

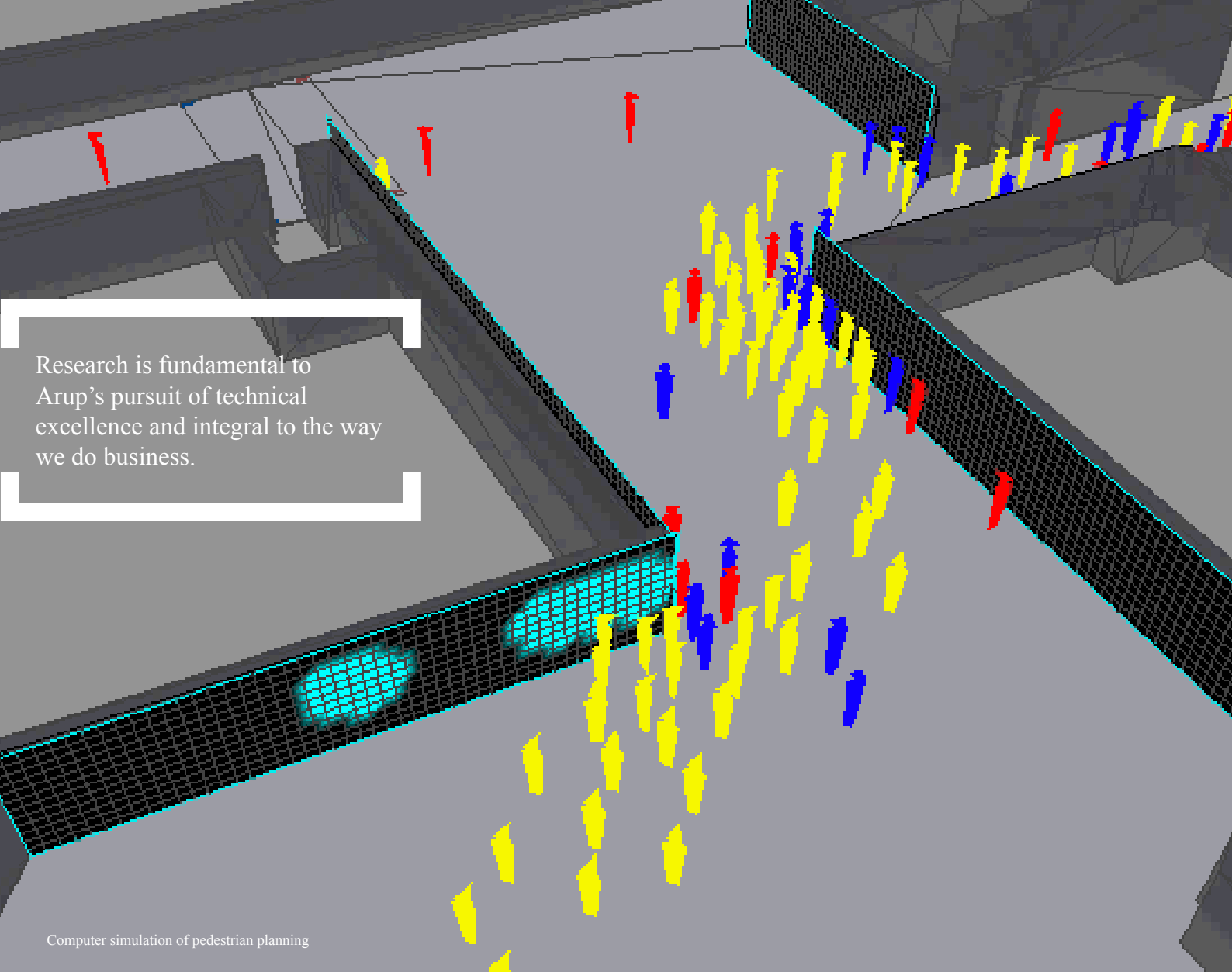
# ATSE FOCUS

NUMBER 167  
AUGUST 2011

## USING OUR RESEARCH

### STRENGTHENING THE UPTAKE LINKS

How can we strengthen the links between Australian industry and our publicly funded research organisations? Contributors look at the issues here and overseas



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Photo: iStockphoto



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## FOCUS

ATSE *Focus* is produced to stimulate discussion and public policy initiatives on key topics of interest to the Academy and the nation. Many articles are contributed by ATSE Fellows with expertise in these areas. Opinion pieces on topics of national interest, particularly the Academy's key interest areas – climate change impact, water, energy and education – will be considered for publication. Items between 800 and 1500 words are preferred. Please address comments, suggested topics and article for publication to [editor@atse.org.au](mailto:editor@atse.org.au).

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ATSE is an independent body of eminent Australian engineers and scientists established to promote the application of scientific and engineering knowledge to practical purposes. ATSE *Focus* is produced to serve this goal.

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# Why the cleft in our innovation system?

We are not merely seeking the knowledge to understand the world – we are asking for the tools to change it.



By Kim Carr

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Australia has some of the best and brightest minds in the world today. With less than 0.3 per cent of the world's population, we produce more than three per cent of its scientific papers. We claim a yet higher share of the most highly cited output, at 4.3 per cent, putting us in the top 10 research leaders of the OECD.

Nor can we doubt the quality of Australian research. The inaugural *Excellence in Research for Australia* report confirmed the phenomenal breadth and depth of our talent pool. In no fewer than 19 disciplines, four or more Australian universities had the highest possible rating for research excellence.

As Minister for Science and Research, I am proud to invest in this world-class asset. As Minister for Industry and Innovation, I question why so few businesses share my enthusiasm.

The latest *Australian Innovation System Report 2011* shows that our rates of collaboration in innovation are low by OECD standards. These results are even lower when we consider business-research collaboration. Business collaboration with universities was 2.4 per cent in 2008-09 and business collaboration with publicly funded research agencies was 4.4 per cent in the same year.

According to these data, business-university collaboration has increased by 50 per cent since 2006-07; while business collaboration with publicly funded research agencies fell by 39 per cent over the same period.

That may, perhaps, account for the fact that Australian currently ranks 26th in the OECD for large business enterprises with new-to-market innovations. For market-leading SMEs, we rank 24th.

This cleft in our innovation system does not merely represent lost revenue for researchers, and lost opportuni-

ties for industry. It is a sign we are not seeing the full value of the taxpayer's investment in our research assets.

Since 2007, the Government has lifted spending on science and innovation by more than 43 per cent. Our annual investment stands today at \$9.4 billion. At a time when resources are strained, and the demands on the public purse are heavy, that massive spending boost must be justified to our people.

From my perspective, the case for public investment in research is straightforward. We are not merely seeking the knowledge to understand the world – we are asking for the tools to change it. That is why I speak of universities and public research agencies as nation-building institutions. They are engines of creativity and discovery, opening our eyes to the phenomenal potential of clever Australians. Our prosperity and our standard of living rest on the realisation of those ideas.

This is not a task for the research community alone – it is an obligation that spans government, industry and the

## Under the spotlight

The Academy recently held a two-day workshop, **Strengthening Links Between Industry and Public Sector Research Organisations**, in Sydney, funded by the Federal Government.

Experts with both international and Australian experience in the linking of research organisations and industry addressed the key issues of collaboration which, to a large extent, reflect the success of a nation's innovation system, which in turn influences its economic prosperity.

Deeper collaboration between industry and academia and research organisations is encouraged by governments to increase national competitiveness and wealth creation. A number of the workshop's presenters have authored articles for this edition of *ATSE Focus*.

## Contributions are welcome

Opinion pieces on topics of national interest will be considered for publication in *ATSE Focus*. Items between 800 and 1500 words are preferred. They must list full name, title/role, organisation (if relevant), city of residence and email address for publication. Please address to [editor@atse.org.au](mailto:editor@atse.org.au)

community. We are separate but mutually dependent parts of a complex innovation system. Our task as a national government is to take the disparate parts, and make them work together. We must translate the excellence in our universities to the factory floor, and beyond.

That philosophy is the core of the Innovation portfolio the Government created in 2007. It unites the Commonwealth's policy and delivery strengths in basic research, applied research, business support, industry development, research commercialisation and intellectual property. This unique structure captures the full breadth of the innovation journey, from a good idea to a good return for the nation.

Powering Ideas, our 10-year national innovation agenda, sets out the targets and the path we have laid down. We are determined to double industry-researcher collaboration by the end of the decade. This is a fixed and measurable goal. It is undoubtedly ambitious, but it can be achieved with the support of industry, researchers, and government at all levels.

The announcement of the Clean Energy Future package has only strengthened the imperative for success. The carbon price will unlock unprecedented resources for innovation in clean technology. Collaboration is vital to maximise the returns on that investment. Industry is looking for

cleaner, cheaper tools. Consumers are looking for products that are easy on the environment and the hip pocket. I am confident our research community can supply them.

Wherever I go, I see signs of the rich contribution every research field is making to this national effort. This is the moment for the research community to show that potential to firms who can take it to market.

This is scarcely a new message from the Government – it has been built into every strategy and program in the Innovation portfolio. Universities have been closely involved in that process from the outset. The finalisation of our mission-based compacts with individual institutions will reaffirm their unique place in the national innovation system.

Our Joint Research Engagement (JRE) initiative encourages higher education institutions to source more of their research income from industry, and non-government research sectors, by giving greater weight to this type funding in its allocation formula.

At the same time, the Government is working directly with industry to encourage investment in Australian research. We are taking down the practical and the cultural impediments that have stunted the ambitions of innovative firms, particularly smaller enterprises.

The introduction of the new R&D Tax Credit is cen-

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CONTENT MATTERS

tral to that agenda. It will channel some \$1.8 billion to firms conducting genuine R&D in Australia, offering more generous and accessible support than the existing tax concession. Fewer than 1000 of Australia's two million firms are registered for the Concession. Many more will be persuaded by the incentive of the Credit.

It will be complemented by the resources which the Government offers to stimulate and reward collaboration with the research community. That includes Commercialisation Australia, which was launched in early 2010 to directly help both private and public sector innovators bring new products and services to the marketplace. Commercialisation Australia is designed to help innovators bridge the 'valley of death' by providing not just financial support, but access to the skills and networks necessary to accelerate successful commercialisation. Since it opened, the program has provided more than 120 grants worth almost \$50 million.

The Government is also accelerating the development of Australia's venture capital industry. Innovative companies engaged in converting Australian research outcomes into marketable products require access to high-risk capital. The venture capital sector provides that vital lifeline. The Global Economic Crisis demonstrated the vulnerability of the sector to unforeseen shocks, crippling the prospects of innovators across the OECD. The Government's investments sustained Australia's fledgling industry, and will support its maturation in the decades ahead. Programs like the Innovation Investment Fund, the Innovation Investment Follow-on Fund, and complementary tax concession programs encourage private sector venture capital investment, and give companies access to fund managers with valuable business and financial advice.

The Government is working in partnership with industry and research institutions to spread awareness of these new mechanisms, using our deep networks across the Innovation portfolio. One such network is Enterprise Connect, the Government's major initiative targeting small and medium enterprises. It includes the Researchers in Business program, which provides firms up to \$50,000 towards the cost of placing a qualified researcher into the heart of their business. The program is intended to build lasting bridges between the public and private sectors at the SME level and to enhance the commercialisation potential of SME-researcher engagement.

I have also tasked the Advisory Council on Intellectual Property (ACIP) to investigate the impact of the IP system on industry-university collaboration. The ACIP review will consider any impediments and incentives built into the current regime, and their interaction with broader factors influencing behaviour in the innovation system.

This is a comprehensive agenda for change.

That does not mean this transition will be easy, for re-



Collaboration pays off – microbiologist Naomi McSweeney, a 2010 Fresh Science awardee working in a collaborative project between Alcoa of Australia, CSIRO and the University of Western Australia, has found that a previously unknown species of naturally occurring bacteria has the potential to save the alumina and aluminium industries millions of dollars by removing sodium oxalate, an organic impurity produced during the refining of low-grade bauxite into alumina.

searchers or for industry. We are trying to lead a massive cultural shift, in a climate of fear and uncertainty. We are transforming the way Australians do business.

I trust, as we continue that work today, we will not lose sight of the goal which ultimately unites us all. We have seen the promise of a richer, fairer and greener world – and we must work together to achieve it. ◀

**SENATOR KIM CARR** was elected to the Senate in 1993 and to Labor's front bench in 1996, serving first as a parliamentary secretary and opposition spokesman on education in the Senate (1996–01), and then as a shadow minister (2001–07). Following Labor's election in 2007 he was sworn in as Minister for Innovation, Industry, Science and Research and retained the portfolio when the Gillard government was sworn in on 14 September 2010. Senator Carr was educated at NSW and Victorian state schools and at the University of Melbourne, where he completed a BA (Hons), MA and DipEd.



# World-class research links with industry to deliver positive health outcomes

In an era where technology and treatment options in health are advancing alongside a growing awareness of the importance of prevention and early intervention, the Sansom Institute for Health Research at the University of South Australia is riding a wave of innovation.

The Sansom's varied research agenda applies research into products, practices and policies to bring about better health outcomes. This is achieved with the support of many collaborating partners around the globe; with more than 50 organisations in Australia and another 40 across 16 countries.

One of the Sansom's focus areas is the Therapeutics and Pharmaceutical Science research concentration. More than 30 pharmaceutical and medical scientists collaborate across a diverse range of cutting edge projects aimed at treating disease and optimising health.


Strengths include the development of synthetic and natural products, drug delivery, pharmacokinetics and computer modelling of drug disposition, fundamental surface science in biochemical processes, pharmacogenetics and ethnopharmacology.

In one exciting project, pharmacologists are working together with partners from north Queensland to develop a new product to treat inflammatory skin conditions such as psoriasis and dermatitis. With provisional patents granted, scientists are now working to formulate the best application method for a compound sourced from a plant identified by indigenous healers.

The Institute also boasts the Centre for Drug Formulation and Delivery (CDF&D), a collaborative initiative with partners such as Mayne Pharma, Virient, and the Royal Adelaide and Queen Elizabeth Hospitals. With these partnerships, the Centre is focused on the development of novel drug delivery techniques.

From small-scale drug manufacturing and testing, to the development of novel drug delivery systems such as adhesive mouth patches, the Therapeutics and Pharmaceutical Science research concentration is just one area of the Sansom Institute demonstrating clear health benefits, delivered through research expertise working closely with industry.

For more information about the Sansom Institute for Health Research, visit [unisa.edu.au/sansominstitute](http://unisa.edu.au/sansominstitute)



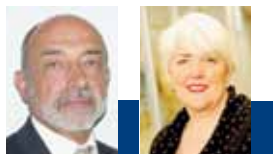
*From identifying better medicines for angina and infection, to developing safer treatments for psoriasis and skin cancer, the Therapeutics and Pharmaceutical Science research concentration is involved in a wide range of projects aimed at treating disease and optimising health.*



University of  
South Australia

# What works in business-university knowledge exchange

The growing importance of the 'Impact Agenda' in university research funding reflects a parallel concentration on areas of national economic and social priorities.



By Philip Ternouth and Cathy Garner

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**T**oday it is commonly accepted that the productive knowledge flows from the research base to companies and organisations can accelerate their rate of innovation. But has our understanding of how productive knowledge flows are generated increased?

The accepted model for over half a century has been the 'patenting and licensing' model in which university-developed technology flowed into new products in companies. While such a model has been appropriate for selected technologies it has never been sufficient for economic success, even in places such as Silicon Valley.

A narrow view of the way in which knowledge flows operate has, however, coloured the metrics of success by many governments and has driven unproductive behaviours.

In the late 1990s however, the metrics which had been applied to evaluate the performance of this model came to be seen by practitioners in the UK as being too narrowly defined to relate to a growing body of their experience. This recognition led the Council for Industry and Higher Education (CIHE) to develop a research program which has done much to elucidate the mechanisms of not just what is understood by practitioners to work in generating economic value in business – but also how and why it works.

Research undertaken through three significant major studies has revealed the importance of key underlying approaches and mechanisms that predispose towards success.

The first examined the experience and practices of 40 major multinational businesses with footprints in the UK. Interviews were undertaken with senior business personnel. This study revealed CIHE's first key finding: **Apart from the need to recruit internationally competitive graduates, UK multinationals valued collaboration far more than access to university-developed technology.**

Two further major research exercises followed up on these findings. First, a multinational study in the UK, the US, Canada and Japan, undertaken in collaboration with the Centre for Business Research at the University of

Cambridge, confirmed the importance of collaboration.

Collaboration was shown to be of vital importance through co-formulating/co-designing projects with the ability to jointly take university research findings and enable them to be transformed into company products and processes. The second benefit of such collaboration lay in enabling the development and embedding of intellectual assets under the company's control. These 'intellectual assets' went far beyond technology into product and included new manufacturing, product development or service processes.

Technology development and transfer accounted for no more than 20 per cent of cases. Overall more than 80 per cent of the nearly 100 cases studied, which were selected by the participating companies as successful examples, resulted from some form of co-formulation. This and subsequent studies included both multi-nationals and small and medium enterprises (SMEs).

CIHE's second key finding also came from this study: **Productive university business knowledge flows are contingent on the "absorptive capacity" of the company.**

A company is only able to collaborate effectively with a university if it has the intellectual resources to co-recognise and co-formulate projects with academic researchers; if it has management with a willingness to commit resources to collaborative projects (knowledge absorption and translation is not free); and it has the ability to commit staff to work on the collaborative projects to undertake a process of "learning by doing" – thus acquiring the new intellectual asset.

For a company to commit such resources requires the development of trusting relationships with academic partners. Likewise the development of trust needs the willingness of academic staff to take opportunities to meet company staff, to recognise opportunities, build relationships and then to work alongside the company staff in developing and implementing projects.

Intermediaries, such as technology transfer staff without detailed tacit knowledge of the research focus and out-

comes, can play only a limited role in the co-formulation and implementation process. But intermediaries may play a critical role in setting up opportunities for meetings to occur and in smoothing any necessary contractual arrangements, such as those for access to co-developed or background IP.

Understanding the process by which successful knowledge flows occur enables policy interventions and metrics to be designed to encourage such behaviour and to strengthen the absorptive capacity of the system. In the UK, interventions such as Knowledge Transfer Partnerships and Engineering Doctorates have been successful as has the Small Business Innovation Research in the US.

Each of these directly targets the potential barriers which the lack of absorptive capacity erects. Current UK initiatives such as the launch of Technology Innovation Centres (TICs) are also directed to address the capacity limitations of the translation of research outcomes to application by co-location of research and company R&D personnel.

Second, a third study undertaken for the UK Research Councils pushed the examination of these aspects even further. As well as probing in detail the role of the components of absorptive capacity, the study elucidated the role of university research in successful company innovation strategies.

This study demonstrated, first, that different companies could use university research outcomes at different stages in the innovation process, ranging from horizon-scanning for future product opportunities at one end (notably from companies in sectors with long innovation pipelines) to projects with an immediate market impact at the other.

Second it illustrated the very complex and non-linear process through which opportunities for business university collaboration were conceived and developed. Company issues or challenges interact with a body of research outcomes developed over time – not just the results of a single project. These outcomes include the experience and understanding of the researchers, techniques and methods they have developed, and the more explicit outcomes (such as intellectual property and technology) that they have developed. These may (and with ‘real world’ problems often do) cross the boundaries of single academic disciplines.

Finally, a third important finding was that, irrespective of the stage of the project in respect to its eventual commercial impact for the company, the competitive advantage of university research compared with other external knowledge sources stemmed from the academic driver of curiosity. This does not however mean there is a *laissez-faire* approach to publicly funded research.

The growing importance of the ‘Impact Agenda’ in university research funding reflects a parallel concentration on areas of national economic and social priorities. The academic driver of curiosity is seen to be valued but

nonetheless constrained within areas of priority in which funding is being prioritised.

The Impact Agenda reflects the growing desire of the UK Government to incentivise researchers to work with business and see the fruits of their research in the form of economic and social value. It is being implemented in a number of ways.

**1** The Research Excellence Framework (REF) – through which block grants will be allocated to universities which they can then use to invest in their research infrastructure and environment – will include an impact measure through which 20 per cent of the assessment will be based on how the university can show impact from past bodies of research.

**2** The bids for project funding to the Research Councils must now include an impact statement which describes the potential value of the research outcomes to potential users, and an impact pathway which describes the steps which the researchers will take to ensure that these opportunities are identified and realised.

**3** This focus on impact is complemented by an increasing concentration by the Research Councils on stimulating research which will address key technological challenges and market opportunities (such as the development of key technology platforms and advanced manufacturing capability). The Research Councils increasingly identify the focus of major funding calls in collaboration with research users and the panels which award major collaborative grants (such as Engineering Doctorate Centres) include significant industrial representation, which includes organisations such as CIHE.

**4** There has also been substantial financial support over the past decade which has succeeded in its purpose to stimulate and support the development of a capacity and capability in universities to engage with business. This so-called ‘third leg’ funding in the Higher Education Innovation Fund (HEIF) is now moving from allocation in order to build capacity to means of allocation based on an evaluation of performance.

Recent CIHE research has demonstrated the importance of clear articulation of the connection between university research, engagement of university researchers with business, and delivering economic impact from the research. Impact arises from research users making a change which exploits research outcomes, not the outcomes themselves. This relies on constructive engagement throughout the process of identifying research themes and the localisation and adaptation of outcomes to market application through collaboration.

This does not mean that there should be an emphasis on the predictability of research outcomes or that academic researchers should be responsible for delivering direct economic value. To do so would in the long run undermine the value which stems from the curiosity driver in university re-

PHOTO: ISTOCKPHOTO



The “Impact Agenda” for research funding is increasingly important

search which has been clearly shown to be valued by business.

The difference lies between user-informed research and user-directed research. Evidence suggests that the former actually promotes the academic standing of the research. Clear articulation of this message is essential to manage the tension between curiosity and economic drivers. The availability and prioritisation of public funding for research is a lever for behavioural change and interaction with business is expected.

Far from wishing to direct academic research our findings show that experienced research users want to engage with academic researchers at two key stages. The first is in the process of formulating research questions to understand the issues in which business has an interest. This requires that academics are prepared to do the same. The second is during the process of research so that opportunities for application can be recognised and then formulated into collaborative projects so that these opportunities can be realised. Where appropriate, programs which support the absorptive capacity of companies to collaborate effectively can then be exploited.

In summary there are several threads to what is emerging as strategy in the UK for developing the innovative capacity of the economy:

- incentivising academic researchers to engage with business to understand business issues both through the impact agenda and targeted research programmes;
- developing the capacity and capability of universities to engage with business; and
- supporting the absorptive capacity of business to engage.

Having university research excellence is undoubtedly a necessary condition for the development of a thriving and globally competitive Australian innovation system. Yet research such as that from CIHE is now showing that this will not be sufficient on its own.

Globally competitive places depend on more widely distributed capacities for innovation and a bi-partisan research agenda between the academy and business. Coordination of policies to link university and business drivers to engage and the level of absorptive capacity are two of the most critical. One element of such coordination is a shared agenda and a bi-partisan forum to own it. ◀

## Further Reading

*Absorbing Research* by Dr David Docherty, Keith Herrmann and Philip Ternouth, published by CIHE 2010

*Valuing Knowledge Exchange* by Philip Ternouth and Cathy Garner, published by CIHE 2009

*Universities, Business Links and Knowledge Exchange* by Maria Abreu, Vadim Grinevitch, Alan Hughes, Michael Kitson and Philip Ternouth, published by CIHE and the Centre for Business Research, University of Cambridge 2008.

*Universities and the Knowledge Economy* to be published by Routledge in December 2011 ([www.routledge.com/books/details/9780415884662](http://www.routledge.com/books/details/9780415884662)), ed. Paul Temple, chapter 4 ‘Universities and Knowledge Creation’ by Philip Ternouth

As an example of a bi-partisan forum convened by CIHE see ‘The UK’s Sputnik Moment’, [www.huffingtonpost.co.uk/david-docherty/the-uks-sputnik-moment\\_b\\_897968.html](http://www.huffingtonpost.co.uk/david-docherty/the-uks-sputnik-moment_b_897968.html)

**PHILIP TERNOUTH is Associate Director of R&D and Knowledge Transfer (KT) with CIHE since 2002 and is Visiting Professor in Innovation at Salford Business School. He has extensive experience in both industry and in KT in the Higher Education sector, having run KT activities from 1995 to 2001 in Manchester University and acted as a KT adviser for a number of years. His work for CIHE has concentrated on the development of a better understanding of the detail of interactions between universities and business through a number of research, teaching, and consulting activities. These have included a series of publications for CIHE from 2002.**

**DR CATHY GARNER is dedicated to understanding and driving social and economic improvement through innovation. She has focused both her academic and practitioner careers on tackling urban issues through technological and social innovation. As Chief Executive of Manchester: Knowledge Capital she built a globally recognised partnership for innovation by bridging the boundaries of business, universities and government. Manchester was named most admired Knowledge City in 2009. She is an Associate of CIHE, served on the Strategic Advisory Board for Intellectual Property for the UK 2008–10 and was a member of the Cabinet Office Innovators’ Council in 2010.**

# Explore, listen and persist for better research links

The Australian system is more vulnerable than many, particularly for research-intensive universities, because of the funding model of successive Australian governments.



By Paul Greenfield

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**T**he actor Bill Murray features heavily in innovation pathways. Attending a meeting the objective of which is to improve the linkages between publicly funded research organisations and industry has many similarities to the movie *Groundhog Day*.

My colleague, Dr Geoff Garrett AO FTSE, Queensland Chief Scientist, also reminds us that *Lost in Translation* (another Murray classic) describes much of what currently occurs between the players.

Why is it so difficult? Perhaps it is because:

- governments rarely 'get it', hence, policy and programs are badly matched – even if intentions are positive;
- universities are driven by a set of measures that mean, in the absence of specific incentives, other drivers dominate behaviour; and
- the focus of much of the commercial world is so short-term that mismatches with external research providers are inevitable.

Yet, it is relatively straightforward. As in any meaningful relationship, the fundamentals (rationale, quality, etc) must be sound. At least two sets of ears need to be at the negotiating table and time issues must be addressed up front.

But firms often lack a propensity for innovation risk (cost), absorptive capacity or an understanding of and

## Four distinct rationales for industry cooperation with universities on R&D

Table 1

1. Cooperation outcomes for product and process development

2. Access to academic networks

3. Human capital development

4. Direct business opportunities

The last 3 are also relevant for a teaching-only institution.

'Firms' rationale for interaction with research universities and the principles for public co-funding; Anders Brostrom (Swedish Institute for Studies in Education and Research and CESIS, February 2008

Source: Australian Institute for Commercialisation (AIC)

'knowing' the research institution (for example, how, who, IP, execution).

For universities, the reasons are more complex and depend very much on their desired profile. Modern universities are generators of intellectual, social and economic capital to varying degrees as well as being significant economic entities in their own right as focal points of regional investment and consumption.

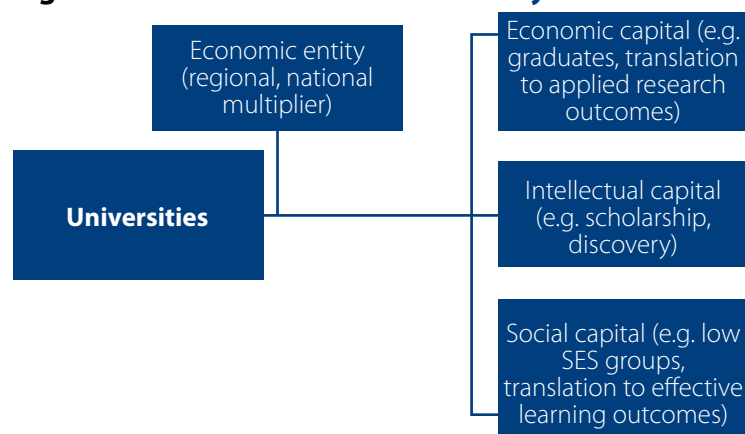
The complexity in terms of industry-university interactions comes from the fact that international (and indeed national) reputation rests primarily on an assessment of the intellectual capital. In turn, the ability of a university to recruit and retain the best students and best staff depends on this reputation.

The Australian system is more vulnerable than many, particularly for research-intensive universities, because of the funding model of successive Australian governments. This requires significant transfer from fee-paying international students to cross-subsidise the education of Australian undergraduates and contribute to research infrastructure.

Hence, international reputation is vital in the business model by which research intensive universities survive.

Tables 2 and 3 indicate the importance of research and peer reputation in determining rankings for two of the international systems. They demonstrate clearly the priority which research universities must give to traditional quality measures.

Figure 1 Roles of a modern university



## Shanghai Jiaotong Top 500

Table 2

CRITERIA	INDICATOR	CODE	WEIGHT
Quality of education	Alumni of an institution winning Nobel Prizes and Fields Medals	Alumni	10%
Quality of faculty	Staff of an institution winning Nobel Prizes and Fields Medals	Award	20%
	Highly cited researchers in 21 broad subject categories	HiCi	20%
Research output	Articles published in <i>Nature</i> and <i>Science</i> *	N&S	20%
	Articles indexed in Science Citation Index-expanded and Social Science Citation Index	PUB	20%
Per capita performance	Per capita academic performance of an institution	PCP	10%
Total			100%

\* For institutions specialised in humanities and social sciences such as London School of Economics, N&S is not considered and the weight of N&S is relocated to other indicators.

## QS World University Ranking

Table 3

INDICATOR	EXPLANATION	WEIGHTING
Academic peer review	Composite score drawn from peer review survey (divided into 5 subject areas). 6354 responses in 2008	40%
Employer review	Score based on responses to employer survey. 2339 responses in 2008	10%
Faculty student ratio	Score based on student faculty ration	20%
Citations per faculty	Score based on research performance factored against the size of the research body	20%
International faculty	Score based on proportion of international faculty	5%
International students	Score based on proportion of international students	5%

Quacquarelli Symonds (QS) World University Rankings were conceived to present a multi-faceted view of the relative strengths of the world's leading universities

## What has worked

Table 4

CRCs and other centres involving long-term industry commitment

ARC Linkage Grants

Queensland NIRAP Grants (or their equivalent in other states)

Industry-funded positions (particularly at professorial level)

TechFast (managed by Australian Institute for Commercialisation)

University commercialisation companies

## What has not worked

Table 5

Secondments either from university to industry or vice versa

Developing industry internships into deeper relationships

Meaningful interactions with early stage venture capital

Significant interactions with SMEs

However, some initiatives have worked. Tables 4 and 5 summarise my perception of these, together with some that I do not think have significantly improved industry-university linkages.

What can be done from the university side to improve the situation? I suggest that if a university is serious about developing extensive industry linkages, it must address key cultural and structural issues, while both university and industry partners must address the issue of 'receptor' development.

Key facets of these are found in Tables 6, 7 and 8.

Finally, the issue of capacity must be addressed. Industry typically wants problems solved. Effective research academics are time-poor, especially if they have teaching responsibilities. Realistic expectations and a focused approach on both sides are important.

As issues and problems become larger and more complex, scale becomes significant. Addressing issues of scale can often best be done via collaboration.

An example of the effective use of scale is the Australian Baosteel Research Centre, which is a comprehensive research program between four Australian universities (UQ, UNSW, Monash and Wollongong) and a Chinese company, which exploits the complementary skills found in the Australian partners.

A second example is the Queensland Alliance for Agriculture and Food Innovation (QAAFI), which is a joint venture between UQ and the Queensland Government, under which about 40 researchers from government have joined an equivalent number at UQ to create major research groups in plant, animal and food science and technology. The government researchers have joined the university with an appropriate funding transfer to offset salaries and with the university managing the research and government managing its implementation.

Finally, UniQuest now provides commercialisation

## Figure 2 The Benefits of Scale

Eight Commercialisation Collaborations = access to the ideas and inventions of 5000+ students and 7000+ research staff



services for a number of universities and research centres in Australia. All partners in this endeavour recognise the need for scale in the commercialisation model of technology transfer, depicted in Figure 2.

In conclusion, it is a strange world. Industry-university linkages are frustratingly few, encouraged by government only through 'lip service', but too important to ignore. We can learn, however, from Bill Murray in *Groundhog Day*. Explore, listen (not necessarily to Bill Murray's choice of morning music) and, most importantly, persist. ◀

*Acknowledgment: I wish to acknowledge significant input from Rowan Gilmore, the previous CEO of AIC.*

PROFESSOR PAUL GREENFIELD AO FTSE was appointed Vice Chancellor of the University of Queensland in 2008 and was previously Senior Deputy Vice-Chancellor from 2002. Professor Greenfield is on a number of company boards and has consulted and worked widely with industry on a range of projects spanning biochemical engineering, wastewater treatment and waste and environmental management, as well as economic evaluation of projects. His interests lie in biotechnology, environmental management and R&D management and commercialisation. He is Board Chair of ANSTO, a member of the DSTO Advisory Board and Chair of the Group of Eight research-intensive universities.

## Go8 launches new research gateway

The Group of eight (Go8) universities have launched a new tool designed to improve university/business interaction – a new search engine to raise the visibility of what universities can offer the business and wider community in addressing problems requiring advanced know-how.

Go8's Knowledge Gateway is a searchable database linking directly to researcher expertise – developed with Funnelback Website and Enterprise Search. Funnelback is an Australian company which grew out of Australian research based at the ANU and CSIRO and now has 25 staff and offices in Canberra, Sydney, Brisbane, London and Wellington.

"World-class research and innovative activities occur every day in Australia's universities, but it can be difficult for individuals and industry to identify and access specific expertise," said Go8 Chair, Professor Paul Greenfield AO FTSE, launching the Gateway in Sydney.

"Not only will it assist industry and government in quickly locating experts in a particular field, but it will also help potential research students find a PhD supervisor.

"We need to lift our game as universities by making our knowledge outputs and the expertise of our researchers more accessible."

The Gateway uses key words so users don't need to be familiar with academic terms and it identifies individuals and institutions with strength in particular research disciplines.

### Culture issues

### Table 6

Signals and commitment from the top, e.g. at UQ we group all our activities under the pillars of Learning, Discovery and Engagement, each of which is recognised

Internal university reward system e.g. promotions (at UQ it is possible to be promoted principally because of your engagement success and reputation), school or institute KPIs

External university reward system e.g. does ERA encourage or discourage? Separate Innovation metrics?

### Structure issues

### Table 7

How do you support within university structure? Need to focus

Capacity to approach industry at multiple levels – e.g. Executive Director – Business Engagement

One size does not fit all e.g. the likely pathways for capturing the economic benefits of medical biotechnology will differ from those in mineral processing

How do you develop capacity? Role of Continuing Professional Development?

### Receptor issues

### Table 8

It takes time to develop receptors at both ends and at least two pairs of ears

Prioritise target areas – some industry sectors and academic units are much more receptive than others

Start modestly, take a long-term view

# Entrepreneurship: issues for start-up companies

Taking technology to market –  
a Better Place battery swap station.

Most start-up companies cannot work at the leisurely discovery pace of grant-funded research at universities. Speed is of the essence.



By Alan Finkel

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**E**ntrepreneurs are responsible for their own destiny – but governments and institutions can and should make it easier for them to establish a start-up company.

Governments and institutions should train innovative thinkers, support risky initiatives and simplify processes wherever possible.

Looking at government funding, the question – as always – is about quality and quantity. When it comes to ‘quality’ of funding, let’s assume that this term describes speed and flexibility.

Fortunately, Commercialisation Australia, a recently established Government agency, addresses both speed and flexibility. It provides small companies with expert advice and funding for commercialisation. Its key distinction is the many kinds of support that it offers.

Funding is delivered in several forms including: funding for advice; for executive salaries; up to \$250,000 for a 50:50 matching, non-repayable grant for proof of concept

creation; and up to \$2 million for a 50:50 matching, interest-free repayable grant for early-stage commercialisation.

One of the particularly good things about Commercialisation Australia is that companies can apply for support at any time. They do not have to wait for annual, semi-annual or even quarterly submission dates. This is most unusual. Being able to apply at any time during the year removes one of the key limitations of most government funding.

It is a cleverly conceived program that will play a useful role, but it suffers from two problems. First, on the issue of quantity, the total funding of approximately \$80 million dollars a year is a drop in the ocean. For the program to have a major impact it must receive substantially increased funding. The second problem is that the Commercialisation Australia program adheres to the common notion that the player has to have ‘skin in the game’ by providing matching funding.

This requirement makes it hard for some early stage

companies to get started at all. It is particularly a problem for R&D-oriented companies, which admittedly are not the focus of Commercialisation Australia.

## SBIR in the US

An alternative is the Small Business Innovation Research grant scheme, known as SBIR, which has been operating for nearly 30 years in the US.

Applications can be submitted three times a year. Upon successfully completing a six-month Phase I program, funded with up to \$150,000 of government money, recipient companies can apply for additional funding of up to \$1 million for Phase II, operating over two years.

This two-phase, peer-review process weeds out the non-performers early.

Unlike in Australia there is no need for matching funding by the recipient. Nor does the granting agency take an equity share. The government trusts the peer-review system to identify the most worthy recipients, then provides 100 per cent of the cash for the projects.

The absence of a need for matching funding means, for example, that a poorly paid university researcher who rents an apartment and drives a derelict car can be funded to take a risk – to quit the university to try her hand at commercialising her invention.

The return to the government is through future taxes paid and increased economic activity.

I started a company, Axon Instruments, in California in 1983 to make scientific measurement devices for neuroscience research. In 1986 we applied for and received an SBIR grant that enabled us to develop a new kind of brain-activity measurement instrument that substantially expanded our business. The government got a good return on its investment.

A recent report by the National Research Council in the US found that the SBIR program meets its objectives, and in particular that a significant proportion of the SBIR awardees achieve commercialisation.

## Tax

The most substantial government support for R&D in Australia is the R&D tax offset. It is broadly applicable, covering new or improved products, devices, materials, processes or services. It leads to a cash benefit of 37.5 per cent. For example, if a non-profit-making start-up spends \$100,000 on eligible R&D it will receive a cheque from the ATO of \$37,500. This is generous, and clearly helps to make R&D more affordable.

The obvious problem is that since there is no review process there is no assessment of the quality of the R&D. If you meet the tax definition of R&D you receive the benefit.

According to a 2007 Productivity Commission report, a large share of the R&D eligible for the R&D tax benefits would have taken place in the absence of public funding support. That was certainly my experience. As an operating company we undertook R&D because we absolutely needed to do so in order to remain competitive. The R&D tax benefit was a bonus at the end of the year, not a driver.

On the other hand, the system has an upside in that it allows the recipient companies total flexibility in defining the R&D that suits their strategies and needs, unlike a competitive grant system.

If the government is looking to expand its generosity, based on my experience I would recommend that it should increase grants for R&D rather than increase the tax benefits for R&D.

## Universities

University research is different to the usual corporate R&D. University research is nearly all R and very little D. Corporate internal research is usually little R and lots of D.

The interdependence is powerful – as stated by Indian innovator Dr Ramesh Mashelkar FRS FTSE: “University research converts money into knowledge; industrial innovation converts knowledge into money.”

The first change for the better in maximising the innovation potential of the research emerging from universities would be to speed the pace of collaborative research. Most start-up companies cannot work at the leisurely discovery pace of grant-funded research at universities. In the world of start-up companies, speed is of the essence.

The Australian Government is helping companies and universities collaboratively translate university discoveries and expertise into commercial products through the ARC Linkage Grants scheme, but to be maximally useful this scheme needs to be more nimble.

Specifically, the funding cycle should be shorter. Today, Linkage Grants can only be submitted twice a year, so if you assume three months to write the application and you commence the grant application process at the wrong time in the cycle you can lose nine months before the next opportunity to submit.

Then it takes another seven months for grant approval and commencement. That's more than a year and a quarter from concept to start of funding. Then – under the rules – the grant itself has to run for a minimum of two years. That adds up to more than three years before the commercial benefits start to flow. This is simply too long for a start-up company to bear.

To correct this incongruity, the funding application cycle should be shortened and, at the option of the re-

# Can small Australian companies work with universities?

Most companies have little idea of how to identify and work with the most appropriate researchers.



By Rowan Gilmore

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It's tempting to believe that Australian companies would automatically turn to publicly funded research, as performed in our universities and research organisations, to help them develop new products and services – in other words, to innovate – particularly for radical innovation. Unfortunately, such assumptions are wrong on several counts.

First, the evidence is that the greatest inspiration for innovation comes not from the research sector at all, but from employees, customers, and the supply chain. Second, even when research might prove useful to them, most companies have little idea of how to identify and work with the most appropriate researchers. Third, few companies possess the absorptive capacity to be able to transform and adapt the research into new products or services even if they were inclined to do so.

As a result, the collaboration between Australian industry and the research sector is among the lowest in the OECD. A survey from the Australian Government department responsible for innovation found that the Australian innovation system “consistently underperforms on most measures of collaboration and networking” and that 84 per cent of innovation-active businesses had no collaborative arrangements.

There are solutions available to increase such collaboration. Unfortunately, there is a lack of will on the part of most research organisations to incentivise the right behaviours, on the part of governments to invest in the necessary intermediary programs, on the part of the financial sector to accept the risk inherent in early stage technological development, and on the part of many firms to realise the long-term benefits of collaboration with the research sector.

Which, of course, begs the questions, why bother trying?

If we accept the fact that innovation is the life-blood of nations that, over the long term, can differentiate their economies and improve quality of life, we should be concerned. If we accept that Australia needs a Plan B in the event that Plan A (thrive on a commodity boom) falters, then we should be very concerned.

The barriers that prevent greater industry-research collaboration are well known.

Researchers often choose the university work environment precisely because it is culturally different from industry, and they are able – and indeed are often required to – focus on publishing to advance their careers.

Firms, on the other hand, in addition to lacking the motivation to innovate or adequate absorptive capacity to process new knowledge, might have trouble understanding who to approach, how to negotiate the intellectual property (IP) that might be created, and how to establish a collaboration with a research organisation (whether it be a university, medical research institute or CSIRO).

## Innovation intermediaries

Innovation intermediaries first appeared a decade ago, and their mission is to build such collaborations and thereby foster innovation for economic growth. Some online marketplaces where IP and ideas can be exchanged, such as



A fresh look –  
the greatest  
inspiration for  
innovation  
comes from  
employees,  
customers,  
and the supply  
chain

Even if the research sector is flourishing and has the capability to seed radical innovation through invention, only industry has the capability to drive innovation through to implementation and ultimately value creation.

Nine Sigma, Innocentive, Yet2, TopCoder, or Kaggle, position themselves as ‘intermediaries’.

They create a marketplace between those who are seeking IP and those who might offer it, but their starting point is to assume the company already understands the need for IP, knows how to collaborate, and has sufficient absorptive capacity to use the IP. Unfortunately, not enough Australian SMEs do.

The more difficult challenge is to build enough trust and shared understanding to seed collaboration between industry and research to enable knowledge transfer to begin. Too many companies fail to understand why they should collaborate with a research organisation, perhaps to solve a problem they face or to develop a new product or service. An intermediary organisation – such as the Australian Institute for Commercialisation (AIC) can help the business to articulate that requirement as a research project, identify the best researchers, help to negotiate, and work through the cultural issues that inevitably arise.

Large companies will rarely have need for such facilitators; they are sufficiently experienced in such matters. However, for most SMEs, such assistance is essential because they will have never attempted to work with a research organisation before; or, if they have, will often have failed.

Why can't a research organisation help the business itself, without an intermediary? Some can. However, they are ultimately a ‘seller’, and negotiating a sale price for open-ended research services with a risk-averse buyer can entail a high transaction cost. If a small company starts out doubting whether research can help them, it can prove too difficult to ‘get across the line’, even before the challenges with cultural alignment and mismatched expectations begin.

AIC is an example of an independent innovation in-

termediary that has no vested commercial interest in such a collaboration, as it is paid by government to offer the service. It works firstly to establish trust between two or more sets of people.

This requires extensive networks and a mix of technology, entrepreneurial, negotiation and business skills that government generally finds hard to recruit into its bureaucracy. Those skills, plus the ability to protect confidential information or strategic intent from both sides, bring assurance that the high transaction costs will most likely yield a worthwhile result. Of course, the SME must also be carefully evaluated as well, to ensure that only SMEs with sufficient absorptive capacity are involved.

## Economic impact

TechFast was an AIC intermediary program funded by a number of state governments and the Australian Government from 2004–10, one that has been formally reviewed several times. The total cost of delivering intermediary services was \$5.4 million over that period. The program established collaborations for 194 Australian SMEs.

In late 2010, the AEC Group undertook an independent economic analysis to assess the impact of the AIC's intermediary program on the economy. It found that 40 per cent of SMEs surveyed had already experienced direct revenue increases they would not have otherwise enjoyed, ranging from 10 per cent to 25 per cent of their sales, and that a significant number still expected to see sales increases as their new products came to market.

Accounting only for those firms that had already experienced increased revenues, AEC modelled the economic impact of this to the economy as an additional \$350 mil-

## Rip Curl and the H-Bomb

Rip Curl, in its continuous search to advance wetsuit design and manufacture, recently released a heated wetsuit called the H-Bomb.

Through its TechFast program, the AIC was engaged to assist Rip Curl to find new technologies and advanced materials that would keep the second-generation H-Bomb at the forefront of wetsuit development.

The AIC worked with Rip Curl to determine the areas of development where it could best help, including access to new materials and a university testing facility to improve the wetsuit's thermal characteristics and heat retention.

New materials were used to improve the performance of the heating elements. This technology enhancement significantly reduced heat loss and resulted in lower battery power

consumption, allowing the H-Bomb to operate longer from its existing power source. This benefit offers considerable cost advantages as the equivalent enlargement of the battery unit to achieve the same performance gains would be far more expensive and increase weight.

A research organisation was introduced to Rip Curl in a meeting facilitated by the AIC. Researchers left the meeting with product samples to evaluate processes of applying nanoparticles to modify surface characteristics for improved heat distribution profile.

The AIC also introduced Rip Curl to a number of other technology providers in the automotive, giftware and safety products industries in Victoria. These businesses were able to directly transfer their technology and

manufacturing capability into an entirely new market. The businesses were identified as having complementary equipment, technologies and knowledge to achieve the development of a new product feature that Rip Curl had been seeking to develop for some years.

One of the technology companies produced working prototypes for testing within four weeks using its existing manufacturing process and materials technologies. Further research into advanced materials and dedicated manufacturing techniques will be carried out in the future.

In all, Rip Curl was introduced to five Victorian manufacturers and three research bodies for discussions on potential collaboration opportunities.

lion in economic output benefit annually (sales revenues), resulting in more than \$150 million of economic value-add per year and the creation of 1100 new jobs.

## International comparisons

An intermediary program is sometimes compared directly with a knowledge exchange program (for instance, a voucher program for collaboration, or the UK's Knowledge Transfer Program). Although knowledge exchange for innovation is the ultimate end goal of both, the latter assumes that collaborations are already seeded. They fail to address the root cause: the inertia that exists between SMEs and the research sector.

This is why at the recent inaugural meeting of the International Commercialisation Alliance, an Ottawa-based grouping of 47 economic development agencies or intermediaries from 18 countries, the AIC's demand-pull model for facilitating new collaborations and new value chains was identified as ground-breaking, and governments from Canada and the UK expressed great interest in the activity.

Research collaborations to exchange science within Australia, and internationally, are well supported by government. Innovation collaborations are not, with only the CRC Program and the Researchers in Business (RIB) Program available to assist in the transfer of research into industry. However the RIB program budget is only \$10 million over three years – too small to make an impact. While others internationally are increasing their focus on transferring knowledge to businesses for economic gain, Australia is cutting back and focussing on core research activity.

Intermediaries are an important catalyst in encouraging and seeding open innovation. They span organisational boundaries, linking R&D suppliers to decision makers,

able to achieve outcomes because they are trusted, credible, and legitimate. They navigate a company across the complexity of an innovation system, making it simple. Yet Australian independent intermediaries rely on the largesse of government for survival, because a small firm's appetite for the risks and benefits of innovation does not extend to paying for facilitation. The Australian Government's innovation solution for small firms, Enterprise Connect, no longer supports independent intermediary services to stimulate its Researchers in Business program.

If industry-research collaboration is so important, and is all about economic growth, Australia has lost an opportunity with the demise of intermediary programs offered by Australia's only two best-practice independent intermediary programs (the AIC's TechFast and InnovationX-Change).

The networks, skills, processes, and intellectual capital have now dissipated because of the lack of political will to actively facilitate open innovation collaborations between small firms and the Australian research sector.

I worry about Plan B. ◀

**DR ROWAN GILMORE FTSE** was CEO of the Australian Institute for Commercialisation until June 2011. During his eight-year tenure at the AIC, the first TechFast and TechClinic programs that introduced demand-pull methodologies into the commercialisation of research were delivered. Prior to this he worked extensively in the ICT industry and was based in London and Geneva from 1998 as Vice President of Network Services (Europe) for the airline IT company SITA (now France Telecom's Orange subsidiary). He is also a Director of EMClarity Pty Ltd, an Australian microwave radio equipment designer and manufacturer.

## Copeland's 'no-dig' solution

Copeland Industries is an innovative and progressive plastic injection and moulding business based in South Australia. It is a market leader in plastic product development for the construction, plumbing, infrastructure, industrial fabrication, mining and defence industries and supplies retailers including Mitre 10, Reece Plumbing and Hills Industries.

For the past 18 months Copeland has been working on the R&D phase of a project to upgrade ageing potable water pipes without the need to dig out existing infrastructure. The commercialisation process began in 2010.

The assistance provided by the AIC enabled the company to access the Australian Government's Enterprise Connect Researcher in Business (RIB) program to collaborate with

Flinders University in product development.

The program provides up to \$50,000 to small and medium-sized businesses to help cover the costs of accessing a researcher to assist in the development and commercialisation of new processes, products and services.

According to Copeland's Managing Director Peter Mew, the collaboration with Flinders University, as well as with worldwide partners including European machine design manufacturers, has been invaluable.

"The assistance we received meant we were able to successfully identify a research partner through the Researchers in Business grant," Mr Mew said. "Flinders University has been invaluable in developing the specialised polymer substance required for

our potable water pipe project."

Professor David Lewis, of Flinders University said: "The AIC's assistance to access the Researchers in Business program was the first tangible step in enabling Flinders University to provide technical support for Copeland, resulting in a highly effective and potentially productive collaboration with the potential of significant benefits for both organisations."

One of the unique outcomes, as a result of the trust and confidence established via the program, is that Copeland has offered broad access to industrial equipment and premises that will provide university researchers and Copeland with the capability to create a range of new products that would not be possible for either organisation individually.

# Venture capital shrinkage needs to be reversed

If each of the major super funds invested 0.5 per cent of its portfolio in venture capital we would have an extremely healthy flow of capital.



By Katherine Woodthorpe

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Figure 1 Venture capital fundraising by financial year, 2001–10

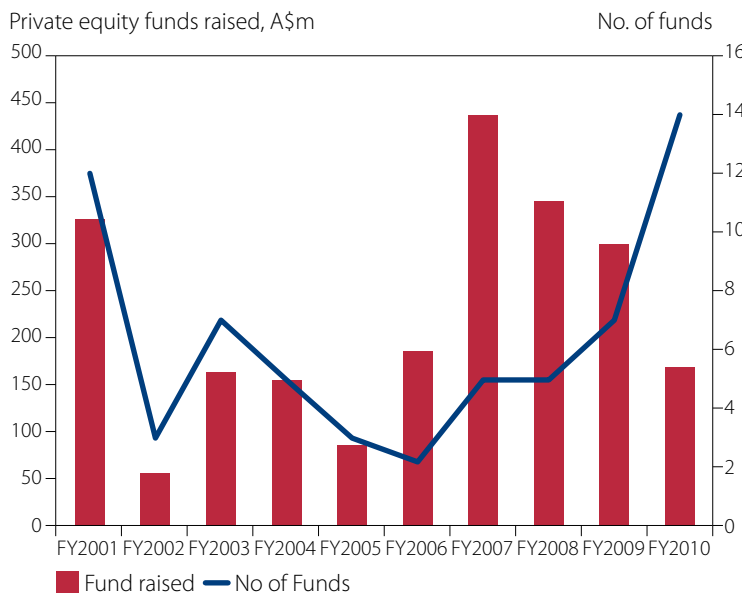
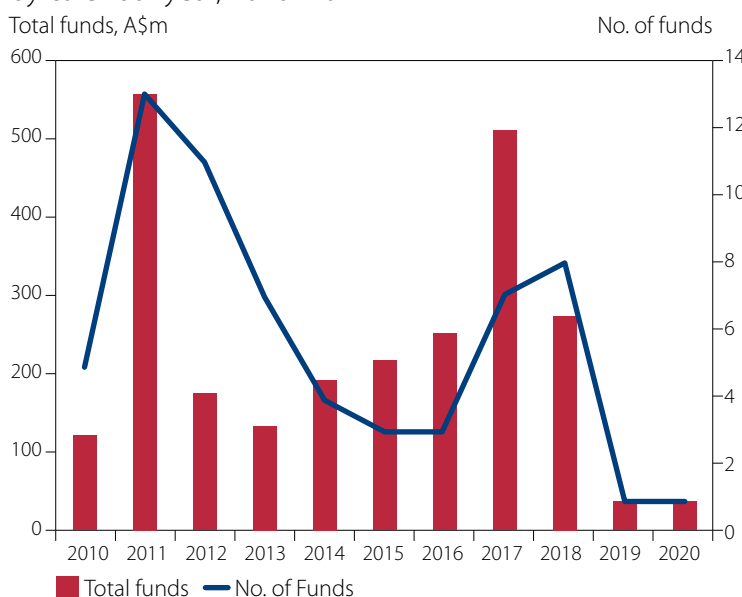


Figure 2 Estimated venture capital fund terminations by calendar year, 2010–20



The Australian Government spends upwards of \$7 billion a year on research. Obviously a large proportion is ‘blue sky’, purely to add to the knowledge base. But a very large proportion is based on the expectation that something will come out of it which enhances our lives.

It might be technology making our world cleaner, our communications faster, or life science research aiming to improve the quality of our health. We spend research dollars on making our industries more productive in order to deliver jobs in the future.

To achieve these outcomes we need to commercialise the research. Currently this is achieved through a number of different approaches, but two major routes are direct licensing of intellectual property (IP) to industry or creating spin-out companies to commercialise the products and services.

The venture capital (VC) industry worldwide, including in Australia, supports spin-out companies from public sector research agencies as well as those companies formed by entrepreneurs. Often seeking VC support is the only way to raise enough funds to commercialise a piece of IP.

What does the VC industry look like in Australia at the moment?

There are approximately 26 funds but of these probably only 10 are actively investing. They most commonly invest in life sciences (45 per cent), ICT (30 per cent) and cleantech (five per cent). There are some 250 to 300 active portfolio companies currently and the average investment range is \$4 to \$15 million. The total funds under management are about \$2.3 billion.

However, these numbers belie some fundamental problems with the industry here and overseas. These include problems with fundraising, difficulty in exiting in poor markets and withdrawal of government support.

As Figures 1 and 2 show, funds raised in Australia have declined steadily since 2007 in dollar terms, although the number of funds has increased, demonstrating a rise in the

number of smaller and less economically viable funds. At the same time, several VC funds are coming to the end of their contractual lifetime and unless a significant number and value of funds are raised in the near future, the industry will shrink severely over the next few years.

There is a commensurate reduction in investments made. Figure 3 shows that although the number of investments appears to remain steady this is mostly reflecting an increase in follow-on funding for existing investments and the underlying number of new investments has declined sharply.

This exacerbates the already strong discrepancy between the level of innovation activity in Australian compared to the local capacity to fund its commercialisation.

We are rightly proud of the outcomes of our investment into R&D in Australia but a substantial number successful overseas companies, not Australians, have reaped that benefit, such as Suntech, commercialising solar cells based on research from UNSW.

The problems in venture capital are not unique to Australia (Figure 4) but are exacerbated by the relative newness and size of our industry. In the US, the National Venture Capital Association estimates that the number of funds has shrunk by as much as 50 per cent. In Israel, so often held up as an example that we should emulate, the venture industry has shrunk so much, and is viewed with such opprobrium, that it no longer has a VC industry association but has become the High Tech Industry Association.

Specific issues facing Australian VC are the reduction and imminent termination of government support for the industry, coupled with a withdrawal of Australian superannuation funds from any illiquid assets.

Government support for the industry, primarily through the Innovation Investment Fund (IIF) program, has helped the industry develop from an almost non-existent base 15 years ago. The review of the IIF program showed that the returns to investors from co-investing with the Government in VC funds under the scheme, have been worthwhile and the total cost to the Government relatively low compared to the outcomes of growing companies ([www.innovation.gov.au/Innovation/Policy/Documents/IIFEquityProgrammeAssessment.pdf](http://www.innovation.gov.au/Innovation/Policy/Documents/IIFEquityProgrammeAssessment.pdf)).

However, this program has only one more tranche of funds before it ends later this year and there is no appetite from the Government to extend it in any form. The Australian Private Equity and Venture Capital Association Ltd (AVCAL) spent a year working with the super indus-

Figure 3 Number of venture capital investments by quarter FY05 - FY10 Q2

No. of funds

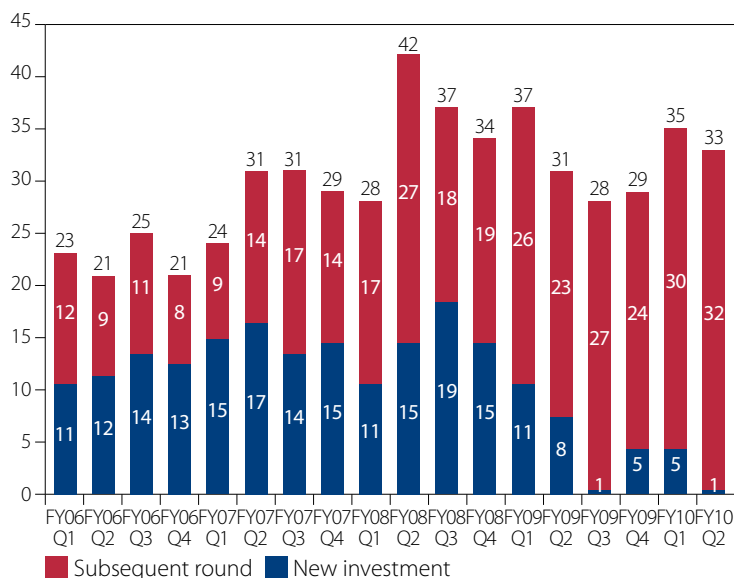
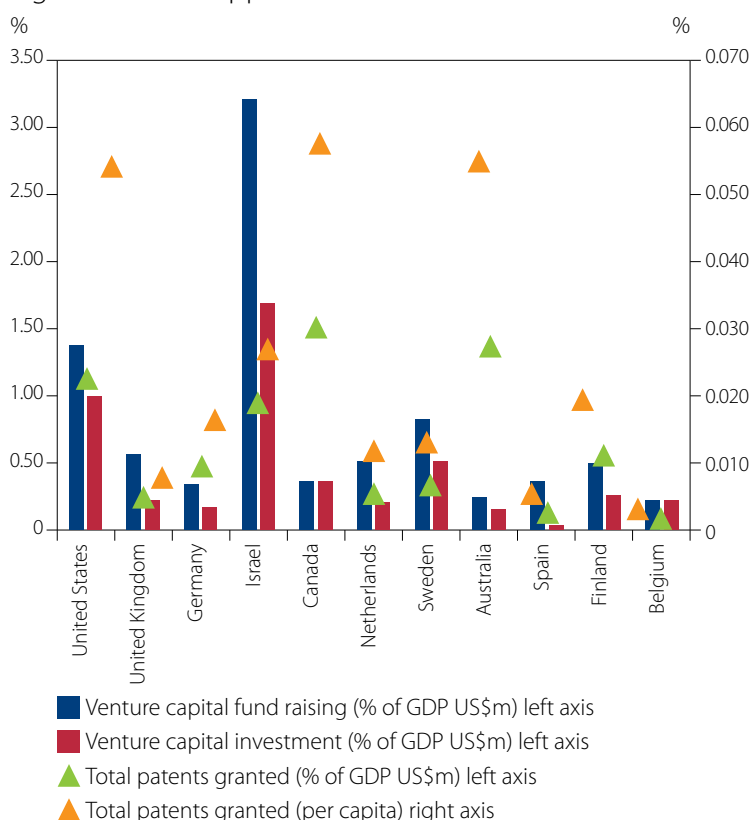


Figure 4 An untapped resource for innovation



try and others to develop proposals to fill this looming gap but they have been rejected.

The Australian superannuation industry has been a modest investor in VC over the past 10 years but that in-

## Letters to the Editor

ATSE Focus welcomes letters from readers in response to articles. Please keep letters brief to enhance publication prospects. Longer letters may be run as contributed articles. Please address to [editor@atse.org.au](mailto:editor@atse.org.au)

vestment is now waning as the Figures show. The reasons for this are many. A key one is the lack of consistent returns from VC, which is not surprising given the newness of the industry. Another structural problem is that as super funds increase in size and coupled with an ongoing trend of mergers in the super industry, they are finding it less attractive to make relatively small investments. Between these two issues the industry has almost completely withdrawn from investing in venture.

What can we do about it?

One thing is that as super fund members we should make sure our trustees know that we are not happy with this investment approach. If each of the major super funds invested 0.5 per cent of its portfolio in VC we would have an extremely healthy flow of capital. It's not exactly a high risk strategy for the super funds.

As an example, how many university researchers would be aware that Unisuper does not invest in VC? Would they be pleased to know that their super fund has no interest in supporting the work that they do and enabling R&D to be commercialised into companies delivering an economic value to the country?

In fact Unisuper did have a Private Equity (PE) and VC

portfolio until recently. It sold the portfolio on 31 March and the following quarter the portfolio gained 20 per cent. So we can't really rely on the trustees to make good decisions.

A second is to lobby government to continue to support the VC industry and also to mandate that super funds invest in VC. The excuse that they shouldn't interfere is weak when you consider that the super industry exists by government mandate, taking out nine per cent of our salaries every year and has a beneficial tax regime.

So don't let our venture capital funds disappear or we will have a much-reduced capital base to support the commercialisation of Australian research. ◀

**DR KATHERINE WOODTHORPE** is Chief Executive of AVCAL, the national association representing the venture capital industry's participants and encouraging investment in growing business enterprises. Previously, Dr Woodthorpe was Chief Executive of the Technology Industries Exporters Group, an industry peak body she helped establish to assist technology companies improve their export performance. With more than 25 years' experience in the technology and commercialisation industry she has held a broad range of management and board positions and consulted to government groups on innovation and commercialisation.

◀ FROM PAGE 16

## Entrepreneurship: issues for start-up companies

searchers and company, there should be flexibility to allow them to spend the money in a shorter time frame, achieving a 'fast and furious' research agenda.

The second change for the better would be to reduce the complexity of the legal agreements. This complexity greatly slows down the knowledge transfer process and in some cases kills the deal for the wrong reasons. The standout reason for excessive complexity is risk avoidance, applied mostly to IP concerns but also to financial fears.

Most agreements for access to technology are written by lawyers for whom protecting their client from risk is the single most important imperative. Access to technology could be dramatically simplified if management – on both sides – ensured that the legal agreements were written with commercial outcomes as the priority rather than risk-avoidance.

Everybody acknowledges this but very few have the courage to pursue it. It isn't easy – managing the external legal and accounting professionals who work for you is one of the toughest tasks in management.

I can give you an example of "quick and effective". Shortly after I started Axon Instruments I had the opportunity to in-license some software from the California Institute of Technology.

In one visit from my offices in San Francisco to Caltech in Pasadena I met the inventor, met the in-house general counsel and agreed on the terms of a licence agreement. Within two weeks it was all signed up. It could not have been easier and this relation-

ship underpinned 20 years of continuous growth for this particular software product.

The secret to this rapid closure was that both sides were willing to show some trust in each other.

I re-emphasise my two main points:

- first, when it comes to helping innovative start-ups, I see an important role for government grants, some of which should not require matching funds – following the example of the SBIR grants in the US; and
- second, start-ups need more than just money and patents – they need the funding and intellectual property transfer processes to be facilitated so that they are easy and fast. Universities, funding agencies and the companies themselves need to rely on risk minimisation rather than risk elimination. ◀

**DR ALAN FINKEL AM FTSE** is the Chief Technology Officer of Better Place Australia, a 'clean energy for electric cars' company. Previously, for 20 years, he ran Axon Instruments, an American company that made electronic instruments used in the discovery of new medicines. The founder of two magazines – *Cosmos* (science awareness) and *G* (environmental sustainability), his passion for education led him to establish the Australian Course in Advanced Neuroscience and lead the establishment of STELR – a secondary science program running in nearly 200 Australian secondary schools. He is the Chancellor of Monash University and Chairman of the Australian Centre of Excellence for All-Sky Astrophysics.

# Australia can learn from the lessons in China

A key policy of China is to import, absorb, develop and create, to underpin the nation's strategic development in science and technology.



By Liangchi Zhang

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**E**ffective industry-university collaboration plays an important role in maximising the innovation efficiency. However, such collaboration cannot survive if the needs of each party are not satisfied. Government encourages collaboration as a means of achieving its strategic aims – realising a faster economy growth, strengthening the nation's position in science and technology, enhancing wealth creation and improving the nation's competitiveness and security.

The aim of industry through such collaboration is to have more effective product development; to establish new technologies; to improve its global competitiveness; to obtain solutions for its technical problems; and to maximise its economic benefit.

A university, on the other hand, has its own agenda. Its basic function is to provide talents for the community and to create new knowledge. Thus the objective of university through industry-university collaborations is to improve education and research training programs, via seeking insight into industrial fundamentals and new research directions. A university also wants to gain funding to enhance its research and teaching and to obtain financial rewards from innovation and technology commercialisation.

To conduct effective industry-university collaborations, two levels of solid platforms must be available.

The essential platform is assured by the government policies, funding resource and incentives to promote collaboration. The second-level platform for effectiveness is determined by industry and university, influenced by a series of generic factors in the management of collaboration and in the cultural integration of the two parties. These include the collaboration objectives and milestones, commitments, communications, continuity and stability – and mutual trust, understanding, and benefits.

China has certainly understood some of these basics and has been practising them through its large-scale industry-university collaboration programs. With its significant investments in R&D, China has continued to improve its

competitiveness in science and technology.

For instance, a key policy of China is to import, absorb, develop and create, to underpin the nation's strategic development in science and technology. This is best exemplified in the advancement of manufacturing capacity, where the aim is to lift the country's standing in the field and then to become a world-best manufacturing centre and a leader of core technologies.

The Chinese Government has established a comprehensive platform through various funding schemes, such as those through the Ministry of Science and Technology, to encourage industry to form tight links with universities. With the embedded incentive system, industry has generated a strong willingness to collaborate with universities, on the premise that functional collaborations amount to economic benefits as well as fostering efficiency and competitiveness in new areas of expertise, employing university infrastructure to full capacity.

Similarly, Chinese universities also see this as an invaluable opportunity to reach their aims of better education development, significant funding opportunities and improved capacity for research. These State Programs for the development in science and technology, including the Primary Programs and Major Key Programs (of which some are known as the 973, 863, Xinhua and Huoju Programs) are for research in the nation's strategic directions, such as the projects for high/key technologies and foresight developments.

The size of a project depends on the nature of the research and collaboration, of which some can be up to tens of millions of – or even a billion – renminbi (RMB). In addition to these large-scale resources in place, some industry sectors are keen to establish joint research centres with universities and research institutions. Some of them also establish oriented research projects through the National Science Foundation.

Apart from the platform established by the Central Government, local governments (mainly provincial) have

established similar programs. It is worth noting that at the provincial level, the emphasis is more directed towards technological transfer and on the cultivation and birth of new production basis.

In other words, the focus at this level is for more direct technological and economic impacts to the nation. These are promoted through numerous promotion programs such as the establishment of technology parks for spinoff companies from universities. Aligned with these, the local government platform also encourages private and small industry sectors to seek close links with universities for opportunities in new technological areas, to enable them to grow in the increasingly competitive market.

The policy in China has laid a good foundation for promoting industry-university collaboration. Because the majority of the funding sources are governmental, industry and university have been motivated to form closer links. Some industry sectors use the scale of such research collaboration as a measure of their R&D level. The universities, similarly, place the funding from such sources

as an important criterion to assess the performance of their staff members. To encourage staff members to attract more such funds, some universities allow their staff to take certain portions of the funds as their personal income in addition to normal salaries. The ability of the funding scale has a significant influence on the university ranking.

The policies of government, university administrations and industry have indeed motivated greatly the industry-university collaboration in China. The obvious achievement by the nation in the past 30 years speaks well for the effectiveness of the collaborative platforms that they have established and practiced.

For example, there are many spinoff high-tech companies from universities, whose products have occupied a noticeable portion of the global market. The value and technical content of the products of the nation's export has changed from the previous low-tech items in the 1980s and 1990s (for example, raw agricultural products, simple toys and low-cost garments) to many of the current high-tech products (for example, cars, electronic products, aircraft and launching services for satellites). The publication record of research papers by university academics has reached a high level internationally.

However, there are also noteworthy drawbacks associated with these funding policies. Given that the funding is mainly from the various levels of government, some individuals are, more often than not, ill-motivated in purely obtaining these funds, rather than establishing co-formulated schemes to maximise the national benefit. Due to the disproportionately strong university assessment policy on staff performance and the additional income allowed (based on the amount of the funds received), academics have experienced high stresses, with undeniable flow-on effects to the quality, effectiveness, and – to a certain degree – the nature of the collaboration.

Furthermore, owing to news media demands for fast economic development, some new programs can be prematurely executed, leading to considerable wastage of efforts and funds. In some cases, the ratio of outcome to investment can be much lower than initially forecasted.

There are some obvious drawbacks in the current practices in the industry-university collaboration programs in China, which are the lessons for us to learn in Australia:

#### ■ Unequal funding opportunities for individuals

This is mainly caused by incomplete assessment and application processes, such that people involved in established and entrenched 'research clubs' led by well-established personnel can get information earlier about certain funding opportunities

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**Zhengrong Shi, whose success at the head of the solar technology company Suntech Power has made him one of the most recognisable faces of innovation in China.**

# Swedish experience can help drive innovation

The innovation paradox seems to be in operation in Australia but there appear to be a sound awareness and readiness to change.



By Anders Hallgren

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To maintain competitiveness in an advanced knowledge-based economy requires constant renewal and innovation. A strong national innovation system that drives economic growth and prosperity will draw upon research strength and expertise, exchange of knowledge and mutual learning, all of which are enriched by well-established and strong collaboration between academia, industry and public sectors – the so-called triple helix constellation

The conditions for innovation changed with the transition from an industrial to knowledge-based society. The environment for knowledge exchange between companies – as well as between companies and the research community and within the research community itself – was revolutionised.

At the same time, promoting knowledge-based innovation became a focus for the policies seeking to stimulate economic growth and prosperity in many OECD countries such as Australia and Sweden.

## The Swedish landscape

Historically, a number of important innovations originated in Sweden. The life-saving pacemaker, the ball bearing, the safety match, the adjustable wrench, and the zipper are all examples of Swedish inventions that are products of a long history of scientific research and development in Sweden. These inventions formed part of the Swedish base industry, noticeably contributing to national growth, improving the welfare state and further industrial development.

During the period 2009–12 the Swedish government investments in research and innovation are around A\$15 billion, accounting for approximately four per cent of the Swedish GDP. These investments are mainly directed towards:

- medicine and biotechnology;
- technology platforms in electronics, photonics and systems design; and
- clean technologies and sustainable systems.

As much as 97 per cent of the publicly funded research in Sweden is carried out at the universities, complemented by networks and agencies to support industry and univer-

sity collaborations. In the past couple of funding rounds from the Swedish Research Council (SRC) and other strategic research funding bodies, there has been a notable increase in cross-disciplinary research projects and the formation of research and business clusters. An additional A\$250 million has recently been directed to support a number of strategic R&D centres resulting in large clusters nearby the major universities.

## The Swedish paradox

In terms of international comparisons – such as *The Global Competitiveness Report 2010-11* (World Economic Forum) – Sweden ranks amongst the top five nations for investments in R&D and performance in knowledge creation for innovation. Despite these high R&D expenditures and rankings, outcomes are relatively modest in terms of producing profitable innovations – commercially viable products and services.

This has become known as the ‘The Swedish Innovation Paradox’ and was the subject of intense discussion and analysis in the 1990s. Substantial efforts were made during the latter part of the 1990s to prevent the further development of the paradox and to find sustainable remedies. Four widespread theories for the development of the paradox prevailed at the time:

- knowledge generated from R&D generally remained in the R&D sphere (in publicly funded or private research organisations) and therefore was not translated into innovations. Obstacles in the translation process impeded knowledge transfer to the commercial sphere and hence it was not made useful to the society;
- a perceived imbalance or disconnect between basic R&D and more needs-oriented R&D;
- historically, GERD and BERD (Government Expenditure on R&D and Business Expenditure on R&D respectively) were directed to traditional sectors – the forestry, the paper and pulp and the steel industries, rather than being directed strategically; and
- the dominance of large multinational companies in the

Swedish innovation scene led to the returns on BERD being captured abroad rather than benefitting the Swedish economy. This fourth hypothesis is one that is especially relevant for a small country like Sweden whose economy is highly dependent on export trade.

All these theories remain relevant, but a closer look at Sweden in the mid-1990s reveals fundamental weaknesses in the Swedish innovation systems and additional practical explanations of the paradox emerged. As a result of fragmentation of resources, there was an unmistakable lack of critical mass, meagre end-to-end thinking with insufficient long-term focus or commitments and ad hoc allocations of GERD. Much effort was put into rectifying these circumstances and during the past 10 years the situation has improved substantially but The Swedish Innovation Paradox is still in operation, albeit mitigated.

### Re-powering innovation

The improved Swedish situation was partially due to realising that the successful translation of knowledge needs a vigorous ecosystem based on strong partnerships between academia, industry and public sectors supported by a mutually agreed innovation policy. With this realisation, corrective work commenced.

Rather than being established on a national basis, partnerships were established on a regional basis and achieved critical mass, engagement and catalytic synergy by capitalising on regional strengths. Conditions for sustained effort were created, allowing knowledge and entrepreneurship to

develop in a concerted way into new products and services.

The public sector played an important role not only in providing a support structure for the ecosystem but also in an active role as facilitator. Good examples of recent developments are the progress of innovation clusters in the Oresund Region (Copenhagen/Malmö and Lund), Business Region Göteborg AB (Gothenburg), Uppsala Science Park/UU Innovation (Uppsala) and STING (Stockholm).

### The Australian landscape

As someone quite recently arrived in Australia and new to the Australian innovation landscape, I see the intellectual capital, the research achievements and innovations turned into profitable global products as rather impressive. Even so, an official (state or federal) clear vision and direction for knowledge-based innovation is not obvious. There is a certain familiarity in the sense of there being rich potential but fragmentation vis-à-vis establishing critical mass and allocation of resources, not unlike the one seen in Sweden 10 years ago.

The innovation paradox seems to be in operation in Australia but there appear to be a sound awareness and readiness to change. In progressing, there may be a few lessons to be learned from the Swedish developments.

First, high-level national priorities in regard to innovation policy need to be in place and supported by regional level innovation policies and strategies with clear objectives, activities, milestones and KPIs. The regional strategies need to be based on local conditions as best practice cases from other parts of the world will not necessarily

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## Australia can learn from the lessons in China

and have a higher rate to success. Sometimes due to the insufficient discussion for the establishment of certain funding programs, premature applications are funded.

### ■ Incomplete assessment of collaboration outcomes

Since the majority of funding resources are from the government, the emphasis of both the industry and university is on the success rate of funding applications. The lack of comprehensive processes and strict assessment criteria on research outcomes often leads to the low ratio of outcome to investment.

### ■ Improper pressure on individuals that can bring about unhealthy development

Many senior academics spend the majority of their time attempting to maximise their funding. Consequently, research quality and strategic directions are overlooked. The direct detriments include more short-term research projects, less innovation and creation in research, degraded quality of research training (more research students to work on the increased projects with less supervision) and lack of strategic agenda for long-term development. In some cases, collaborations can be solely income-driven. Young and junior academics who have not yet

established sufficient links with industry or have not yet been included in 'research clubs' have experienced difficulties in their career development. By the same token, publications in high impact journals have become another critical assessment criterion for staff performance and promotion. The combined pressure of the income-driven collaborations, the high demand of publishing papers, and the lack of essential supervision of research students is partly responsible for academic plagiarism by some students and academics. ▶

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translate to the Australian landscape.

Second, the development of a vision-driven leadership and a systemic governance to impose vision, direction and profile proved to be very effective, especially in the Business Region Goteborg AB case. Practically, this leadership could be established in the form of an official 'Innovation Vehicle' with a CEO and a board comprising members reflecting multiple disciplines and faces of the community (corporate/public/university) charged as convener, broker and a collective voice.

Third – and possibly most importantly in the Swedish experience – was to identify and focus on acknowledged research strengths warranting cross-pollination between different sectors or scientific fields to broaden mind-sets and create new opportunities for introduction of unique products, processes and services into the market place.

## The role of the university

Innovations generated from academic research are commonly in a very early and uncertain stage of development. Typically, patents are filed in the idea phase, with no prototype in place, too early for conventional industry take-up to engage in further development or commercialisation. Adequate engagement and collaboration between inventors and end-users in early phases, as well as in the following development, need to be strengthened.

Universities need to take a proactive and outreaching role initiating and coordinating the building of regional innovation capacity. The technology transfer offices, such

as Sydnovate at the University of Sydney, are logically well suited for this purpose taking on the role as the facilitating link and driver in the innovation system. By providing increased opportunities for end-user interactions with academic research an increase in the output and quality in the translation and exchange of the knowledge generated at the universities will be a logical result. ◀

## Further reading

- The Swedish Paradox – Unexploited Opportunities!  
[www.innovationsbron.se](http://www.innovationsbron.se)
- [www.businessregiongoteborg.com](http://www.businessregiongoteborg.com)
- [www.uppsalasciencepark.se](http://www.uppsalasciencepark.se)
- Uppsala University Innovation, [www.uuinnovation.uu.se](http://www.uuinnovation.uu.se)
- STING Stockholm Innovation & Growth,  
[www.stockholminnovation.com](http://www.stockholminnovation.com)

**DR ANDERS HALLGREN** is Director of Sydnovate, the commercialisation arm of the University of Sydney. He has nearly 20 years' experience directing international business and technology development, commercialisation and growth. He was Director of Lund University Innovation System (2007–09) and President of Lund University Campus Helsingborg (from 2002). His experience in research-based business development includes active participation in facilitating the commercialisation of academic research. He holds a PhD in chemical engineering and industrial process technology (Lund Institute of Technology) and business, business law and international industrial marketing qualifications from the Lund School of Economics.



Research is the start of much innovation – UQ Vice Chancellor Paul Greenfield and Prime Minister Julia Gillard at the announcement of a government investment of \$40 million in UQ's National Imaging Facility.

# Linking industry and research – in an ideal world

Much stronger engagement between the best researchers in the university sector with industry at all levels to the extent that the interface was almost seamless.



By Les Field

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Industry and the university sector engage across a broad spectrum of activities ranging from relatively weak engagement, with industry nibbling around the edges of universities – and vice-versa – through to situations where some universities are almost embedded within an industry setting or where industries are physically located on, or adjacent to, university campuses.

In some parts of the world, industry depends on the close interaction with the tertiary research sector for the supply of well-trained graduates and industry is actively engaged to have 'early visibility' over the potential employment talent pool.

The common current modes of interaction include:

## ■ Contract Research

Effectively well-defined, self-contained projects that originate as required. Contracts are handled on a case-by-case basis and they typically carry a minimal amount of 'baggage', such as longer-term obligations or the paperwork and agreements to initiate them. The obvious limitations arise firstly from the inefficient matchmaking between those that need some research undertaken and those that actually have the right expertise and capacity to conduct it. Second, the fact that contract research is intentionally short term and very focused means that often new developments and observations are frequently left unexplored.

## ■ Linkage Grants

Joint research projects that leverage Government support via the Australian Research Council and the NHMRC. Linkage Grants typically provide up to three years for a research project and must have a solid academic 'discovery' aspect associated with end-user 'industry' support. The obvious limitation for Linkage Grants is the timing – grant applications come about only twice a year and each application takes about six months to consider. By the time the application and assessment cycle is complete quite often, the program has simply moved on.

## ■ The CRC program

Again, to support joint research projects that leverage Government support. However, the CRC program is

geared towards longer-term partnerships tackling more substantive projects. The CRC program has funded longer term programs (seven years, with the possibility of renewal) and many of the CRC programs have been successful in establishing excellent cooperation between CSIRO, industry and university researchers. The obvious limitations of the CRC scheme arise firstly from the fact that the CRC program is administratively and bureaucratically the most demanding of the granting schemes and secondly from the fact that the scheme has been scaled back significantly so that success rates are low and it is a disincentive for many to even consider an application to the scheme as simply too much investment for little prospect of success.

There is no question that the most successful partnerships do rely on the build up of individual two-way, trust and engagement.

In an ideal world:

**1** There would be stronger and deeper interactions between the university research sector and industry – very much more of a partnership than a customer/client relationship. We would see sharing of the responsibility for R&D where the partners recognise that the universities probably have more capacity for the 'R' side of R&D and that industry partners have better capacity for the 'D' side of R&D.

**2** We would see a stronger build up of the R-side of the R&D culture within industry such that industry was actively engaged in look towards the university sector for access to future technology and improving current technologies. One would also see the establishment of more identifiable 'industry research arms' on campuses.

**3** We would see a stronger build up of the D-side of the R&D culture within the university sector such that universities recognised that industry partnerships provide much better opportunity for technology transfer and technology translation to actually get good research out into the community where it may have a real impact.

**4** We would see a much closer engagement of industry with specific critical individuals in the university sector who have

industry-relevant expertise in return for early vision over likely future directions and developments in the area. This is a model that works well in the US where it isn't unusual for academic researchers to be strongly linked to one or more industry partners in their field. Industry particularly spends time in the academic environment and vice versa. Industry gets both advice, when required, and also vigilance over the pipeline of new ideas and developments that may become the way of the future. The academic researchers keep a finger on the pulse of what is actually going on in the 'real world' – the issues and challenges as well as the opportunities for moving their new ideas into concrete examples of technology transfer.

**5** We would also have a much better training stable for our graduate students. Having industry partners actively part of research groups provides an insight into what it is like to work 'in the real world' with industry constraints. Industry also has a long-term exposure to research students as they mature through their graduate years and often actively encourage, nurture and recruit the best students.

**6** IP management is often the stumbling block to getting strong university-industry interactions off the ground. We would see a much more pragmatic (and less legalistic) approach to managing IP. In most instances, we need to take a step back and move away from the 'fight-to-the-death' over every tiny IP issue that might hypothetically have importance (someday). The ideal world would see us properly protect IP and focus on the end-point of getting new research and technology out into the community managing research publication and with dealing with academic freedom.

**7** We would make joint appointments (or transfers) between industry and academia much easier. We should work towards more flexible, less restrictive work practices and employment practices that make it as easy as possible to have joint employments or to hold down two or more

fractional appointments. Even factors such as superannuation arrangements and taxation arrangements often present obstacles for individuals to have joint appointments in different organisations.

There is also an important role for government (at all levels) in promoting the best engagement between our best researchers in universities and the industry sector, in providing a clear policy framework in which collaborative programs can readily develop. This includes minimising disincentives that might penalise close collaborations and actively providing incentives (such as tax incentives) to promote industry/university engagement.

In an ideal world there would be much stronger engagement between the best researchers in the university sector with industry at all levels to the extent that the interface was almost seamless.

We would see more excellent university research making it through the 'technology transfer barrier' and having a real impact on the wider community and we would see the bolstering of industry activity as one builds up the pipeline of good ideas and good people entering the industry sector. ◀

**PROFESSOR LES FIELD AM FAA** has been Deputy Vice-Chancellor (Research) at the University of NSW since 2005 and was the Acting Pro-Vice-Chancellor (Research) (2001–03) before resuming his position as Professor of Organic Chemistry until 2005. He was Head of Chemistry at the University of Sydney from 1997 to 2001. His academic awards include the Rennie Medal (1983), the Edgeworth David Medal (1986), the Organic Chemistry Medal (1992), the Centenary of Federation Medal in 2003 and the RACI Leighton Medal in 2010. He has served as a member of the Council of the Australian Academy of Science (2004–06) and the Council of the Royal Australian Chemical Institute (2004–08).

The CASTvac™ chill vent vacuum valve, developed by CSIRO researchers and Nissan working together through the CAST CRC.

## Casting technologies underpin car component manufacture

Access to a portfolio of cost-competitive CSIRO casting technologies was crucial to Nissan Casting Australia's (NCAP's) recent successful bid to manufacture components for the Nissan Motor Company's new LEAF electric car in Dandenong, Victoria, the company has said.

"NCAP's access to CSIRO's advanced casting technology, which offers significant potential future savings, was instrumental to our winning the contract," said NCAP's business development and corporate planning manager, Brian Cooper. "Nissan Motor Company's R&D engineers in Japan were highly impressed by the level of CSIRO R&D innovation, as well as the extent of state and Australian Government support available to the Australian die-casting industry."

Technologies jointly developed by CSIRO and NCAP through the CAST CRC will be implemented as part of the Australian Government's recently announced \$21 million investment in sustainable, zero-emission

technologies. These include the CASTvac™ technology, a low-maintenance vacuum valve that eliminates machine stoppages due to valve blockages by molten aluminium, which has been estimated to save about \$100,000 a year in the production of a single component.

The Group Executive of CSIRO's Manufacturing, Materials and Minerals Group, Dr Calum Drummond FTSE, said the outcome was an example of how CSIRO research enhances Australia's ability to compete successfully in international markets.



PHOTO: ANDREW BARCHAM

# AUSTRALIA AND CHINA LINK ON AGRICULTURAL WATER



Yonghui Yang and Keith Bristow inspect research plots

Australian and Chinese water specialists are working on new approaches to agricultural water management after a bilateral series of field visits on the North China Plain and a water workshop in the city of Shijiazhuang in May.

The China visit, to explore collaborative opportunities, developed from the successful workshop organised in the Barossa Valley of South Australia last November by AAS, ATSE and the Chinese Academy of Sciences (CAS) with sponsorship from the Australian Department of Innovation, Industry Science and Research (DIISR), which was part of the

2010 annual Australia–China symposium on Topics of National Importance to both economies.

The Hebei Province workshop addressed New Approaches to Agricultural Water Management in a Changing Climate and involved seven Australian and seven Chinese delegates meeting in Shijiazhuang, preceded by two days of field visits.

The event was arranged by CAS. The program was developed by Professor Yonghui Yang of the CAS Centre for Agricultural Resources Research (CARR) and Dr Keith

Bristow of CSIRO Land and water, Townsville.

ATSE Water Forum Chair Dr John Radcliffe AM FTSE was one of the seven Australian participants who learned about the use of saline water for mid-winter irrigation of cotton, wheat, herbs, condiment crops and trees for carbon sequestration. The team also inspected research stations and water storage and distribution facilities, including part of the central “south-to-north” canal, one of three 1300-kilometre canals to take water from the Yangtze River to Northern China.

A three-hour drive across the North China Plain to Shijiazhuang gave delegates a sense of the size, evenness, flat topography and great productivity of the intensive cultivation of wheat crops by small-holders.

The first day of the workshop consisted of a series of papers by the Australian and Chinese delegates outlining their current work and interests relevant to the subject. The second day was devoted to identifying the project proposal – which seeks water security, food security and environmental health as its outcomes – to be undertaken by the Australian and Chinese scientists.

Dr Bristow and Professor Yang will drive the proposal identifying additional potential participants and potential Chinese, Australian and International investors.

## A PRICE ON CARBON: PAY NOW NOT LATER

Why and how carbon can be priced is a vital discussion for Australia, ATSE has told Australia's parliamentarians.

In a June letter to all Federal MPs and Senators, ATE President Professor Robin Batterham said the development and deployment of low-carbon energy technologies for electricity production was imperative to meet greenhouse gas emissions targets and ensure energy security.

Australia would need an increased national focus on the R&D, commercialisation and deployment of low-carbon technologies, requiring significant investment in R&D and pilot-scale facilities to drive down the learning curves and make these technologies cost effective, he said.

He noted that ATSE had identified that an

investment in new energy technology in the range of \$350 to \$500 billion was needed in the next 40 years to achieve a target greenhouse gas emission reduction of 80 per cent.

“A price on carbon is a mechanism to make these low emissions technologies economic, commercially viable and enable innovative technology solutions that will boost Australia's ‘green industries,’” he said.

“The proceeds of a carbon tax could be used to support the required investment in low-carbon technologies. Pricing carbon also reveals the hidden environmental and social costs of fossil fuel power generation.

“Energy and technology policy and delivery through innovative industries is of long-term strategic importance to Australia and the Academy has undertaken significant research

and analysis in this area. We also have developed a discussion paper proposing an alternative methodology on how to price carbon.”

A summary of the Academy's work in this important area can be found at [www.atse.org.au/news/featured-articles/260-pricing-carbon-pay-now-not-later](http://www.atse.org.au/news/featured-articles/260-pricing-carbon-pay-now-not-later).

Professor Batterham said ATSE provided independent policy advice based on robust scientific and technological evidence and was prepared to aid the development of policies that would support Australia's transition to a prosperous low-carbon economy.

He offered Parliamentarians the opportunity to discuss how ATSE could assist the technological challenges and offer unbiased comment and advice on implementing a future low-carbon economy.

# STELR ACHIEVES ANOTHER MILESTONE

By Jenny Sharwood

STELR Curriculum Coordinator

The STELR team is delighted to report that all the schools participating in the STELR Project in 2011 have now received electronic copies of student booklets and teacher resources for three different curriculum programs. These were designed to cater for the different needs of the schools, so that their science staff could select the curriculum program or programs that best suited their students. Since the booklets are in electronic format, teachers can then modify any program and tailor its delivery.

The three STELR curriculum programs were completed after *Australian Curriculum: Science* was published in December 2010 to ensure they were closely aligned with the curriculum and exemplified its inquiry-based teaching approach. Each is designed to model best practice in developing a meaningful, coherent and balanced program in which the three content strands – Science Understanding, Science as a Human Endeavour and Science Inquiry Skills – are interwoven.

The three curriculum programs are:

## 1 STELR CORE CURRICULUM

A 6 to 10-week program designed for Year 9 students. The emphasis in this program is on the physical sciences. All STELR schools have received sufficient full-colour print copies of both the teacher resource and student work booklets for this curriculum to meet their needs. The teacher resource provides the teacher with relevant background information as well as detailed advice on how to run the program and some optional extension activities.

## 2 STELR INTEGRATED CURRICULUM

A 10 to 12-week program designed for Year 9 students, although it is also very suitable for Year 10 students. In this curriculum, the physical sciences and chemical sciences and some aspects of earth and space sciences and biological sciences are all interwoven. This program includes a greater range of experiments and hands-on activities and is more demanding than the core program. The student booklets include background information.

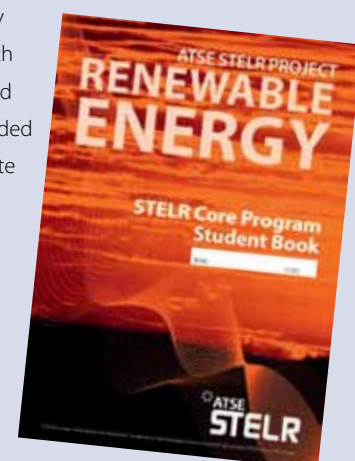
## 3 STELR CHEMISTRY CURRICULUM

A 5 to 6-week chemistry program that was designed for Year 10 students who completed the STELR physical sciences program in the previous year. Most of the experiments and much of the theoretical material in this curriculum are the same as in the integrated curriculum, or are modified versions of them. But the student booklet includes experiments that were only offered as optional extension practical activities in the integrated program.

All six booklets are also supported with additional material such as PowerPoint

presentations. Many other resources, such as career profiles and post-tests, are provided on the STELR website ([www.stelr.org.au](http://www.stelr.org.au)).

The STELR Core  
Program student  
book.



## WOMEN IN TSE:

# ATSE TAKES FURTHER GENDER EQUITY STEPS

The Academy has taken an historic step by committing to elect a target of one-third women among its annual election of new Fellows from 2012.

This target will enable ATSE to strengthen its role in the application of technological science and engineering for the benefit of Australia and its leadership on gender equity for the workforce in these fields.

ATSE has also endorsed the United Nations Women's Empowerment Principles and the development of a Program of Action to back ATSE's Gender Equity Policy (including implementing the gender targets for membership) by an ATSE Gender Equity Implementation Group.

These steps follow the Academy's adoption in November 2010 of its Gender

Equity Policy, which "recognises leadership is needed to address the gender imbalance both within the Academy membership and its activities as well as more broadly in promoting women in senior level in technological sciences and engineering in Australia".

Dr Cathy Foley PSM FTSE, President of Science and Technology Australia, commended ATSE.

"ATSE has shown great leadership in a very challenging area and in doing so will realise the economic and social benefits of its actions," Dr Foley said. "In addition to setting ambitious targets, ATSE has endorsed the UN Women's Empowerment Principles. I congratulate ATSE on the leadership it has shown."

ATSE has committed to promoting women within its own organisation,

engagement with other organisations on gender equity issues, promotion of women in technological sciences and engineering and career development of younger women.

In reaffirming its commitment to the importance of the full participation of women in technological sciences and engineering in Australia, ATSE's Gender Equity Policy highlights that women constitute a wealth of talent and creativity. Both the private and public sectors need to adopt mechanisms that enable women in technological sciences and engineering to actively contribute to Australia's prosperity and productivity.

ATSE has appointed Professor Susan Pond AM FTSE, a Director of ATSE, to lead this initiative in conjunction with the ATSE President, the Board and the ATSE CEO.

# Science meets Parliament tackles key issues

ATSE again sponsored Science meets Parliament (Smp) 2011, a major event in Canberra conducted in June by Science & Technology Australia (STA) – formerly the Federation of Australian Scientific and Technological Societies (FASTS).

ATSE's silver sponsorship entitled it to nominate four mid-career scientists as delegates to attend: Martin Duriska of Monash University (nominated by Dr Terry Turney FTSE); Rita Lim of DSTO (nominated by Dr Len Sciacca FTSE); Chris Munnings of CSIRO (nominated by Dr Sukhvinder Badwal FTSE); and Yap Pang Chuan of the University of Queensland (nominated by Professor Anton Middelberg FTSE). The Fellowship responded strongly to a call for nominations and those who responded to the invitation will be invited to nominate delegates in 2012, should ATSE again be a sponsor.

The two-day event, focused on the major science and technology issues of the day, included a Science meets Parliament dinner at Parliament House, a National Press Club lunch, briefing sessions on presenting science to Parliamentarians and meetings between

participants and Federal parliamentarians to discuss issues of mutual interest.

ATSE Fellow Dr Cathy Foley, President of STA, welcomed guests to the Science meets Parliament dinner. Senator Kim Carr, Minister for Innovation, Industry, Science and Research, addressed the delegates at Parliament House (page 33) and the keynote speaker at the National Press Club lunch was Australia's Chief Scientist, Professor Ian Chubb (page 34).

Despite the impact of the Chilean ash cloud on flight plans, which caused some to have to leave early, the ATSE delegates agreed the event was of value to them and enhanced their understanding of politics and the media.

## What the ATSE delegates said

**Dr Martin Duriska**, a Monash University chemistry PhD, said Science meets Parliaments gave him a valuable appreciation of the life of a politician at Parliament House and an



**Martin Duriska**

understanding of the succinctness in which your life's work in research needs to be presented to the media and politicians.

"It was clear that scientists, politicians and the media speak different languages," he said.

"For scientists to effectively convey their message to policy makers and the public they need to remove the jargon and present their work in a way people can relate to. Important points to remember are not to fight decision makers on a topic but educate them and present the facts so that they themselves can make informed decisions.

"This is a unique event that brings together scientists from all fields and was a great opportunity to meet scientists one would not have the chance to meet at normal, discipline-specific conferences. The opportunity to network at this level is invaluable."

**Dr Rita Lim**, with chemistry degrees from both Flinders University and Monash University, has worked

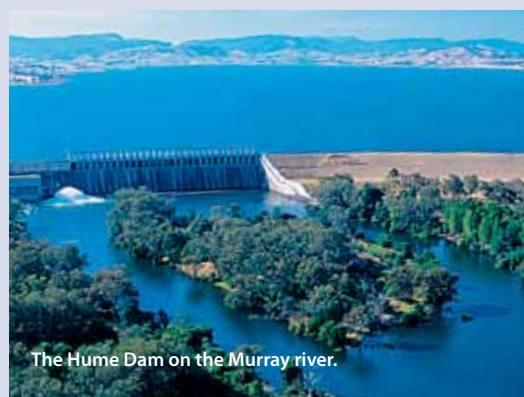


**Rita Lim**

## A SUITE OF ISSUES IN DAM PLANNING

ATSE has told a parliamentary taskforce that a suite of issues need to be considered in developing policy related to dams – particularly the issue of conflicting objectives that may cloud the purpose of a dam.

PHOTO: eWATER CRC, ANDREW TATNELL



The Hume Dam on the Murray river.

In a submission to the Coalition Dams and Water Management Task Force, ATSE said dams and all other forms of water assets/ infrastructure should be considered on their merits, taking into account the full suite of

economic, environmental and social factors, and not unduly influenced by short-term political considerations.

"Water infrastructure has a life span of many decades and decisions should be fully informed by appropriate expertise taking full costs and benefits into account," ATSE said.

It said no water resource infrastructure should be laid to one side without objective consideration because of what have been described

as pre-determined 'policy bans'.

The Academy said it was not in a position to suggest where specific dams might be located or removed, but any consideration of potential dam sites needed to take into account many factors, including the estimated reliable yield, the use and value of the resource retained by the dam, the potential impacts on downstream flows, environmental and diversity impacts, water demand trends and economic value-adding potential, social impacts, and all potential benefits and costs – including the issues of energy production and flood mitigation.

When all these factors were fully considered, good technical and social assessments were the appropriate means

at the Defence Science and Technology Organisation (DSTO) since 2007 conducting investigations into defect/ failures of ADF aircraft and related components and providing recommendations to assist in mitigation. She also researches on topics that impact the ADF, like alternative materials to asbestos and the use of lead-free solder in ADF applications.

She said SmP was a unique experience – informative presentations from a variety of guest speakers and intimate interactions with parliamentarians on the topic of science.

"The SmP presentations were invaluable, delivering material to assist scientists on how to convey research objectives concisely and effectively. Practising a one-minute speech as part of an interactive exercise was useful in preparation for the scheduled meetings on the following day," she said.

"Overall SmP was a grand opportunity into understanding political processes, maximising the valuable albeit short time period to discuss our work project and 'selling' the beneficial impacts of our scientific research."

**Dr Christopher Munnings**, with a PhD in materials science from Imperial College, London, is a senior research scientist with CSIRO Energy Technology based in Melbourne and has a strong background in energy conversion

technologies such as fuel cells. He joined CSIRO in 2010 and is currently working on the development of fuel cells that directly convert coal into electricity after some processing. He has worked within a number of European universities, the NRC (Canada) and Rolls-Royce.

SmP "was an excellent event held in difficult circumstances including a volcanic ash cloud, which caused travel chaos, and a challenging political landscape with scientific integrity at the very forefront of political debate," he said.

"The two-day event provided a fantastic insight into what happens behind closed doors in Parliament, what motivates the press and politicians and how best to engage with them.

"I look forward to putting the new skills I have learnt this week into practice and raising the profile of my research"

*Chris reported in July that CSIRO had hosted a visit from The Speaker of the House of Representatives, Mr Harry Jenkins, at its Clayton site in Melbourne, which was a follow up engagement from the SmP event. "The visit was hugely positive and we had the opportunity to show off a wide range of our latest technologies," Chris said.*



**Christopher  
Munnings**

**Dr Yap Pang Chuan** is a PhD in bioengineering from the Australian Institute for Biotechnology and Nanotechnology (AIBN), at Queensland University (UQ) and has worked at AIBN since 2009 as a postdoctoral research fellow at AIBN's Centre for Biomolecular Engineering.

His interest in biomolecular engineering of recombinant subunit vaccine has led him to investigate virus-like particles (VLPs) as a rapid-response vaccine platform and he currently drives an Australian Government initiative (NIRAP, based at The University of Queensland) to develop VLP vaccines for tropical diseases.

"My motivation to attend (SmP) was that I have always been interested in learning more about the ways scientists can communicate their information to the public and policy makers," Dr Chuan said.

The conference provided great sessions on conveying our messages to the mass media and what they need to turn our science into newsworthy materials. It became clear to me that professional development in engaging with the public is a rather critical aspect of our work."



**Yap Pang Chuan**

to determine acceptability or otherwise. 'Policy bans' or false perceptions of the problems or advantages of dams should not over-ride thorough assessment of all the relevant factors.

The submission noted that – apart from the purpose of the dam – a suite of other issues were relevant in determining dam policy. These included the need to have a catchment management plan; possible climate change impacts; impact of land use change; existing rights; market demand; power generation; pumping costs; supply variability; economics; and food security.

The submission is at [www.atse.org.au/resource-centre/func-startdown/436/](http://www.atse.org.au/resource-centre/func-startdown/436/)

## Safer, greener, fairer future

Australia's scientists and researchers were working hand in hand with the Australian Government to give Australians a safer, greener and fairer future, Senator Kim Carr, told the 2011 Science meets Parliament delegates at Parliament House, Canberra.

"Together, I believe we can help solve global challenges like our changing climate and food security," Senator Carr said. "This Government has the courage to attempt hard things. We know that solving big problems requires investment and trust. And that is why we will spend almost \$9.4 billion dollars on innovation, science and research in the year ahead.

"As part of our partnership, we – the Australian Government – believe you should

be free to undertake frank and fearless research, free from political interference both at the Government and university level. That's why we are supportive of the Respect the Science campaign."

Senator Carr also said the Government wanted all Australians to be more engaged with science.

"Through our \$21 million Inspiring Australia program we hope to bring science to every Australian, regardless of location, ethnicity or age. This will help put more young people on the path to science careers, celebrate our great strengths in science and help people understand what science can do to improve their lives," Senator Carr said.

# Key to tackling the big issues - Chubb

Science is the key to understanding and tackling the big issues we face as a nation and as a world, Chief Scientist Professor Ian Chubb told the National Press Club at a lunch in June linked to Science meets Parliament.

"Science has got us to where we are today – many of the good bits and sometimes the bad – and it holds the key to our future," he said.

"Now if science is so important – you may well ask – why does it struggle to cut through into the mainstream debate?

"Unfortunately, we seem to be living in a world where sport, celebrity and the 24-hour news (cycle) – or, more accurately, a 24-hour commentary cycle sprinkled with news – seem to dominate relentlessly.

"Of course, in the global scheme of things, none of these things matters much at all. But science does. Science can cure diseases. It has given us GPS and mobile phones, and it has given us the 'talking movies' and the internet.

"But because it's everywhere, we don't often seem to think about what science has done for us, just as we sometimes seem to take both the power and the potential of science for granted – as in, 'she'll be right, it'll be there when we need it,'" he said.

"Unfortunately, expenditure on science is too often seen as a cost – something that is somehow taking away from other more pressing, more immediate needs. And its value

gets lost in the 'it costs a lot' argument. But far from being just another cost, expenditure on science is a sound and prudent investment.

We must encourage the Government to continue its commitment: it will reach nearly \$9.4 billion this financial year and includes a record investment in CSIRO, important provision for infrastructure, supporting better the indirect costs of research, growing PhD scholarships and other important elements.

"We need also to provide the Minister with the evidence to argue for growth.

"In economic and in quality of life terms, for ourselves and others around the world, investments like these have been an unparalleled success. Australia must continue

to expand its scientific capabilities if we are to remain internationally engaged, competitive and relevant.

"And sure... this costs money. And of course how much will always be a judgement call. But if we want that prosperous, healthy and secure future we must organise for it and continue to invest for it.

"I want the Office of the Chief Scientist to play a substantial part in providing the evidence that not just underpins the hard decisions, but encourages them to be made."

Full address [www.chiefscientist.gov.au/2011/06/professor-ian-chubbs-address-to-the-national-press-club](http://www.chiefscientist.gov.au/2011/06/professor-ian-chubbs-address-to-the-national-press-club)



Ian Chubb

Science has got us to where we are today – many of the good bits and sometimes the bad – and it holds the key to our future.

– Chief Scientist Professor Ian Chubb

## LETTER

### THE 'CLOCKWORK' UNIVERSE

In the current debate about climate change the two antagonists seem to be absolutely convinced in the certainty of their contradictory predictions.

I think that the following extract from the 1935 conference paper 'Statistique et déterminisme' by Max Born\* (presented at Comptes Rendu de la 7-me semaine internationale de syntèse, the proceedings of which were published in 1944 by Presse Universitaire, Paris) can be a useful reminder that the view of Pierre-Simon Marquis de Laplace about the deterministic, 'clockwork' universe has collapsed more than a hundred years ago.

I quote Max Born (the English translation of this extract is mine and I hope it can accurately and correctly communicate the original): "Modern

science does not deny that everything in nature happens in accordance with the exact laws of science. It denies, however, that the knowledge of these laws is sufficient to predict the future with certainty, or to alter its outcome. These laws in fact forbid the prediction of the future and our ability to influence the outcome of the future events.

However, they allow us, be it only in part, to lift the veil of the unknown, and to find some answers based on probability and statistics."

– Professor Alek Samarin, FTSE

\*Max Born (1882–1979) was Professor of Theoretical Physics at Göttingen (1921–33), Lecturer at Cambridge (1933–36), Professor of Natural Philosophy at Edinburgh (1936–53) and received the Nobel Prize for Physics in 1954.



# GLOBAL WARMING HEALTH RISKS CLUSTER

A new research cluster aims to protect urban Australians from a range of health risks associated with global warming. With \$3.15 million provided over three years through CSIRO's Flagship Collaboration Fund, the Climate and Health Cluster will foster collaborative research into strategies to tackle climate-change-related health issues ranging from the spread of mosquito-borne diseases to heat stress, air pollution and food security.

Managed by CSIRO's Climate Adaptation Flagship, the Cluster's members are: the Australian National University, University of Queensland, University of Melbourne, University of Western Sydney, Curtin University, James Cook University, Queensland Institute of Medical Research and the international design and engineering firm Arup.

Cluster Leader, ANU Professor Tony Capon, said the cluster would help the 90 per cent of Australians living in urban areas by providing new knowledge to enable urban planners and policymakers to effectively counter threats to human health in a changing climate. He said a significant proportion of the cluster's funds would be allocated to improving strategies for managing mosquito-borne diseases.

## REDUCED STORM INTENSITY CUTS RAIN

A decrease in the average intensity of storms over southern Australia has caused decreasing autumn and winter rainfall in recent years – a trend that is forecast to continue for another 50 years.

CSIRO climate scientist Dr Jorgen Frederiksen told the International Union of Geodesy and Geophysics conference in Melbourne in July that these changes were due to reductions in the strength of the mid-latitude jet stream and changes in atmospheric temperatures. The jet stream comprises fast-moving westerly winds in the upper atmosphere.

"The drop in winter and autumn rainfall observed across southern Australia is due to a large downturn in the intensity of storm formations over at least the past three decades compared with the previous three decades, and these effects have become more pronounced with time," Dr Frederiksen said. "Our recent work on climate model projections suggests a continuation of these trends over the next 50 years."

Dr Frederiksen's address was based on recent CSIRO and Bureau

of Meteorology (BoM) research. Based on observations and climate modelling, the research centres on changes in southern Australian winter rainfall linked to atmospheric circulation changes that are directly associated with storm formation, particularly rain-bearing lows and frontal systems crossing southern Australia.

The most important circulation feature associated with winter storm formation is the strength of the subtropical jet stream. Winter storms give south-west Western Australia much of its rain, but between the 20-year periods 1949–68 and 1975–94 south-west WA rainfall reduced by 20 per cent. In south-east Australia, there were reductions of 10 per cent.

"Our research has identified the historic relationship between the reduction in the intensity of storms, the southward shift in storm tracks, changing atmospheric temperatures and reductions in mid-latitude vertical wind shear – the change in the westerly winds with height – affecting rainfall.

"Trends during the 21st century are likely to be similar to those observed during the second half of the 20th century, when we saw substantial declines in seasonal rainfall across parts of southern Australia. Reductions in projected southern Australian rainfall during the 21st century, particularly over south-west WA, may be as much as, or larger than, those seen in recent decades," Dr Frederiksen said.

*The research results from collaboration between the BoM's Dr Carsten Frederiksen and Janice Sisson, and CSIRO's Dr Jorgen Frederiksen and Stacey Osbrough. It was conducted for the Australian Climate Change Science Program, funded through the Department of Climate Change, and the WA Department of Environment and Conservation, under the Indian Ocean Climate Initiative.*

## FIRE WILL BECOME MORE IMPORTANT

Fire – one of nature's primary carbon-cycling mechanisms – is likely to become an increasingly important driver of atmospheric change as the world warms, according to CSIRO's Dr Melita Keywood. She says that how the frequency and intensity of wildfires and intentional biomass burning will change in a future climate requires closer attention, noting the link between long-term climate change and short-term variability in fire activity is complex, with multiple and potentially unknown feedbacks.

"Understanding changes in the occurrence and magnitude of fires will be an important challenge for which there needs to be a clear focus on the tools and methodologies available to scientists to predict fire occurrence in a changing climate," she told the International Union of Geodesy and Geophysics 'Earth on the Edge: Science for a Sustainable Planet' July conference in Melbourne, involving about 4000 scientists from 100 countries.

Dr Keywood said there was some evidence that fire activity may already be increasing in western US forests, and recent exceptionally intense fire events – such as 2009's Black Saturday fires and 2010 Russian fires – highlight the devastation from fires associated with extreme weather.

"The impacts of emissions from fires on global atmospheric chemistry, and on the atmospheric burden of greenhouse gases and aerosols, are recognised but gaps remain in our scientific understanding of the processes involved and the environmental consequences of fires," she said.

# Advocating for the integrity and public role of science



By Professor Ian Chubb

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I recently gave the JR Vickery Address at the 44th Annual AIFST Conference (Australian Institute of Food Science and Technology) and I note that the very man was a founding Fellow of ATSE\*.

In my address, it was easy to draw illustrations from the forward thinking innovations of Vickery's contribution to science, especially during World War II, to show why technological sciences and engineering are crucial to our everyday lives.

ATSE's vision that "Australia's prosperity, national harmony and role as a responsible global citizen is underpinned by technological sciences and engineering" encapsulates how I feel about science generally and that is what led me to accept the position of Australia's Chief Scientist.

When I began my new role at the end of May, I was looking forward to the opportunity to be an advocate for science across its broad spectrum, and I haven't been disappointed so far. It has been an interesting experience.

Part of my role is to advocate for science, the integrity of science and its place in the public debate. I will be helping, therefore, to broaden the understanding of science and its importance, to people directly, as we secure an economically, socially and culturally prosperous future for Australia.

It is important that the role of science in our world is understood. There are critical challenges that face us and science will be a major part of the solutions to many. If I had to choose just one close to home to illustrate the point, and the importance of science, I would pick food.

With the global population predicted to reach nine billion by 2050, a major issue will be the planet's capacity to provide adequately nutritious food for that number. Doing more of what we do now will not be the answer – climate change, changing patterns of rainfall and the degradation of arable land and declining soil fertility put paid to that simplistic notion.

The supply of adequate food is already an issue – even in 2011 with around two billion fewer to feed. We already know just how much and how urgently we need to discover better ways to ensure food supply; and that is before the problem shifts from the present inadequacy globally to the near catastrophic by 2050 if too little is done now.

It is imperative to invest in our wit, and build our capacity, to develop our scientific research and our industry for our future. It is the best way to look after ourselves, and the best way for us, still 'small' in population terms, to make a contribution to the great global challenges.

## NEW CSIRO BOOK ON CLIMATE CHANGE

CSIRO has launched *Climate Change: Science and Solutions for Australia* to help inform business, government and the community about the many issues that need to be addressed in response to climate change.

The book highlights the importance of climate change as a matter of significant economic, environmental and social concern in Australia and provides the latest information on international climate change science and potential responses.

CSIRO Chief Executive Dr Megan Clark FTSE launched the book at the GREENHOUSE 2011 climate change conference in Cairns.

"This publication draws on the latest peer-reviewed literature contributed by thousands of researchers in Australia and internationally," Dr Clark said. "It seeks to provide a bridge from the peer-reviewed scientific literature to a broader audience of society, while providing the depth of science that this complex issue demands and deserves."

"CSIRO works with its partners to develop practical responses to the global challenges of climate change, working across three areas of research: understanding the science of climate change; adapting to unavoidable climate impacts; and reducing Australia's greenhouse gas emissions."



Megan Clark  
launches the book.

PHOTO: CSIRO

Download *Climate Change: Science and Solutions for Australia* for free at [www.csiro.au/Climate-Change-Book](http://www.csiro.au/Climate-Change-Book)

It will be science that provides the answers – good science, relevant science and ethical science; science conducted with integrity; and science that responds to critique made with integrity.

Unfortunately, we are in an era where shouting (literally as well as metaphorically) takes discussion to new lows; where the sowing of doubt is seen by some to be all that has to be done – not the hard yards: taking care to be right, by sharing knowledge, facilitating understanding, advising and informing so that people have the information to make up their own minds.

Negativity can be easy. Just use innuendo to take important statements or work out of play; hint slyly that the authors and reviewers, the scientists, have some ulterior but well-hidden motive known only to an insightful few.

Seeking to prevent certain research, or destroying it, is reminiscent of the Dark Ages or even the early 19th century in Britain. Surely we are past that – at least we all must hope so if we care at all for humanity.

Science is a crucial part of our world and our future. It is important for the voices of science to be heard and understood – by politicians, by policy writers and the public. As experts in their field, scientists have an obligation to use that expertise to help place the evidence before the public.

This is itself a skill and one that we probably need to acquire early. Maybe it is time to encourage university science courses to include lessons focusing on the ways of managing scientific evidence and discoveries within the public domain.

Can I ask that you join with me, and that you work at all levels, to engage with your industry partners in Australia and overseas, with the community and with your local schools to remind them just how important science is to their lives.

I also ask you to be vocal in your communities in your support for science and particularly in this area of science where you have special expertise. The reality is that if we don't tell people about the importance of science and what it means to them, the importance of what you do, how will they ever really know? And it is too important simply to think that they will find out, somehow.

As I said in the Vickery address, it is too important to leave it to others to get the message across. We scientists must own that responsibility. ◀

*\*James Richard Vickery (1902–97) was Chief of the CSIRO Division of Food Preservation 1940–67. He had originally joined the CSIR Section of Food Preservation and Transport in 1931 as Officer-in-Charge. In 1929 he was as biologist on a scientific survey party sent from England at the request of the New Zealand Government to examine and report on certain aspects of the export lamb trade. He was a Foundation Fellow of ATSE. He won fame for extending the storage life of chilled beef and improving the quality of frozen beef during WWII. One of his tasks was to develop dehydrated meat for the Allied forces. In Britain it became known as 'Vickery mutton'.*

**PROFESSOR IAN CHUBB AC** was appointed Chief Scientist in April 2011 following 10 years as Vice-Chancellor of the Australian National University and six years as Vice-Chancellor of Flinders University. Professor Chubb studied at Oxford University, where he was a Wellcome Foundation Scholar, a Junior Research Fellow of St John's College, and a Royal Society Research Fellow. Before this he spent 1969–71 as a JF & C Heymans Research Fellow at the University of Ghent, Belgium. Professor Chubb's research focused on the neurosciences and he has co-authored some 70 full papers and co-edited one book all related to his research.

## NICTA'S 'CRASH-PROOF' CODE IN WORLD TOP 10

NICTA's formal code verification technology has been included in Massachusetts Institute of Technology *Technology Review's* 2011 TR10, an annual list of the world's 10 most important emerging technologies.

Each TR10 winner is drawn from the editors' coverage of key fields and is based on a simple question: is the technology likely to change the world?

These innovations – each represented by a researcher whose vision and work is driving the field – promise fundamental shifts in areas from energy to health care, computing to communications.

"The embedded computers that are essential to controlling modern cars and medical devices rely on software for their safe operation, but testing that software for reliability has largely relied on trial and error," said Stephen Cass, special projects editor of *Technology Review*.

"With the creation at NICTA of the core of an operating system that can be mathematically proven to be crash-proof, such control software could be made much safer, which is vital for the foundations of our increasingly computer-driven world," he said.

"NICTA leads the world in this important

area of scientific research," said Professor Hugh Durrant-Whyte FRS FAA FTSE, NICTA's Chief Executive Officer. "This recognition from MIT is a fitting tribute to the vision and hard work of an enormously talented cross-disciplinary team and endorses NICTA's unique research approach."

This recognition from MIT is a fitting tribute to the vision and hard work of an enormously talented cross-disciplinary team and endorses NICTA's unique research approach.

– Professor Hugh Durrant-Whyte

# Joint Research Engagement: is the policy appropriate?

The Joint Research Engagement Policy has not been very successful in increasing the rewards to the top performing universities in terms of end-user research collaborations.



By Frank Larkins

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In a policy paper released in 2009 entitled *Transforming Australia's Higher Education System*<sup>1</sup> the Commonwealth Government announced that the Institutional Grants Scheme (IGS) that was part of the Research Block Grant funding schemes to Universities would be replaced from 2010 by the Joint Research Engagement (JRE) program to give greater emphasis to end-user research as an incentive to increase collaboration with industry, community partners and public sector research agencies.

The principal motivation for the policy change was that there was perceived to be a significant weakness in Australia's innovation system, since a 2004 survey ranked Australia last among 26 OECD nations for research collaboration between industry and universities.

The allocation formula was changed by removing the Australian Competitive Grants (ACGs) research income from the formula, while retaining other public sector, cooperative research centre, industry and other research funding as eligible research income. The JRE formula retained the structure of the IGS formula with weightings of 60 per cent research income, 30 per cent research student load and 10 per cent research publications.

The JRE funding allocations for 2010 and 2011 have totalled \$647.4 million, compared with \$622.6 million for the past two years, 2008 and 2009, of IGS funding<sup>2</sup>. The two-year increase of \$24.8 million represents a gain to the sector of four per cent.

It is instructive to examine the changes that have occurred in the redistribution of funding relative to the IGS allocations in the previous two years. Some 27 of the 41 institutions eligible for JRE funding have received increased funding totalling \$33.4 million over the two years, while \$8.6 million was redistributed away from 14 institutions when compared with their IGS funding in the previous

two years. The 10 universities receiving the highest gains and the 10 institutions receiving the highest losses are shown in Table 1.

The institutions listed account for 86 per cent of the gains and for 99 per cent of the losses. The University of New South Wales is the recipient with the largest increase in funding followed by Curtin. Overall the top 10 institutions receiving increases include three Go8 universities, three Australian Technology Network (ATN) Universities and four universities from the Innovative Research Universities (IRU) group. Four of the Go8 universities received the largest decreases in funding (ANU, Adelaide, UWA and Queensland) along with four universities unaligned to any network, one ATN university (UTS) and one IRU (James Cook).

At one level the redistribution may be viewed as a positive incentive and reward for engagement; however, to examine only the changes in funding is misleading as to the overall performance of universities in terms of the extent of collaboration with end-users. If one accepts that the JRE funding is a surrogate for external collaboration, then absolute performance should be related to total JRE funding received by an institution.

The allocations to the 10 leading institutions are given in Table 2. They received 68.1 per cent of the available funding. The Go8 universities are the top eight recipients of JRE funding with the other two top 10 universities being Curtin and Newcastle.

Four of the top 10 performing universities rewarded for their end-user collaborations are also the ones that have lost the most income from the formula change.

If the Government's policy objective was to reward the universities most engaged in end-user collaboration then it has not been successful. If the motive was to distribute research infrastructure more widely across institutions then the policy has been more successful.

It is also instructive to compare the JRE performance with the performance of universities receiving Research

Four of the top 10 performing universities rewarded for their end-user collaborations are also the ones that have lost the most income from the formula change.

Infrastructure Block Grant (RIBG) Funding<sup>2</sup>. The RIBG funding, as a reward for research excellence, is allocated to universities based 100 per cent on the proportion of the peer-reviewed ACGs that universities receive.

The performance of the top 10 Australian Universities in receipt of RIBG funding for 2010 and 2011 also is shown in Table 2. The 10 leading universities for RIBG funding receive 79.8 per cent of the available funding with the Go8 group again being the leading eight universities. The only change compared with the JRE performance is for Tasmania to replace Curtin. Tasmania was the 12th ranked university for JRE funding and Curtin the 18th ranked university in terms of RIBG funding.

Clearly, there is a strong correlation between peer-reviewed research excellence and collaboration with end-users. The Government's JRE policy severs this direct link.

The Government needs to decide if it wants a policy to reward institutions with the strongest research collaboration record or if it wants a mechanism to spread research infrastructure funding more broadly across institutions. The JRE is not the answer to the former. ◀

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2. [www.innovation.gov.au/Research/ResearchBlockGrants/Pages/default.aspx](http://www.innovation.gov.au/Research/ResearchBlockGrants/Pages/default.aspx)

**PROFESSOR FRANK LARKINS AM FAA FTSE** is Professor Emeritus in the School of Chemistry at the University of Melbourne. He is a former Deputy Vice Chancellor at the university. He has recently published a book, *Australian Higher Education Research Policies and Performance 1987-2010* (MUP 2011). This article was first published by the LH Martin Institute for Higher Education Leadership & Management.

**Table 1 Universities showing the highest gains and the highest losses in Joint Research Engagement Funding in 2010-11 relative to Institutional Grants Scheme Funding in 2008-09**

University	JRE Funding Increase (\$ millions)	University	JRE Funding Decrease (\$ millions)
UNSW	8.77	ANU	-2.12
Curtin	4.15	Adelaide	-1.42
QUT	3.50	UWA	-1.29
USA	2.90	Queensland	-0.83
Sydney	2.61	Tasmania	-0.60
Griffith	1.80	UTS	-0.51
Newcastle	1.71	James Cook	-0.48
Melbourne	1.46	Macquarie	-0.45
La Trobe	1.15	UNE	-0.40
Charles Darwin	0.69	Wollongong	-0.38

**Table 2 Joint Research Engagement Funding and Research Infrastructure Block Grants to the 10 highest recipient universities for 2010 and 2011**

University	JRE Funding for 2010 and 2011 (\$ millions)	University	RIBG Funding for 2010 and 2011 (\$ millions)
Melbourne	74.74	Melbourne	60.69
Sydney	72.33	Sydney	54.99
Queensland	57.28	Queensland	47.74
UNSW	56.67	UNSW	40.43
Monash	49.26	Monash	39.55
UWA	33.02	ANU	29.21
ANU	32.35	UWA	27.72
Adelaide	30.56	Adelaide	26.07
Curtin	17.53	Tasmania	11.71
Newcastle	16.87	Newcastle	10.50

## MAIA WINS R&D 100 AWARD

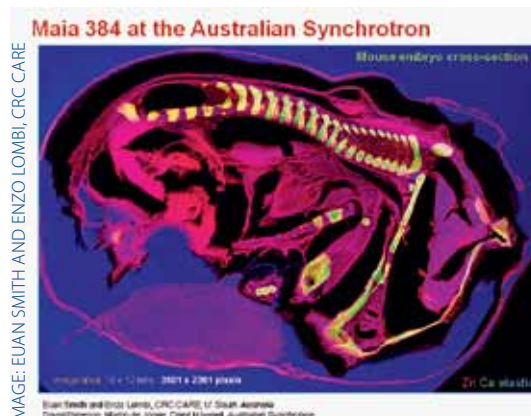
The Maia X-ray Microprobe Element Imaging System developed for use at the Australian Synchrotron by CSIRO and Brookhaven National Laboratory in New York has won a prestigious R&D 100 Award.

Convened by the US-based *R&D Magazine*, the annual R&D 100 Awards recognise the 100 most technologically significant products from around the world introduced into the marketplace in the past year.

The Maia system is a high-throughput

X-ray fluorescence detector system that – when combined with a focused X-ray source such as a synchrotron X-ray microprobe beamline – can produce high-definition, quantitative elemental images with microscopic or nanoscopic detail in real time.

Development of the Maia detector was commissioned by the Australian Synchrotron in 2008 and since its delivery in March 2010 has provided high-definition elemental images of complex natural samples.



**An Australian Synchrotron Maia image of the trace element distribution in tissue and bone of a mouse embryo.**

# FRESH SCIENTISTS TACKLE SOME BIG ISSUES

Smart bandages that change colour to reveal the state of the wound beneath, a car fuel efficiency device, a plant gel that regenerates nerves and a planet going backwards around its sun – this is just some of the research by the 16 top young scientists who were recently named as Australia's Fresh Scientists for 2010.

Their research was presented for the first time in public through Fresh Science, a national program sponsored by the Australian Government that identifies and publicises new and interesting research being done by early-career scientists around the country.

The 16 winners are selected from 80 nominations. They are flown to Melbourne for a day of media training after which they presented their work to the media, school students, the general public, scientists, government and industry over three days in a 'boot camp' in science communication. Now in its 14th year, Fresh Science is designed to enhance reporting of Australian science, highlight and encourage debate on the role of science in Australian society and provide role models for the next generation of Australian scientists.

This edition of *Focus* takes a look at the work of five of the 2010 Fresh Scientists. Details of all winners at <http://freshscience.org.au>.

## The 2011 Fresh Scientists are:

■ **Daniel Bayliss**, an astronomer at ANU/Mt Stromlo Observatory looking for extra-solar planets;

■ **Regina Belski**, a lecturer at Victoria University exploring lupins and heart health;

■ **Prasanth Divakaran**, a PhD student at the University of Melbourne who is looking into ocean circulation;

■ **Lachlan Gray**, a NHMRC Fellow working at Monash University/Burnet Institute who is looking into HIV dementia;

■ **Ina Happon**, a PhD student at the Walter and Eliza Hall Institute who is tracking down suicide genes;

■ **Morgan James**, a PhD student at the University of Newcastle who is looking into cocaine addiction;

■ **Brandon MacDonald**, a PhD student at CSIRO/the University of Melbourne/who is developing solar inks;

■ **Stephen Redmond**, a biomedical engineer at UNSW who is finding out how to keep our elderly upright;

■ **Anna Richards**, a postdoctoral fellow at CSIRO Ecosystem Sciences looking at the relationship between fire management and climate change;

■ **Andrew Rodda**, a postgraduate research student at Monash University looking into medical applications of plant-based gels;

■ **Vijaya Singh**, a postdoctoral research fellow at the University of Queensland who is looking at root systems and droughts;

■ **Charis Teh**, a PhD student at the John Curtin School of Medical Research at ANU who is looking at a human system restore point;

■ **Louise van der Werff**, a PhD student at Monash University/CSIRO is researching how smart fabrics can be used in medical treatment.

■ **Frank Will**, PhD student and senior lecturer at Deakin University who is improving fuel consumption;

■ **Emily Wong**, a postdoctoral researcher at the University of Sydney who is looking into how baby marsupials survive in dirty pouches;

■ **Barbara Wueringer**, a PhD candidate at the University of Queensland who is asking what sawfish do with their saw;

## SMART BANDAGE CAN MONITOR HEALING

Melbourne researchers have developed smart bandage fibres that change colour to reveal the state of the wound beneath.

The colour-changing material the researchers have developed is in the form of a fibre, which may be woven or knitted into a loose textile product for incorporation into a wound dressing. It will allow both patients and clinicians to determine the temperature across the wound and surrounding tissue without using electronic equipment – but by simply comparing the colour of the fibres with a calibrated chart.

This could lead to more timely, effective and relevant treatments by doctors and nurses and to limited self-diagnosis by patients allowing faster closure of the wounds.

So far the team has created the fabric. Within six months they'll have turned it into a bandage, and then they'll work with industry to trial the new bandages. A manufacturer of bandages is supporting the research.

"We hope that the dressing could lead to more rapid and effective treatment of chronic

wounds such as leg ulcers, saving time and money, as well as improving patient wellbeing," says lead inventor Louise van der Werff, a CSIRO materials scientist and Monash University PhD student.

"We've created a fabric that changes colour in response to temperature – showing changes of less than 0.5°C. We expect that, when incorporated into a bandage it will allow nurses to quickly identify healing problems such as infection or interruptions to the blood supply, which are typically accompanied by a local increase or decrease in temperature," she says.

Up to three per cent of Australians suffer from chronic wounds, costing the healthcare system more than \$500 million a year. Reduced blood supply due to systemic diseases such as diabetes, or inflammation as a result of infection, can lead to significant delays in healing.

"If problems are not quickly identified and treated," Louise says, "Wounds

can persist for months or years resulting in a major reduction in quality of life. And the average cost of treatment is over \$25,000 per wound."

"Having the ability to collect a broader range of data on a wound's status will have a significant impact on the understanding of chronic wounds and how best to treat them," says Mr Robin Cranston, the leader of the joint research project.



The new fibres indicate changes in wound temperature.

## WASTE HEAT CAN SLASH FUEL CONSUMPTION

A minor modification to your car could reduce fuel consumption by more than seven per cent, according to researchers at Deakin University, who have used waste heat to reduce friction by warming the engine oil.

A typical car engine wastes about 80 per cent of the fuel consumed. Only 20 per cent of the fuel's energy is used to drive the car forward. The rest is lost as heat.

The system, which can be retrofitted, works by diverting waste heat to bring engine oil up to its optimal operating temperature. It was developed by researchers at Deakin University led by Mr Frank Will, of the School of Engineering, during his PhD project, and is named OVER7™.

A prototype has been built and tested and the inventors are now talking to car manufacturers and developing an aftermarket conversion kit. Other benefits include the potential to reduce engine wear and improve performance.

"Preliminary testing of our system has demonstrated fuel savings of over seven per cent as well as significant reductions in exhaust emissions," Frank says. "One of its most important features is that it doesn't have to heat all the oil in the sump. Instead, it heats only the active oil in the engine lubrication system. This makes the overall heat transfer process much more efficient."

"The system has the potential to be retrofitted to existing engines and we don't think it will require big changes. It should be much cheaper to fit than an LPG conversion for example. Built into a new car it should pay for itself within a month or two," he says.

"We also think the system will be suitable for a range of vehicles, including diesels, hybrids and those using alternative fuels."

"We were very pleased with the results of tests on our prototype system. Now we are working on further testing with car manufacturers and their suppliers, in order to optimise the technology to best suit their needs."

**Frank Will with the Formula SAE racing car developed and built by a team at Deakin University.**



PHOTO: DONNA EDWARDS

## 99% MATERIALS SAVING IN SOLAR CELLS

Australian researchers have invented nanotech solar cells that are thin, flexible and use only one per cent of the materials of conventional solar cells.

Printable, flexible solar cells that could

dramatically decrease the cost of renewable energy have been developed by PhD student Brandon MacDonald in collaboration with his colleagues from CSIRO's Future Manufacturing Flagship and the University of Melbourne's Bio21 Institute.

Their patented technology is based on inks containing tiny, semiconducting nanocrystals, which can be printed directly onto a variety of surfaces. By choosing the right combination of ink and surface it is possible to make efficient solar cells using very little material or energy.

"The problem with traditional solar cells," Brandon says, "is that making them requires many complex and energy intensive steps. Using nanocrystal inks, they can be manufactured in a continuous manner, which increases throughput and should make the cells much cheaper to produce."

Nanocrystals, also known as quantum dots, are semiconducting particles with a diameter of a few millionths of a millimetre. Because of their extremely small size they can remain suspended in a solution, which can then be deposited onto a variety of materials, including flexible plastics or metal foils. It is then dried to form a thin film.

Brandon and his colleagues discovered that by depositing multiple layers of nanocrystals they can fill in any defects formed during the drying process. The result is a densely packed, uniform film, ideal for lightweight solar cells.

The nanocrystals consist of a semiconducting material called cadmium telluride, which is a very strong absorber of light. This means that the resulting cells can be made very thin.

"The total amount of material used in these cells is about one per cent of what you would use for a typical silicon solar cell. Even compared to other types of cadmium telluride cells ours are much thinner, using approximately one-tenth as much material," Brandon says.

The technology is not limited to solar cells. It can also be used to make printable versions of other electronic devices, such as light emitting diodes, lasers or transistors.

For his work Brandon has received the 2010-11 DuPont Young Innovator's Award and has had his work published in the journal *Nano Letters*.



PHOTO: ANTHONY CHESMAN

**Brandon examines one of his nanocrystal inks.**

# CUT FIRES, BOOST CARBON IN SOIL

Decreasing the frequency of wild fires in northern Australia would lead to an increase in the amount of carbon stored in the soil, significantly lowering greenhouse gas emissions, according to CSIRO ecologist, Dr Anna Richards.

Anna's studies show that reducing fire frequencies results in greater carbon capture. Up to four times more greenhouse gases are stored underground – and that means they are not going up in smoke. Using measurements of soil carbon from long-term fire experiments conducted near Darwin and sophisticated computer modelling, Anna found that reducing fire frequency to one fire every four to six years is best for storing carbon.

Fire is part of the natural cycle of northern Australia's savannas. There are more fires each year in the northern third of the country than anywhere else in Australia. These fires account for about three per cent of the nation's greenhouse gas emissions. While fire is important for maintaining a healthy environment in northern Australia, Anna says,

scientists have become concerned at the increase in frequency and intensity of wild fires over the past century.

"About half the Top End is burnt each year and this is changing the environment as well as releasing large quantities of greenhouse gases into the atmosphere."

Until now, it was assumed that it was really only the amount of smoke that contributed to these emissions, but Anna has shown that things are much more complicated than that. There is an interaction with the soil as well.

"The frequency of fires affects the chemistry of the soil and the workings of the plant roots – hence the capacity of the soil to store carbon," she says. "In general, the greater the frequency of fires, the more carbon is released from the soil, and vice versa."

"Until now, scientists have known little about the impact of different fire management options on the amount of carbon stored in soil. These findings are significant for managing carbon in northern Australia, particularly for programs that use indigenous

fire management practices to reduce fire frequency and severity," she said.

Anna is conducting further research on the effects of fire on soil carbon as part of the Tiwi Carbon Study in the Tiwi Islands, north of Darwin. The Tiwi Carbon Study is a partnership between CSIRO, the Tiwi Land Council, the Tiwi College and Tiwi Forests.

**Fresh Scientist**  
**Anna Richards.**



PHOTO: MARK COULSON

## SENSOR HELPS AGED STAY UPRIGHT AND STAY AT HOME

A new technology to stop falls before they happen could help the elderly stay in their own homes longer. Researchers at the University of New South Wales (UNSW) have developed a simple way of predicting the likelihood of an elderly person falling in the near future, allowing action to reduce the chances of it happening.

One in three persons in Australia over the age of 65 falls each year. The cost of treating them last year was estimated to be close to \$850 million.

"By asking elderly people to perform three normal everyday physical activities and one test of their reactions, and then observing how well they do, we can estimate their likelihood of falling," says Dr Stephen Redmond from UNSW's Graduate School of Biomedical Engineering.

"Their performance is measured by a small device worn on their waist. This allows the test

to be done at home, at any time, by anyone, without supervision. It's a big step forward from existing clinical assessments."

Because they require the assistance of well-trained staff, the current methods used in medical clinics to assess the risk of falling are limited in their ability to screen large numbers of people. Stephen's research has shown that it is feasible for the elderly to measure their own risk at home.

"We use a common movement sensor known as an accelerometer. We tested 68 elderly patients with the normal clinic assessment and then tested them again with our unsupervised assessment, using the sensor as they would use it at home. And we found the unsupervised predictions were 99 per cent in agreement with the clinical falls-risk estimate."

The research team expects such home-monitoring technologies will be able pick out people in need of help, and improve their quality of life. They should also reduce the incidence of falls generally, together with the associated cost of hospitalisation.

"At present we require people to go through a scripted series of assessment tasks. In future, we hope that just by getting them to wear the sensor for a period of time we can unobtrusively estimate their risk of falling by monitoring how they perform activities like walking as they go about their daily lives. What we have learned so far tells us this is a very achievable goal."



PHOTO: GRAINNE MCMAHON

**Stephen Redmond**  
**and his wearable**  
**movement sensor.**

# LARGEST SOLAR THERMAL HUB OPENS

Australia's Solar Thermal Research Hub.

PHOTO: JOHN MARMARAS

The recent launch of the CSIRO Solar Tower in Newcastle will position Australia at the forefront of global solar thermal research with the facility becoming an international hub for solar tower research, development and commercialisation.

It is the largest solar thermal research facility in the country and has been supported by a \$5 million foundation grant from the Australian Solar Institute.

The 30-metre-high solar tower surrounded by 450 locally manufactured, custom-designed mirrors (heliostats) is capable of generating temperatures of up to 1,500° Celsius. The increased temperatures mean higher efficiency and lower costs. The facility will also be used to research solar energy storage, high temperature steam generation, solarised fuels and thermoelectric generators.

Unlike most solar thermal power stations which require water, this facility will initially be used to develop and test a solar air turbine, which will generate electricity from air and sunshine only.

This offers real opportunities for cost effective and efficient energy solutions in remote arid regions.

The project has attracted partnerships with two of the world's most prominent solar energy organisations, Japan's Mitsubishi Heavy Industries and Spain's Abengoa Solar, with more international interest expected.

## SOLAR PROJECTS WIN \$750 MILLION

Two of the largest solar power stations in the world will be built in Queensland and NSW with more than \$750 million of Federal funding.

The Solar Dawn consortium, led by Areva Solar, will build a 250 megawatt (MW) solar thermal gas hybrid power plant near Chinchilla in Queensland – one of the largest power plants of its kind. During construction, Solar Dawn estimates the project will generate \$570 million in economic activity in the region and create 300 jobs on

average, with at least 85 per cent of its power generation emissions free.

The Moree Solar Farm consortium, led by BP Solar will build a 150 MW photovoltaic power plant near Moree, NSW. This is nearly twice the size of any photovoltaic power plant operating in the world today and is estimated to create on average around 300 jobs during construction.

Work will commence next year and the plants are expected to be completed and commissioned by the end of 2015.

Prime Minister Julia Gillard and Resources and Energy Minister Martin Ferguson recently announced the record funding to support construction of the solar projects under Round 1 of the Australian Government's \$1.5 billion Solar Flagships program, saying investment in clean energy projects will continue to help make industrial-scale solar power more feasible, affordable and viable.

The Government will contribute \$464 million for the project in Chinchilla worth an estimated \$1.2 billion and \$306.5 million towards the project in Moree worth an estimated \$923 million. Together, the projects are expected to generate enough power to support the electricity needs of more than 115,000 Australian homes a year.

## KOGAN CREEK GETS GOVERNMENT'S NOD

The Federal and Queensland governments have given approvals for one of the world's largest solar projects, the \$104.7 million Kogan Creek Solar Boost Project, near Chinchilla in south-west Queensland.

CS Energy's 750 megawatt coal-fired Kogan Creek Power Station will soon become home to a 44 megawatt solar thermal addition representing the largest solar project in the Southern Hemisphere and the world's largest solar integration with a coal-fired power station.

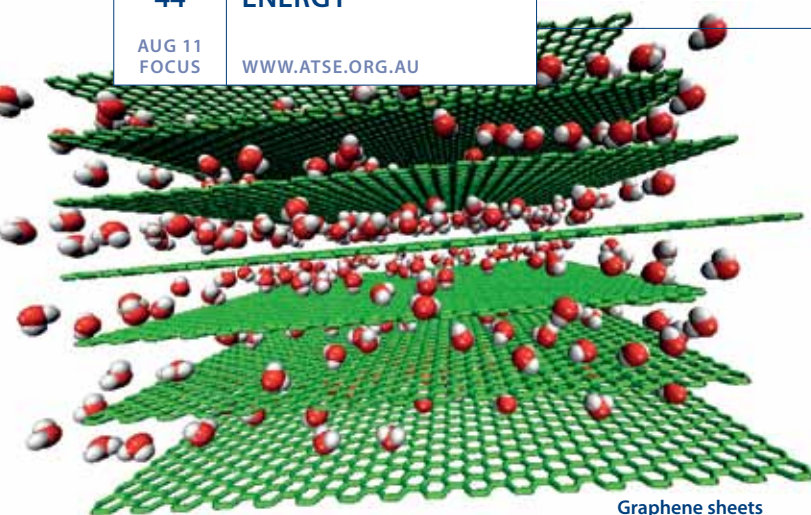
The project will use AREVA Solar's Australian-pioneered compact linear Fresnel reflector (CLFR)

technology to supply additional steam to the power station's turbine, supplementing the conventional coal-fired steam generation process. The technology uses heat from the sun to convert water to steam with zero emissions. It is claimed as the most land-efficient solar technology, generating 1.5 to 2.6 times more peak power per acre of land than competing solar technologies and the only CLFR provider to supply superheated steam which has specific application to the power generation market.

The Kogan Creek Solar Boost Project will increase the amount of electricity generated by up to 44 megawatts during peak solar conditions, providing an additional 44,000 megawatt/hours of electricity per year. The solar power will also be generated directly into the electricity transmission grid to power homes and businesses.



Kogan Creek Power Station



Graphene sheets

## GRAPHITE AND WATER A NEW BATTERY RECIPE

A combination of two ordinary materials – graphite and water – could produce energy storage systems that perform on par with lithium ion batteries, but recharge in a matter of seconds and have an almost indefinite lifespan.

Dr Dan Li, of the Monash University Department of Materials Engineering, and his research team have been working with a material called graphene, which could form the basis of the next generation of ultrafast energy storage systems.

"Once we can properly manipulate this material, your iPhone, for example, could charge in a few seconds, or possibly faster," said Dr Li.

Graphene is the result of breaking down graphite, a cheap, readily available material commonly used in pencils, into layers one atom thick. In this form, it has remarkable properties. Graphene is strong, chemically stable, an excellent conductor of electricity and, importantly, has an extremely high surface area.

Dr Li said these qualities make graphene highly suitable for energy storage applications. "The reason graphene isn't being used everywhere is that these very thin sheets, when stacked into a usable macrostructure, immediately bond together, reforming graphite. When graphene restacks, most of the surface area is lost and it doesn't behave like graphene anymore."

Dr Li and his team have discovered that water is the key to maintaining the remarkable properties of separate graphene sheets. Keeping graphene moist – in gel form – provides repulsive forces between the sheets and prevents re-stacking, making it ready for real-world application.

## RENAULT, BETTER PLACE SET 2012 TARGET

International vehicle maker Renault and Better Place, the electric vehicle services provider, have expanded their global partnership to introduce the first mass market, electric car with unlimited range and a switchable

battery to Australia in 2012. The partners claim this will be a critical step in accelerating the transition to sustainable transport in Australia, giving Australians a zero-oil and zero-emission transportation option.

Under the agreement, Renault Australia will import the Fluence ZE and Better Place will provide the electric car charging network. The partners will jointly commence a marketing campaign for the Renault Fluence ZE vehicle in Australia leading up to launch in 2012. Under the proposal customers will buy the Fluence ZE from Renault and sign up for a Better Place membership, which will relieve buyers from having to purchase their battery.

The Renault Fluence ZE, unveiled at the Australian International Motor Show in Melbourne in July, is a 100 per cent electric, five-seat family car, with a primary range of 185 kilometres. The effective range in Australia will be unlimited, as 'switchable' batteries enable drivers to immediately 'fill up' their Fluence ZE in a fully automated process in any Better Place battery switch station – in less time than it takes to fill up with petrol.

Better Place plans to have the largest electric car charge network in the world in Australia by 2013, providing owners unlimited access to batteries, the network of public charge spots and battery switch stations, and personal charge spots at home or work.

Better Place plans to begin rolling out its electric car charging network in Canberra from later this year, with a progressive national rollout to follow.

The Renault Fluence.



## GISERA TO SUPPORT SUSTAINABLE CSG

CSIRO and Australia Pacific LNG have launched a research alliance to support the sustainable development of the coal seam gas (CSG) industry.

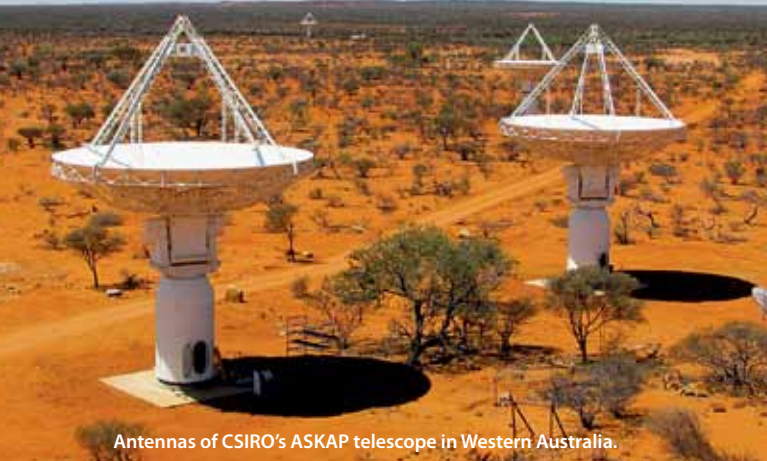
CSIRO Chief Executive Dr Megan Clark said the Gas Industry Social and Environmental Research Alliance (GISERA) has been founded by CSIRO and Australia Pacific LNG (a CSG to LNG joint venture between Origin and ConocoPhillips) to undertake research in five key social and environmental areas – groundwater and surface water, biodiversity, land management, the marine environment and socio-economic impacts.

"CSIRO and Australia Pacific LNG have provided initial seed funding totalling \$14 million over the next five years for the Alliance to undertake this research into the Queensland CSG industry," she said.

The CSG industry has been providing significant quantities of gas for Queensland for more than 30 years. It now provides 90 per cent of Queensland's gas supplies and about 15 per cent of its electricity generation.

Mr Page Maxson, Project Director, Australia Pacific LNG, said this was an exciting development for Queensland and Australia as a whole because of the potential significant economic benefits the CSG/LNG industry, but noted additional information about the CSG industry was being called for by stakeholders such as regional communities, farmers and conservation groups.

## SKA POTENTIAL GLIMPSED



Antennas of CSIRO's ASKAP telescope in Western Australia.

PHOTO: TERRACE PHOTOGRAPHERS

The discovery potential of the future international SKA radio telescope has been glimpsed following the commissioning of a working optical fibre link between CSIRO's Australian SKA Pathfinder (ASKAP) telescope in WA, and other radio telescopes across Australia and New Zealand.

Six telescopes – ASKAP, three CSIRO telescopes in NSW, a University of Tasmania telescope and one operated by Auckland University of Technology – were used together in June to observe a radio source that may be two black holes orbiting each other. Data from all sites were streamed in real time to Curtin University (a node of the International Centre for Radio Astronomy Research) and processed there to make an image.

This ability to successfully link antennas (dishes) over large distances will be vital for the future \$2.5 billion SKA telescope, which will have several thousand antennas, up to 5500 kilometres apart, working together as a single telescope. Linking antennas in such a manner allows astronomers to see distant galaxies in more detail.

CSIRO astronomer Dr Tasso Tzioumis and fellow CSIRO astronomer Dr Chris Phillips controlled all the telescopes over the internet from Sydney. Curtin University's Professor Steven Tingay and his research team built the system used to process the telescope data.

## MAKING MORE FROM TITANIUM ORE

Australia has the world's largest reserves of titanium ore and there is no end to its potential uses, from hip replacements, to cookware, to fighter planes. Today, most of our titanium ore is shipped overseas and bought back after processing. We could keep that up for 90 years at the current production rate, says CSIRO – but John Barnes says he has a better idea.

As the new leader of the CSIRO's Titanium Technologies Theme, in the Light Metals Flagship, John is determined to turn our natural wealth into high-wage jobs for Australians and high-value products for the world, noting that if we converted just one per cent of our ore reserves

each year to metal for high-value manufactured items, they would achieve the same annual export earnings – for another 9000 years.

John is enthusiastic about titanium and its phenomenal performance characteristics, which are critical to the aerospace industry. In his previous job with Lockheed Martin he helped build titanium components into the stealth fighter aircraft, critical for the protection of troops in combat.

He says the true potential of titanium remains to be uncovered, as the arrival of additive manufacturing technologies, which directly generate 3-D shapes, changes the game. Instead of machining a product out of a block of metal, with up to 90 per cent of the metal lost as waste, additive manufacturing builds up products layer by layer out of powder or metal wire, using energy from lasers or electron beams to bind the metal into a shape. It is faster, cheaper and cleaner and will change the way the world does business.

Australia is well-placed to get ahead in the race, John says. We already have the highly skilled, educated workforce needed for computer-aided product design and management of high-tech additive manufacturing facilities. With the right technology, we would gain a powerful edge over mass-scale, low-wage producers overseas. Additive manufacturing enables labour-efficient manufacturing and is suited to investment by small businesses, so there is huge potential for growth.

PHOTO: CSIRO

A green-spotted Triangle Butterfly, found in tropical NE Queensland.

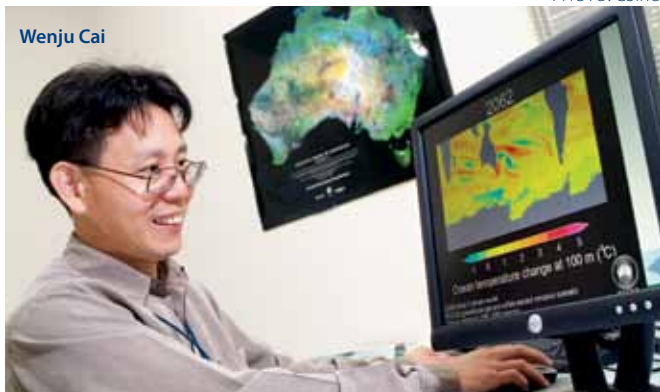
## MOTHS AND BUTTERFLIES IN BARCODING 'BLITZ'

A team of Canadian researchers has 'barcoded' in just 10 weeks 28,000 moth and butterfly specimens – about 65 per cent of Australia's 10,000 known species – held at CSIRO's Australian National Insect Collection (ANIC) in Canberra. Conducted in collaboration with the Atlas of Living Australia (ALA) as part of the International Barcode of Life (iBOL), the project involved extracting DNA from each specimen to record its unique genetic code and entering the results, together with an image and other details, to the ALA and ANIC databases.

ANIC was the first national collection to integrate the new barcoding approach for a major group of insects. ANIC's Director, Dr John La Salle, said DNA barcoding was a kind of 'genetic fingerprinting', which had proven useful in identifying different forms of life. "Barcoding will be critically important to our goal of being able to rapidly identify most organisms on the planet within the next decade or so," he said.

PHOTO: CSIRO

Wenju Cai



## NEW CLIMATE CHANGE TEAM ESTABLISHED

One of Australia's leading climate change modelling experts, CSIRO Wealth from Oceans Flagship's Dr Wenju Cai, has been awarded a five-year CSIRO fellowship to establish a new research team examining climate influences on Australia. Dr Cai will build the team, based at CSIRO Marine and Atmospheric Research in Melbourne, with funds from a 2011 CSIRO Office of the Chief Executive Science Leadership Award.

CSIRO Chief Executive, Dr Megan Clark FTSE, said there has never been a greater need for Australian science to secure its knowledge base with expanded observations and modelling expertise. "This research will help us understand the impact of climate change on Australia's cycle of droughts and flooding rains," she said.

## ANSTO SOFTWARE AIDS POWER SUPPLY

Australia's demand for electricity is skyrocketing while the country's power infrastructure ages, but a new software program developed by ANSTO's materials engineering specialists aims to help coal-fired power stations improve their efficiency and sustain a reliable output.

The software, 'Remlife', is already in use by several power companies across Australia to gauge the wear and tear of plant infrastructure.

Most of Australia's coal-fired power stations are several decades old. With no new power stations coming online in the near future, the challenge is for existing stations to cope with the added pressure of rising demand.

The Remlife software means power stations can generate electricity more reliably, says Dr Warwick Payten who headed its development.

"The software calculates the damage a power plant sustains during its operating cycle, which allows prediction of how much longer plants can operate safely," Dr Payten explains. "If plant operators better manage their operating profiles and more accurately identify areas that need proactive maintenance, then you have the capacity to increase the life of the station and boost the efficiency of the unit."

"The Remlife program means that, rather than spending a week to assess a single component within the power plant, we can now carry out that assessment in minutes."

Power stations using the Remlife software include Eraring and Wallerawang in NSW and Kwinana in WA.

## NATION'S BIGGEST ROOFTOP PV SYSTEM

Construction has been completed on the nation's largest flat-panel photovoltaic solar power system, at the University of Queensland's St Lucia campus in Brisbane.

The \$7.75 million system generates 1.22 megawatts of power from the sun, harvested from 5004 panels on the rooftops of four of UQ's biggest buildings and will provide between five and six per cent of peak electricity demand at the St Lucia campus.

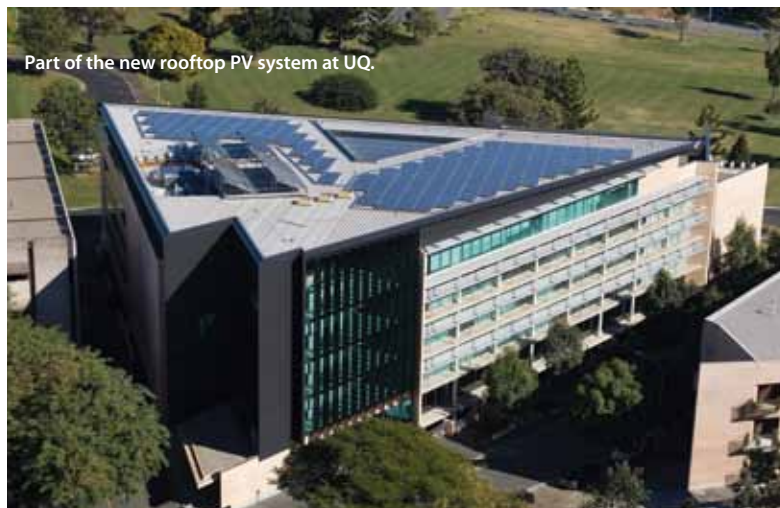
Designing and installing Australia's biggest rooftop PV solar power system drew on the combined resources and significant expertise of UQ academics and engineers, working with industry leaders. The array is almost 25 per cent larger than any other flat-panel PV system in Australia, with the added complexity of being split between four buildings.

Vice-Chancellor Professor Paul Greenfield AO FTSE said the UQ Solar Array would be shared with the community, by giving industry, researchers, school students, teachers and any other interested people access to a website showing live and historical data about the solar power it generated.

"The university is focused on reducing carbon emissions and increasing its use of renewable energy," Professor Greenfield said. "As well as being part of the university's functional energy infrastructure, the solar array will underpin research in diverse fields including physics, engineering, economics and sustainability."

"The project is enhanced by its strong industry partnerships, including research agreements with a number of world-leading companies in renewable power."

Separate to the rooftop panels, UQ has installed a ground-mounted, seven-metre-by-six-metre, 8.4-kilowatt concentrating photovoltaic array (CPV) that follows the sun each day as it moves across the sky and will allow UQ researchers to undertake detailed comparisons with a different type of solar technology.



Part of the new rooftop PV system at UQ.



## Three Fellows named in Queen's Birthday Honours

Three Fellows were honoured in this year's Queen's Birthday Honours.

**Dr John Michael Schubert AO FTSE**, company director, Sydney, was honoured for distinguished service to business and commerce through leadership and management in the area of financial services, transport and mining, and to the community.

Dr Schubert was until recently Chairman of the Commonwealth Bank of Australia and was also previously Chairman of WorleyParsons Ltd and President of the Business Council of Australia. Dr Schubert was also Managing Director and Chief Executive Officer of Pioneer International Ltd from 1993 until 2000.

He held various positions with Esso in Australia and overseas. In 1983, he was appointed to the Board of Esso Australia. In 1985, he became Esso's Deputy Managing Director and in 1988 he became Esso's Chairman and Managing Director.

Dr Schubert was appointed to the Qantas Board in October 2000. He is a Director of BHP Billiton Ltd and BHP Billiton plc. He is also Chairman of G2 Therapies Ltd and the Great Barrier Reef Foundation.

**Dr Ian Geoffrey Gould AM FTSE**, Chancellor of the University of South Australia and Chair of the Council of the Australian Institute of Marine Science, was honoured for his services to mining and education.

Dr Gould, who has been UniSA's Chancellor for nearly three years, is a geologist by profession. He has 40 years' experience in the minerals industry, having worked in CRA and Rio Tinto Group before becoming Group Managing Director of Normandy Mining Ltd. The Award particularly notes his efforts as a proponent of environmental management in the mining sector.



Ian Gould



Kadambot Siddique

He is also a member of the Royal Flying Doctor Service, St Andrew's Hospital and Economic Development boards in SA.

**Winthrop Professor Kadambot Siddique AM FTSE**, Chair in Agriculture and Director, Institute of Agriculture, University of Western Australia, was honoured for his services to agricultural science.

Professor Siddique has developed and commercially released several grain legume varieties that have superior yield, quality and disease resistance. He is acknowledged for his contribution to Australian and international agriculture, particularly innovative research and leadership in production agronomy, farming systems, crop physiology, germplasm development and breeding of grain legumes and cereal crops of benefit to the grains industry in Australia and overseas.

### Ian Johnston named to Hall of Fame

National Transport Commission (NTC) Deputy Chairman Professor Ian Johnston AM FTSE has been inducted into the first Australian Road Research Board (ARRB) Hall of Fame, recognising his significant and sustained contribution to ARRB and the transport industry.

"Ian has been an asset to the NTC since his appointment as a Commissioner in 2008. His wide-ranging experience within the transport industry has been vital in helping shape many

of our reforms," said NTC Chief Executive, Nick Dimopoulos.

Professor Johnston's career spans all modes of transport, where he has worked in various roles including researcher, policy analyst, program administrator, senior executive and non-executive board member. His particular passion lies in road and transport safety issues and their role in societies, governments and organisations.

Professor Johnston joined ARRB in 1979 as one of three chief scientists leading the organisation's research into human factors and road safety. His most profound achievement with ARRB was convincing its Board to fund research into the effects of alcohol-affected drivers on our roads.

Professor Johnston said the most satisfying aspect of his career has been working towards ensuring safer roads for all users. "I feel very fortunate in being able to assist in saving lives and reducing injuries, as road crashes place an enormous burden on our society," said Professor Johnston.

Professor Johnston continues to make a contribution to the reduction in death and serious injury on Australian roads through his active work as a member of the National Road Safety Council.



Ian Johnston

# Liveris named co-chair of Obama's Manufacturing Partnership

Dr Andrew Liveris FTSE, Chairman and Chief Executive Officer of The Dow Chemical Company, has been appointed by US President Barack Obama as Co-chair of the newly formed Advanced Manufacturing Partnership – a private-public-academic sector partnership around advanced manufacturing aimed at recovering America's manufacturing leadership.

Dr Liveris, the Darwin-born Australian who was the keynote speaker at the 2011 ATSE Clunies Ross Awards dinner in Brisbane,

and to ensure a vital and globally competitive manufacturing sector.

"I am honored to have been selected to co-chair the Advanced Manufacturing Partnership," said Dr Liveris at the launch at Carnegie Mellon University in June.

"Through success in manufacturing, the US can generate meaningful long-term employment in key industries and the support positions that accompany them – every new manufacturing job on average creates five additional jobs.

"By recovering US

manufacturing leadership, the US can also maintain and grow its role as the world's innovation engine. Success at R&D, and in turn, the production of new ideas as products, go hand-in-hand – they can't be separated. A vibrant manufacturing sector is essential to our competitiveness in cutting-edge technology."

Dr Liveris added: "This partnership draws together three mission-critical elements:

academia, industry and government. A united – and non-partisan – approach must underpin our effort as we mobilise to renew and extend our manufacturing competitiveness."

Last July, Dr Liveris on behalf of Dow launched Dow's Advanced Manufacturing Plan for America (AMP). AMP calls for action on a number of fronts to lower structural costs that hinder US manufacturing and to establish a policy framework that will enable economic growth.

In January, he published *Make It In America: The Case for Re-Inventing the Economy*, which articulates AMP in detail. Dr Liveris, a University of Queensland graduate, has been named as the inaugural Chair of the University of Queensland in America Foundation.

made a strong call in his Clunies Ross speech, beamed live from New York, for Australia to use its natural resources for value-added manufacturing and made a similar call at a joint ATSE-ICHEME national dinner event in Melbourne last year.

Dr Liveris will be joined by Susan Hockfield, President of the Massachusetts Institute of Technology, in heading the Partnership, which includes other major US manufacturers, several top US engineering universities and key government technology leaders. Its key goals will be to build a roadmap for advanced manufacturing technologies, accelerating ideas from the drawing board to production and competitive advantage in the marketplace,

Andrew Liveris

## Stephen Gumley leaves DSTO

Dr Stephen Gumley AO FTSE has retired as the Chief Executive Officer of the Defence Materiel Organisation (DMO) after more than seven years in one of the most difficult and challenging jobs in Government.



Stephen Gumley

His service was acknowledged by Defence Minister Stephen Smith and Defence Materiel Minister Jason Clare, who said that Dr Gumley had done a difficult job very well since he was appointed in 2004.

As Australia's largest project manager, the DMO is responsible for more than 200 major projects each worth more than \$20 million and 120 minor projects.

Dr Gumley, a Fellow since 2007, has led significant reforms to Defence procurement, including the recommendations of the Kinnaird and Mortimer Reviews and significant contracting reforms which have led to a reduction of the schedule slippage of around 20 to 25 per cent.

Over the past seven-and-a-half years he has managed the delivery of significant military equipment to the ADF including Super Hornets, Abrams Tanks, Bushmasters and C-17s, and overseen Australia's involvement in the Joint Strike Fighter Program.

Prior to being appointed the CEO of the DMO, Dr Gumley had 20 years of international commercial and project management experience. He was CEO of the Australian Submarine Corporation, Vice President of Boeing, based in Seattle, and the CEO of a number of research, development, manufacturing and exporting corporations.

## ATSE Fellows again prominent in Top 100 Engineers listing



**Beverley Ronalds**



**Adi Paterson**



**Mary O'Kane**

More than 30 per cent of Australia's "most influential" engineers are Fellows of ATSE, according to Engineers Australia's 2011 Top 100 Engineers listing.

Published in *EA Magazine*, the Top 100 lists engineers in seven categories: Industry, Consulting, Academia/Research, Innovation/Expertise, Associations, Public Service and Politics/Other.

ATSE Fellows made up 33 of the names in the 2010 Top 100 Engineers list, the eighth year it has been organised by Engineers Australia. There were 34 new names in the 2011 list

ATSE Fellows contributed 12 names to the list of 45 comprising the biggest category (Industry).

These were: Mr Leigh Clifford AO FTSE (Chair, Qantas), Dr Bob Every FTSE (Chair, Wesfarmers), Dr Peter Farrell AM FTSE (Chair and CEO, ResMed), Mr James Graham FTSE (Group CEO, Gresham Partners), Mr John Grill FTSE (CEO, Worley Parsons), Dr Andrew Liveris FTSE (Chair, President and CEO, Dow Chemical), Ms Susan Murphy FTSE (CEO, WA Water Corporation), Mr Doug Rathbone AM FTSE (CEO, Nufarm), Dr Chris Roberts FTSE (CEO, Cochlear), Mr Julian Segal FTSE (CEO, Caltex), Dr Zhengrong Shi FTSE (CEO and Chair, Suntech Power Holdings), Mr David

Stewart FTSE (CEO, Leighton Holdings).

ATSE dominated the Academia/Research listing, providing nine names in a category of 12 – Professor Mike Dureau FTSE (Chairman and ED, Warren Centre for Advanced Engineering), Professor Hugh Durrant-Whyte FRS FAA FTSE (CEO, NICTA) Professor Peter Gray FTSE, (Director of AIBN, Queensland University), Professor Paul Greenfield AO FTSE (VC, Queensland University), Professor Peter Lee FTSE (VC, University of Southern Cross), Dr Adi Paterson FTSE (CEO, ANSTO), Professor Beverley Ronalds FTSE (Group Executive, Energy, CSIRO), Professor Ian Young FTSE (Vice Chancellor, ANU), Professor Alex Zelinsky FTSE (Group Executive, Information and Communication Sciences and Technologies, CSIRO).

ATSE Fellows also dominated the Innovation/Expertise category, notching five of the seven rankings. These were Mr Alexander Gosling FTSE (Executive Chair, Metsol) Mr Chris Vonwiller (Chair, of Appen Butler Hill), Professor Stuart Wenham FTSE (Director, ARC Photovoltaics Centre of Excellence, University of NSW), Professor Aibing Yu FTSE, (ARC Federation Fellow, University of NSW), Professor Dongke Zhang (Director, Centre for Energy at the University of WA).

In the Consulting listing, ATSE again contributed two names – Mr Paul Douglas FTSE (CEO, Sinclair Knight Merz) and Dr Robert Care FTSE (Chair, Arup Group, UK, Middle East and Africa).

In the Public Service listing, four ATSE Fellows were named – Dr Geoff Garrett AO FTSE (Queensland Chief Scientist), Dr Stephen Gumley AO FTSE (CEO, Defence Materiel Organisation), Mr Menno Hennevelde FTSE (MD, Main Roads WA), Professor Mary O'Kane FTSE (NSW Chief Scientist and Scientific Engineer). In the Associations listing, ATSE President Professor Robin Batterham AO FREng FAA FTSE was named.

Mr Andrew Jessett (CEO, MineWare, Brisbane) was also named

in the Innovation/Expertise category. Mr Jessett won a 2010 ATSE Clunies Ross Award for his achievements in the development of mining technology.

The 2011 selection panel of five included:

- ATSE Director and mechanical engineer Mr Peter North AM FTSE, a former Director of Leighton Holdings and Cochlear and past Chair of the Warren Centre for Advanced Engineering at Sydney University;
- former ATSE Director and Vice President Dr John Nutt AM FTSE, a civil engineer and former Australasian Chair of consulting engineer Arup; and
- Dr Michael Sargent AM FTSE, an electrical engineer and former Chair of ATSE's International programs, a Director of the Australian Energy Market Operator and a former President of Engineers Australia.

## Carfrae and Mai join Royal Academy of Engineering

Mr Tristram Carfrae FREng FTSE has been elected a Fellow of the Royal Academy of Engineering. Mr Carfrae, an international expert in structural engineering and building design, is an Arup Fellow, working out of the Arup office in Sydney, and has been a Fellow since 2002.

Professor Yiu-Wing Mai AM FRS FREng FAA FTSE has been elected an International Fellow of the Royal Academy of Engineering. Professor Mai, a Fellow since 1992, is a specialist in mechanical and mechatronic engineering and holds a Personal Chair in Mechanical Engineering at the University of Sydney.



**Yui-Wing Mai**

**Tristram Carfrae**



Alan Robson

## Food and water security under threat

Australia must immediately address its significant shortage of trained scientists to support primary industries focused on food and water security, according to Professor Alan Robson AM FTSE, Vice Chancellor of the University of Western Australia.

"In order to maintain Australia's global leadership position in food and water security issues, we need a steady stream of passionate young people moving into a range of science-based careers in primary industries," Professor Robson said.

"Without this, Australia's research and development will be less efficient, food and fibre production will drop and we will fail to adequately address our food and water security challenges."

These issues dominated an industry Think Tank in Canberra in June, organised by the Primary Industry Centre for Science Education (PICSE) and AgriFood Skills Australia, which involved people from government, education and research, agribusiness, food retail and students.

The Think Tank followed the first meeting of PICSE's new National Advisory Board, chaired by Professor Robson, which aims

to raise PICSE's profile nationally, helping it continue its efforts to attract more bright young minds to careers in agricultural science and food security.

Other members of the newly created 10-member Board include WA's Chief Scientist Professor Lyn Beazley AO FTSE and Mr Arthur Blewitt, CEO of AgriFood Skills Australia, the Industry Skills Council for agriculture, food processing, meat, seafood and racing.

"The Board has a number of passionate and unique people from varied walks of life, making it well placed to raise PICSE's profile around the nation," Professor Robson said.

"PICSE's unique and successful model builds relationships between primary industries, universities, teachers and students. It increases agricultural productivity by encouraging more young people to enter science careers that lead to innovation and development for the Primary Industry sector."

■ *The Primary Industry Centre for Science Education is funded by the Federal Government's Diversity and Structural Adjustment Fund, University of Tasmania, University of Western Australia, University of New England, University of Southern Queensland, University of the Sunshine Coast, Flinders University, Charles Sturt University, Curtin University and the Grains RDC, Fisheries RDC, Dairy Australia, Horticulture Australia Ltd, Cotton RDC, Murray–Darling Basin Authority, Dow AgroSciences, Woolworths Ltd and the National Centre for Groundwater Research and Training.*

## Batterham and Foley at Equinox

ATSE President Robin Batterham AO FREng FAA FTSE and FASTS President Dr Cathy Foley PSM FTSE both participated in Equinox Summit: Energy 2030, an international science/technology /policy meeting in Canada in June.

The Waterloo Global Science Initiative launched an ambitious undertaking to reboot the global conversation on energy and learn how cutting-edge science and technology may advance an electrified and sustainable future.

The inaugural Equinox Summit: Energy 2030 took place in Waterloo, Ontario, at the Perimeter Institute for Theoretical Physics at

the University of Waterloo, which fosters high level scientific collaborations and public outreach activities.

Professor Batterham told the summit up to half of Australia's basic electricity needs could be met by 'hot rocks' within just a few years, but only if there is a price on carbon.

Advocating hot rocks technology, known as geothermal – which involves heating water by the natural heat of some geological formations and using it to drive steam turbines – Professor Batterham said Australia had a lot of potential.

"The estimates in Australia are that you could, by 2050, reach 50 per cent baseload power on geothermal. The question is how realisable is that," he said.

He called for government investment to provide the right financial environment to get geothermal projects into the ground and said a commercial-scale geothermal power plant could be running within as little as five years.

Dr Foley told the summit the future of electricity might depend on replacing the iconic copper wire.

"I believe superconductors can deliver the solution. Having a superconducting transport wire system would allow you to have significant amounts of current going through much narrower wires," Dr Foley said.

"We are already seeing in the embryonic stages, new methods of cooling that can achieve cryogenic (ultra-cold) temperatures in a compact form. Trials of superconducting technologies are already underway in several sites in the US.

"I think we'll see superconducting power applications becoming the norm," she said.



Cathy Foley

Robin Batterham

# Brian O'Brien's long dusty trail to the moon

ATSE Fellow Professor Brian O'Brien has been at the core of a project that has discovered unexpected facts that change long-accepted interpretations of two of three lunar dust experiments carried out during the NASA Apollo moon missions.

Sticky lunar dust was the top environmental problem for every one of the 12 Apollo astronauts who walked on the surface of the Moon.

A recent review by Professor O'Brien (an original Apollo Principal Investigator) indicates results from the Apollo 17 experiment, designed to measure cosmic dust – but thought for the past 33 years to have measured levitated lunar dust particles – were based on electrical interference instead of dust measurements.

In his role as Adjunct Professor at the University of Western Australia's School of Physics, Professor O'Brien has analysed about a thousand raw data from the Lunar Ejecta and Meteoroids (LEAM) experiment and has presented a chain of evidence that the data were not caused by lunar dust as commonly assumed, but by noise bits generated by electrical interference in the circuits of LEAM on the moon – interference which was noted in LEAM systems tests on earth prior to the lunar missions.

Professor O'Brien was put on the track of the new findings when he became the first person to recognise that the LEAM raw data occurred in short bursts of 'events' with long intervals before the next burst, reminding him of electromagnetic interference from switching of heavy currents in a space payload.

He then found two Bendix Aerospace Corporation reports of acceptance testing in 1972 of the Apollo 17 scientific observatory before launch where on three occasions, LEAM was the only one of five major

On the moon – the Apollo 12 dust detection experiment equipment.



experiments to produce noise bits caused by such effects.

Knowledge of lunar dust is important not only to scientists but to astronauts and designers of robotic moon buggies, planned by China, the European Union, India, Japan, Russia and the US. Apollo 17's scientist-astronaut Dr Harrison-Schmitt has said "dust is the Number 1 problem on the moon".

Professor O'Brien reports that: "Scores of times during and after each expedition each Apollo astronaut commented on effects of clinging dust.

"All Apollo astronauts emphasise the importance of inescapable dust. Yet the voices of Apollo lunar explorers were and still are largely neglected. Apollo put only two minimalist experiments on the moon to assist astronaut and robotic activities on the lunar surface and to research lunar dust."

Professor O'Brien was the inventor and Principal Investigator of the first such experiments, matchbox-sized Dust Detector Experiments (DDEs) put on the Moon by Apollo 11, 12, 14 and 15 astronauts, which made about 30 million measurements between 21 July 1969 and 30 September 1977, when all Apollo scientific systems were switched off.

His review also updates his first suite of seven discoveries in the journal *Geophysical Research Letters* on 6 May 2009, made after he revisited the data in 2007 after hearing that NASA had misplaced all copies of the

computer tapes before they were archived. The results were acclaimed globally and he has subsequently given invited lectures to European and US space scientists in three overseas trips.

Professor O'Brien, the only Apollo Principal Investigator in two different disciplines of experiments – radiation and dust – deployed by astronauts on the moon, was invited to write the first review of the three Apollo dust experiments for a special issue of *Planetary and Space Sciences* devoted to 'Lunar Dust, Atmosphere and Plasmas: The Next Steps'.

Commenting on Professor O'Brien's latest work, Dr James Gaier, Senior Research Scientist at the NASA Glenn Research Centre, said: "The O'Brien review is the definitive work on what Apollo can teach us about dust in the lunar environment. It is not just a collection of the experimental results, but a fundamental re-interpretation of them. This review should trigger a cascade of new studies on the basic properties of lunar dust in the lunar environment ... It may also call for the re-interpretation of the results from other experiments carried out on the lunar surface during the Apollo program."

Professor O'Brien presented his report at the 4th Lunar Science Forum on 19-21 July at the NASA Lunar Science Institute in Ames, California, and at Rice University, Houston on 25 July.

# Terry Walker pioneered nuclear science

David Gaston (Terry) Walker AM FTSE AM has died at the age of 82. Elected to the Academy in 1987, he was one of the pioneers of the field of nuclear science in Australia and made a major contribution to the development of nuclear technology in this country.

Educated at Scotch College, Melbourne, he graduated with a BSc from the University of Melbourne in 1950, majoring in chemistry and metallurgy, followed by an MSc in 1952, majoring in metallurgy. He continued as a demonstrator and lecturer in metallography in the School of Metallurgy.

He attained his PhD in 1962 and then joined the staff of the Australian Atomic Commission at the Lucas Heights Research Laboratories in Sydney, initially as a group leader and later as Chief of the Materials Division, which became renowned internationally for work on ceramics, particularly beryllium oxide, in all of which he was an active participant.

The high quality of his work was recognised when he and three of his colleagues were awarded the David Syme Prize for

Research in 1964. Terry had an incredible knowledge of materials behaviour. When his colleagues wanted information on some aspect of materials behaviour the first thing to do was to "ask Terry" – and he usually knew the answer!

Terry spent 1968-69 as a visiting scientist at the Atomic Energy of Canada Research Establishment at Chalk River. He then served as Atomic Energy Councillor with the Australian Embassy in Washington from 1973-75, at the end of which his services as adviser were requested by Mr Justice Fox,



**Terry Walker**

Ambassador for Australia's role in the Nuclear Non-Proliferation Treaty.

After he returned to the Atomic Energy Commission he was involved in a major review of its roles and tasks and then was appointed Director of the Research Establishment and later, a Member of the Commission. When the AAEC was replaced in 1987 by the Australian Nuclear Science and Technology Organisation (ANSTO) he became its first Executive Director.

After retiring from ANSTO in 1988 he was made a Member of the Order of Australia (AM) for services to science in the energy sector – and was honoured with a Centenary Medal in 2001. He was a Fellow of the Institution of Engineers, Australia, and a member of the Royal Australian Chemical Institute and a former Member of the Australasian Institute of Mining and Metallurgy.

In retirement Dr Walker continued his association with nuclear matters, undertaking consulting assignments for a number of organisations including the International Atomic Energy Agency, ANSTO and Energy

Resources of Australia. He was a member of the Nuclear Panel of the Institution of Engineers, Australia (now Engineers Australia) and served as Secretary for about 10 years until moving with his wife Leonie and son Michael to Brisbane in 2005, close to their daughter Sue and family.

He also worked as a volunteer guide and researcher for the Mitchell Library in classifying, reviewing and transcribing historical documents, in particular the exploits of Captain Mathew Flinders, and he continued these tasks by correspondence after leaving Sydney.

Terry Walker was respected and admired by a wide range of friends for his broad scientific achievements and experience, and his leadership abilities, coupled with outstanding personal characteristics.

As one contemporary remarked recently, "one of the nicest guys you could know".

– Keith Alder AM FTSE  
and Brian Hickman FTSE

## Peter Cook steps down at CO2CRC

Dr Peter Cook CBE FTSE will step down from the position of CEO at of the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) in August, following his announcement of that intention in March.

He will be succeeded by Dr Richard Aldous, most recently the Deputy Secretary Energy and Earth Resources in the Victorian Government's Department of Primary

Industries, with responsibility for energy, geological survey, energy technology innovation, investment attraction and the regulation of mining, oil and gas and pipeline development. He has previously held key roles in the earth resources industry



**Peter Cook**

in Australia, South Africa, the UK and Zimbabwe and has worked with BHPB, Newcrest, Iluka and Western Mining Corporation.

The CO2CRC Board has paid tribute to the achievements of Dr Cook, who will continue in an active role with CO2CRC.

It noted he had created a strong and internationally acclaimed CCS research centre, had made an enormous contribution to the Centre and to CCS more generally during his 13-year tenure and is leaving CO2CRC in a great position for further development.

## John Radcliffe

Dr John Radcliffe AM FTSE has been appointed Chair of the Research Advisory Committee of the Australian Government-funded Brisbane-based Australian Water Recycling Centre of Excellence which is being hosted after 1 July 2011 by SEQ Water.



## Icy resting place for Phillip Law

The man known as 'Mr Antarctica' has been laid to rest on a rocky outcrop near Mawson Station in Antarctica in a ceremony attended by the 19 wintering expeditioners at Mawson.

The ashes of Dr Phillip Law AC CBE FAA FTSE and those of his late wife Nellie Law were interred at a ceremony at West Arm overlooking Horseshoe Harbour in June.

Dr Law died in Melbourne last year aged 97 and Nel Law died in 1990 aged 75. Their ashes were transported to Mawson station on the icebreaker *Aurora Australis* in February.

Australian Antarctic Division Director Lyn Maddock said Dr Law's final wish was to be interred with his wife alongside the graves of three other expeditioners who lost their lives on the icy continent.

"Dr Law was particularly fond of Mawson as it was the first Australian station he founded in 1954," Ms Maddock said. "He is a giant in Australian Antarctic history and we are honoured to welcome Dr and Mrs Law back to the continent and to their final resting place."

Dr Law founded Australia's three continental stations and explored extensive tracts of the Australian Antarctic Territory.

He was appointed as the first Director of the Antarctic Division in 1949 and continued in that role for 17 years. He also established Australia's National Antarctic Research Expeditions (ANARE) as the forerunner to today's Australian Antarctic program, with an

emphasis on scientific research in the region.

In his 19 years as an Antarctic explorer Dr Law personally led 23 voyages to the Antarctic and sub-Antarctic.

Nel Law was the first Australian woman to set foot on the Antarctic Continent when she visited Mawson station in 1961. She was a talented artist and produced a magnificent series of oil and watercolour paintings of her first Antarctic voyage.

## Barry Jones: Ross Garnaut and climate change

Ross Garnaut has made a greater impact on policy formulation in Australia than any other economist or social scientist since 'Nugget' Coombs, Dr Barry Jones told a Melbourne audience recently.

Speaking at the launch of Professor Garnaut's book *The Garnaut Review 2011: Australia in the Global Response to Climate Change* (Cambridge University Press), Dr Jones said that as Prime Minister Bob Hawke's principal economic adviser 1983-85 he was the architect of Australia's dramatic change in economic directions after 1983.

"My prime qualification to be the launcher (of Professor Garnaut's book) is that on the climate change controversy I can claim to be the oldest surviving inhabitant," Dr Jones said.

"I gave my first major speech (at least, I thought it was major) about the human

Mawson Station "winterers" place rocks on the cairn holding the ashes of Phillip and Nellie Law.

contribution to climate change, especially global warming, in 1984 when I was Minister for Science.

"A fat lot of good it did me with my colleagues, because my argument was dismissed then as alarmist and premature. In politics, timing can be everything. For many years – and certainly for my remaining period as a Minister – I was in a category of one on the issue of climate change, increasingly recognised as being more complex than warming alone."

Dr Jones targeted the group he called "the confusionists". "Sustained attacks on the mainstream scientific arguments for the need to take action to mitigate anthropogenic climate change have been from groups which could more accurately be described as 'confusionists', than 'deniers' or even 'sceptics'," he said.

"The opponents do not analyse the evidence and advance alternate hypotheses which are themselves testable: their main goal is to promote confusion. To confusionists, persuading citizens to conclude 'I just don't understand' is a very satisfactory outcome."

In a subsequent article published in *The Age*, under the heading 'Intelligent discussion all but extinct', Dr Jones lamented the lowering of the quality of political debate in Australia.

Dr Jones's Garnaut launch speech is posted in the Fellows private area of the ATSE Website ([www.atse.org.au/resource-centre/Occasional-Papers-and-Speeches](http://www.atse.org.au/resource-centre/Occasional-Papers-and-Speeches)).

*Dr Barry Jones is the only Fellow of all four of Australia's Learned Academies. He became an ATSE Fellow in 1992. He is a writer, lawyer, social activist, quiz champion and former politician. He served as a Victorian MLA (1972-77), Federal Member for Lalor (1977-98), Minister for Science (1983-90) and ALP National President (1992-2000, 2005-06).*



Barry Jones

# Antoni Karbowiak: from Warsaw to Sydney, by microwave

Foundation Fellow Emeritus Professor Antoni Karbowiak, who died while holidaying in Germany in July, aged 88, was a prominent electrical engineer and pioneer of modern telecommunications.

Professor Karbowiak was head of the Department of Communications at the University of NSW from 1964 until his retirement in 1987.

Born in Poland, he held a PhD and DSc from London University and worked as a senior research engineer, head of the Microwave Laboratory and head of the Optical Systems Group at the Standard Telecommunication Laboratories (STL), UK, from 1955–64, before coming to Australia.

He was conscripted into the German Army in Poland and trained in setting mine fields. He found himself on the beach at Normandy and experienced the RAAF carpet bombing. He was slightly wounded but eventually he and a Polish mate escaped from the German army and, in the deserted city of Cherbourg, exchanged their German uniforms for overalls and caps.

They stumbled across an American Army unit conversing in Polish, which



Antoni Karbowiak

led to him being sent to England as a POW, where he established his Polish identity and was befriended by a refugee teacher from the college where his father had been head teacher. He served with a Polish Engineers' unit in northern Scotland collecting and destroying war debris in the North Sea.

After peace was declared he took advantage of Churchill's offer to assist such volunteers complete their education in Britain. He matriculated and, with the sponsorship of the teacher who had befriended him and recognised his talents, obtained scholarships to complete his degree and eventually his PhD in the 'Propagation of Surface Waves'. This marked the beginning of his distinguished career in the field of communications, starting at STL, where he became a world expert in microwave technology.

The University of NSW offered him the Chair of Electrical Engineering and he moved to Australia with his family in 1964, continuing his association with STL for a number of years while building up the facility for optical communications research at UNSW.

His family recall he wrote two papers in 1964 that laid the foundation for the work that Charles K Kao developed and published in 1965, leading to his joint Nobel Prize for Physics (2009) in relation to the optical fibre.

In the 1970s, with students, he did research for Telecom whose network was in urgent need of modernisation. Without the introduction of a computerised network to replace the old crossbar switches, services such as the internet would not have been possible. In 1980 he took leave of absence from UNSW to help Telecom implement this new technology.

Then in 1982, as a member of the Government-appointed committee,

he wrote the report for 'The Committee of Enquiry into Telecommunication Services in Australia'.

He retired from UNSW in 1987 just before his 65th birthday and enjoyed sailing and spent time at the family house on the Hawkesbury River, north of Sydney. He was a member of a variety of professional bodies and was awarded a Centenary Medal for his services to telecommunications.

## Bill Algar a leader in the paper industry

Mr William Herbert Algar died in Melbourne in June, aged 86, following a long illness.

Mr Algar was elected to the Academy in 1980 and was the former Research Manager and later Assistant General Manager – Technical with APM Ltd (later Amcor). He joined APM in 1942.

He had a distinguished business career, during which he was a Foreign Member of the of the Royal Swedish Academy of Engineering Sciences, A Fellow of the Royal Australian Chemical Institute, and President of both the Australian (now Australasian) Industrial Research Group (AIRG) and the Australian and New Zealand Pulp and Paper Technical Association (Appita).

He won Appita's L R Benjamin Medal in 1978 and was made an Honorary Life Member in 1992.

His 1980 ATSE Fellowship citation notes he played a significant role in the technological development of the Australian pulp and paper industry and that his early research work on dissolving pulp and pulp bleaching proved that dissolved pulps of commercial quality could be made from Australian eucalypts. "Other outstanding work has resulted in the acceleration of the pulping process, patented and now being licensed internationally, the cold corrugating process and a new paper-board-forming unit now licensed and operating in seven countries," it said.

He wrote a review of the Australian pulp and paper industry in *Focus* 101 (March/April 1998).



Bill Algar

## Fellows

### Jarlath Ronayne

Professor Jarlath Ronayne AM, the Tan Sri Jeffrey Cheah Distinguished Professor at Sunway University, Malaysia, has been appointed as Director of the Manchester Business School Centre at Sunway. The Centre delivers to Manchester MBA to about 250

students. He has also been appointed to the Academic Board of Le Cordon Bleu Australia, which offers joint degrees and diplomas in culinary arts and management through Sunway. Professor Ronayne served as the first Vice-Chancellor of Sunway University from 2004 until 2009, following 12 years as the Vice-Chancellor of Victoria University.

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Professor Paul Meredith is a strong advocate of renewable energy and is leading several solar infrastructure projects, including an extensive 1.2MW solar array at UQ, made possible through collaboration with industry and government.

Paul's research focuses on discovering new, economical and more sustainably advanced materials for solar energy conversion and high-tech electronics.

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