Science and Technology for the Social, Environmental and Economic Benefit of Australia

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Executive Summary

The Federation of Australian Scientific and Technological Societies (FASTS) is the peak representative body for 60,000 Australian scientists and technologists.

Science, engineering and technology (SET) are fundamental to Australia's future economic, environmental and social development.

The nation's SET base is a significant driver of productivity growth and the evidence linking investment in science and high public and private economic, social and environmental returns on investment is well established.[1]

Australia has a high quality science base and are global leaders in a wide range of biomedical, climate change, mining, agricultural, ICT, astronomical, materials, environmental sciences and many other areas of fundamental science.

However, there are key challenges that must be addressed if Australia is to fully leverage its capabilities; including

- More sophisticated approaches to supporting the multiple pathways to adoption of knowledge including commercial use.
- Developing more effective modes of knowledge transfer between universities and industry and the community, including rapid migration of PhD graduates into industry;
- Developing the capacity for high level strategic analysis of the directions of Australian science;
- Forging stronger linkages between science, business and venture capital;
- Addressing science skills shortages in specific areas (eg statistics); and
- Strengthening the quality of science teaching

[1] See for example, The Allen Consulting Group, *The Economic Impact of Cooperative Research Centres in Australia*, 2005; Steve Dowrick, A Review Of The Evidence On Science, R&D And Productivity Steve Dowrick, DEST, August, 2003.

The proposals in this submission are not intended to be a comprehensive policy agenda but rather, offer some suggestions to build on the Government's existing policy frameworks as articulated, primarily, in *Backing Australia's Ability* and *Backing Australia's Future*.

Summary of measures proposed

Program	Budgetary impacts
100 Post-Docs in industry	$4.5m in the first year and $9m pa for the second and subsequent years
Expanding 'trusted intermediaries'	One off grant of $2m to the innovation exchange to train additional intermediaries ($1m) and build the necessary ICT infrastructure ($1m
Commercial Ready	Review application and compliance regime.
Commercial Ready	Extension of COMET with a particular emphasis on building in-house expertise
Biodiversity	Additional $5m pa for the next decade to develop the *Atlas of Living Australia*
Indexation of university grants	Adopt model based on a 75% Wage Cost Index (Education) and 25 per cent CPI.
Direction of Australian Research	New money to establish ongoing capacity for strategic oversight of Australian research
Research Quality Framework	New money for implementation and increase quantum of funds for R&D.
Research Quality Framework	Increase impact measures in funding matrix
Research Quality Framework	Funding caps to be implemented in even steps over 3-year period, not a 5% cap.
Knowledge transfer	$10m in 2006/7 for pilot of contestable knowledge transfer fund for knowledge transfer partnerships
International Postgraduate Research Students	Doubling the 330 EIPRS places pa, and transform them into 660 prestigious, competitive, fee-free scholarship stipends worth up to $25,000,
International Postgraduate Research Students	Allocate 660 strategically targeted fee waivers, with additional funding to offer stipend funding on a 50:50 matching basis with participating institutions or research organisations

The Australian Economy

The Australian economy has been characterized by a long period of sustained GDP growth.

FASTS are concerned that even though this growth has occurred during a period when our terms of trade have been highly favourable we have had persistent deficits in our balance of trade. This was $1.33b seasonally adjusted in October 2005 and 2.5% of GDP.[2].

If, as expected, commodity prices come under pressure in the next few years, then the necessity to better leverage our SET base will become a greater imperative.

[2] ABS, 5368.0 *International Trade in Goods and Services*. ABS, 5206.0 *Australian National Accounts: National Income, Expenditure and Product*

Taking a longer view, Government investment through the budget process must prioritise national capabilities to address:

- A sustainable environment, including impacts of climate change;
- Biosecurity;
- Need for increasing productivity to address pressures of an ageing population; and
- Building capacities to ensure a highly skilled and educated workforce.

Budget Surplus

According to the MYEFO, there will be a fiscal surplus of $10.4 billion for 2005-06, up $3.0 b on the 2005-06 Budget forecast and strong increases in the out years.[3]

The surge in the budget surplus appears to reflect strong business profits, particularly in the mining sector, strong export prices for key commodities and relatively low unemployment.

In this environment, the Government will come under great pressure to reduce income and business tax rates.

However, FASTS urges the Government to take a long-term view and commit some of this surplus to investment in building Australia's productivity base through;

- Measures to increase the core rate of innovation in the Australian economy, including enhancing mobility between universities, public sector research agencies and companies;
- Addressing indexation deficiencies in university and R&D programs;
- Increased investment in research infrastructure;
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- Additional funding to both bed in the Research Quality Framework, and to provide new money to ensure that the high ranking groups remain internationally competitive, and
- Providing additional funding to enable stronger partnerships in knowledge transfer (third stream funding).

Innovation and research commercialisation

Research and innovation are fundamental to Australia's capacity to maintain and improve high levels of productivity growth.

A policy weakness in the current policy framework is over emphasis on the 'linear' model of commercialisation: exploiting IP developed by publicly funded R&D through 'spin-off' companies. FASTS argues there are many different pathways to adoption and commercial use of the knowledge, insights and skills of universities and public sector R&D.[4]

To increase the core rate of innovation in the Australian economy there needs to be a greater focus on the mobility and networks of 'people', as distinct from the 'ideas' of R&D. It is people who create wealth rather than 'ideas' per se.

[3] http://www.budget.gov.au/2005-06/myefo/html/index.htm

[4] See, for instance, Howard and Partners, *The Emerging Business Of Knowledge Transfer Creating Value From Intellectual Products And Services*, DEST, 2005.

A sophisticated economy should not choose between adopting other people's research (fast follower) and doing their own – it must do both. Moreover, these two objectives are not mutually exclusive. A high quality R&D sector provides the skills and capabilities to allow understanding, appreciation and rapid adoption of non-Australian R&D.

To re-orient Australia's innovation and commercialization framework toward human capacities, key policy initiatives are required to

- Enhance mobility between industry and research agencies and universities;
- Enhance knowledge transfer partnerships
- Build linkages between inventors, business and venture capital.

In addition, a number of changes are recommended to make 'commercial ready' more attractive to technology SMEs.

100 Post-Docs in industry

PhD students are a considerable national resource. The skills and experience they gain through their research is at least as important, if not more so, as the new knowledge they produce in terms of their value to industry innovation.

Currently, there is no systematic collection of longitudinal data on the destinations of PhD graduates. FASTS suspects that too many doctoral candidates are narrowly focused on, and advised to follow, academic research as their career pathway due, in part, to a lack of appreciation of the opportunities and value of industry. Concomitantly, we suspect that many firms are not aware of the skill sets that SET PhD graduates have as a consequence of their research training.

FASTS believes cultural factors in both universities and industry constrains career pathways into industry. Accordingly, FASTS argues there are compelling reasons to put in place incentives for a more dynamic uptake by industry of the skills acquired in PhD programs.

FASTS proposes a new competitive scheme to fund 100 post-docs a year into industry whereby the Government contributes 50% of a salary package of $90,000 (including oncosts). The costs to Government would by $4.5m in the first year and $9m pa for the second and subsequent years.[5]

Employment of postdoctoral scientists, engineers and technologists would not be restricted to the enterprise's R&D programs but would be available throughout the organisation providing opportunities in commercialisation activities, marketing and management. After two years the industry employer and the postdoctoral fellow would be released from their obligations - the company would be free to offer continuing employment should that be mutually acceptable.

Such a scheme would be more flexible than current programs in the ARC and Commercial ready as these (respectively) require formal linkages with universities or research institutions or confine the funding to a specific R&D activity.

The advantages of this program would be:

- an injection of talent into industry of young scientists and technologists, all with new approaches,

[5] This equates to the lower end of the level B postdocs in universities and the ARC. It is up to industry to supplement as appropriate.

project management expertise and strong links back to the research and training sector;
- a clear incentive for universities to place greater emphasis on industry options and mobility in their management of research training.;
- a bridge across the cultural divide between research and industry in Australia with attendant benefits on both sides;
- useful exposure to industry for a significant group of the brightest young scientists and technologists creating a new awareness of industry priorities in this group;
- to encourage industry to employ people with the qualifications most likely to contribute to the development of new and improved products;
- to create a new source of demand for recent science and technology post-graduates, thus encouraging enrolments and lifting the national skill level in these areas; and
- provide a career path into industry management with an attendant increase in scientific and technological knowledge in the boardroom.

Expanding 'trusted intermediaries'.

FASTS is a strong supporter of the Innovation Exchange's 'trusted intermediaries' program. This has already proven to be effective in bringing together university researchers and entrepreneurs/businesses in a targeted and strategic manner. However, there are two weaknesses in the program that warrant modest support from the Government to enable the program to ramp up its effectiveness:[6]

1) bringing researchers and business entrepreneurs together is only part of the solution. In addition, the program needs to connect with private venture capital, and
2) the program desperately needs more intermediaries to meet growing demand and the ICT infrastructure to support global connections.

Accordingly, FASTS recommends the Government provide a one off grant of $2m to the innovation exchange to train additional intermediaries ($1m) and build the necessary ICT infrastructure ($1m). A condition of this funding should be the intermediaries program makes venture capital the third party to the intermediary process.[7]

Commercial Ready

FASTS are concerned that that an unintended consequence of rolling BIF into 'commercial ready' and changes to application and compliance requirements is a relatively low number of smaller grants (under $200k) being awarded. FASTS believes that the grants made under BIF were more 'user friendly' than the current regime and provided capital at the earlier stage of R&D which is essential.

FASTS welcomes the changes to the timing of funding periods for successful applications on as announced on 1 September 2005 and believe this will enhance the attractiveness of 'commercial ready'. However, examination of the application and compliance regime is warranted.

FASTS supports extension of COMET with a particular emphasis on building in-house expertise.

[6] A useful exploration of knowledge exchange networks is John Howard, *Knowledge exchange networks in Australia's innovation system: overview and strategic analysis***,** A report commissioned by BIHECC, 2005. Available at http://www.dest.gov.au/sectors/science_innovation/publications_resources/profiles/ken.htm

[7] Disclosure – FASTS is a complimentary member of the Innovation Exchange.

Biodiversity

Australia is one of only nineteen countries classified as 'mega-biodiverse" and has an extraordinary high level of endemism with more than 80% of our species found only in Australia or Australian waters.[8]

Australia has more than twice the number of species as Europe and North America combined.

Understanding and classifying Australia's biodiversity is essential for sustainable environmental management. Moreover, this biological wealth is 'living capital' which presents a wide range of economic opportunities in pharmaceuticals, agriculture, aquaculture, manufacturing, mining, environmental remediation and other biotechnology and chemical applications.

Recent advances in genomics, bioinformatics and ICT is enabling a revolution in taxonomy.[9]

However, much of Australia's biodiversity remains either unknown or not fully classified. Moreover, Australia is losing the human capital to undertake the taxonomic investigation required to classify Australia's biodiversity, as an ageing taxonomy workforce is not being replaced

As a first step to ramp up current efforts to address the shortfall of Australia's knowledge of our biodiversity, FASTS recommends the Government commit an additional $5m pa for the next decade to provide for an *Atlas of Living Australia* as recommended in the PMSEIC working group paper.

Public sector SET

Indexation of university grants

Since 1995, the indexation methodology for university grants has born no relationship to the significant increases in actual costs.

Consequently the value of the Commonwealth investment has declined in real terms for the past decade. One estimate is that if indexation were based on AWEs then universities would have received an additional $800m in 2003. [10]

This has resulted in the running down of capacity and infrastructure particularly given the increase leveraging of university funds (approx $450m pa) to participate in national competitive grants schemes including ARC Discovery, Centres of Excellence and Federation Fellowships.

FASTS does not agree with the advice provided to the Minister by DEST and other Departments this year on maintaining the status quo.

FASTS urges the Government to change the current Cost Adjustment Factor (CAF) to a model based on a 75% Wage Cost Index (Education) and 25 per cent CPI.

[8] For an overview of these issues refer Snow Barlow et al, *Biodiscovery*, PMSEIC, December 2005.
[9] Taxonomy is the science of classification, including increasingly genetic classification, of animals, plants and microorganisms.
[10] M. Gallagher & J. Mitton, *A Comparison of Different Index Values of the Salary Component for Higher Education Funding*, November 2003.

Direction of Australian Research

A weakness in Australian research is there is no body charged with looking at the strategic directions of where Australian research is heading and providing high-level advice to Government on such issues.

Changes, for example, to CRC selection criteria or the strategic focus of CSIRO may create gaps and overlaps in Australian research. However, currently, there is no systematic identification or examination of the consequences of such changes: Are there gaps? Do they need to be filled? If so, by whom?

FASTS recommends that PMSEIC be given additional resources to carry out this function, which may also be informed by the results of the Research Quality Framework.

Research Quality Framework

FASTS affirms its support for assessing the quality and impact of Australian research in an international context and the policy intent to fund high quality, high impact research wherever it is conducted.

Implementation of the RQF will have costs over and above that currently required to administer and comply with requirements for the Institutional Grants Scheme and the Research Training Scheme. If the panels are to be credible there must be new money to ensure the integrity and robustness of assessment especially if the goal of 50% international membership of the panels is to be achieved.

It is proposed that the RQF should be trialed in 2006 before implementation in 2007. The trial(s) will be crucial for understanding the impact the RQF will have on funding and possible perverse outcomes.

FASTS are concerned that impact will not be given sufficient weight relative to quality measures. While recognizing and supporting high quality research must be a fundamental objective of the RQF the current matrix may serve as a disincentive for researchers and institutions to place sufficient priority on more industry oriented research where impact is more significant than academic quality per se.

The Preferred Paper presents a matrix combining a 5-point quality scale and a 3-tier impact scale. However only high impact research can modify the aggregate score of quality and impact by increasing quality rankings of 4, 3 and 2 by one point. This has the effect of reducing the 3-tier impact to a 2-tier system [11]

Research Quality				
	5	5	5	5
	4	4	4	5
	3	3	3 (4)	4
	2	2	2	3
	1	1	1	1
		Limited	Moderate	High
		Impact		

The purpose of the combined score is to drive funding allocations to institutions.

[11] Refer table 5, 2.6.3, Expert Advisory Group, *Research Quality Framework: Assessing the quality and impact of research in Australia: The Preferred Model*, DEST, 2005.

Our concern is this matrix creates incentives for institutions and research groups to focus on high quality basic research rather than seeking to maximise the impact of more industrial or applied research. This may result in universities lowering their commitment to the sort of research undertaken by CRCs.

FASTS believes the criteria for 'moderate' impact is sufficient to warrant recognition in the RQF matrix. One option is to increase the value of moderate impact by increasing 3-point quality to 4 (in brackets in table). This also provides an incentive for solid research to seek to enhance its impact.

FASTS do not support placing a funding cap of 5% on the first iteration of the RQF. While there are political and planning reasons to smooth the funding effects of the RQF, restricting the impact to that extent undermines the policy intent of the RQF and creates a major disincentive for research groups and institutions to engage with the RQF process. FASTS recommends that changes in allocation be introduced in equal steps over each three-year cycle of the RQF.

RQF and ARC/NMHRC

FASTS do not support the RQF being used in the assessment process of individual grants. The proposed units of measure in the RQF are research groups and Departments. However, it is sometimes the case that outstanding individual researchers may work in lower rated research groups. Conversely, not every researcher in a highly rated group will be outstanding. Therefore there is a risk that applying the RQF will, in practice, undermine the fundamental selection criteria for individual grants of excellence and quality.

FASTS do, however, believe there is a case for the RQF informing distribution of funds between broad disciplinary groups supported by the ARC and NHMRC (currently the ARC distributes funds between disciplines largely on a demand driven basis).

However, use of the RQF for this purpose should not be formulaic. If the RQF demonstrates relative weakness in some sub-disciplines or multi-disciplinary fields of inquiry this may present a case for additional investment to increase the quality and impact of research if the area is of national strategic importance.

Knowledge Transfer

One outcome of the RQF debate was the proposition that Australia should introduce a 'third stream' fund analogous to that introduced in the UK in 1999.

FASTS do not support adopting the UK model nor do we support the introduction of a 'third stream' or 'engagement' fund designed to compensate institutions who are 'losers' in the RQF.

There is, however, a compelling case to provide new money to build stronger knowledge transfer capacities and capabilities between universities, industry and community.

Such a program should be contestable, and accessible for all universities (irrespective of their performance in the RQF).

There are already a number of successful 'third stream' funding streams notably CRCs and ARC linkages grants. FASTS supports additional funding for these programs.

The key policy question is what are the gaps in the current funding regime that need to be addressed (this is an important role for the strategic oversight function discussed above)? FASTS submits the two key areas that need addressing are;

- Mobility between universities and industry and communities, and
- Strong networks/partnerships.

FASTS are aware that DEST are preparing detailed policy advice on how knowledge transfer might be enhanced. While the definitions and scope of such a program are yet to be determined and approved by Government, FASTS argues that $10m should be allocated in the 2006/7 budget for pilot programs to commence in calendar year 2007.

Knowledge Transfer Partnerships

Building and maintaining linkages between universities, industry and communities to maximise rapid and effective knowledge transfer requires resources.

FASTS recommends that a key feature of new money to support knowledge transfer activities is the funding should go to the partnership rather than directly to universities, industry, local Government or community organisations.

An example of the type of activities that should be supported is the Australian Mathematics-in-Industry Study Group (MISG).

The Mathematics-in-Industry Study Group (MISG) was formed in 1984. MISG conducts intensive weeklong workshops addressing projects proposed by industry. Since 1984 a total of 17 MISG Workshops have been conducted. During that time 77 companies have participated with 120 individual projects. Testimony to the success of the MISG Workshop is that 30% of companies have returned to the Workshop in future years.

The MISG Workshop was organised by CSIRO from 1984 to 1993 but was nevertheless staged at a University Campus. Since then the Workshop has been organised and staged by the University of Melbourne from 1994 to 1997, by the Queensland University of Technology (QUT) in 1998 and 1999, by the University of South Australia (UniSA) from 2000 to 2003 and by Massey University in NZ from 2004 to 2006. The need for the hosting University to provide substantial capital investment and the *ad hoc* nature of the arrangements has meant that the future of the MISG Workshop is not properly secured.

There are many small to medium enterprises (SME's) that can benefit from the application of smart quantitative and qualitative solutions. However many of these organisations cannot find a feasible way forward to engage in this process. The first step in providing access to industrial mathematics is to establish and maintain a viable and visible network with a particular focus on initial consultation and advice leading to a commercial research and/or consulting arrangement with a qualified service provider.

This is an excellent example of the sort of partnership and collaborative network that a knowledge transfer (third stream) fund should support.

Government support for such a network would allow many SME's to obtain access to research and consulting services that would greatly enhance their viability and would enable more rapid technology diffusion and greater productivity across many sectors in the Australian economy.

International Postgraduate Research Students

The employment of scientists and technologists operates in a global marketplace. Many of Australia's best and brightest scientists are attracted overseas, and we should naturally do our best to retain these valuable people whose education we have already funded.

However, we should also aim to attract bright young scientists and technologists from the global marketplace whose education has been funded by other nations, to ensure that the inflow of talent more than balances the outflow. One avenue to achieve this is to create a new integrated system of postgraduate recruitment and immigration protocols to enhance our intake of overseas postgraduate *research* students, whose undergraduate education has already been funded by other countries.

Currently the Federally-funded Endeavour International Postgraduate Research Scholarships Scheme (EIPRS) provides for 330 students each year spread over all Australia's higher education institutions (compared to 1550 domestic Australian Postgraduate Awards). The EIPRS scheme pays the course fees and insurance costs over the 3 year postgraduate course (with up to a one year extension on academic grounds), which typically amounts to between $20,000 and $25,000 p.a. per student depending on the discipline and the institution. Added to that, the universities provide a stipend to cover living allowances, at a similar level.

FASTS recommends increasing the number of overseas postgraduate research students by

- doubling the 330 EIPRS places offered each year, and transform them into 660 prestigious, competitive, fee-free scholarship stipends worth up to $25,000, while continuing to allocate these to universities under the current criteria, and
- allocate a similar number of strategically targeted additional fee waivers, with additional funding to partner the stipend funding 50:50 with the institution e.g. Cooperative Research Centres, Centres of Excellence, Major National Research Facilities etc., to enhance their impact in areas of high research quality, or to address skills shortages in specific disciplines.

The advantages of these measures include:

- Australia will gain a large pool of highly trained, talented young people who will immediately contribute a net benefit to our national research effort;
- They will help reverse the decline in numbers of domestic postgraduate students with specific skills, particularly in the enabling sciences (physics, mathematics, chemistry). Consequently they will not displace high quality domestic students.
- They will help build a critical mass in our research groups.
- They will create valuable future networks in their home nations (should they decide to return), which will enhance Australia's economic, social and national security interests.