Australian Government

Department of Education,
Science and Training

Response to
the Productivity Commission's Draft Research Report on
Public Support for Science and Innovation

January 2007

The Department of Education, Science and Training (DEST) welcomes the Productivity Commission's draft report on *Public Support for Science and Innovation* and the timely analysis of Australia's science and innovation (S&I) system that it presents.

DEST notes the Commission's recognition of the strong rationale for public investment in S&I and the significant positive economic, social and environmental impacts that ensue. However, DEST is of the view that the analysis presented in the Commission's draft report would be greatly enhanced by more substantive examination of some key areas, such as global engagement, human capital development, and infrastructure. This submission briefly canvasses these issues, and additionally provides comments in response to some of the Commission's specific findings relating to current policies and programmes.

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1. Introduction

Public support is an integral component of Australia's overall S&I investment. Its presence is critical to ensuring that a diversity of investments is catered for, and the effective functioning of the S&I system as a whole is sustained. The 2001 and 2004 *Backing Australia's Ability* (BAA) packages reflect the Government's acknowledgement of the need for an appropriate level of public investment in S&I. These packages have allocated $8.3 billion in funding to more than 40 programmes and initiatives aimed at strengthening Australia's ability to generate ideas, accelerate commercialisation, and develop and retain skills.

With an improving information base, the returns on these and other investments are becoming evident. In its draft report the Commission has referenced a number of studies that provide a quantitative analysis of these returns. DEST notes that recent research commissioned by DEST and conducted by economic consulting firm Econtech[1] adds further weight to this body of work. Econtech estimates the impact of publicly supported R&D on the economy at $9,116 million per annum (or a net permanent increase in GDP of 1.02 percent). The impact on living standards (as measured by private consumption) is estimated to be of the order of $3,648 million per annum (or a permanent increase of 0.70 percent per annum).

However, it is important to recognise that such economic modelling is still a developing science and cannot fully capture the diverse impacts of public support for S&I. It is necessary to additionally examine the functionality of the system, and in particular its capacity to meet both Australia's immediate, and its longer-term, *needs* and *aspirations,* in considering the level of public investment required.

Australia's *aspiration* to maintain a high quality and internationally competitive S&I system requires investment that keeps pace with technological developments and changing social, economic and environmental demands. This point is highlighted in the *Australian Government's Innovation Report 2005-06* [2] which states:

> *"Although Backing Australia's Ability represents an unprecedented investment by the Australian Government in areas of science and innovation, further work must be undertaken to ensure that Australia remains well placed to capture the maximum benefits from its investment and remain globally competitive."*

It is clear that ongoing and flexible investment strategies that both address current impediments to the optimal functioning of Australia's S&I system, and build future capacity or "options" within it, are vital if Australia is to achieve its potential over the coming decades.

In its draft report the Commission has identified a number of impediments to the effective functioning of Australia's S&I system. These include, among others, issues relating to the diffusion and transfer of knowledge and infrastructure deficiencies. DEST considers that several of these impediments merit consideration of further investment and these are discussed further in the body of the submission.

The Commission has given significantly less attention to the role of investment in building capacity to respond to future challenges and opportunities. The knowledge and skills supplied by basic research activities provide an important means for Australia to prepare for uncertainties and capture the positive returns that flow from emerging opportunities. Building "*options*" in this way provides a strong rationale for investment and warrants further attention by the Commission in preparing its final report.

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[1] Econtech Pty Ltd, *Economic Impact of Public R&D Activity in Australia,* DEST, Canberra, 2006.
[2] Department of Educaiton, Science and Training*, The Australian Government's Innovation Report 2005-06: Backing Australia's Ability: Real Results Real Jobs*, page 3, DEST, Canberra, 2006.

2. Maintaining the Foundations – Infrastructure

As noted by the Commission in its draft report, research infrastructure is an important input to S&I. As well as providing the critical capability for the production of world-class research, it is essential to the operation of the S&I system as a whole.

- **Research productivity and knowledge flows**

  By making research more capital-intensive infrastructure makes research more productive. In recent years technological advances, for example, have vastly magnified the ability of researchers to gather, analyse and extract value from data and to diffuse it. As a result, researchers are producing incomparably more knowledge per unit of labour input than has been the case in previous generations, and are disseminating it more rapidly and more broadly.

- **Human capital**

  Research infrastructure plays an important role in both attracting talent and facilitating the development of networks and skills. As a world leading research facility, ANSTO's new Open Pool Australian Light water reactor (OPAL), for example, is expected to attract Australian and foreign scientists and engineers, and allow Australian scientists enhanced reciprocal access to complementary, first-class research facilities around the world.

- **International engagement**

  By developing the capabilities required to participate in global science as an equal partner, leading edge infrastructure has the potential to further integrate Australia into the international research system. Improved participation in turn has the potential to deliver significant flow-on benefits by attracting human capital and inward investment and by promoting Australia's capabilities on the world stage.

The effective operation of Australia's S&I system, however, is dependent upon infrastructure that is both *accessible* and *relevant* – impediments to utilisation and failure to keep pace with developments have the capacity to significantly compromise research quality and its pathway to market/end-users, hinder research training, and reduce the attractiveness of Australia to inward investment. They thus present a strong rationale for remedial action through public investment strategies.

2.1 Accessibility

A key consideration in determining investment strategies is to ensure that there is optimal utilisation of infrastructure already available. The Commission has highlighted this issue in its draft report, noting (draft finding 5.1):

> *"major publicly funded research infrastructure should be priced to maximise utilisation, while avoiding congestion;"*

DEST notes that the access policies of the National Collaborative Research Infrastructure Strategy (NCRIS), which emphasise opening up infrastructure to all Australian researchers on the basis of merit, will promote the best utilisation of NCRIS infrastructure investments and enable fixed capital costs to be spread across the largest possible user bases.

Proposed investments under the NCRIS capability "Platforms for Collaboration" will moreover play a central role in promoting access to and utilisation of research data, facilitating information flows throughout Australia's science and innovation system. Such information flows, both within the research community and between it and the wider community, are fundamental to ensuring that research is undertaken efficiently and made accessible to end-users for broader social, environmental and economic utility.

2.2 Maintaining the relevance of Australia's infrastructure

While the Commission has acknowledged the need for efficient utilisation of Australia's existing infrastructure capabilities, DEST considers that the more central issue is whether these are sufficient to meet Australia's needs. DEST notes that even with optimal utilisation of Australia's infrastructure capabilities escalating demand for equipment and facilities and increasing costs of provision are likely to introduce new pressures in the years ahead.

This is particularly the case for Australia's higher education sector, for which ageing infrastructure presents considerable challenges as it strives to maintain high quality, and internationally competitive, research and training environments.

Estimates of universities' deferred maintenance for 2005 totalled $1.5 billion (up from $1.2 billion reported for 2004)[3]. While reporting mechanisms prevent a detailed analysis of maintenance requirements on individual areas, such as science-related facilities, case studies can give a sense of the problem. For example, work undertaken by the Australian National University (ANU) to assess the condition of laboratory facilities at its main campus indicated high levels of deferred maintenance on science facilities. The condition audit, performed by consultant architects, identified that the construction costs of eliminating the deferred maintenance to existing laboratories and associated facilities was of the order of $165 million.

Such high levels of deferred maintenance contribute to increasing pressure on current funding mechanisms. In the latest (2006) round of Capital Development Pool (CDP) funding, for example, universities submitted applications for 114 projects totalling $528.8 million for available funding of $93.8 million. Of these 114 projects, 75 related to science, engineering or health sciences infrastructure and totalled over $378 million.

DEST considers that the Commission's final report would benefit from a closer consideration of the implications of such emerging pressures on Australia's infrastructure. The key concern is to maintain the *quality* and *impact* of Australia's research activities - Australia must build infrastructure capabilities within a flexible investment framework that keeps pace with rapidly changing technologies and practices to achieve this goal. NCRIS is a laudable step in this direction, however the challenge in moving forward will be to maintain the momentum it has achieved to ensure that Australian research remains world-class and continues to deliver significant returns to the Australian public.

3. Strengthening the Linkages - Cooperative Research Centres

The various elements of Australia's S&I system are distinct but interdependent – strong linkages are integral to maintaining a flow of knowledge and skills that can sustain the system as a whole.

Linkages between Australia's publicly funded research sector and industry are particularly important in this regard, playing a critical role in ensuring that the potential of Australian ideas and expertise is fully captured through rapid uptake and utilisation.

Australia's premier programme for encouraging such linkages is the Cooperative Research Centres (CRC) programme and accordingly the Commission has offered a number of comments relating to this programme in its draft report. In particular it notes that:

> "*Since its introduction, the CRC program has developed into an emblematic feature of Australia's innovation system. It has also been heralded internationally as a pioneering example of collaborative research arrangements – variants of which have been adopted in number of other OECD countries.*"

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[3] As part of their financial statement returns, universities report the amount of estimated deferred maintenance (i.e. the level that should have been undertaken but was deferred). Although provided by the universities at the same time as their audited financial statements, this estimation is not audited, and must be viewed as an estimate only.

DEST welcomes the Commission's recognition of the important role that the CRC programme has played, and continues to play, in supporting long-term partnerships between Australia's publicly funded research and business sectors. Indeed it was as a result of a view that the public research sector and industry were not well engaged that the CRC programme was initially introduced.

While acknowledging the value of the CRC programme, however, the Commission has also offered some suggestions of how it might be enhanced in the future through a reconsideration of objectives and the share of public funding (draft finding 9.4):

> "*The CRC program could be improved in several ways:*
>
> - *the original objectives of the program – the translation of research outputs into economic, social and environmental benefits – should be reinstated. This is likely to produce better outcomes than focusing public support on the commercialisation of industrial research alone; and*
> - *the share of public funding should be aligned to the level of social benefits provided by each CRC, thereby reducing some of the large rates of subsidy to business collaborators.*"

DEST notes in response to these comments that two recent impact studies (Allen Consulting Group 2005[4] and Insight Economics in 2006[5]) have shown that the programme provides clear additionality – i.e. the substantial measured benefits to industry and to the Australian economy would not have occurred without the CRC programme. DEST furthermore notes that the industry contribution for 2004-05 (around 20%) cited in the draft report relates to CRCs operating before July 2005, when the objective was changed to give a sharper focus on economic benefits. A strong trend of increasing industry contributions over the five years to 2004-05 is continuing.

In addition to increasing industry productivity and global competitiveness, moreover, the CRC programme provides a valuable source of human capital – highly trained, industry-ready postgraduates as well as industry-tailored training at a range of other levels. In 2004-05, more than 2000 Full Time Equivalent post graduate students were doing their studies through a CRC. During that year, some 576 post graduate students commenced their studies through a CRC, while 318 post graduate students from CRCs gained employment in industry. In addition, some 4550 undergraduate students were receiving education and training through CRCs during 2004-05. In terms of industry tailored training, 288 structured professional training courses were conducted with the aim of transferring know-how or practical information to industry. A further 790 conferences, seminars or workshops were hosted by CRCs for the purpose of transferring know-how or practical information to end users. The benefits of this human capital accrue to the wider economy as well as to the individuals themselves and the industry that employs them.

DEST furthermore notes that, while the Commission suggests that the CRC programme in its current form places too much emphasis on commercialisation, this is only one of the recognised paths to adoption for CRC research. A number of CRCs use direct utilisation and uptake by users to disseminate their research outputs to industry. This has proved a workable model across all industry sectors.

Finally, DEST wishes to draw to the Commission's attention a number of factually incorrect statements in relation to the CRC programme in its draft report (pages 9.39 – 9.56). Factual corrections have been supplied to the Commission separately to this submission.

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[4] Insight Economics, *Economic Impact Study Report – CRC Programme,* DEST, Canberra, 2006.

[5] The Allen Consulting Group, *The Economic Impact of Cooperative Research Centres in Australia*, CRC Association, Melbourne, 2005.

4. Building Future Options - Human Capital

Human capital plays a crucial role in contributing to Australia's national productivity and long-term economic growth. A highly skilled workforce is, other things being equal, a more innovative workforce and provides Australia with the capacity to respond flexibly to emerging opportunities and challenges.

While a diverse spectrum of skills is integral to the effective operation of Australia's innovation systems, science, engineering and technology (SET) skills are particularly critical, providing the capacity to both produce and work with technological innovation – a key driver of economic growth and development.

A number of factors, including R&D target setting and the rapid growth of emerging economies such as China and India, have been driving increased global demand for SET workers in recent years. Between 1995 and 2004 employment in science and technology professions has grown twice as fast as overall employment in most countries, representing between 25% and 35% of total employment in most OECD countries. These high levels of demand are expected to continue and increase further in many countries. The US Bureau of Labour, for example, has estimated that demand for scientific and engineering occupations in the US will increase by 26% from 2002 to 2012 (compared to 15% for all occupations)[6]. Europe, has been estimated to require an additional 700,000 researchers to meet its R&D targets of 3% of GDP by 2010.[7]

The tightening global supply market for scientists and engineers presents an imminent challenge to Australia when coupled with current and projected domestic shortages in key science and engineering professions[8].

While the Commission has acknowledged the difficulties that such domestic labour shortages introduce however, it suggests that these do not warrant a policy response. In particular, the Commission suggests that market mechanisms, particularly when coupled with broad promotion of sectoral employment prospects, will tend to adjust for cyclical variations in supply and demand without government intervention.

DEST considers that such a view ignores other factors, such as the quality and relevance of SET education. Evidence suggests that these are important determinants of student course and career choice and require ongoing improvement strategies to ensure that students remain sufficiently engaged with SET to be in a position to make appropriate vocational choices in response to market shifts.

DEST further considers that the Commission's analysis would benefit from a consideration of the importance of a highly skilled workforce to building future *capacity* or *preparedness*. The lead time to train highly skilled graduates is significant, whereas many emerging challenges and opportunities are immediate and require the maintenance of a diverse pool of SET skills that can meet demand as, and when, the need arises.

For example, in the face of increasing global concern at the need to reduce greenhouse gas emissions, the development of viable alternative energy options has assumed significant importance but at the same time exposed potential weaknesses in Australia's capacity to respond. The Australian Business Council for Sustainable Energy has commented[9]:

> "…*we foresee rapid growth in our industry that is likely to come up against serious shortage of suitably qualified personnel… our members have explained that we are already encountering some shortages in skilled personnel*…"

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[6] National Science Board, *Science and Engineering Indicators 2006*, Two Volumes, Arlington VA: National Science Foundation (volume 1 NSB 06-01, volume 2 NSB 06-01A), 2006.
[7] Organisation for Economic Co-operation and Development, *OECD Science, Technology and Industry Outlook 2006* OECD, 2006.
[8] Department of Education, Science and Training, *Audit of Science, Engineering and Technology Skills*, DEST, Canberra, 2006.
[9] Australian Business Council for Sustainable Energy, *Submission to the Audit of Science, Engineering and Technology Skills*, BCSE, Melbourne, 2005.

Similarly, the recent *Uranium Mining, Processing and Nuclear Energy* draft report[10] notes that:

> "*Significant additional skilled human resources will be required if Australia is to increase its participation in the nuclear fuel cycle.*"

The issues faced by Australia's energy sector are echoed elsewhere and highlight the need to maintain a diverse and high quality SET workforce that can serve a broad spectrum of skills requirements. DEST notes that considerable benefits might be derived from the development of stronger and more iterative linkages between Australia's schools, higher education, vocational education and training (VTE), research and industry sectors. Improved linkages and dialogue have the capacity to better couple research and industry requirements with education relevance and supply and to improve the efficiency and effectiveness of knowledge diffusion across Australia's S&I system.

5. Funding Arrangements - Higher Education

5.1. Balance of funding in higher education

Australian Government policy is to operate a "dual support system" of funding in its higher education sector, providing support through a mix of block grants and merit-based competitive processes. Achieving an appropriate balance between these funding mechanisms introduces flexibility for Government and universities to both support strategic objectives and maintain a diverse spectrum of quality research activity.

The Commission has concluded in its draft report that:

> "*The rationales for dual streams of funding of higher education research are sound.*
>
> *– An appropriate balance of block and competitive funding should be maintained. In particular, as block funding levels should be sufficient to enable meaningful strategic choices to be made at the individual institutional level their share should not be reduced further*."

DEST notes that as a result of Government policy and funding initiatives the relative share of research block grants has diminished compared to competitive grants (see **Figure 1** below).

The new policy initiatives set out in the Government's 2001 *Backing Australia's Ability* and 2004 *Backing Australia's Ability – Building our Future through Science and Innovation* packages doubled the funding available through the Australian Research Council National Competitive Grants scheme. These increases recognised a need to strengthen Australia's research capability and improve its international competitiveness. They were complemented by increases to Research Infrastructure Block Grants (RIBG), acknowledging the continued importance of supporting universities in meeting infrastructure and overhead costs associated with undertaking competitively funded research projects.[11] The Government maintained other block grants (such as the Institutional Grant Scheme (IGS) and the Research Training Scheme (RTS)) at their existing levels (indexed in the normal manner). The net result of these actions was a substantial overall increase in funding available to the research sector, but a relative decline in the share of block grants compared to competitive grants.

DEST will continue to monitor and provide advice to Government on the balance between block and competitive funding.

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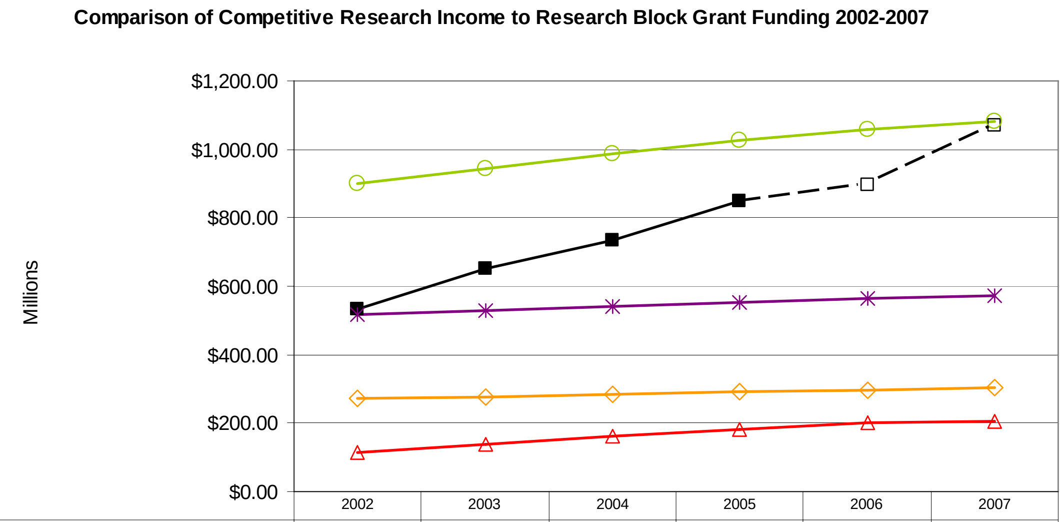
[10] Commonwealth of Australia, *Uranium Mining, Processing and Nuclear Energy – Opportunities for Australia?*, Report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, Canberra, 2006.

[11] The Government sets RIBG funding at 20c for each dollar of Australian competitive research income earned by universities.



	2002	2003	2004	2005	2006	2007
Australian Competitive Grants Register (ACGR) Income Actual	$533.28	$650.40	$734.20	$847.28		
ACGR Income Estimated					$894.91	$1,068.92
RIBG	$113.86	$137.00	$160.31	$182.98	$199.91	$203.91
IGS	$271.68	$278.11	$284.61	$290.59	$296.11	$302.04
RTS	$516.22	$528.47	$540.80	$552.15	$562.64	$573.90
Total Block Grants	$901.77	$943.58	$985.72	$1,025.73	$1,058.67	$1,079.84

Figure 1: Comparison of Competitive Research Income to Research Block Grant Funding 2002-2007

5.2. The Research Quality Framework

The Commission raised a number of concerns in its draft report about the Research Quality Framework (RQF), which was still in development during the Commission's consultation process. In its draft findings it concludes (draft finding 11.1):

> *"Consideration should be given to delaying the adoption of the RQF further, while undertaking the following investigations and analyses:*
>
> - *continue with limited trials based on the RQF peer-review principles, but focus them on providing indicators of the quality and impact of research dependent on block funding;*
> - *systematically examine whether current procedures within institutions are sufficiently rigorous to promote quality and impact of block-funded research;*
> - *examine what fine tuning of existing formulae, if any, might be advantageous in promoting incentives for continuing enhancement of quality and impact of research funded through block funding; and*
> - *examine the merits of externally applied, risk-minimisation approaches to enhancing the quality and impact of block-funded research (applied in conjunction with formula-based funding)."*

Since the publication of the draft report, the RQF Development Advisory Group has completed its *Recommended RQF*[12] and presented it to the Minister. The Minister announced on 14 November 2006 that the Government has endorsed the RQF and that it will be implemented from 1 July 2007, with the assessment process to take place in 2008. The Minister has also announced over $87 million in financial support for the implementation of the RQF.

In the context of the announcement of the RQF, and to provide additional information to the Commission to inform its final report, this section outlines the value proposition for implementing a quality-based approach to assessing research, and how some of the Commission's concerns will be addressed in the particular design of the RQF.

5.2.1. The Value Proposition for an RQF

The Australian Government presently provides over $1 billion per year in research block grants to 39 universities and three other higher education providers (HEPs). Two of these programmes, the Research Training Scheme (RTS) and the Institutional Grants Scheme (IGS) will constitute respectively $574 million and $302 million in 2007. The RTS and the IGS both use the quantity of research publications as an indicator in their allocation mechanisms. This indicator has led to significant changes to the behaviour of researchers in the higher education sector, with the key outcome of encouraging the research community to publish their research wherever possible. Concurrent with these increases in activity is evidence that publication activity has not been coupled with an increase in the *quality* of Australia's publication output. This was acknowledged in the report *Mapping Australia's Science and Innovation*[13], from 2003, and later addressed in the Evaluation of the *Knowledge and Innovation* (K&I) reforms, to which the Government responded in 2004. Following widespread consultation with the sector, the Evaluation recommended that thought be given to enhancing the quality of publicly funded research, and, in particular, how best to undertake a cost-effective research quality assessment. In 2004 in *Backing Australia's Ability: Building our Future through Science and Innovation*, the Australian Government announced Quality and Accessibility Frameworks for Publicly Funded Research.

These concerns have informed the Department's development of the RQF. A different approach to rewarding research activity in the higher education sector will lead to changes in the behaviour of researchers in the higher education sector. In short, the RQF will reward and consequently encourage research activity that leads to high quality and high impact outcomes.

The development of the RQF has since been informed by a high level of stakeholder input. The higher education sector has consistently indicated that the approach used in the RQF provides the best approach to conducting a quality-based assessment process. Since the publication of the Commission's draft report and the decision by the Government to implement the RQF, the sector has continued to indicate a broad level of support, with some hesitation related to details that will be addressed in the implementation process.

5.2.2. The Design of the RQF

The Commission expressed concern in its draft report that while the proposed RQF has some benefits, there are also considerable costs. It therefore proposed that the implementation of the RQF be delayed while other options for assessing and improving the quality and impact of block-funded university research are explored. The Commission also proposed that the RQF model be trialled before full assessment takes place.

Due to the timing of the Commission's study, it was not possible for DEST to provide advice on additional processes related to the RQF that have since been announced. Many of these processes will address the Commission's recommendations.

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[12] Department of Education, Science and Training, *Research Quality Framework: Assessing the quality and impact of research in Australia. The Recommended RQF*, Development Advisory Group for the RQF, Canberra, 2006

[13] Commonwealth of Australia, *Mapping Australian Science and Innovation*, Report prepared on behalf of the Australian Government by the Science and Innovation Mapping Taskforce, page 57, DEST, Canberra, 2003.

Assessment of impact

DEST notes the Commission’s concern that there is less confidence about how impact will be measured effectively. Unlike the UK-RAE and the NZ-PBRF, the RQF will assess research impact as a separate variable from research quality. Research impact refers to the outcome of activity that extends beyond the institution, and encompasses the application of research rather than the intrinsic value of a research output. This separation of quality and impact will allow a broad spectrum of research activity to be measured and actively encouraged. Research impact will allow for system-wide assessment of current collaborative work, activity with participants outside the higher education sector, and work that is more applied in nature.

In particular, the assessment of research impact will act as an incentive for knowledge transfer activities. By assessing this activity of researchers in higher education institutions, the RQF will encourage more activity in this area.

The assessment of research impact as a separate variable from research quality is new, and has not been tested at a sector-wide level. Nevertheless, a large number of universities have trialled various elements of the RQF including research impact, using its definition as outlined in the Expert Advisory Group’s (EAG) work from 2005.

Trialling the RQF

DEST notes the Commission’s proposal that the RQF be trialled before the full assessment take place. The planned implementation of the *Recommended RQF* will conduct trials with sector participants, with leadership from DEST. In particular, it will use the notion of research impact that was outlined by the Development Advisory Group in 2006, which refined much of the work of the EAG. The outcomes of the trials will inform the finalisation of the RQF guidelines. The guidelines for these trials will be developed with consultation from the sector.

It is envisaged that trial participants will be issued with draft Guidelines and have six weeks to gather data and submit electronic Evidence Portfolios which will then be collated and distributed for assessment to the appropriate panels. These trials will test the assessment mechanisms for quality and impact, and the moderation process.

The financial burden of the RQF

DEST also notes the Commission’s concerns that the RQF not create a costly burden on the higher education sector. There is significant work required in the early stages to establish new systems for participating in the RQF. The Government has considered and given recognition to this with the introduction of the RQF Implementation Assistance Programme. This programme will provide $16.4 million over three years to ensure that the best information and results can be obtained from the RQF for the benefit of the individual universities, the Australian Government, taxpayers, the sector, business and industry.

The information gained from the RQF will provide significant benefits to the sector, including strong evidence for institution’s research managers on the level of quality and impact of their own researchers. It will characterise and give a broader perspective of areas of ‘perceived’ research strength across an institution, successful collaborations and the value of application. Exactly how this information is used will be up to the institution.

In providing support for the implementation of the RQF, the Australian Government has also announced the Australian Scheme for Higher Education Repositories (ASHER), which will provide $25.5 million over three years. This programme will provide assistance to the sector to establish or refine their institutional online systems for data storage, known as digital repositories, to store the evidence portfolios and research outputs for review by the RQF assessment panels. Funding will support the purchase of the hardware and software required by higher education providers to establish an appropriate repository to meet the RQF requirements. For those providers with an established repository that does not meet the technical requirements to participate in the RQF, funding will assist with migrating research outputs to a suitable repository platform. The programme will also support higher education providers to populate repositories with the research outputs for assessment in the first RQF cycle and if necessary to modify their repository to meet the RQF requirements.

The use of institutional repositories will ensure significant efficiencies in the assessment process by removing the need for a paper-based process. Most crucially, though, the programme will assist in aligning the RQF process with the intent of the Accessibility Framework, currently being developed by DEST, by making it possible for research conducted in Australian higher education providers to be discoverable, accessible and shareable. DEST considers that the system-wide use of repositories beginning with the RQF will lead to significant benefits for Australia.

The RQF is not exclusively concerned with peer assessment in the traditionally used sense, recognising that much of the research submitted to the RQF will already have been submitted to rigorous peer review processes. In many cases it will be more sensible for assessors to consider the quality of research outputs in terms of quality-based assessment mechanisms that already exist for some disciplines. For example, in the case of many (but not all) of the natural and physical sciences, it will be possible to use citations and journal impact factor analyses to inform the quality of a piece of research. There will be a range of situations when assessors will not have to read all of the research outputs to be sure that the research is of high quality, given that the assessors will have a level of knowledge that enables them to interpret the metrics. The citation rate, coupled with a panel's knowledge of the robustness of these metrics for the particular discipline, will allow quality scores to be reached without unnecessary duplication of effort.

A quality-based approach to research assessment is not an all or nothing exercise. Metrics will not wholly replace the peer assessment process, even for some disciplines that are experienced with the use of metrics. On the other hand, there will be a range of situations in which research – ranked exclusively on metrics measures – appears to be of high quality, but in reality is not. DEST expects these situations to occur, and expects the panel members to be capable of identifying those discrepancies.

The UK Research Assessment Exercise

DEST notes the concerns raised by the Commission that Australia will be proceeding with an RQF while the UK has considered radically modifying its own Research Assessment Exercise (RAE). In announcing changes to its RAE earlier in 2006, the UK proposed to move entirely away from a peer assessment approach, and towards a metrics based approach. The options that were proposed appeared to be intended as a one-size fits all tool for assessing research, an approach from which DEST is moving away.

DEST notes that the UK has since announced that its RAE will be succeeded by a new framework for assessing research quality and allocating funding which is "more metrics based". Following the 2008 RAE, an initial quality indicator will be used in 2009 for science, engineering, technology and medicine, which will begin to inform funding in the 2010-11 academic year. Other subjects will not be assessed under the revised approach until 2013, which will "continue to involve a lighter touch expert review of research outputs, with a substantial reduction in the administrative burden".[14]

DEST acknowledges the imperative to reduce unnecessary administrative burden in the RQF. However, DEST notes that over a period of some two decades the RAE has introduced significant changes to the UK higher education sector. The UK's movement to a lighter touch approach to research assessment is only possible because the changes to research activity have already occurred. DEST will continue to monitor the RAE's revised approach as it refines its approach to using metrics in the RQF.

6. The Global Dimension

Australia's S&I system is embedded within a global S&I system that is making substantial contributions to the growth and diversification of the global economy. The scientific knowledge developed on Australia's shores is only a small proportion (~2.9%) of a significant, and rapidly expanding, global pool of knowledge that is accelerating that growth and diversification. It is critical that Australia effectively engage with the global community to access this knowledge pool and to ensure that developments are rapidly diffused into our domestic S&I system, and through it to the Australian economy.

International engagement strategies and programmes are being developed by many of the major R&D players[15] as they recognise the importance of global technological developments to meeting their own economic, social and environmental goals. The transition from insular to globally-oriented approaches is most evident in emerging economies such as China, but is also apparent in the strategies of traditional economic heavyweights, such as the United States and United Kingdom, as they attempt to maintain competitive advantage in the global marketplace.

As outlined below the benefits to Australia of outward-looking S&I investment strategies are significant:

> *Access to infrastructure and expertise*
>
> Infrastructure - In the face of escalating costs and scale of scientific infrastructure it is inconceivable that Australia should attempt to maintain the full suite of cutting-edge capabilities that a high quality and diverse spectrum of research activities requires – it is important instead to leverage access to complementary capabilities through international partnerships and programmes.
>
> Expertise - Time spent overseas interacting with leaders in their research fields plays an important role in exposing Australian researchers to knowledge and skills that they would not otherwise have garnered and that can be productively diffused into Australia's industry and research sectors on their return.
>
> *Broader economic and social 'spillover' benefits*
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> Inward R&D investment - A globally connected Australian S&T community helps attract investment from multi-nationals and foreign governments that are looking to acquire high quality R&D capabilities and solutions.

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[14] *Response to consultation on successor to research assessment exercise*. 6 December 2006. http://www.hefce.ac.uk/news/hefce/2006/rae.htm

[15] *Australia's Science and Technology Priorities for Global Engagement*, A report of the Prime Minister's Science Engineering and Innovation Council (PMSEIC) working group, DEST, Canberra, 2006.

Contributions to domestic industry - International collaboration can have substantial 'flow-on' benefits for domestic industries both nationally and regionally. For example, a 2005 study by ACIL Tasman[16], estimated that if the planned international Square Kilometre Array (SKA) radio telescope is built in Australia, and makes significant use of Australian technology, the (mathematical) expected benefit-cost ratio for Australia, taking account only of tangible economic benefits, would be 1.84. The positive economic impact on the proposed region for the core of the SKA in regional Western Australia was also estimated to be substantial - including the creation of 50-75 direct jobs on average for the 10-year SKA construction period - a very significant impact for a region with total employment of around 1,100.

Sustaining Australian export industries - It is reasonable to expect that international collaboration that enhances Australia's reputation as a technically advanced nation has a positive impact on Australian exports. This is particularly so for international education services, Australia's fourth largest export earner.

Expanding Australia's global influence - Australia's connections with the global science community support our reputation as a responsible and proactive international citizen and provide opportunities to contribute to meeting global challenges (e.g. participation in the *Asia Pacific Partnership for Clean Development and Climate* will accelerate development of clean energy solutions).

While Australia has much to offer other countries (and much to gain in return), an ongoing impediment to its capacity to extract the full potential from its international engagement is the difficulty of meeting high levels of demand from both potential partners and domestic researchers. This high demand is demonstrated by the pressures on the *International Science Linkages* (ISL) programme. All competitive elements of the ISL programme are over-subscribed with typical application success rates of around 10%. The external panels which assess proposals have commented previously that, while the applications selected for funding are world-class, low success rates mean that a significant number of similarly high quality and worthwhile proposals remain unfunded.

Recent Australian Government initiatives have taken steps to address these pressures. Earlier this year, the Prime Minister announced the new five year, $20 million *Australia – India Strategic Research Fund* to support research collaboration between Australian and Indian researchers. The 2006-07 Federal Budget also quadrupled funding provided under the bilateral fund with China through reprioritisation of existing funds.

However, there is scope for consideration of strategies that might further enhance Australia's capacity to grasp appropriate opportunities to partner as, and when, they arise. A recent working group of the Prime Minister's Science and Engineering Council (PMSEIC), for example, has recommended a focus on what it has termed the "four P's"[17]:

- **p**articipation – in large and ground-breaking multinational science projects;
- **p**eople – facilitating the two-way flow of scientists into and out of Australia;
- **p**artnerships – consolidating and establishing relationships with traditional and emerging science partners; and
- **p**romotion – expanding the promotion of Australian science internationally.

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16 *The Square Kilometre Array - The Business Case*, A report prepared for CSIRO Australia Telescope National Facility, ACIL Tasman, February 2005.
17 *Australia's Science and Technology Priorities for Global Engagement*, A report of the Prime Minister's Science Engineering and Innovation Council (PMSEIC) working group, DEST, Canberra, 2006.

Continuing to strengthen engagement in such areas has the capacity to significantly enhance the effective functioning of Australia's S&I system, and to boost Australia's performance and profile.

DEST notes that the Commission makes little mention of global engagement in its draft report. While DEST recognises that the global dimension may introduce further complexities into the Commission's analysis, it nevertheless considers that, as an intrinsic component of Australia's innovation landscape, it cannot be ignored. Impediments to Australia's participation in the global S&I system compromise the quality and relevance of Australian science and its capacity to meet Australia's needs and goals – they thus warrant further consideration by the Commission in its final report.