon Kim Carr, for his leadership in this vital area.

The Honourable Julia Gillard MP
Prime Minister of Australia



MINISTERIAL FOREWORD

A strong research workforce is vital to Australia's prosperity in the global knowledge economy.

We are a small nation, rightly aspiring to high wages and a high standard of living. Our businesses rely on the knowledge, the skills and the ideas of our world-class researchers to stay ahead.

They have sustained growth in our high-tech emerging industries, from nanotechnology to nuclear medicine. They have transformed established firms looking for new products and better processes. And they have generated jobs and opportunities across every sector of the economy.

The future of the research workforce is too critical to be left to chance and remnants of historical arrangements. It belongs at the core of research policy and planning in universities, in government, and in industry.

That is why, through Powering Ideas, the Labor Government committed to the development of Australia's first national research workforce strategy.

Research Skills for an Innovative Future is the culmination of over eighteen months of consultation and research. Working collaboratively across the research and business community, we have mapped our research needs to 2020; and identified the factors that make for high quality research training. We have built a comprehensive plan to match our capabilities to our innovation goals.

As we enter the implementation phase, I encourage our partners in all sectors to renew their commitment to our shared vision for the research enterprise.

Together, we can meet the aspirations of our researchers and the ambitions of the nation.

Senator the Hon Kim Carr
Minister for Innovation, Industry, Science and Research

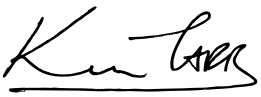


TABLE OF CONTENTS

ABBREVIATIONS

ABS	Australian Bureau of Statistics
ANSTO	Australian Nuclear Science and Technology Organisation
APA	Australian Postgraduate Award
APA-I	Australian Postgraduate Award – Industry
ARC	Australian Research Council
AQF	Australian Qualifications Framework
CCI	Coordination Committee on Innovation
CHASS	Council for the Humanities, Arts and Social Sciences
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSTACI	Commonwealth State and Territory Advisory Council on Innovation
CTS	Commercialisation Training Scheme
DEEWR	Department of Education, Employment and Workplace Relations
DIISR	Department of Innovation, Industry, Science and Research
ECR	Early career researcher
ERA	Excellence in Research for Australia
FASTS	Federation of Australian Scientific and Technological Societies
HDR	Higher Degree by Research
HESA	Higher Education Support Act
IHEAC	Indigenous Higher Education Advisory Council
IPRS	International Postgraduate Research Scholarship
MCTEE	Ministerial Council for Tertiary Education and Employment
NCGP	National Competitive Grant Program
NHMRC	National Health and Medical Research Council
OECD	Organisation for Economic Co-operation and Development
PhD	Doctor of Philosophy
PMSEIC	Prime Minister's Science, Engineering and Innovation Council
R&D	Research and Development
RITA	Researchers in Industry Training Award
ROPE	Research Opportunity and Performance Evidence
RTS	Research Training Scheme
TEQSA	Tertiary Education Quality and Standards Agency

EXECUTIVE SUMMARY

2020 AND BEYOND – THE RESEARCH WORKFORCE AND AUSTRALIA'S PRODUCTIVITY CHALLENGES

A strong and vibrant research workforce is paramount to Australia's future prosperity. Our researchers are a vital asset which needs to be recognised and supported.

Australia's economy has been characterised by strong economic growth over the majority of the last twenty years, supported structurally by the microeconomic reforms of previous decades and more recently by strong global demand for our commodities.

However, in recent years multifactor productivity – the efficiency with which we translate labour and capital into outputs – has stalled to fall below the average of Organisation for Economic Co-operation and Development (OECD) countries and well behind the heights achieved in the 1980s and 90s. At the same time, the demographics of our population have changed and reflect a much older age-profile; a situation which (based on current trends) is likely to become more pronounced in future years, resulting in reduced workforce participation and growing demand in areas such as health and income support services.

These trends occur against the backdrop of emerging pressures on our economy, environment and way of life from global financial instability and climate change.

Australia can meet these challenges by inculcating a stronger culture of innovation and strengthening the capabilities that underpin innovative activity across our economy. That is, by: lifting levels of business research and development (R&D) investment; building more and stronger research collaborations within Australia and between Australia and other countries; and improving the human and physical resources available to research organisations to undertake world-class research and innovation.

These goals are the essence of the Australian Government's ('the Government's') 10 year *Powering Ideas* agenda and (along with other key innovation capabilities) are the focus of its $3.1 billion targeted package of science, research and innovation measures in the 2009-10 Budget.

While the implementation of *Powering Ideas* reforms is now well advanced, the Government recognises that lifting Australia's innovation performance will ultimately depend on not only appropriate levels of targeted innovation support but the availability of a sufficient number of research qualified and highly skilled people.

In particular, increasing the number of businesses investing in R&D in Australia will require more people with the research and technical skills to conduct and support the additional R&D. Similarly, enhancing levels of research and innovation-based collaboration will require improvements in the increasingly people-based networks and communication channels used to convey demand and source expertise. Finally, provision of world-class research infrastructure capabilities to Australian researchers will require skilled research and technical staff to operate and maintain the facilities.

VISION FOR THE RESEARCH WORKFORCE

The Government's vision for 2020 is of a strong and productive Australian research workforce, comprising the scale, breadth and depth of skills required to support innovation, educate the next generation of Australians, and ultimately drive productivity improvements across the economy.

It is underpinned by seven aspirations, targeting key factors influencing our ability to meet the immediate challenges of the decade ahead and position us for the many challenges and opportunities beyond.

These aspirations are that:

- Australian firms have access to the research skills and experience that will enable them to move up the value-chain and be globally competitive.
- Australia's public sector research organisations have a sufficient research skills base to support their diverse roles.
- Australia's higher degree by research (HDR) graduates have the skills and attributes to both engage in world-class research and make productive contributions in a wide spectrum of professional roles.
- Australian universities, as the major providers of research training in Australia, have sufficient numbers of research qualified staff to develop the next generation of researchers.
- Australian research students, researchers and research support staff are provided with clear and equitable pathways for career progression and supported to meet individual career needs and objectives.
- Australian research employers have in place the communication channels and linkages which promote the effective diffusion of knowledge (both codified and tacit) across the economy.
- Australia effectively draws on and harnesses the potential contributions of all research qualified individuals and facilitates participation in and engagement with the research workforce.

They are closely aligned with and will directly support the Government's seven *Powering Ideas* innovation priorities, including in particular priority two: Australia has a strong base of skilled researchers to support the national research effort in both the public and private sectors.

ACHIEVING THE VISION – A NATIONAL RESPONSIBILITY

THE ROLE OF GOVERNMENT

As outlined in Chapter 1, the Government is and will continue to be instrumental in supporting Australia's research workforce to meet this vision – as a primary investor and support provider, as the custodian of the policy, financial and regulatory frameworks which promote or discourage research activity and employment, and as an employer of researchers in its own right.

While the Government plays a critical role, however, the development and deployment of Australia's research workforce to meet the Government's 2020 vision is a shared responsibility and the Government cannot achieve it alone.

In particular, while the Government is responsible for establishing the policy parameters and funding settings to support positive research workforce outcomes, it is important that other levels of government, research employers, research training providers, professional associations, researchers and students all do their part.

The states and territories play a complementary role to the Commonwealth in supporting activities which benefit the research workforce through institutional support, scholarships and fellowships and other initiatives targeted at specific state or regional needs.

Research employers around Australia set the tone and culture within their workplaces and ultimately have responsibility for the provision and promotion of viable career paths for researchers and research support staff in Australia.

Universities and other research training providers are responsible for nurturing and developing our future researchers and maintaining the international reputation of Australia as a research training provider of choice for students from around the globe.

Finally, capable and committed students and researchers are ultimately the backbone of Australia's research workforce, determining the scale and quality of Australia's research outputs and acting as important role-models for future generations of Australians contemplating a research career.

Without the concerted efforts of all these parties the full potential of Australia's research workforce will not be realised.

THE IMPORTANCE OF A STRATEGIC APPROACH

Building research workforce capacity to meet the Government's vision is a complex challenge, requiring a long-term outlook and whole-of-economy perspective.

Key considerations (discussed in Chapters 1 and 2) include that:

- Our research workforce is characterised by individuals with a broad range of skill sets and qualifications, encompasses a number of occupations and industries, and increasingly engages on not only national but global scales;
- Influence factors in relation to our research workforce are diverse, including Government policy settings such as financial and taxation parameters, regulatory frameworks, education participation targets and migration arrangements, and external drivers such as global demand for our human resources, products and services;
- Our research workforce is significantly older than the professional workforce as a whole, suggesting strong replacement demand in future years; and
- Roles and responsibilities for research workforce support and maintenance in Australia are diffuse, including all levels of government, a large number of employment sectors and organisations (primarily universities) involved in research training.

These issues highlight the imperative for effective focus and coordination to avoid duplication of activity and solicit the best possible returns on investments made. They also highlight the need for flexibility in the planning and prioritisation of resources to accommodate shifts in economic and workforce parameters that may occur over time.

THE IMPETUS FOR ACTION

Recognising the critical role of Australia's research workforce in supporting innovation outcomes, the Government initiated several processes over 2008 to 2010 to gather detailed information on the state of Australia's research workforce and identify any emerging areas of opportunity or concern. These included:

- A Government inquiry into research training and research workforce issues in Australian universities;
- A Government inquiry into Australia's international research collaboration, including examination of impediments and facilitating factors for researcher mobility; and
- A significant analysis and consultation process anchored by the Department of Innovation, Industry, Science and Research (DIISR) to inform the research workforce strategy.

These processes, which built on major reviews of the national innovation system and Australian higher education in 2008, reveal that Australia has a strong foundation of research skills relative to international standards and has consolidated a firm position as one of the key research training and research employment destinations globally.

This situation is tempered, however, by evidence of emerging weakness in domestic supply channels, deepening concerns regarding the clarity and attractiveness of research careers in Australia, and Australia's exposure to increasingly intense global competition for highly skilled workers.

WHERE WE ARE DOING WELL

Australia performs strongly on a number of key measures of research workforce capability relative to comparator countries.

While the scale of our research workforce is small by global standards, in line with the relative size of our population, we possess an above the OECD average number of researchers for every thousand people in our workforce and a relatively strong rate of HDR completions as a proportion of our overall population[1].

Available metrics furthermore suggest that our research workforce is very productive, publishing at a rate within the top 10 for OECD countries, and punching above its weight in a number of fields, such as molecular biology and genetics and immunology[2].

Australia also enjoys a positive reputation globally as a world-class research destination for researchers and research students. Australia ranked 10 on the most recent World Economic Forum Global Competitiveness Reports[3] (for example, on the quality of its scientific research institutions), and international student uptake of research training in Australia has grown strongly in recent years, reflecting a growing recognition of Australian research qualifications around the globe.

1 OECD (2009), OECD *Science Technology and Industry Scoreboard 2009*
2 Thomson ISI, National Science Indicators database, 2008
3 World Economic Forum, Geneva, Switzerland, 2010, *The Global Competitiveness Report 2010-11*

WHERE WE WOULD BENEFIT FROM IMPROVED PERFORMANCE

The Government's review and development processes have identified five key areas of particular challenge for Australia's research workforce over the coming decade:

- Meeting anticipated demand for research skills in the workforce;
- Strengthening the quality of supply through the research training system by improving the standard and relevance of research training programs;
- Enhancing the attractiveness of research careers;
- Facilitating research workforce mobility; and
- Increasing participation in the research workforce.

These challenges (discussed in more detail in Chapters 3 to 7) reflect the impact of a range of drivers on Australia's research workforce, now and into the future. For example, the need to lift the supply of research skills to our workforce reflects the combined influence on Australia's research workforce of a number of factors including: age-related retirements; employment growth in relevant sectors; increased demand for high-level research skills across the economy; and a stalling in domestic student uptake of research degrees. Similarly, the need to improve the relevance of research training in Australia reflects a growing trend for research careers outside of academia, along with the changing nature of research itself, which is increasingly placing emphasis on collaborative, multidisciplinary and end-user engaged activities.

Review processes have also revealed a need to improve the coordination of research workforce effort and activity in Australia. This need is most apparent in relation to the primary source of research skills to our economy – our research training system – where, until recently, universities have had little incentive to look beyond the academic sphere to the needs and potential contributions of other employment sectors. It is also apparent in the absence of dedicated monitoring and planning mechanisms for the research workforce which can reconcile supply and demand priorities at both a national level and within individual disciplines and sectors.

WHY WE NEED TO ACT

The research workforce strategy development process and recent major reviews and inquiries all highlight the need to refresh our research workforce policy settings to address areas of identified weakness and reflect shifting economic and geopolitical realities.

The current global economic downturn also presents an opportunity to further consolidate and improve the competitiveness of Australia's research workforce capabilities. In particular, with our comparatively strong economic position, we are well positioned to strengthen the quality of our research training programs, build enduring research and research training partnerships (both domestically and globally), and actively recruit talent to our shores.

We need to act if we are to fully capitalise on our *Powering Ideas* investments and secure the long-term benefits to national productivity and competitiveness that they will deliver over time.

PRIORITY AREAS FOR FUTURE FOCUS

The Government is committed to building a world-class research workforce to meet Australia's needs. To this end, it is putting in place a long-term strategic policy framework (see **Table 1**) to guide support over the decade ahead and beyond.

In line with the vision outlined in *Powering Ideas,* the Government is planning for an *innovative* Australian future – a future characterised by a significant expansion of R&D in both our public and private sectors and an enhanced role of research and innovation in addressing the major social, environmental and economic challenges of the 21st century.

Accordingly, the Government's strategic framework is intended to position Australia to meet a significant expansion of demand for research skills in future years and higher expectations of our research graduates and researchers. It includes both some immediate actions by Government and a set of longer term priorities to guide the activities of both Government and other stakeholders (a full list of priorities and those which will be progressed in the immediate term are outlined in **Appendices A** and **B** respectively).

In identifying priorities to underpin the framework, the Government's key concern has been to build flexibility and responsiveness into Australia's research workforce policy and funding settings. The rapid pace of change and diverse factors influencing Australia's research workforce are such that agility, rather than rigid targets or narrow prioritisation, will be Australia's greatest asset in building future capacity. In particular, a long-term outlook, underpinned by effective processes for monitoring progress and adjusting policy settings as required, will be essential.

The Government intends to work collaboratively with the states and territories, researcher employers, research training providers, professional bodies, researchers, student bodies and other key stakeholders to implement the strategic framework. The establishment of enhanced oversight arrangements for the research workforce, including a new research workforce strategy advisory group comprising representatives from all key stakeholder groups, will facilitate this dialogue.

Key elements of the strategic framework are outlined further in Chapters 3 to 8. Specifically:

- Chapter 3 considers the challenges and opportunities associated with meeting demand for research skills in Australia, key actions already being progressed by the Government and other stakeholders, and priority areas for future focus;
- Chapter 4 considers issues, actions and needs associated with strengthening the quality of supply through Australia's research training system;
- Chapter 5 considers issues, actions and needs associated with enhancing the attractiveness of research careers in Australia;
- Chapter 6 considers issues, actions and needs associated with facilitating research workforce mobility;
- Chapter 7 considers issues, actions and needs associated with increasing participation in Australia's research workforce; and
- Chapter 8 highlights the long-term nature of Australia's research workforce challenges, emphasising the need for ongoing focus on building a solid evidence base to inform decision making, along with effective governance structures to coordinate efforts across jurisdictions in the years ahead.

TABLE 1: STRATEGY VISION, ASPIRATIONS AND PRIORITY AREAS

VISION AUSTRALIA'S RESEARCH WORKFORCE COMPRISES THE SCALE, BREADTH AND DEPTH OF SKILLS REQUIRED TO SUPPORT INNOVATION, EDUCATE THE NEXT GENERATION OF AUSTRALIANS AND ULTIMATELY DRIVE PRODUCTIVITY IMPROVEMENTS ACROSS THE ECONOMY.

ASPIRATIONS

- Australian firms have access to the research skills and experience that will enable them to move up the value-chain and be globally competitive.
- Australia's public sector research organisations have a sufficient research skills base to support their diverse roles.
- Australia's higher degree by research graduates have the skills and attributes to both engage in world-class research and make productive contributions in a wide spectrum of professional roles.
- Australian universities, as the major providers of research training in Australia, have sufficient numbers of research qualified staff to develop the next generation of researchers.
- Australian research students, researchers and research support staff are provided with clear and equitable pathways for career progression and supported to meet individual career needs and objectives.
- Australian research employers have in place the communication channels and linkages which promote the effective diffusion of knowledge across the economy.
- Australia effectively draws on and harnesses the potential contributions of all research qualified individuals and facilitates participation in and engagement with the research workforce.

PRIORITY AREAS

Meeting demand for research skills in Australia (Chapter 3)	Strengthening the quality of supply through Australia's research training system (Chapter 4)	Enhancing the attractiveness of research careers in Australia (Chapter 5)	Facilitating research workforce mobility (Chapter 6)	Increasing participation in Australia's research workforce (Chapter 7)
■ Establishment of national research workforce planning processes ■ Increased flexibility within current scholarship programs to provide further financial incentives to attract students in demand areas ■ Expansion over time in the number of research training awards available to international students	■ Review of the RTS ■ Examination of the full cost of research training provision in Australian universities ■ Development of new models for research training focused on the professional employment needs of graduates ■ Establishment and monitoring of research standards and quality benchmarks for research training	■ Establishment of a web-based communication platform for research career opportunities and support options ■ Review of the balance of fellowship support provided by the Government ■ Increase opportunities for early career researchers within the ARC Discovery Scheme	■ Incorporation in existing and future funding schemes of supported opportunities for inter-sectoral and international mobility ■ Further refinement of processes to remove impediments to individuals returning to the workforce after a career break ■ Investigation of metrics for measuring excellence in applied research and innovation	■ Removal of impediments for part-time candidature within research training support schemes ■ Development and promotion of family-friendly research workplaces ■ Implementation of an Indigenous research workforce plan for the higher education sector

CURRENT AND FUTURE PRIORITIES

SUPPORTING PLATFORMS

- Strengthened oversight arrangements to support improved planning and decision making
- Improved data collection and reporting in relation to the research workforce
- Ongoing investment in the research base

1. AUSTRALIA'S RESEARCH WORKFORCE – A VITAL ASSET

1.1 WHY OUR RESEARCH WORKFORCE MATTERS

The availability of a highly skilled workforce is central to knowledge-based societies and an enabling element of national innovation systems. Research skills are particularly important, as the pace of social and technological change strengthens demand for individuals who can engage with the cutting-edge of knowledge and assess and adapt new technologies and innovations as they emerge.

The benefits of a strong and productive research workforce can be felt in all sectors of the economy and society:

- *Within the private sector*, research skills enhance the capacity of firms to move up the value chain and differentiate products and services within tightly contested markets.
- *Within the public and not-for-profit sectors*, research skills play a critical role in promoting public good outcomes, underpinning efforts to address major national challenges of the 21st century, such as environmental sustainability, health care and public safety, among others, along with the education of Australia's future research and wider workforces.
- *Within the community*, research skilled and qualified individuals assist in building public understanding of, and propensity to adopt, new concepts and developments, ultimately fuelling the innovation cycle through expanded consumer demand for innovative products and services.

At the highest level, these benefits translate to labour and capital efficiencies that ultimately underpin long-term gains in national productivity and contribute to the growth of our national economy.

1.2 WHO CONTRIBUTES TO AUSTRALIA'S RESEARCH WORKFORCE?

Australia's research workforce comprises the men and women who contribute to the conception and/or active conduct of R&D[4] in Australia. It encompasses a spectrum of roles (researchers, technical and other dedicated research support staff, research students, and research managers involved in the planning and direction of research activities) and spans all sectors of the Australian economy.

Importantly, our research workforce is characterised by individuals with both highly specialised skills (often specific to an individual discipline) and more generic, high-level cognitive and technical capabilities which are broadly transferrable across different domains. It is the combination of these skills and attributes which has enabled individuals and organisations within the research workforce to contribute to some of the most transformative innovations developed in Australia in recent times.

4 R&D is defined, for the purposes of the strategy, according to the OECD Frascati Manual definition "Research and experimental development (R&D) comprise the creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications". OECD (2002), *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*, OECD Paris 2002

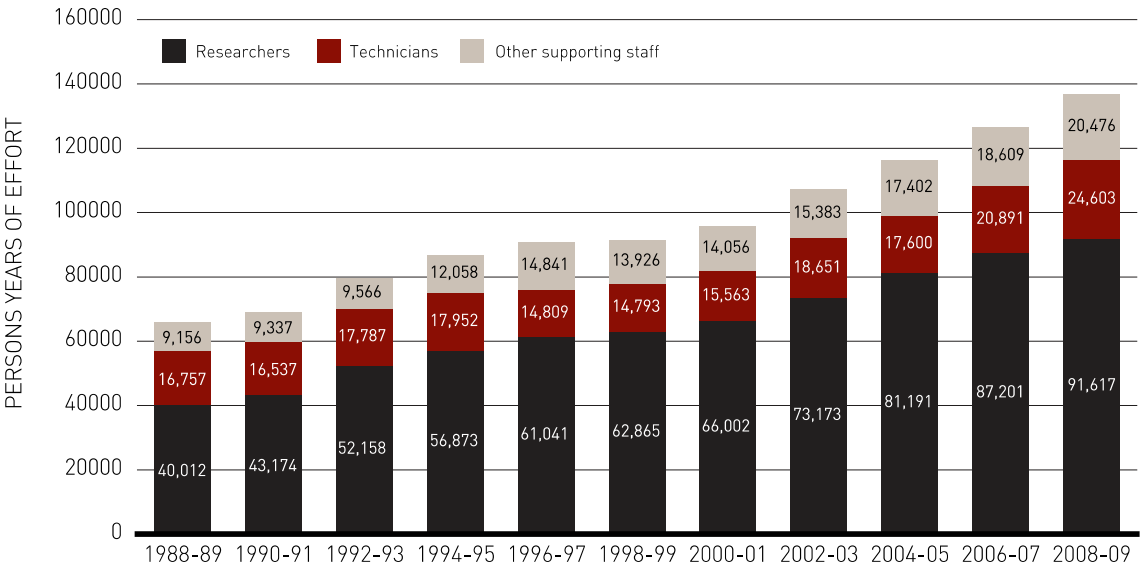
1.21 DISTRIBUTION OF OUR RESEARCH WORKFORCE

Total human resources devoted to R&D in Australia in 2008-09 amounted to 136 696 person years of effort[5]. Of this, over two thirds (67 per cent) were researchers, with the remainder being technicians or other dedicated support staff. The size of this workforce almost doubled over 1998-99, increasing by 49 per cent over the last decade alone (see **Figure 1**).

Higher education is our largest research employment sector (responsible for around 45 per cent of human resources devoted to R&D in 2008-09), followed by the business sector at 39 per cent in 2008-09.

Our researchers are most likely to be employed in higher education (58 per cent of all researchers in 2008-09), while the greatest contributions of technical and other support staff are found in our business sector (59 per cent of all technicians and other support staff in 2008-09). These patterns are consistent with the sectoral focus of our R&D effort, which sees the majority of basic research undertaken by higher education providers and applied/development activities by our business enterprise sector.

FIGURE 1: HUMAN RESOURCES DEVOTED TO R&D IN AUSTRALIA



Source: ABS Research and Experimental Development, All Sector Summary, cat. No. 8112.0

5 One person year of effort is equivalent to a full time employee whose time is wholly devoted to R&D for a whole year.

1.22 PATHWAYS TO OUR RESEARCH WORKFORCE

Not all individuals within our research workforce possess a formal HDR qualification (doctorate by research or masters by research) and the continued growth of our technical and other research support staff suggests an ongoing role for other skill and qualification mixes, including vocational education and training (VET) degrees in future years. In particular, VET and bachelor-qualified trades and technicians have been and will continue to be fundamental to the ongoing maintenance and operations of the major facilities and infrastructure on which much modern research is grounded.

HDRs remain, however, the most important training pathways to research and research related roles in Australia, reflecting a dedicated investment over several years in the development of deep subject expertise and a rigorous methodological grounding for conducting research at the highest level. It is important to recognise that the dependence of progression to an HDR on sufficient levels of attainment at earlier stages of the education pipeline, means that the journey to a HDR is a long one and critically reliant on early student attraction to and engagement in the chosen area of study.

Importantly, a significant proportion of current HDR qualified individuals in Australia were born elsewhere. Just under 50 per cent of doctorate qualified individuals in 2006 were born in other countries and around 22 per cent of our annual supply of doctorates to the workforce is sourced through international channels[6] – either as international research students who stay on in Australia upon completion of their studies or individuals who gained their qualifications in another country and entered Australia through temporary or permanent migration processes. This historic dependence on international supply channels is and will continue to be an important consideration for Australia in planning its research workforce resources.

1.23 WHAT MAKES OUR RESEARCH WORKFORCE UNIQUE?

The composition of Australia's research workforce contrasts with that of other OECD countries, which on average have a greater proportion of their researcher workforce in the business enterprise sector[7] (see **Figure 2** below).

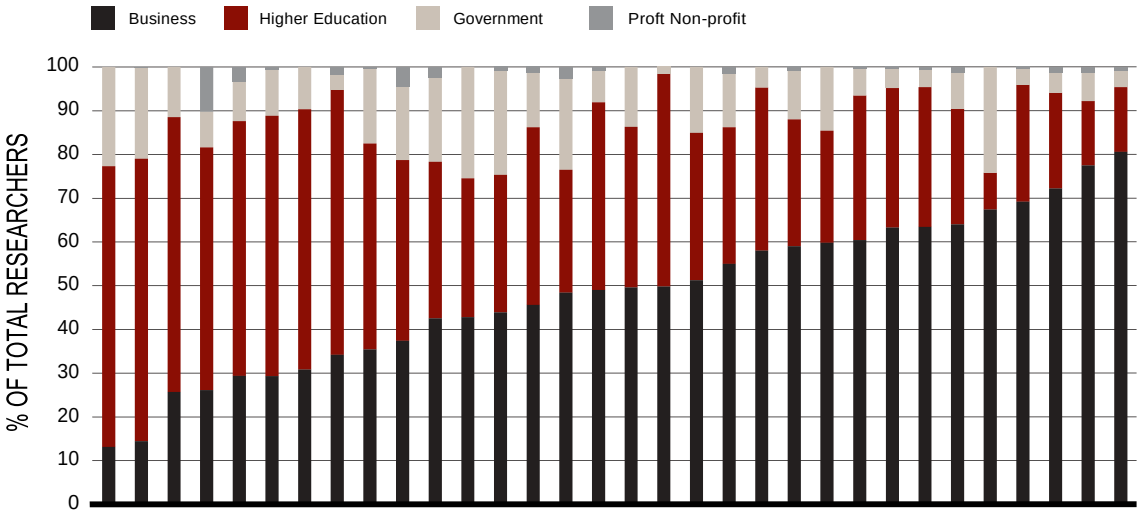
These compositional differences are likely to reflect a range of factors, including: the structure of our economy, which is dominated by small to medium sized enterprises (approximately 99.7 per cent of all businesses) and a significant base in the services sector; the focus of our R&D efforts, which has a lower technology intensity than other countries in key sectors such as manufacturing[8]; and above OECD average levels of business funded R&D in the higher education and government sectors.

Such factors emphasise the need for tailored policy and investment settings which reflect the unique characteristics of our economy. In particular, given our proportionally smaller concentration of researchers in the business enterprise sector, it is critical that we build strong collaborative linkages between industry and universities and other public sector research organisations. It is also important that we ensure that impediments to knowledge diffusion and movements of highly skilled people or 'brain circulation' are minimised.

6 Australian Council for Educational Research (2009), *Supply, Demand and Characteristics of the Higher Degree by Research Population in Australia*, Report for DIISR, 2009
7 OECD Science Technology and Industry Scoreboard 2009
8 Ibid p33

Looking to the future, we also need to consider the long term implications of the structural characteristics of our research workforce to growth and competitiveness. If we aspire to move up the value chain and compete more effectively in the industries of the future, increased engagement of researchers within our business sector may be required.

FIGURE 2: RESEARCHERS BY SECTOR OF RESEARCH PERFORMANCE – BY OECD COUNTRY, 2007



Sources: Main Science Technology Indicators (MSTI) 2006/1*, MSTI 2010/1

1.3 THE ROLE OF GOVERNMENT

The Government plays an important and multifaceted role in meeting Australia's research workforce needs: as the primary *investor and support provider*; as the *custodian* of the policy, financial and regulatory frameworks which promote or discourage research activity and employment; and as an *employer* of researchers in its own right.

1.31 INVESTING IN THE RESEARCH WORKFORCE

The Government's direct *investment* in the research workforce spans both supply and demand channels, encapsulating:

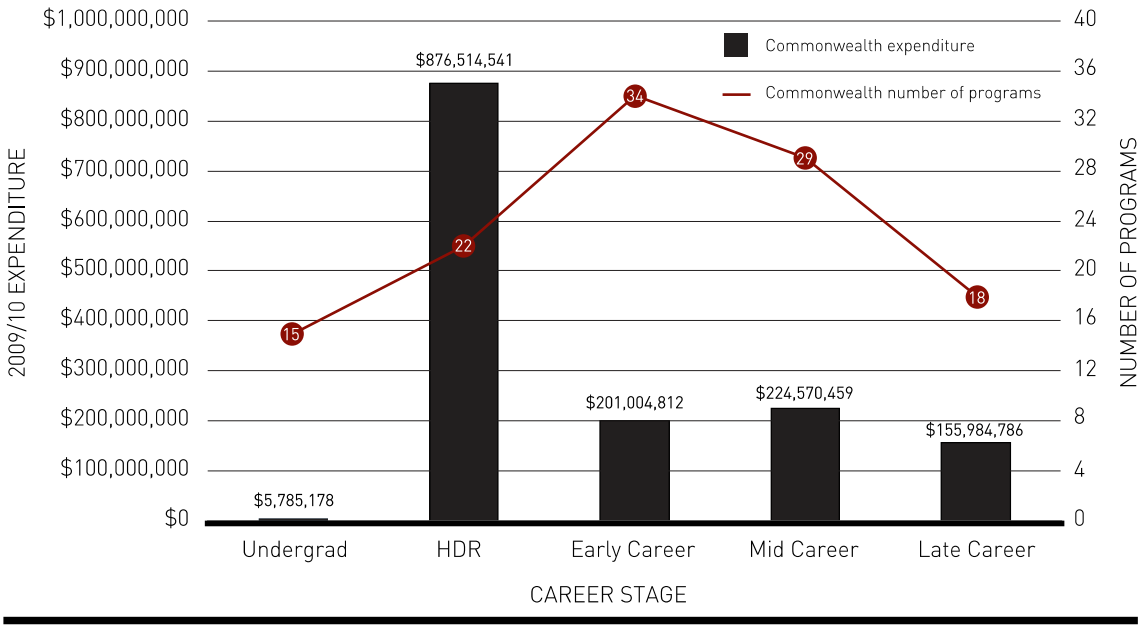
- Investment in research training (primarily through block grants to universities);
- Investment in individual researchers and research groups (primarily through fellowships and competitive grant programs);

- Support for employers to engage researchers and up-skill existing staff; and
- Provision of opportunities for international students to undertake research degrees in Australia under dedicated visa classes and for employers to access international research skills through the skilled and employer sponsored elements of Australia's migration program.

Together, this investment amounted to an estimated $1.5 billion dollars in 2009-10; around 18 per cent of the Government's total investment in science and innovation and around 96 per cent of total public investment (commonwealth and state and territory) in the research workforce in Australia.

The majority of this expenditure is targeted at boosting supply of research skills, through direct support for research training programs or research student scholarship schemes, however significant expenditure (and the largest number of support programs) is also directed at research career development (see **Figure 3** below).

FIGURE 3: COMMONWEALTH 2009-10 EXPENDITURE AND NUMBER OF RESEARCH WORKFORCE PROGRAMS BY CAREER STAGE

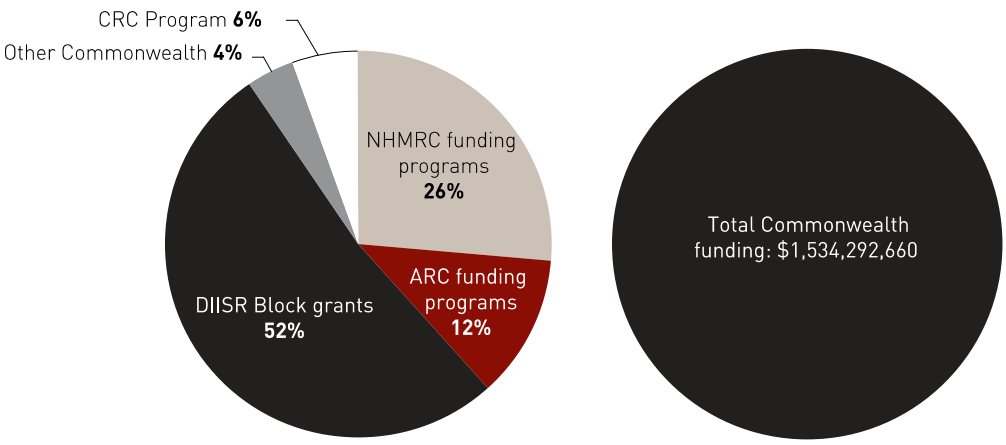


Source: DIISR, 2010

Note: Figures are estimates only. As many programs support more than one career stage, the total expenditure for these programs has been averaged across the relevant categories to give a more representative expenditure. The individual programs may be counted more than once across categories.

Government research workforce initiatives and programs are administered by a wide range of Commonwealth portfolios. The DIISR portfolio administers the majority of funding, via research block grants to universities such as the Research Training Scheme (RTS), competitive funding under the Australian Research Council's (ARC's) National Competitive Grant Program (NCGP) and multi-sector support programs such as the Cooperative Research Centres (CRC) program. However, targeted support for key groups such as international researchers and students and health and medical researchers is administered by a number of other departments and agencies, including the Department of Immigration and Citizenship (DIAC) and National Health and Medical Research Council (NHMRC) (see **Figure 4** below).

FIGURE 4: COMPARATIVE 2009-10 EXPENDITURE OF MAJOR COMMONWEALTH FUNDING PROGRAMS AS A SHARE OF THE TOTAL COMMONWEALTH RESEARCH WORKFORCE FUNDING



Source: DIISR, 2010

Note: Proportions are indicative only, based on estimated funding associated with both dedicated research workforce support programs and programs where only an element of support is focused on the research workforce. ARC and NHMRC proportions in particular may not fully reflect the extent of support provided.

1.32 LAYING THE FOUNDATIONS FOR THE RESEARCH WORKFORCE

In addition to direct investment, the Government is also instrumental in laying the foundations which sustain the research workforce through ongoing support for the educational institutions which impart knowledge and skills to future generations and the infrastructure which enables both research and learning outcomes. Investment in the higher education teaching workforce, delivered through the Commonwealth Grant Scheme and other teaching and learning grants, is particularly important in this context, as it is this workforce which ultimately trains and develops future generations of researchers for all sectors in the Australian economy. Investment in research infrastructure, facilitated by processes such as that currently being progressed to develop a Strategic Framework for Research Infrastructure Investment, is also critical.

Furthermore, by directly stimulating R&D investment and activity and maintaining the stable macroeconomic conditions that ultimately enable research and innovation to flourish, the Government contributes to demand for research skills across the economy. R&D grants and taxation incentives are particularly vital elements of this mix, as without such Government stimulus, market failures which discourage private investment in research (such as access to seed funding for innovative but high risk projects) and which reduce demand for and utilisation of research skills would not be overcome. Funding to promote collaboration between the public and private sectors is also critical, as the transaction costs associated with partnership may otherwise limit their occurrence and the associated spill over benefits which ensue.

1.33 EMPLOYMENT PROVIDER

Finally, as an important employer of research staff in Australia, the Government plays an active role in deploying research skills to where they can best contribute to the public good and inform Government decision making capacity.

Commonwealth and state and territory governments accounted for around 12 per cent of direct employment of human resources devoted to R&D in Australia in 2008-09, including employment within major research organisations such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Australian Nuclear Science and Technology Organisation (ANSTO) among others. The full contribution of government to research employment in Australia is likely to be considerably larger, however, when research consultancies and other procured services are taken into account.

1.34 STRATEGIC OVERSIGHT

Above and beyond these roles, the Government is responsible for setting strategic directions for Australia's research workforce at a national level; that is for monitoring the level and quality of skills supply, assessing in what areas Australia's investment will be best targeted, and providing leadership in addressing challenges and capturing opportunities as they emerge. This role does not detract from the importance of stakeholder groups who have a complementary responsibility for setting strategic directions at state, sectoral and organisational levels.

1.4 RESPONSIBILITIES OF OTHER STAKEHOLDERS

While the Government can provide strategic vision and leadership and targeted support, it is important to recognise the limitations of this role.

States and territories, businesses, public research organisations, universities, professional bodies and societies, researchers and students all make vital contributions to the health and vitality of Australia's research workforce – as employers, research training providers, support providers and engaged individuals. The maintenance and enhancement of Australia's research workforce capacity is dependent on the efforts of all these parties and their cooperation with each other and with Government.

Furthermore, not all influences on our research workforce performance are amenable to intervention. For example, labour market competition for skilled workers stemming from the strength of our economy may constrain domestic research workforce supply despite the best efforts of Government and other stakeholders. Similarly, the health of other global economies may ultimately limit our capacity to meet additional demand for research skills through international sources.

2. VISION FOR THE RESEARCH WORKFORCE

2.1 VISION FOR THE RESEARCH WORKFORCE

The Government's vision for 2020 is of a strong and productive Australian research workforce, comprising the scale, breadth and depth of skills required to support innovation, educate the next generation of Australians, and ultimately drive productivity improvements across the economy.

This vision recognises the central role of our human capital – in particular, individuals with HDR qualifications and specialised technical skills – in strengthening both our capacity to innovate and our ability to adopt or adapt innovations developed elsewhere.

It further acknowledges the role of our research workforce, through the conduct of teaching responsibilities, in lifting the educational attainment of all Australians; a key driver of improvements in Australia's workforce participation and productivity.

The vision is underpinned by seven aspirations (see **Box 1**), targeting key areas underpinning our research workforce's capacity to meet demand from all sectors of our economy; both now and in the years ahead.

BOX 1: 2020 ASPIRATIONS FOR AUSTRALIA'S RESEARCH WORKFORCE

- Australian firms have access to the research skills and experience that will enable them to move up the value-chain and be globally competitive.
- Australia's public sector research organisations have a sufficient research skills base to support their diverse roles.
- Australia's higher degree by research graduates have the skills and attributes to both engage in world-class research and make productive contributions in a wide spectrum of professional roles.
- Australian universities, as the major providers of research training in Australia, have sufficient numbers of research qualified staff to develop the next generation of researchers.
- Australian research students, researchers and research support staff are provided with clear and equitable pathways for career progression and supported to meet individual career needs and objectives.
- Australian research employers have in place the communication channels and linkages which promote the effective diffusion of knowledge (both codified and tacit) across the economy.
- Australia effectively draws on and harnesses the potential contributions of all research qualified individuals and facilitates participation in and engagement with the research workforce.

2.2 HOW WE ARE TRACKING?

The Government initiated several processes over 2008 to 2010 to gather detailed information on the state of Australia's research workforce and identify any emerging areas of opportunity or concern. These included:

- A Government inquiry into research training and research workforce issues in Australian universities;
- A Government inquiry into Australia's international research collaboration, including the examination of impediments and facilitating factors for researcher mobility; and
- A significant analysis and consultation process anchored by DIISR to inform the research workforce strategy.

These processes built on major reviews of the national innovation system and Australian higher education in 2008 and were complemented by wider studies of key economic, environmental and social challenges for Australia, such as the 2008 Garnaut Climate Change Review and the Government's 2010 Intergenerational Report.

They reveal that while Australia's current research workforce performance is on the whole very strong, it is vulnerable to the impact of emerging areas of weakness in domestic capability, increasing global competition for skilled human capital, and external drivers on our economy, such as climate change, in future years.

2.21 WHERE WE ARE DOING WELL

Australia performs strongly on a number of key measures of research workforce capability relative to comparator countries, including among others our researcher intensity, researcher productivity, and attractiveness to global talent.

Our research workforce is small by global standards, with only 2 per cent of all OECD full-time equivalent researchers residing in Australia, compared to around 35 per cent in the United States and around 17 per cent in Japan[9]. Relative to the size of our population and workforce, however, Australia performs very well, possessing a well above the OECD average number of researchers per thousand people employed and one of the highest OECD rates of HDR completions as a proportion of relevant age groups.

Our research workforce punches above its weight in many areas. We possess one of the top 10 publication outputs per thousand researchers of OECD countries, indicating our research workforce is highly productive by global standards. The quality of our research workforce's outputs is also of a demonstrably high standard, with the impact of our publications well above the world average in a number of fields, including molecular biology and genetics and immunology among others.

Australia also enjoys a positive reputation globally as a world-class research destination for researchers and research students. Australia ranked 10 on the most recent World Economic Forum Global Competitiveness Report[10], for example, on the quality of its scientific research institutions – a key factor cementing countries' global status as an R&D player. Furthermore, Australia possesses one of the largest shares of foreign born individuals in its total annual doctorate output across OECD countries – a share which has been steadily growing in recent years in response to strong demand from international students and growing global recognition of the Australian HDR degree.

9 OECD (2010), Main Science and Technology Indicators Vol 2010/1
10 World Economic Forum, Geneva, Switzerland, 2010, T*he Global Competitiveness Report 2010-11*

2.22 WHY WE WOULD BENEFIT FROM IMPROVED PERFORMANCE

While Australia's research workforce has served it well in previous decades, the pace of change is swift and our research capabilities must adapt to rapidly changing needs and priorities.

The increased social and economic pressures arising from the ageing of our population alone in future years necessitate significant improvements in national productivity performance if we are to maintain our current high standard of living. Increasing levels of innovation across our economy will be a key platform to achieving this outcome and will place new demands on the scale of supply to our research workforce in both the immediate and medium terms.

Furthermore, changes in the conduct of research activity to reflect more globally oriented, collaborative and multi-disciplinary approaches necessitate reassessment of the quality of our research training programs and the preparedness of our research graduates for the careers they are likely to face in the future – whether as researchers or in a wide range of other occupations and roles.

Finally, the increasingly competitive global market for highly skilled human capital and growing international mobility of researchers emphasise the need for renewed focus on the research environment within Australia; in particular, the quality and currency of the infrastructure, support and professional development we offer our researchers. The current global economic downturn presents a unique opportunity to attract some of the best and brightest to Australia. If we are not vigilant, however, we could also suffer a net loss of talent should our researchers see more attractive opportunities elsewhere.

2.1 PURPOSE OF THE RESEARCH WORKFORCE STRATEGY

The research workforce strategy has been developed to position Australia's research workforce to meet the Government's 2020 vision. In line with the aspirations of *Powering Ideas*, it plans for an innovative future Australia, involving a significant expansion of national R&D effort and a strengthened role of research and innovation in supporting mainstream policy and targeted efforts across the economic, environmental and social domains.

It focuses on five key areas, identified through a substantial consultation process over 2009 and 2010, of particular challenge to Australia and opportunity in future years:

- Meeting anticipated demand for research skills in the workforce;
- Strengthening the quality of supply through the research training system;
- Enhancing the attractiveness of research careers;
- Facilitating research workforce mobility; and
- Increasing participation in the research workforce.

These areas are discussed further in Chapters 3 to 7.

The strategy is not intended to be proscriptive. Rather it aims to establish a shared agenda based on areas where intervention can and will make a positive difference, with the right efforts, over time. While framed primarily from the perspective of the Government, it is intended to act as guiding framework for all key stakeholders.

Enhanced planning and monitoring processes to support this role are discussed in Chapter 8.

3. MEETING DEMAND FOR RESEARCH SKILLS IN AUSTRALIA

3.1 AUSTRALIA'S KEY CHALLENGES

3.11 THE PROBLEM

The most pressing research workforce challenge for Australia in future years will be to keep pace with escalating demand for research skills.

Workforce projections[11] indicate that demand for research qualified people is set to grow at a faster rate than overall employment demand in our economy over the decade to 2020, with the number of employed individuals with a doctorate by research qualification alone expected to rise by 3.2 per cent per annum over this period.

This strong demand for research skills can be expected to be further magnified as the Government's aspirations for research, innovation and higher education in Australia are fulfilled. Increasing the number of businesses investing in R&D in Australia in line with the Government's *Powering Ideas* vision will require more researchers to perform the R&D (see **Box 2**). Similarly, expanded numbers of Australians engaging in a university education, in line with *Transforming Australia's Higher Education System* targets, will require more (primarily research qualified) academics to teach the additional students (see **Box 3**). Finally, the development of national capacity in key research areas integral to Australia's future, such as climate change science, will require additional human capital with specialised research skills and experience to achieve (see **Box 4**).

Against this backdrop of increasing demand, Australia's key source of research workforce supply is showing signs of strain. Growth in domestic doctorate by research commencements has stalled since 2004 and both domestic masters by research commencements and completions have undergone a steady decline over the last decade.

The outlook for Australia from this picture for our capacity to support an innovation economy – the future for which the research workforce strategy is planning – is concerning: net shortfalls in the supply of research skills to our workforce over almost the full extent of the *Powering Ideas* implementation timeframe[12] and a significant constraint on Australia's capacity to meet the productivity challenges it faces in the decades ahead, if there is significant growth in R&D expenditure between now and 2020.

11 Access Economics (2010), *Australia's Future Research Workforce: Supply, Demand and Influence Factors.* Report for the Department of Innovation, Industry, Science and Research, 2010

12 Ibid

BOX 2: RESEARCH SKILLS IN SUPPORT OF INNOVATION

Powering Ideas outlined the Government's vision for an innovative Australian future, characterised by a significant expansion in R&D in both the public and private sectors and an enhanced role of research and innovation in addressing the major challenges of the 21st century.

DIISR commissioned Access Economics in early 2010 to examine the impact of this vision, along with other future scenarios, on Australia's research skills requirements; or more specifically, on demand for HDR qualified individuals across the workforce.

Access Economics examined several scenarios for supply of and demand for HDR qualifications in its study, including a 'base scenario' benchmarked on the base case economic parameters outlined in the Government's 2010 Intergenerational Report, and an 'innovation economy' scenario taking into account the impact of growth in national R&D expenditure, as a proportion of gross domestic product, to 2.5 per cent by 2020 (with business delivering the majority of the increase in expenditure).

The study's findings predict that, while under a 'base scenario' Australia will be well placed to meet demand for HDR skills, under an innovation scenario (the scenario closest to the Government's *Powering Ideas* vision) demand for HDR skills will outstrip supply for almost all of the forthcoming decade.

That is, in the absence of intervention, Australia's capacity to realise its innovation ambitions and achieve the productivity improvements required by our economy will be significantly constrained by a lack of availability of suitably skilled people.

3.12 KEY CONTRIBUTING FACTORS

Australia's research workforce outlook is the product of both internal and external influences on our economy, not all of which are amenable to direct action or intervention.

Growth in demand for research skills is being driven by the combined effects of employment growth, age-related retirements and skills 'deepening' as the propensity for industries and occupations to draw on high-level skills and qualifications rises over time.

These factors in turn reflect key characteristics of our economy and research workforce. Projected net employment growth, for example, is a by-product of the health of our economy, which has performed strongly by global standards on the back of the recent global financial crisis. Similarly, deepening demand for high-level skills is a marker of the ongoing shift of Australia to an innovation economy; that is, from the labour-intensive industries and occupations of past generations to the knowledge-intensive industries and occupations of the future.

Domestic student uptake of research degrees is also subject to a range of domestic and global influences. Key factors include, among others, the number of individuals graduating from earlier stages of the educational pipeline in a relevant discipline, individuals' immediate earning potential in the employment market, and the perceived quality and utility of research studies. Flows of international research skills to the Australian workforce through graduate student or international researcher migration are similarly influenced by the perceived quality and utility of an Australian research degree, the relative strength of the Australian dollar, and the availability of opportunities and incentives for research study and employment in Australia relative to other countries.

Current instabilities in global financial markets, an increasingly aggressive international competition for highly skilled people, and declining student engagement at formative stages of education in key disciplines such as science and mathematics can be expected to reinforce the pressures exerted by these factors in the future.

3.13 WHERE ACTION CAN HELP

To meet anticipated future shortfalls in research workforce supply, Australia needs to lift levels of student uptake of research degrees and facilitate employers' access to research skills from both domestic sources and other countries.

These are not new issues for Australia; indeed they have been instrumental in determining existing Government and employer policies. What is new is the immediacy of the challenge and, in the face of growing global competition, the need to be smarter and more strategic in addressing it.

3.2 PROGRESS TO DATE

The Government has already taken important initial steps to improve outcomes in key areas.

3.21 EXPANDING THE POOL OF STUDENTS WITH THE PREREQUISITE EDUCATION TO UNDERTAKE RESEARCH TRAINING

The Government has initiated an ambitious agenda to lift the educational attainment of the Australian population, with a particular focus on improving access to higher education for previously under-represented groups, lifting levels of student engagement, and improving pathways between tertiary education sectors.

The Government's ambition for 2025 is that 40 per cent of 25-34 year olds will hold a bachelor degree level qualification or above.

The Government's efforts to increase access to and completion of higher education degrees are complemented by efforts to improve educational outcomes at the critical earlier, formative stages of education. These efforts recognise that learning is a life-long process which begins in early childhood and continues through formal schooling and beyond. If positive foundations are not established in these early stages, the desire for and capacity to undertake further study are not developed.

The Government is targeting two key areas with a particularly significant impact on engagement with education – access to high quality teachers and infrastructure. Key actions include, among others, the provision of incentives for teacher training graduates to work as teachers, establishment of improved national professional standards for teachers, and direct financial support to underpin the education experience of Australian children with leading edge technologies and infrastructure. These actions are complemented by investment in informal and unstructured learning through initiatives such as the *Inspiring Australia* strategy and the ongoing excellent work of organisations such as Questacon.

BOX 3: RESEARCH SKILLS IN SUPPORT OF A MORE HIGHLY SKILLED AND PRODUCTIVE WORKFORCE

Transforming Australia's higher education system outlines the Government's vision for how Australia's higher education sector can contribute to a stronger and fairer Australia and landmark reforms to support Australia's transition to such a future.

Central to the Government's vision and reform agenda and a cornerstone of its wider strategies to strengthen national productivity is its ambition to substantially lift higher educational attainment levels in Australia. Specifically, the Government has set a target for 40 per cent of 25 to 34 year olds to hold a bachelor level qualification or above by 2025.

Both the Government's target and wider reforms to higher education have significant implications for Australia's future research skills requirements. In particular, they imply not only an expansion in the number of students studying at the bachelor degree and above but in the numbers of university academic staff available to teach them; that is, in the number of HDR qualified individuals working in the university sector. This is a critical issue for Australian universities, given the ageing profile of the academic workforce and the anticipated progressive impact of age-related retirements over the next decade.

Access Economics modelling conducted for DIISR in early 2010 indicates that, on current trends, Australia may face some challenges in meeting this academic workforce issue. In particular, a net shortfall in supply of new HDR skills can be expected in the short term (2012 to 2014) in a 'base scenario' and for the full decade to 2020, if the significant growth in R&D expenditure associated with an 'innovation scenario' is achieved.

3.22 INCENTIVES FOR RESEARCH STUDY

In addition to efforts to expand the pool of candidates in a position to proceed to research studies, the Government is also working actively to encourage the best and brightest research students to study in Australia.

A particularly pertinent issue influencing student decisions to undertake study and the modes (part-time versus full-time, on or off campus) in which they engage with it, is the availability and level of support available to them.

Recognising this, the Government is doubling the number of Australian Postgraduate Award (APA) scholarships it supports each year over the four years to 2012 and has increased the value of the APA stipend by 10 per cent. In the future, the stipend will also benefit from an improved indexation rate which provides a more realistic and appropriate reflection of the living costs of research students.

3.23 REMOVAL OF IMPEDIMENTS TO AND PRIORITISATION OF TEMPORARY AND PERMANENT MIGRATION

As outlined in Chapter 1, Australia relies and will continue to rely heavily on international sources, as a supplement to domestic training, to replenish its research workforce. Just under half of our doctorate qualified population in 2006 was born overseas and for every 1000 new migrants (excluding graduate student visa categories) to Australia around 15 are estimated to hold a HDR qualification[13]. Similarly, key professional groups, such as scientists and academics, are highly internationally mobile, with Australia on the whole increasingly acting as a net beneficiary of these people flows as they have adjusted to the expanding needs of our workforce[14].

Recognising the growing importance of employer access to highly skilled individuals from around the globe, the Government has put in place a suite of complementary reforms to facilitate the visa application process and improve the alignment of Australia's migration program with employer needs.

Key actions recently taken by the Government which will greatly assist research employers to access international research skills in the future include, among others: the introduction of a new skilled migration Points Test which affords priority to migrants with the highest levels of human capital; streamlining of visa categories to assist employers in navigating different visa options for prospective employees; and adjustment to the risk assessment level for Postgraduate Research Sector (subclass 574) visa applicants to allow research students to undertake studies without onerous integrity checks or guarantees.

These and other Government actions are complemented by the considerable efforts of state and territory governments, businesses, universities, and publicly funded research organisations. Examples include, among others, the ongoing provision of scholarships and scholarship top-ups to attract the best and brightest students into HDR study in individual organisations or disciplines and educational programs aimed at lifting interest and performance at pre-HDR levels of education.

13 Access Economics (2010), *Australia's future research workforce: supply, demand and influence factors*, Report for DIISR, 2010

14 OECD (2008), *The Global Competition for Talent: Mobility of the Highly Skilled*, Paris: OECD 2008

BOX 4: RESEARCH SKILLS IN SUPPORT OF CLIMATE CHANGE SCIENCE

Climate change is one of the most significant social, economic and environmental challenges facing Australia.

Our capacity to fully understand the factors that contribute to climate change, along with our ability to develop successful strategies to mitigate its impacts, rest centrally on the quality of our science capabilities; that is, on the availability of highly skilled scientists and researchers, world-class infrastructure and effective communication between scientists, policy makers and the wider community.

The Australian Government's *National Framework for Climate Change Science* identifies national climate change science priorities for the coming decade. The framework highlights the fact that skills shortages within Australia's science agencies are one of the major constraints on Australia's capacity to deliver high quality climate change science into the future.

In particular, the framework identifies a pressing need for more early and mid-career researchers in all of the major climate research organisations in Australia, along with more creative and stable career pathways for young researchers. The framework also highlights recent decreases in the numbers of the specialised technical staff (for example, data management and interpretation personnel and software engineers) which ultimately underpin climate science research efforts and recommends longer term, secure investment in specialised technical staff.

These issues provide a highly pertinent specific example of the challenges facing Australia's research workforce as a whole.

3.3 FUTURE PRIORITIES

What is currently missing from Australia's research workforce policy settings is a robust information base to inform planning and prioritisation. There is also insufficient flexibility within existing funding schemes to support effective targeting of resources to areas of high need and/or priority.

To address these gaps, the Government has identified the following priorities for future focus.

Priority 3.1: Establishment of new processes to improve national research skills planning capacity.

While it is clear at a national level that Australia is set to face shortfalls in the supply of research skills to its economy in future years, it is less clear to what extent these shortfalls will impact on individual disciplines and sectors[15].

15 Preliminary analysis undertaken within DIISR suggests significant differences in the demographic profile of HDR qualified individuals across disciplines, the stability of supply through the research training system, and the scale of demand for research graduates in future years.

The Government intends to work collaboratively with research employer groups, professional societies and research training providers over 2011 and 2012 to identify and map priority research skills needs within individual disciplines and industry sectors over the short, medium and long terms (2 to 10 years).

The Government envisages that this process will include an examination of both the formal qualification requirements of research employers and the broader generic or professional skills needed for employees to be fully effective, along with an assessment of these needs against current skills availability.

In addition to supporting the overarching aspirations of the research workforce strategy, it anticipates that the mapping process will directly inform planning in other areas of national significance, such as the implementation of a national climate change science framework for Australia.

Priority 3.2: Increased flexibility within Commonwealth postgraduate research scholarship programs for higher education providers to provide additional financial incentives to attract high quality students in demand areas.

The Government recognises that a key factor constraining supply of research skills through the research training system is the difficulty in attracting students to further study in fields where immediate employment and remuneration prospects are very high. Universities are not always in the position to offer additional incentives for study, in spite of the calibre of the student and the need to maintain a steady flow of HDR graduates in the field.

The Government further recognises that additional scholarship support can play an important role in attracting groups currently under-represented in the HDR population, such as Indigenous Australians, which may have additional financial and family pressures to balance with study.

The Government will provide additional flexibility for scholarship top-ups from within the existing APA grant to institutions in agreed priority areas. It envisages that priorities will include national areas identified in consultation with all key stakeholder groups through the research skills mapping process (**Priority 3.1**), and local or institutional priorities negotiated with universities as part of the ongoing Compacts process.

Priority 3.3: Expansion, over time, of Government research training awards available to high quality international students.

Recent enrolment trends, which have seen international HDR students grow strongly in comparison to their domestic counterparts, indicate that international students represent an as yet not fully tapped potential source of supply to Australia's research workforce.

The Government recognises that for Australia to remain competitive in the international global market for high quality research students it will be necessary to offer competitive levels of support for their study. The Government is accordingly opening access to APA scholarships on a competitive basis to recipients of International Postgraduate Research Scholarship (IPRS) awards from 2011. Available evidence indicates that these students are of the very highest quality and have the potential to enrich the productivity of Australia's research workforce both during and post study[16].

16 Australian Government (2010), *International Postgraduate Research Scholarships Evaluation*, Canberra 2010

Given the demonstrated quality of IPRS students and the need to expand the supply of high quality HDRs to our economy, the Government will also give consideration to the need for an expansion of the size of the IPRS program over time.

To complement these actions, it will be critical that universities and other research training providers continue to enhance policies and support structures targeted at building welcoming and supportive environments for international students studying in Australia. The Council of Australian Governments' International Student Strategy provides a framework to support and guide action in key areas.

4. STRENGTHENING THE QUALITY OF SUPPLY THROUGH THE RESEARCH TRAINING SYSTEM

4.1 AUSTRALIA'S KEY CHALLENGES

4.11 THE PROBLEM

While achieving the right levels of research skills supply will be the foremost challenge facing Australia's research workforce over the next decade, it is critical that scale be complemented by quality. In particular, our researchers need to be equipped with the suite of skills which will enable them to both engage in world-class research and contribute productively in a wide range of employment contexts.

While the majority of Australian universities are globally recognised as providers of world-class research training, there is a need to ensure that we add greater value to the research student environment to keep pace with the changing nature of both research activity and the modern employment environments in which it occurs. There is also a need to ensure that we minimise the reputational risk posed by poorly performing institutions in a tightly contested global market for research talent.

A growing body of evidence suggests that our researchers and recent higher degree by research graduates lack core competencies required in the modern workplace. A 2010 study of researcher employers conducted for DIISR by The Allen Consulting Group, for example, indicates that communication, teamwork and planning and organisational skills are key 'soft-skill' areas in need of improvement[17]. The study also points to researcher knowledge gaps in areas important to the utility and effectiveness of research staff in a business context, including business and financial management skills, commercial acumen, commercialisation skills and intellectual property management, among others.

It is also evident that the environments which our postgraduate research students experience vary considerably (both across and within institutions) in the standard of resources provided to support study[18] and the quality of the research environment in which study is embedded[19], compromising ultimately not only the individual candidate but the international standing and marketability of our research training programs.

17 The Allen Consulting Group (2010), *Employer Demand for Researchers in Australia*, Report for DIISR, 2010.

18 Council of Australian Postgraduate Associations (CAPA) (2010), *Minimum resources for postgraduate students 2010; CAPA (2009), The research training experience in 2009*, Report for the Department of Innovation, Industry, Science and Research, 2009

19 Excellence in Research for Australia, results available through the ARC website: http://www.arc.gov.au

4.12 KEY CONTRIBUTING FACTORS

The changing needs of research training in Australia are a reflection of wider changes in the global and domestic landscapes in which research and research training is conducted. The pace of change in research has been considerable in recent years, with pronounced shifts in the breadth of human and physical resources required to remain at the cutting edge of research endeavours. In particular, collaborative and multidisciplinary research environments are increasingly a necessity rather than an option, as the complexity of research problems transcends the capacity of individual groups, institutions, and (in many cases) countries to approach alone. Similarly, the boundaries between research and its application are diminishing, increasing the exposure of researchers to the commercial realities of product or process development, along with the intellectual property and financial frameworks in which these occur.

At the same time the occupations and sectors in which research graduates are employed have diversified. Only 26 per cent of doctorate qualified people in Australia in 2006 were employed as university and vocational education teachers[20] and only 28 per cent of recent doctorate graduates in 2008 were employed in higher education[21], with the remainder being dispersed across a wide range of public and private industry employment sectors. Graduates need not only academic skills, but a wide range of generic competencies to operate effectively in these diverse contexts.

Together, these developments demand a contemporary approach to research training which continues to focus first and foremost on the development of the 'scholar' but places increased emphasis on the 'employee' and 'innovator'.

4.13 WHERE ACTION CAN HELP

To strengthen the rigour and relevance of its research training system, Australia needs to establish clear standards for both the conduct of HDR training and qualification attainment, while implementing reforms that will lift the overall quality and breadth of the research training experience provided to students.

4.2 PROGRESS TO DATE

The Government has already taken important initial steps to improve outcomes in key areas.

4.21 STRENGTHENING QUALITY STANDARDS

The Government's ambitions to lift higher education attainment in Australia are firmly underpinned by a commitment to quality. This commitment recognises the need for Australia's investment in higher education institutions to be allocated wisely and in the public interest. It also recognises the need to ensure that students are able to make informed decisions as to where they will best benefit from study.

The Government has introduced a number of measures to strengthen quality in higher education.

20 Australian Council for Educational Research (2009), *Supply, Demand and Characteristics of the Higher Degree by Research Population in Australia*, Report for the Department of Innovation, Industry, Science and Research, 2009

21 Graduate Careers Australia (2009), *Postgraduate Destinations 2008: A report on the work and study outcomes of postgraduates*, Graduate Careers Australia, Melbourne 2009

The establishment of a new national body responsible for the accreditation and evaluation of higher education institutions and programs, the Tertiary Education Quality Standards Agency (TEQSA), is a particularly important reform. By setting benchmarks, monitoring performance and promoting best practice in both teaching and research, TEQSA will provide confidence in the capacity of our higher education institutions to meet the demands of the 21st century.

Furthermore, reforms to the Australian Qualification Framework (AQF), currently being progressed through the Ministerial Council for Tertiary Education and Employment (MCTEE), will be an important platform for Australia's transition to a more contemporary education and training system that supports seamless pathways between qualifications and actively promotes and supports the lifelong learning of all Australians. Critically for higher degrees by research, it will be an important tool for aligning Australian qualifications standards with those of other countries and thus contribute to the continuing global credibility and marketability of our research degrees.

Finally, the development of a robust system for assessing the quality of university research, through the now well advanced Excellence in Research for Australia (ERA) initiative, will support the identification and recognition of research strengths within universities – a vital component of quality research training.

4.22 BUILDING PARTNERSHIPS IN RESEARCH TRAINING

In addition to improving the rigour and relevance of Australia's education and training framework, the Government is committed to building enduring training partnerships between educational providers and between educational providers and employers.

For some time now the Cooperative Research Centres (CRC) program has been a leader in collaborative research training, promoting the engagement of industry and other research end-users in CRC research student studies. CRC research students graduating from these programs develop a broad suite of skills and are typically highly successful in securing industry employment. The Government's recent reforms to the program, which extend funding for CRCs to up to 10 years, will allow CRCs to expand and enrich the experience of their research students in the future.

The Government's Collaborative Research Networks, moreover, will support, among other activities, collaboration in research training between less research intensive universities and public and private sector partners. By focusing on less research intensive and non-metropolitan universities, the program will play a particularly important role in linking research students to resources, network and expertise that would otherwise be unavailable.

4.23 MEETING THE COSTS OF RESEARCH TRAINING

Quality research training ultimately comes down to the availability of sufficient resources to support a quality experience. As costs rise, it is critical that universities are able to keep pace with those increases without compromising the scope or standard of training provided to research students.

The Government's new indexation arrangements for Higher Education Support Act (HESA) funding to universities, which applies to all research block grants, will place Australian research and research training on a more sustainable footing in the future and strengthen universities' capacity to invest in the next generation of Australian researchers at appropriate levels.

These and other Government actions are complemented by the ongoing efforts of other stakeholder groups in key areas. The Deans and Directors of Graduate Studies and the executive within universities have worked for some time to develop and promote dialogue on best practice approaches to and guidelines for research training across institutions. Similarly, the Council for Australian Postgraduate Associations is playing an active role in identifying the resources required by students and promoting the implementation of appropriate policies and standards for their provision.

4.3 FUTURE PRIORITIES

While Australia's research training programs and policy settings have served it well in past decades, there is a need to refine our approach to research training to accommodate changing demands in relation to the scale and nature of research skills required by Australian employers and students.

In particular, it is clear that current mechanisms for allocating Government research training funding to universities could better reflect and reward the quality of the research training experience provided by institutions and more accurately reflect the costs associated with delivering it.

Similarly, university training programs could be better targeted to the demands of the labour market through closer engagement and dialogue with key research employer groups and professional bodies.

To address these issues, the Government has identified the following priorities for future focus.

Priority 4.1: Review of the Government's primary research training support program, the RTS.

Australia's policy settings for research training have been in place now for a decade and it is timely to consider whether funding is effectively working to deliver the outcomes we need to compete globally as an innovation economy.

The Government's review of the RTS will include an examination of the extent to which existing funding allocation drivers in the RTS formula incentivise the factors that genuinely promote quality and contribute to positive workforce outcomes.

The RTS review is planned for 2011. The Government intends to consult with universities, research employers and postgraduate student groups on key current issues and future opportunities relating to the program as part of the review process.

Priority 4.2: Examination of the cost of research training provision in Australian universities.

The Government recognises the need for universities to be adequately resourced to conduct high quality research training. It further recognises that costs may vary considerably between disciplines and according to the location and nature of training provided.

The Government's examination of the full costs of university research training will assess current RTS support arrangements and consider whether those arrangements appropriately reflect location and discipline based differentials in the costs of training.

Work on this has already commenced within DIISR and is expected to be completed, with the support of universities, by mid 2011.

Priority 4.3: Development of new models for research training that explicitly focus on the professional employment needs of graduates.

While the CRC program plays an important role in exposing research students to collaborative, end-user engaged research environments, the Government is cognisant that it will be necessary to more explicitly embed the development of both 'soft' or generic skills and innovation capabilities in university research training programs to support students' productivity in a wide range of employment contexts. The provision of such training is currently neither mandated nor explicitly encouraged and evidence suggests that communication channels between employers and research training providers in relation to both the level and nature of skills required to inform training are in need of improvement.

Collaborative work with stakeholders on the development of new training models is planned to commence in the second half of 2011. Work will be informed by consultation with universities and other key stakeholders on the principles and performance indicators which should underpin quality research training (**Priority 4.4**) and draw on both international and domestic best practice.

The early findings from the DIISR evaluation of the Commercialisation Training Scheme support the need to give consideration to extending the APA to include training in commercialisation skills, amongst other skills.

Taking into account these findings, the Government will give consideration to the implications of accommodating additional generic and innovation skill development in research degrees for the time periods of nominal support provided under key scholarship programs, such as APAs and IPRS.

Priority 4.4: Establishment and monitoring of research standards and quality benchmarks for research training.

The Government will consider options for the development of standards for research training. These standards would be developed in consultation with universities, research agencies and other stakeholders in a complementary way to the "Australian Code for the Responsible Conduct of Research" and would build on the existing efforts of individual institutions by establishing clear national guidelines for research training delivery.

The research training standards would need to take into account, among other issues, the quality of the physical and intellectual environments in which training is conducted, institutional arrangements for student selection, admission and award of a HDR degree, and the integration of opportunities for transferable and professional skills development in training programs. They would further need to take into account HDR graduate attribute and knowledge expectations established under the new AQF.

5. ENHANCING THE ATTRACTIVENESS OF RESEARCH CAREERS IN AUSTRALIA

5.1 AUSTRALIA'S KEY CHALLENGES

5.11 THE PROBLEM

A key determinant of Australia's capacity to expand its research workforce to meet demand is the perceived attractiveness of research careers in Australia. In particular, the visibility of career options, employment conditions and opportunities for progression, and national and organisational support structures are all highly instrumental in attracting and retaining research talent.

As outlined in Chapters 2 and 3, Australia has been a strong performer in the global competition for the highly skilled, on the whole being a net beneficiary of international movements of key research professionals, such as academics and scientists in recent years. It has also been highly successful in attracting prospective researchers to undertake research studies in Australia. International commencements of doctorate degrees increased by 93 per cent over 2001 to 2008 and completions more than doubled over this period, indicating growing international recognition of and strong demand for our research degrees.

Domestically, however, there are signs of concern. Information gathered over recent review processes indicates that research employment opportunities are poorly understood by and promoted to Australian researchers and support staff, particularly in relation to the private sector. This information gap extends to both the career options available and the research workforce support provided by the Government through its various funding programs.

It is also apparent that both national and institutional resources could be better targeted to address career bottlenecks at formative stages of a research career, such as the transition from student to independent researcher and from research to leadership roles. The bulk of attrition from the academic workforce – which is particularly vulnerable to age-related retirements in future years – occurs at these junctures.

Finally, it is clear that employers can do more to acknowledge and address the individual career needs of their research employees. Academic staff in Australia report low levels of job satisfaction and high workloads compared to their international and wider national workforce counterparts[22], while technicians and other key support personnel report limited opportunities for promotion and career progression[23].

22 Coates, H. et al (2009), *The attractiveness of the Australian academic profession: A comparative analysis*, Changing Academic Profession Research Briefing, 2009

23 Toner, P., Turpin, T., Woolley, R. and Lloyd, C. (2010), *The role and contribution of tradespeople and technicians in Australian Research and Development – An initial study*, Report to the Department of Education, Employment and Workplace Relations, Canberra 2010

5.12 KEY CONTRIBUTING FACTORS

One of the most significant influences on the relative attractiveness of research careers in Australia is the perceived scope of relevant long-term career opportunities.

Within the university sector, a lack of significant growth in academic appointments in the 1990s and lengthy periods of academic tenure have contributed to a workforce that is considerably older than the professional workforce as a whole and an increasing propensity for less secure, contract-based and casual modes of employment. The long-term career needs and goals of the generation now embarking on an academic career are not well served by such an environment; an issue confounded by the deep reliance of early career researchers (ECRs) on institutional support and encouragement as they build a track record to achieve success in competitive funding processes.

Furthermore, while the overall size of the university research workforce has picked up in recent years, growth in technical and other support staff has not kept pace with that of researchers, increasing the administrative and technical demands on researchers and limiting employment opportunities in technical and other support roles.

Finally, the availability of more attractive remuneration and promotion prospects in a wide range of alternative occupations has and will continue to influence the value proposition faced by individuals contemplating engaging in and pursuing a research career.

5.13 WHERE ACTION CAN ASSIST

To attract the best and brightest researchers to Australia and retain them, Australia needs to both improve its communication of available employment opportunities and ensure that individuals are competitively supported at all stages of their research career.

Australia also needs to improve employer understanding and valuing of research skills – the unique skill sets garnered over the course of HDR studies or through research activity are currently poorly promoted in key sectors of our economy, such as the business enterprise sector.

5.2 PROGRESS TO DATE

The Government has already taken important initial steps to improve outcomes in key areas.

5.21 ENHANCING CAREER SUPPORT FOR AUSTRALIAN RESEARCHERS

Over recent years, the Government has taken a range of steps to create more viable career opportunities and pathways for Australian researchers. These include, among others, the establishment of new Super Science Fellowships and Future Fellowships for early and mid-career researchers respectively and an enhanced Australian Laureate Fellowships scheme for research leaders.

These actions build on a suite of long-standing Government support schemes such as the NHMRC Postgraduate Scholarships, Training Fellowships, Research Fellowships (including Australia and Practitioner Fellowships), and Career Development Awards, and Endeavour Postdoctoral Awards and a range of other fellowship programs offered by publicly funded research organisations, such as the CSIRO.

They are furthermore complemented by the Government's ongoing support for professional bodies, such as the national learned academies, Council for the Humanities, Arts and Social Sciences (CHASS) and Federation of Australian Scientific and Technological Societies (FASTS), to promote research activities and opportunities and facilitate the development of professional networks between researchers in related disciplines.

5.22 IMPROVEMENTS TO THE RESEARCH BASE

Most critically, the Government has made a long-term commitment to Australia's research base. In a tightly contested global market for research skills, it is the quality of the research environment – access to leading researchers, stable financial resources and world-class infrastructure – which is ultimately most instrumental in determining the attraction and retention of talent.

The Government's improved indexation arrangements for HESA funding and the new Sustainable Research Excellence in Universities program will assist Australia's universities in achieving a more sustainable mode of operation in future years. Similarly, world-class research facilities established under programs such as the Super Science Initiative, and the technology development driven by programs like those under the Clean Energy Initiative, among others, will help consolidate Australia's position as a research destination of choice.

The Government's efforts to attract and retain research talent are complemented by recent and ongoing actions by state and territory governments, publicly funded research organisations, medical research institutes, universities and other research employers. These actions include, among others, targeted financial incentives, such as fellowships, to build research capacity at a state or territory or institutional level, and promotional activities, such as awards and prizes, to showcase and reward the achievements of individual researchers – an important means of raising youth and wider public awareness of the value of a research career.

5.3 FUTURE PRIORITIES

To build on and complement existing support for research careers in Australia, the Government has identified the following priorities for future focus.

Priority 5.1: Establishment of a web-based communication platform to promote research career opportunities and support in Australia.

The Government recognises that lifting public perceptions of research careers in Australia is first and foremost a matter of education. The pathways experienced by both our leading and newly engaged researchers need to be communicated more effectively to prospective students, their families and the wider community and our

researchers need clearer information on the support programs available to assist them in achieving career goals. Similarly, employers need to be provided with a strengthened information base on the value researchers and research qualified individuals can bring to their organisation.

The Government plans to work collaboratively with employer groups, professional bodies and research training providers to develop a research communication platform that addresses these needs. It envisages that the development process will be progressive, focusing in the first instance on the information needs of existing research students and researchers by showcasing the breadth of career opportunities open to Australian researchers and the suite of government funding opportunities available to support career progression. Over time, the Government envisages that this information will be augmented with more targeted communications for individual stakeholder groups, such as primary and secondary students and research employers.

Preliminary work on the communication platform has already commenced within DIISR.

Priority 5.2: Review of the balance of support within the existing suite of Government research fellowships to ensure that researchers are adequately supported at all stages of their research careers.

The Government is committed to providing clearer and more seamless career support options for researchers that reflect the realities of the modern research environment in Australia and globally.

The ARC recently reviewed the scope of its fellowship support under its NCGP to identify how the allocation of resources could be improved. Similarly, the NHMRC will be reviewing the balance of its people support schemes in early 2011. The Government will consider extending these review processes to the wider suite of Government support programs in the near future.

Priority 5.3: Increased opportunities for early career researchers (0-5 years post PhD) within the ARC Discovery Scheme.

The ARC's review of NCGP support identified opportunities to improve the success rates of ECRs in discovery projects.

Under the revised Discovery Program, to take effect in 2011 for funding commencing in 2012, ECRs will have access to a separate, flexible award in addition to the Discovery Projects scheme. The availability of a dedicated pool of funding for ECRs will considerably improve success rates and improve, over time, the number of women and international researchers supported through the Discovery scheme.

For maximum impact, it is important that these changes be complemented at an institutional level by more tailored support within universities and other research organisations for ECRs to build their track records and professional networks. The Government will work with universities and other research employers to identify best practice in relation to ECR support and promote it through the new research workforce communication platform (**Priority 5.1**).

6. FACILITATING RESEARCH WORKFORCE MOBILITY

6.1 AUSTRALIA'S KEY CHALLENGES

6.11 THE PROBLEM

The diverse intellectual, human and physical resources which underpin successful innovation are rarely governed by any one individual or organisation alone. Rather they are typically broadly dispersed and appropriated through the codification and public dissemination of knowledge and ideas and through collaboration and networking activities. Movements of skilled people, such as researchers, are particularly important, as they promote the transfer of the 'intangible' or 'tacit' knowledge which is vital to the adoption of new technologies and developments as they become available.

While, as outlined in Chapters 2 and 3, Australia has positively benefited from the circulation (both domestic and international) of research talent in recent years, it is evident that impediments to optimal levels of mobility still exist within our funding and policy settings.

Our researchers cite difficulties in sourcing funding to support international movements, particularly at the critical formative stages of a research career[24]. Furthermore, it is clear that while Australia is successfully tapping into leading researchers through schemes such as the Australian Laureate Fellowships program, it could do more to attract international researchers at the earlier stages of their research career.

Domestically, recent review and consultation processes[25] suggest that both structural and cultural impediments limit mobility of researchers between key sectors within Australia, such as the business enterprise and university sectors; the most pertinent being university recognition and reward structures which focus on the development and maintenance of a track record in academic outputs, such as publications, at the expense of innovation activities and services.

6.12 KEY CONTRIBUTING FACTORS

The imperative for global and domestic movements of our research workforce is driven by the unique structural characteristics of our economy and the realities of our geographical location.

24 Commonwealth of Australia (2010), *Australia's international research collaboration*, Report of the House of Representatives Standing Committee on Industry, Science and Innovation, Canberra 2010

25 Feedback and submissions received from stakeholders as part of the research workforce strategy development process.

As outlined in Chapter 1, the deployment of research skills within Australia sharply contrasts with that of key comparator countries and with the OECD average, with Australia possessing a significantly lower proportion of researchers in the business sector (less than 30 per cent of all researcher person years of effort in 2008-09). The pre-eminence of our public research institutions in the conduct of research necessitates strong collaborative linkages between our industry and public sectors and the removal of impediments to knowledge distribution wherever they occur. The current global economic downturn can be expected to strengthen the importance of such partnerships into the foreseeable future, as the level of resources businesses can direct to major R&D efforts is diminished[26].

From a global perspective, the 'tyranny of distance' is an ever present reality for Australia. Our separation from international production houses, supply chains and knowledge centres places constraints on our capacity to engage as a preferred partner in global innovation and access complementary infrastructure and expertise. For the research workforce distance presents particular issues, as international experience and connections are highly instrumental in developing and preserving professional networks and enhancing the impact of research publications produced over the course of a career[27].

6.13 WHERE ACTION CAN ASSIST

To enhance levels of researcher mobility, Australia needs to inculcate a culture of open innovation, wherein our public and private sector research organisations recognise and draw on complementary skills and expertise. In addition, strategies need to be adopted that minimise both financial and cultural impediments to researcher movements.

6.2 PROGRESS TO DATE

The Government has already taken important initial steps to improve outcomes in key areas.

6.21 EMBEDDING RESEARCHERS IN BUSINESS

The Government recognises the vital role that seed funding and incentives can play in overcoming financial barriers to the mobility of researchers between different sectors. Since coming in to office, it has taken steps to break down these barriers through a range of mechanisms.

The Government recently announced funding for HDR students which will be part of an ARC scheme to be known as Researchers in Industry Training Awards (RITAs), established as part of the Clean 21 Initiative. RITAs will provide HDR students with up to three and a half years of valuable 'hands-on' experience of industry, with a focus on both emerging green industries and the reduction of environmental impact in existing industries. A key feature of the scheme, which builds on the existing ARC Australian Postgraduate Awards Industry (APA-Is), is the provision of increased flexibility in the allocation of funding to provide greater certainty and autonomy to industry partners.

26 OECD (2009), OECD *Science, Technology and Industry Scoreboard 2009*, OECD 2009

27 OECD (2008), The Global Competition for Talent: Mobility of the Highly Skilled, Paris: OECD 2008

The Government's Enterprise Connect *Researchers in Business* program, established in 2008, is also helping businesses to connect with researchers and research students who can assist in developing ideas with commercial potential. The program complements APA-Is and RITAs by supporting shorter (2 to 12 months), more nimble engagements which align with a wider range of business research patterns and needs.

6.22 INTERNATIONALISING AUSTRALIA'S RESEARCH SCHOLARSHIP AND FELLOWSHIP SCHEMES

The Government has also taken important steps to break down financial barriers to international movements of researchers.

Recent enhancements to the ARC's National Competitive Grants Program (NCGP) have opened key ARC scholarship and fellowship schemes to non-Australian citizens, expanding the pool of talent eligible to participate in or lead research teams in Australia.

Furthermore, the Government's recent action to open APA awards to IPRS students will allow Australia to more effectively tap into high quality international students wishing to undertake their studies in Australia and mitigate the impact of a recent stalling in supply of research skills to the workforce through domestic channels.

These recent changes build on the foundations of Government fellowship schemes such as the ARC Australian Laureate Fellowships scheme and NHMRC CJ Martin Research Fellowships, NHMRC China Fellowship, and programs such as the International Science Linkages (ISL) program, which actively support inward and outward movements of researchers to Australia and (in the case of ISL) build critical governmental linkages to facilitate research collaboration and exchange.

The Government's efforts to promote and support both inter-sectoral and international mobility are complemented by the ongoing actions of other key players such as state and territory governments and research employers. Support includes, among other areas, industry placement schemes, expatriate return fellowships and funding to assist in building collaborations across institutions and sectors, both within Australia and in other countries.

6.3 FUTURE PRIORITIES

What is missing from Australia's existing suite of mobility policies and initiatives is targeted action to break down cultural impediments to inter-sectoral movements within Australia.

In addition, while a range of programs are available to attract foreign talent, there are few fellowship schemes which provide opportunities for Australian researchers or students to gain experience abroad.

To address these issues, the Government has identified the following priorities for future focus.

Priority 6.1: Further refinement of processes to remove impediments to individuals returning to the research workforce following a career break.

The Government is concerned to ensure that breaks in a research career – whatever their cause – do not act as a barrier to return.

The Government recognises that for academic researchers, publication track record plays a particularly important role in facilitating or hindering a transition back into the research workforce. Through initiatives such as Research Opportunity and Performance Evidence (ROPE), it has accordingly taken action to ensure that opportunity to publish is appropriately considered in the decisions of competitive funding assessors.

The Government also recognises, however, that other factors may act as impediments to return to the research workforce, including the availability of flexible employment conditions and lack of recognition of the value of non-research or non-academic experience garnered during an absence from or prior to entry to the research workforce among others.

The Government will continue to refine its processes to address such impediments over time. Acknowledging the vital role of research employers in achieving positive outcomes, it will furthermore work closely with employer groups to identify, promote and encourage best practice approaches to accommodating research workforce transitions within individual organisations through vehicles such as the ongoing university compacts process.

Priority 6.2: Investigation of metrics for measuring excellence in applied research and innovation.

The Government is cognisant that a key factor which may discourage researcher transitions between the public and private sectors of employment is a lack of reward structures for non-academic research and innovation contributions.

The Government will investigate metrics for measuring excellence in applied research and innovation activities.

The development process will be informed by international best-practice and be conducted by the ARC, in collaboration with DIISR.

Priority 6.3: Continued incorporation within existing and future funding schemes of supported opportunities for inter-sectoral and international mobility.

The Government will examine the scope to accommodate an increase in supported international and domestic mobility opportunities within existing fellowship awards as part of its wider assessment of the balance of support between Government fellowship programs (**Priority 5.2**).

7. INCREASING PARTICIPATION IN THE RESEARCH WORKFORCE

7.1 AUSTRALIA'S KEY CHALLENGES

7.11 THE PROBLEM

As outlined in Chapter 3, the most pressing challenge facing Australia's research workforce in future years is to ensure that the supply of research skills keeps pace with escalating demand from all sectors of our economy. To meet this challenge it is critical that we not only look to expand the supply of research skills to our workforce from both international and domestic sources but effectively draw on and utilise the skill sets we already possess.

Australia is currently not effectively harnessing the contributions of key groups such as women and Indigenous Australians to its research workforce; a situation which is not only inequitable but undermines our ability to benefit from the unique knowledge and attributes that these groups have to offer.

Women accounted for only one third of doctorate qualified people in Australia in the 2006 Census and are poorly represented in the senior levels of academia and public sector research organisations. Less than 30 per cent of academic positions above the senior lecturer level were occupied by women in 2008, while only 23 per cent of research scientists in our premier science organisation, the CSIRO, are women[28].

Indigenous Australians are poorly represented in both research training degrees and research employment. Indigenous students accounted for only 0.86 per cent of domestic doctorate enrolments in 2008, well below the implicit population share of 2.5 per cent, and the proportion of university research only and research and teaching positions occupied by Indigenous staff are well below that required to achieve population parity.

7.12 KEY CONTRIBUTING FACTORS

A key factor contributing to the underrepresentation of women and Indigenous Australians in our research workforce is the persistence of inequities in educational attainment at earlier stages of the education pipeline which ultimately acts to limit the pool of individuals with the capacity to proceed to research studies.

28 CSIRO (2010), CSIRO 2009-10 Annual Report

Although the gender gap in educational attainment is on the whole narrowing, women remain under-represented at both secondary and tertiary education levels in core scientific disciplines such as mathematics and engineering. Indigenous Australians are under-represented at all levels of education and across all disciplines, with less than half of Indigenous 20-24 year olds completing secondary education and a low proportion of Indigenous people proceeding on to higher education.

While the acquisition of prerequisite skills and qualifications is a core influence on the level and nature of research workforce participation of women and Indigenous Australians, inflexibilities in research support structures and cultures are also a highly influential and often negative influence on the research career prospects of these groups.

Disturbingly, researchers report that family responsibilities are not always well accommodated by employers in Australia, compromising the ability of many women to engage in full-time research employment and develop a solid research profile. Furthermore, it is evident that Indigenous research practice and methodologies are not always well understood in the research community and accommodated in research studies, limiting the capacity of Indigenous researchers to achieve their full potential.

7.13 WHERE ACTION CAN ASSIST

There is no 'quick-fix' solution to these inequities in research workforce participation – they are replicated across almost all employment sectors in the Australian economy and are the subject of concerted efforts of Government, education providers and employers alike to address.

Progressive improvements, however, can be achieved through concerted efforts to reduce barriers (financial and institutional) to participation at all stages of education, create more flexible and culturally sensitive research workplaces, and better recognise and promote the achievements of our female and Indigenous researchers.

7.2 PROGRESS TO DATE

The Government has already taken important initial steps to improve outcomes in key areas.

7.21 ADDRESSING PIPELINE ISSUES

As outlined in Chapter 4, the Government forward agenda for higher education in Australia aims to improve access of previously under-represented groups, such as low-SES students and Indigenous Australians, to higher education courses.

The Government's goals are that by 2020, 20 per cent of higher education enrolments at the undergraduate level will be of people from a low SES background and the gap between Indigenous student attainment at Year 12 or equivalent and non-Indigenous students will be halved. The Government is backing these goals with funding incentives for universities to lift low-SES enrolments under new performance based funding arrangements, and direct financial assistance to Indigenous students, teachers and schools aimed at improving Indigenous education outcomes.

Over time, achievement of the Government's goals will translate to an increased pool of students from low-SES and Indigenous backgrounds proceeding on to HDR studies.

7.22 ENSURING EQUITABLE FUNDING PRACTICES

As outlined in Chapter 6, the Government recognises that career breaks can have an adverse impact on a research career by both disrupting academic publication rates and reducing the 'currency' of an individual's professional and academic knowledge and experience. It further recognises that this impact can be particularly pronounced for women and Indigenous Australians who have their career interrupted as a result of family or community responsibilities.

The Government's ROPE initiative will mitigate this impact as it applies to the ability to compete for national competitive grants, ensuring that our top female and Indigenous researchers are able to compete on an even playing field in which their talents and contributions are assessed and rewarded on a fair and equitable basis.

7.23 PROVIDING TARGETED SUPPORT FOR MERITORIOUS FEMALE AND INDIGENOUS RESEARCHERS

In addition to evening the playing field on which women and Indigenous Australians access research support, the Government is directly enhancing the research funding opportunities available to female and Indigenous researchers.

Two additional research fellowships, specifically targeted at women, were recently added to the ARC's Australian Laureate Fellowships scheme. The fellowships will be available to outstanding female researchers in science and technology and in humanities, arts and social sciences respectively. They will actively support our top female researchers to act as ambassadors and mentors to the generation of women currently embarking on or beginning to consolidate a research career in Australia.

Changes to the ARC Discovery Grants Projects scheme (**Priority 5.3**), which place greater focus on building opportunities for ECRs, will complement these new fellowships by improving success rates of women on competitive grants. The NHMRC is also currently reviewing ways to improve application and success rates of female researchers.

Furthermore, recent increases in funding for and enhancements to the ARC Indigenous Researchers Development scheme, along with the introduction of a new NHMRC strategic framework for improving Aboriginal and Torres Strait Islander Health through Research, will strengthen opportunities for Indigenous researchers in the future.

The Government's actions are complemented by ongoing efforts of state and territory governments, employers and research training providers to encourage and support the progression of women and Indigenous Australians in research careers. In particular, the Indigenous Higher Education Advisory Council (IHEAC) is playing an active role in promoting the needs and contributions of Indigenous researchers and a number of research employers and professional associations have put in place fellowship and professional development schemes specifically targeting improved outcomes for female researchers[29].

29 See for example support outlined in: Bell, S. (2009), *Women in Science: Maximising productivity, diversity and innovation*, Report for the Federation of Australian Scientific and Technological Societies

7.3 FUTURE PRIORITIES

To complement existing efforts, the Government has identified the following priorities for future focus.

Priority 7.1: Removal of impediments within research training support programs for part-time HDR candidature.

The Government recognises that flexibility to undertake studies on a part-time basis may be a key determinant of individuals' capacity to engage in a research degree and that this issue may be particularly pronounced for women and Indigenous Australians seeking to balance study with family, professional and community responsibilities.

The Government will examine the extent to which Commonwealth research scholarship guidelines unduly restrict part-time candidature. It will furthermore work with students and research training providers to ensure that flexible practices are adopted at an organisational level.

Priority 7.2: Development and promotion of family-friendly research workplaces.

It is research employers that set the tone and culture within their workplaces and directly control the opportunities and support available to their research staff. The Government is concerned that many employers could improve their conduct of these responsibilities.

The Government will work with relevant stakeholder groups to identify best practice approaches to building positive research workplaces in Australia and promote such practice through the new research workforce communication platform (**Priority 5.1**).

Recognising that existing concerns of researchers appear concentrated in the higher education sector, the Government will furthermore open an ongoing dialogue on actions taken by universities to improve their research workplaces through the Compacts process.

Priority 7.3: Implementation of an Indigenous research workforce plan focused on the higher education sector.

The Government recognises that the factors influencing the participation of Indigenous Australians in academia and their progression to senior positions are varied and complex and consequently require long-term planning and commitment to address.

A dialogue has already commenced between IHEAC, Universities Australia and DIISR on key actions which might underpin a sustained effort to lift Indigenous academic researcher prospects over the decade ahead. The Government intends to work closely with IHEAC and individual universities to develop an agreed plan for implementation in the near future.

8. IMPLEMENTATION

8.1 PLANNING FOR THE FUTURE

The development and maintenance of a strong and productive research workforce is a long-term challenge for Australia which will require sound planning and investment frameworks to achieve.

The availability of a solid evidence base to inform decision making and the prioritisation of research workforce resources will be particularly vital, as will the existence of appropriate governance structures to coordinate efforts across jurisdictions and sectors.

Recent review processes and studies, however, have all highlighted deficiencies in Australia's existing strategic planning capabilities in each of these areas.

A paucity of data is currently available in Australia to assess key characteristics of our research workforce. Gaps include, among others, information in relation to:

- The scale and nature of the proportion of our population possessing a masters by research qualification;
- The suite of qualifications possessed by our 'active' research workforce, as identified through Australian Bureau of Statistics (ABS) and other R&D surveys;
- The roles and employment classifications of researchers and dedicated research support staff in Australia;
- The precise scale and nature of the supply of research skills to our workforce through temporary and permanent migration;
- The career pathways experienced by HDR graduates following completion of a degree in Australia; and
- The ongoing scale and nature of demand for research skills in individual employment sectors.

Furthermore, Australia currently lacks dedicated structures to support ongoing monitoring of research workforce outcomes and provision of advice to Government and other key stakeholders on areas of emerging opportunity or concern.

The diffuse roles and responsibilities associated with research workforce support and maintenance in Australia, which cross all levels of government, and the large number of employment sectors and all organisations involved in the conduct of research training, reinforce the impact of these gaps on our planning capacity and (more broadly) our ability to harness our limited resources to maximum effect.

8.2 AN IMPROVED GOVERNANCE, MONITORING AND REPORTING FRAMEWORK FOR THE FUTURE

To address these gaps the Government has identified the following priorities for future focus.

Priority 8.1: Establishment of strengthened oversight arrangements for Australia's research workforce.

Powering Ideas considerably strengthened Australia's innovation governance arrangements through enhancements to and improved utilisation of key existing advisory bodies such as PMSEIC, CCI and CSTACI.

The Government will continue to draw on these and other established structures as part of the implementation of the research workforce strategy.

To ensure that key strategy priorities are progressed in a timely and effective manner, however, the Government will additionally, through DIISR, establish a research workforce strategy advisory group to assist in the implementation process.

The advisory group will comprise representatives from key research employer groups (public and private), professional associations, unions, student bodies and commonwealth and state and territory governments. Members of the group will act as conduits to their respective members and networks and work closely with DIISR on key issues and activities requiring action through the strategy.

Priority 8.2: Establishment of strengthened national data collection practices in relation to Australia's research workforce.

Data collection in relation to Australia's research workforce occurs at multiple levels – national, sectoral and organisational. The Government is concerned to improve the rigour and relevance of the information base at each of these levels over the life of the research workforce strategy.

To improve national capabilities, the Government will work with stakeholders to develop improved longitudinal data in relation to research careers in Australia. It will also examine the scope within major ABS collections to improve the granularity and frequency of research workforce data available to Australia.

The Government will additionally, through its national research workforce road-mapping process (**Priority 3.1**), work collaboratively with stakeholders on the identification of key gaps in sectoral and organisational data sets and the establishment of processes to address gaps over time.

8.3 IMPROVED PARTNERSHIPS FOR THE FUTURE

Feedback from Australia's research sector – public and private – has been central in framing the research workforce strategy. The priorities identified within it respond to the concerns raised by individuals, organisations and representative bodies over a substantial review and consultation process over 2009 and 2010.

It is critical that all key players – research employers, research training providers, professional associations, unions, individual researchers and students – now take ownership of the challenges and opportunities the strategy presents.

As outlined in Chapter 1, while the Government is an important influence in key areas, it is ultimately the concerted efforts of all players that will be required to build and maintain research workforce capacity in Australia.

The research workforce strategy is intended to begin a national dialogue on the challenges and opportunities facing Australia now and in the future and to assist in building and maintaining productive partnerships to address them.

APPENDIX A

SUMMARY OF RESEARCH WORKFORCE STRATEGY PRIORITIES

Priority 3.1: Establishment of new processes to improve national research skills planning capacity.

Priority 3.2: Increased flexibility within Commonwealth postgraduate research scholarship programs for higher education providers to provide additional financial incentives to attract high quality students in demand areas.

Priority 3.3: Expansion, over time, of Government research training awards available to high quality international students.

Priority 4.1: Review of the Government's primary research training support program, the RTS.

Priority 4.2: Examination of the full cost of research training provision in Australian universities.

Priority 4.3: Development of new models for research training that explicitly focus on the professional employment needs of graduates.

Priority 4.4: Establishment and monitoring of research standards and quality benchmarks for research training.

Priority 5.1: Establishment of a web-based communication platform to promote research career opportunities and support in Australia.

Priority 5.2: Review of the balance of support within the existing suite of Government research fellowships to ensure that researchers are adequately supported at all stages of their research careers.

Priority 5.3: Increased opportunities for early career researchers (0-5 years post PhD) within the ARC Discovery Scheme.

Priority 6.1: Further refinement of processes to remove impediments to individuals returning to the research workforce following a career break.

Priority 6.2: Investigation of metrics for measuring excellence in applied research and innovation.

Priority 6.3: Continued incorporation within existing and future funding schemes of supported opportunities for inter-sectoral and international mobility.

Priority 7.1: Removal of impediments within research training support programs for part-time HDR candidature.

Priority 7.2: Development and promotion of family-friendly research workplaces.

Priority 7.3: Implementation of an Indigenous research workforce plan focused on the higher education sector.

Priority 8.1: Establishment of strengthened oversight arrangements for Australia's research workforce.

Priority 8.2: Establishment of strengthened national data collection practices in relation to Australia's research workforce.

APPENDIX B

SUMMARY OF RESEARCH WORKFORCE STRATEGY PRIORITIES TO BE PROGRESSED IN THE SHORT TERM

Priority	Implementation Timeframe	Australian Government department/ agency and other stakeholder responsibility
Priority 4.1: *Review of the Government's primary research training support program, the RTS.*	2011	DIISR in consultation with universities, research employers and postgraduate student groups
Priority 4.2: *Examination of the full cost of research training provision in Australian universities.*	2011	DIISR, with the support of Australian universities
Priority 4.4: *Establishment and monitoring of research standards and quality benchmarks for research training.*	Commencing in 2011	DIISR in consultation with the ARC and NHMRC and other stakeholders
Priority 5.1: *Establishment of a web-based communication platform to promote research career opportunities and support in Australia.*	2011	DIISR, with the support of relevant employer groups, student and professional organisations
Priority 5.3: *Increased opportunities for early career researchers (0-5 years post PhD) within the ARC Discovery Scheme.*	2011	ARC
Priority 7.1: *Removal of impediments within research training support programs for part-time HDR candidature.*	2011/2012	DIISR, in consultation with student bodies and universities
Priority 8.1: *Establishment of strengthened oversight arrangements for Australia's research workforce.*	2011	DIISR