

THE INNOVATION DIVIDEND

MORE FROM EMERGING TECHNOLOGIES

Increasing the innovation dividend from emerging technologies is a key challenge for Australia as it faces the need to move beyond the mining boom

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By John Bell

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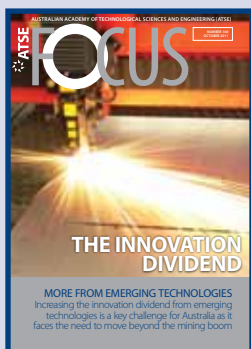
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Front cover: Innovation dividend is in the application – robotic laser cutting

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.

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New incentives for public-private sector collaboration

PHOTO: ROLLS-ROYCE PLC

Australia has a long history of encouraging 'supply-side' innovation measures but 'demand-side' measures have received little attention.



By John Bell

jbell@allenconsult.com.au

The Rolls-Royce scheme in action: a senior researcher sets up a low-pressure turbine "cascade" experiment at the University of Cambridge.

Australia has a strong public sector R&D performance but lacks the scale of linkages to the private sector that occurs in other OECD countries. As a result, Australia is missing out on:

- the innovation dividend from our investment in public sector R&D;
- opportunities for our public sector researchers to contribute to the development and growth of new technology-based firms;
- opportunities for Australian firms to draw on the expertise and knowledge in our public sector research organisations; and
- private sector training opportunities for our research graduates, which research collaboration between public and private sectors can provide.

Australia has a long history of encouraging public researchers to seek links with firms and other end users of research. Examples include the Australian Research Council (ARC) Linkage and the Cooperative Research Centres' (CRC) programs. These are called 'supply-side' innovation measures because they encourage researchers to supply their skills and experience to innovating companies.

The other side of the coin – demand-side measures – has received little attention in Australia. Demand-side measures encourage firms to seek innovation inputs from

the public sector. Recently there has been renewed interest around the world in stimulating private sector interest to build on public sector innovation capabilities.

The US Small Business Innovation Research (SBIR) Program is a demand-side measure that has now been copied or adapted by a number of other countries. The US SBIR has existed for nearly three decades, but changes following reviews and a strong promotional effort by the US Small Business Administration gave it a considerable boost in the past 10 years.

The US Congress established the SBIR Program by requiring major research funding agencies to set aside a small percentage of their budget (currently 2.5 per cent). This 'set-aside' is used to fund contracts with small business to develop new products and services of interest to these agencies. For example, a current US Department of Agriculture SBIR 'solicitation' seeks proposals to develop new biofuels.

While in some cases agencies may wish to purchase the outcome of the funding, this is not necessarily the case. The US National Science Foundation currently has a solicitation on enhancing access to the radio spectrum. It proposes to make up to 35 Phase I awards.

Eleven US Government agencies each operate their own SBIR Program – rules and procedures vary. However, the SBIR objectives and approach are common to all agencies.

The Program aims to stimulate technological innova-

tion, meet federal agency needs, encourage entrepreneurship among socially disadvantaged groups and increase private sector commercialisation of federally funded research. Agencies issue requests for proposals ('solicitations'). Applicants must be majority US-owned firms with fewer than 500 employees. Funding of up to \$150,000 is available for R&D to prove technical feasibility.

Successful completion of this phase makes firms eligible to apply for further RD&D support (the last D stands for demonstration) up to \$1 million over two years. After that, further development has to be funded from other sources, although sometimes agencies that wish to purchase the outcomes of SBIR projects find ways of providing additional assistance.

For example, the development of ways to make aircraft propellers more visible to personnel working in close proximity to these craft, but not increasing visibility at greater distances, was the subject of a US Navy solicitation. This attracted 14 proposals and resulted in three Phase 1 awards. Eventually, one contractor, Noesis Inc, received a Phase III contract of around \$25 million to complete the project.

A related incentive, the Small Business Technology Transfer (STTR) Program, is more focused on public-private sector partnerships. Both the SBIR and STTR Programs provide assistance to start-up companies arising from university research.

In the UK, an SBIR look-alike – the Small Business Research Initiative (SBRI) – is funded from the procurement funds of major government agencies (rather than R&D programs as in the case of the US). The UK program, administered by the Technology Strategy Board, focuses

mainly on the defence, health and constructions sectors.

The Board also operates another demand-side initiative – the Knowledge Transfer Partnership (KTP) Program – which aims to improve the exploitation of science through public-private sector collaboration.

The Board finds public sector partners for interested small businesses, helps to define a project and find a research graduate to staff it. This person usually works on company premises under the guidance of the public sector research partner. The small business pays, on average, about \$A30,000 a year, which is about a third of the cost of the project. Small businesses in this program tend to hire the research graduate at the end of the project.

In Australia, the Victorian Government has an SBIR look-alike – the Market Validation Program. Unlike its US counterpart, the Victorian program is centrally administered, although it seeks specifications for research projects from other State Government agencies. In 2009, 19 project specifications attracted 124 applicants of which 85 proposed collaboration with other firms or public sector researchers. The Program has \$40 million to spend over four years.

Larger firms are well placed to establish their own collaboration arrangements with publicly funded research organisations. In doing so, they can choose some of the best talent anywhere in the world.

The Rolls-Royce University Technology Centres provide a good example, with 19 Centres in UK universities, and others in the US and Korea. Each Centre has a single technology focus and is led by a senior academic with a global reputation. Five-year research contracts, close links to the relevant Rolls-Royce business unit and access to UK

INNOVATION CHALLENGE RESULTS IN DECEMBER

The winners of *The Australian* Innovation Challenge will be announced in December, concluding a competition designed to discover ideas and innovations to inspire our nation.

The Australian newspaper, in association with Shell and with the support of the Commonwealth Department of Innovation, Industry, Science and Research (DIISR), launched *The Australian* Innovation Challenge in August. The Challenge is open to both individuals and teams in a range of professional categories and one general public category.

A panel of eminent judges – chaired by Dr Terry Cutler FTSE and including ATSE President Professor Robin Batterham AO FREng FAA FTSE – are short-listing five entries in each professional category, from which a winner

from each category will be selected and awarded a cash prize of \$5000.

Each professional category winner becomes eligible for the final round of judging, with the overall winner being awarded a further \$25,000 cash prize.

In the Backyard Innovation category, which is open to the general public, judges are selecting five finalists from which they will select an overall winner to receive a cash prize of \$10,000.

The winners will be announced at an awards ceremony on 7 December and published in *The Weekend Australian* on 10 December.

Dr Cutler, CSIRO Deputy Chairman, said the awards would "help spotlight and further unleash the ingenuity we Australians are not only capable

of, but now need to put to work more than ever".

Dr Cutler, who led the Federal Government's 2008 review of the national innovation system, said: "The moment we stop asking how we might do things better or differently, we start to suck oxygen out of our industries and communities. Here is an excellent opportunity to showcase just what we are capable of."

Innovation Minister, Senator Kim Carr, encouraged Australians to take up the challenge. "We are a creative and resilient people – a nation that should be in the business of solutions," Senator Carr said.

"Every Australian can be an innovator, and every Australian can benefit from innovation. The new Innovation Challenge will help us show that phenomenal potential to the world," he said.

and EU funding programs all help to ensure productive research collaborations. There are about 600 researchers working in these centres, as well as 350 PhD students.

How successful?

How successful are these demand-side measures? Reviews of an earlier version of the US SBIR thought that the SBIR generated little additional employment and tended to focus in areas where venture capital was often available. However, the SBIR has evolved since that review and venture capital is no longer as plentiful.

In Australia venture capital has never been plentiful, so such concerns about a lack of “additionality” would not apply. Funding a Commonwealth Government SBIR-type program using a set-aside from research funds would be strongly resisted by the major agencies, but taking these funds from government procurement budgets (as in the UK case) would be less problematic.

Getting government agencies to accept the funding arrangements and take ownership of the SBIR processes is also a challenge, as some countries which have copied the idea have found. The Victorian Government’s approach may be better suited to smaller countries like Australia.

The amounts of SBIR funding provided are not large and would not be sufficient for some projects. In some cases, co-investment from other sources is necessary. In the US, some government agencies operate their own larger-scale procurement programs. Thus the US Department of Energy operates procurement programs to encourage large-scale RD&D projects in the energy sector (for example, to demonstrate concentrated solar electricity generation).

SBIR-type programs are limited to what agencies propose in their requests for proposals. This limits their generality – entrepreneur ideas may not match the areas in which agencies are offering SBIR support, and a relevant request for proposals may not be available at the time when an entrepreneur is seeking support. Nevertheless, the SBIR Programs have their success stories and are a worthwhile addition to the measures available to governments to promote innovation.

Knowledge Transfer Partnerships achieve several goals – engaging new graduates in industrial research and innovation, identifying suitable university partners and using them to contribute to the design and management of projects. The UK scheme is not generous in its funding, which may be one of the reasons why companies have not shown as much interest as might be expected.

The Rolls-Royce example is something that any of Australia’s larger firms could contemplate (and one or two already do on a more modest scale). Australian companies should be able to achieve tax benefits from investment in such university-based centres.

Experts look at commercialising new technologies

Some of Australia’s leading players in the impact of emerging technologies in small and medium enterprises (SMEs) explored ways of increasing the value of innovation and pulling new technologies through to successful commercialisation in a recent Academy workshop in Brisbane.

Dr Ian Nisbet, founder and partner in the biotechnology consulting company, Afandin Pty Ltd, spoke about opportunities in the Australian biotech sector; Mr Chris Vonwiller FTSE, Chairman, Appen Butler Hill, focused on the IT sector; and Dr Calum Drummond FTSE, Group Executive, Manufacturing, Materials & Minerals, CSIRO, addressed the energy sector.

They spoke at a workshop titled *Increasing the innovation dividend from emerging technologies* held at Customs House in Brisbane by ATSE and supported by the Australian Institute of Bioengineering and Nanotechnology at the University of Queensland.

ATSE President Professor Robin Batterham AO FREng FAA FTSE took a global overview of enabling technologies and their impact on productivity and prosperity and Ms Tricia Berman, General Manager, Innovation Policy Branch, at the Department of Innovation, Industry, Science and Research (DIISR), addressed the national innovation agenda.

Dr Rowan Gilmore FTSE, the former CEO of the Australian Institute of Commercialisation, discussed fostering innovation; Dr Carrie Hillyard FTSE, Director of CM Capital Investments, talked about new approaches to raising private capital; Mr Andrew Lawson, Managing Director of MBD Energy Ltd, spoke about how large companies can foster SMEs; and Dr John Bell FTSE, from the Allen Consulting Group, addressed the issue of new incentives to enhance collaboration between Australia’s public and private sectors.

Session chairs included Professor Peter Gray FTSE, Professor Tanya Monro FTSE, Professor Judy Raper FTSE, Professor Ron Johnston FTSE and Mr Peter Laver AM FTSE. Discussion leaders were Dr Colin Adam FTSE, Dr John O’Callaghan FTSE and Professor Gray.

Key speakers have provided articles for this issue of ATSE Focus.

Demand-side incentives to encourage industry-driven innovation and greater public-private sector research collaboration offer a new approach that is worth exploring at both Commonwealth and State government levels. ◀

DR JOHN BELL FTSE is a Senior Associate with the Allen Consulting Group, where he leads teams working on projects in higher education, research and innovation. His career has included Head of the OECD’s Science and Technology Policy Division, Deputy Secretary and Chief Science Adviser in the (former) Commonwealth Department of Industry, Science and Technology. He has also served as Acting Head of the Australian Institute of Marine Science. He has been a member of the Australian Research Council and the Government’s Industry Research and Development Board. He was a Director of the Australian Technology Group Ltd – an early stage venture capital company.



Renewable energy technology for a clean and sustainable future

Research at UniSA's Ian Wark Research Institute (The Wark™) is successfully exploring hydrogen as a renewable energy option to replace dwindling and highly polluting fossil fuels.

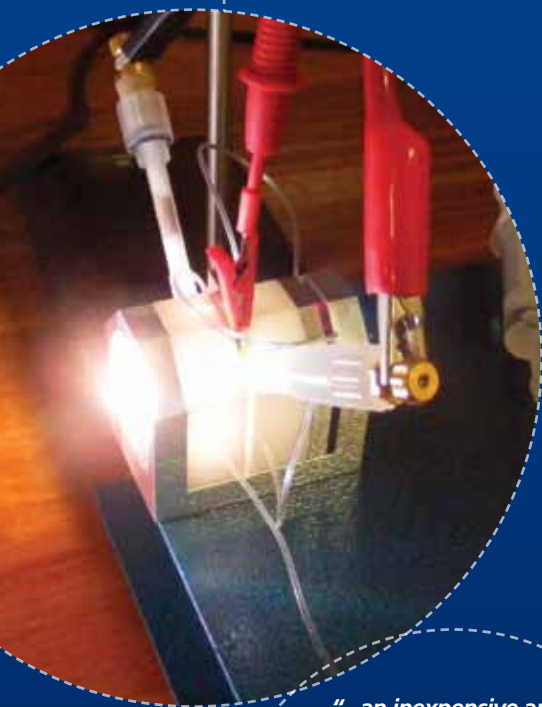
Hydrogen's advantages over other energy sources include its very high energy density, above oil and natural gas; and its easy conversion into other forms of energy.

The significant research is exploring ways to develop the renewable, clean energy potential of hydrogen in a unique process that mimics photosynthesis in plants. It combines electro-chemistry and nanoscience; using a nano-structured electrode and electro-chemical principles to mimic a leaf to realise an artificial photosynthesis system to produce hydrogen.

Project leader Thomas Nann was recently awarded a four-year Australian Research Council Future Fellowship for this work. The University also received the highest ranking of 5 in the relevant research areas of chemical science and physical chemistry in the national Excellence in Research for Australia assessment, confirming outstanding performance, well above world standard.

These significant advances in the development of new innovation again demonstrate UniSA's quest and success in being at the forefront of research that is delivering solutions to the important issues of today.

For more information about the Ian Wark Research Institute, **visit unisa.edu.au/iwri**



"...an inexpensive and environmentally benign inorganic light harvesting nanoarray can be combined with a low-cost electrocatalyst that contains abundant elements. This system provides a stable photoelectrochemical platform for hydrogen production."

(Nann, T. et al., 2010. Water Splitting by Visible Light: A Nanophotocathode for Hydrogen Production. *Angewandte Chemie International Edition*, 49(9), p.1574-1577.)



University of
South Australia

Biotech success? People, cash and infrastructure

The local industry can achieve 'one-off' successes. What can be done to generate more 'one offs' but also, and more importantly, repeat successes?



By Ian Nisbet

nisbet@afandin.com

According to the Ausbiotech website, Australia boasts around 450 public or private biotechnology companies, around 600 medical technology companies and 111 ASX-listed life science companies. Impressive numbers!

According to the Victorian Bioportal, Victoria is home to 41 of those ASX-listed biotechnology companies, with a combined market capitalisation (at 1 June 2011) of \$24 billion. Also pretty impressive (even noting that share prices have dropped significantly since 1 June).

However, dig a little deeper and the picture isn't quite as bouyant. CSL alone accounted for around \$20 billion (more than 80 per cent) of the \$24 billion. And of the 40 companies that represented the remainder, only 12 had a market capitalisation of more than \$100 million.

Across the country the picture is similar – the sector is comprised mostly of minnows. Despite the fact that activity in the sector in Australia dates back more than 30 years, the emergence of medium-to-large, well-capitalised companies has been very 'hit or miss' (and mostly miss).

That's not to say there haven't been some significant successes. Recent examples include companies like Mesoblast, Acrux, Sirtex and Cellectis, which have created new platform technologies and entered into major international partnerships (Mesoblast and Acrux), or developed and internationally marketed successful niche therapeutic (Sirtex) or diagnostic (Cellectis) products.

And with success we've seen some 'cherry picking' of assets by overseas companies. Examples include Cephalon acquiring a significant equity stake in Mesoblast, Cellectis being acquired by Qiagen, Arana and ChemGenex being acquired by Cephalon, and Gropep being acquired by Novozymes.

Such transactions represent both a win

and a loss for the sector – recognition of value created by the Australian companies but, at the same time, reducing the prospects for the emergence of a tier of sustainable, mid-size companies. Despite more than 30 years' experience, there is still no model for sustainability in the sector.

It's clear that 'one-off' successes can be achieved by the local industry. What can be done to generate not only more 'one offs' but also, and more importantly, repeat successes?

Core to the challenge are three basic requirements that are in limited supply in Australia (particularly for life science companies): people, cash and infrastructure.

People

1 I've listed people first because everyone else tends to put cash first – but without good people the cash will be wasted. There is no doubt that there are good, experienced people in Australia. It just happens that they are too few and too thinly spread. And while the shortage is most apparent at executive management and board levels in companies, it is present at all levels and across all facets of the sector.

Associate Professor Ernst Wolvetang (rear), James Briggs and Rachel Horne at work in the AIBN laboratories.



Drug development and commercialisation is tough enough for experienced teams. Spreading limited experience across too many small companies just exacerbates the risk.

One obvious way of consolidating experience and building critical mass would be to have fewer (but larger) companies. Premature listing on the ASX has long been a problem, leading to the raft of chronically underfunded, sub-critical-mass companies noted above.

Maybe the time has come to tighten the listing rules to force some of the smaller companies to either bulk up or close down. A clean up at the bottom end of the ASX would be no bad thing for the sector. Additionally, if the rules regarding transfer of tax losses were relaxed there would be a further inducement for larger companies to mop up some of the smaller ones.

Of course, there's more to solving the problem than just consolidating the experienced people in the sector into fewer companies. There are not enough experienced people in the country in the first place. A source of great frustration is that there are many Australians in senior positions in life science

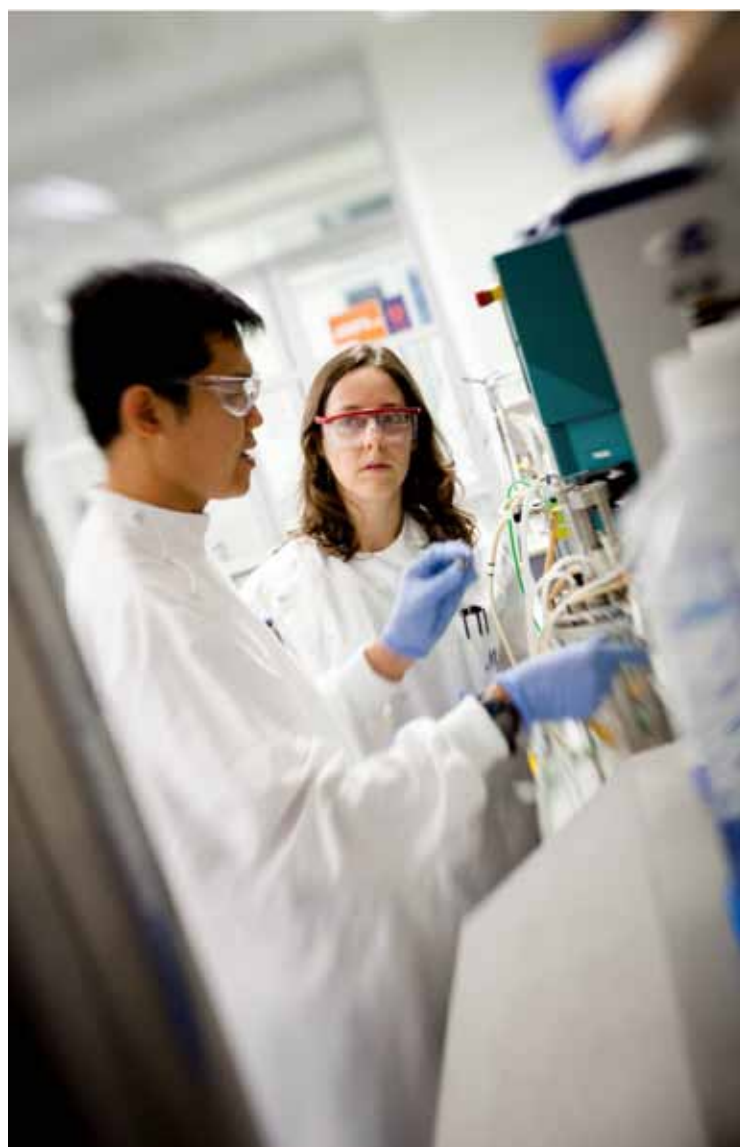
companies overseas but that, in the absence of some external incentive, they are unlikely to return to Australia (except to retire). A package of financial and non-financial incentives needs to be developed to encourage these people back to their homeland.

Finally, there is a desperate need to leverage the academic scientific base. Australia ranks very highly in academic output but very lowly in converting good science into products and services.

We need to get our best scientific minds engaged with industry. We need systems that encourage scientists to move back and forward between academia and industry. We need to recognise and reward commercial achievement as much as academic achievement. We need dual-track positions and career paths. We need to emulate the US model of flexible boundaries between academia and industry.

That's a lot of needs – and they won't be met until a commercial outcome to an R&D project is recognised as being as valuable and as important an achievement as the initial scientific discovery (if not more so). A major re-think of recognition and reward systems is required within academic and government circles.

**Yalun Arifin
and Dr Claudia
Vickers
working at
AIBN.**



Cash

2 There is no avoiding the issue – drug and medical-device development programs consume huge amounts of cash over long periods of time. And most fail! In the absence of patient, risk capital, no new therapies would ever be developed. But patient, risk capital is a rare commodity in Australia.

It's not the 'capital' that's the problem; it's the 'patient, risk' part of the equation that's missing. Australia is awash in investment capital. As of 2010, there was \$1.28 trillion in managed funds from compulsory superannuation alone. Australia has more money per capita in managed funds than any other country in the world. But only a trickle of that capital finds its way into life science companies. In 2010 publicly traded Australia biotech companies raised just \$130 million – equivalent to a measly 0.01 per cent of the funds under management from compulsory superannuation.

While recognising that superannuation funds operate under strict fiduciary regulations, there must be some way of unlocking capital for investing in industries of the future.

Part of the answer is to change the perceived risk/value equation. When US bonds are not AAA rated and when banks require government guarantees, what is meant by a 'secure' investment anyway? There is also a need to encourage long-term thinking and a holistic view on technology investment.

The return for investment in emerging industries developing high-impact products is more than just an IRR equation. It's an investment in the future. And even the failures have long-term benefit. As has been evident in the US biotechnology sector, first time success is rare – it more often comes after a string of failures. Perseverance and a thick skin (not to mention unfettered optimism) are essential components for ultimate success.

At a more practical level, what can be done to increase the pool of risk capital available to life science companies? What about a 'future industries fund'? Where governments are now (or in the future) receiving large revenue streams from the resource industry through royalties or a mining tax (or equivalent), why shouldn't some of that money be invested into future industries? It seems only fitting that some of the profits from a current industry exploiting the nation's non-renewable resources be utilised for the creation of future industries that will be self-renewing.

Other practical government initiatives could include:

- creation of a grant scheme equivalent to the US SBIR scheme (which has been operating effectively in the US for around 40 years, irrespective of the party in power);
- enhancing the Innovation Investment Fund (IIF) program; and
- providing capital gains tax breaks for investment in emerging companies.

Infrastructure

3 One place where governments have been prepared to invest heavily is in academic research facilities, but virtually no investment has been made into incubator space for emerging companies. These are left to fend for themselves in an open market with very limited supply of suitable facilities. Companies need the flexibility to expand (and contract) as required. They need access to shared facilities and capabilities. And they need world-class supporting infrastructure to help overcome the 'tyranny of distance' from their partners and markets.

Governments should require 'incubator space' in proposals for research infrastructure. They should encourage established companies to foster start-ups, maybe by providing incentives to

sublease. And government-funded infrastructure, whether it's in universities or research agencies such as CSIRO, should be made available to SMEs at reasonable rates. Full-cost-recovery models effectively preclude SMEs from accessing such resources. A spin-off benefit from these initiatives would be increased interaction and collaboration between SMEs, universities and research organisations.

Addressing the people, cash and infrastructure challenges will allow Australian life science companies to focus their attention on the real task: developing new drugs and devices. Each success will be a step along the path to a sustainable industry.

But the benefits will not be restricted to the life science sector alone. Much of the experience should be translatable into other emerging industries, such as greentech and cleantech. The reality is that the challenges and opportunities for the Australian biotechnology sector are also the challenges and opportunities the industries of the future – a future based on innovation not excavation. ◀

DR IAN NISBET has more than 30 years of drug development, business development and general management experience in the local and international biotechnology sector. He is a founder and partner in the biotechnology consulting company Afandin Pty Ltd. He has previously been CEO/MD of Xenome Ltd and Meditech Research Ltd and held senior management positions at Millennium Pharmaceuticals Inc, ChemGenex Pharmaceuticals Ltd and CSL Ltd. He currently serves as Chairman of Verva Pharmaceuticals Ltd and vivoPharm Pty Ltd, a non-Executive Director of Velacor Pty Ltd and Deputy Director (Commercialisation) at the Australian Institute for Bioengineering and Nanotechnology (AIBN).

\$15 MILLION FOR NEEDLE-FREE VACCINATIONS

Investors have pledged \$15 million – one of Australia's largest investments in a start-up biotechnology company – to develop a revolutionary new needle-free vaccine-delivery system.

The start-up company, Vaxxas Pty Ltd, will enable Professor Mark Kendall from the University of Queensland's Australian Institute for Bioengineering and Nanotechnology (AIBN) to continue his pioneering research and development of the Nanopatch.

The Nanopatch has thousands of small projections designed to deliver the vaccine to abundant immune cells in the skin, whereas the traditional syringe hits the muscle where

there are few immune cells. Early stage testing in animals has shown a Nanopatch-delivered flu vaccine is effective with only 1/150th of the dose compared to a syringe and the adjuvants currently required to boost the immunogenicity of vaccines may not be needed.

In addition to improving the efficiency of delivery, the Nanopatch has the potential to dramatically improve patient convenience and reduce the complications associated with needle phobia, needle stick injuries and cross contamination, which are key global health issues. It is designed for thermostability not to require refrigeration, making transport cheaper and easier, particularly to developing nations.

The investment is led by OneVentures, with co-investors Brandon Capital, the Medical Research Commercialisation Fund (MRCF) and US-based HealthCare Ventures – and investment from the Government's Innovation Investment Fund. The \$15 million investment was negotiated by UniQuest, UQ's main commercialisation company. UniQuest has led the commercialisation of the Nanopatch technology to date, and will hand over the responsibility to Vaxxas following this investment.

• Professor Kendall's team won a 2011 Eureka Prize – see page 41

You might not have **heard** of us but you have almost certainly **seen** our work.

When an earthquake triggered a devastating tsunami off the coast of Japan in March, the Australian Science Media Centre found expert scientists to talk to journalists.

As disaster followed at the Fukushima nuclear power plant, we were keeping journalists up to date.

We ran media briefings with nuclear scientists to give journalists the background knowledge they needed. We emailed journalists up-to-date expert comments to help decipher what was happening at the plant and set up interviews around the clock.

Thirteen different experts provided crucial context for hundreds of journalists and debunked popular myths at a time when the authorities were unable to comment. The experts we worked with were used in almost 4000 news items world-wide.

This is one example of what we do. We are independent and not-for-profit and we help get science heard when it matters most.

13 sets of expert comments released

A major component of what the AusSMC does is collating expert reactions to the biggest news stories of the day and sending them out swiftly to journalists.

In the four weeks following the quake, the AusSMC distributed 13 detailed Rapid Reactions containing expert analysis and commentary to over 700 registered journalists.

Throughout it all, we liaised closely with Science Media Centres in Japan, New Zealand, Canada and the UK, providing a non-stop flow of communication between scientists and the news media.

120 media enquiries

As with any big story with a science angle, the AusSMC responded to daily enquiries from journalists looking for experts to interview.

In the first week of the crisis, we received 120 media enquiries from journalists in Australia and overseas, initially on the topic of earthquakes and tsunamis and, as the crisis unfolded, on nuclear power and radiation.

2 media briefings

For major news stories, the AusSMC can very quickly organise online media briefings featuring panels of top scientific experts. In the week following the earthquake we hosted two online briefings which 55 journalists attended.

“Thanks for the briefing – love the technology... never experienced it before!”

Neil Keene, Daily Telegraph

“These (alerts) are unbelievably helpful.”

**Kate Stevenson, Producer,
3AW Breakfast with Ross and John**

“You guys are doing an awesome, urgent and valuable job. There’s a lot of nonsensical, inaccurate, contradictory and at times hysterical coverage out there. Yours is a welcome antidote. Keep it up!”

Wilson da Silva, Editor, COSMOS magazine



Finding smart ways to recycle our wealth

We all know stories of Australian innovations that had to go overseas to be developed. It is time to retire that paradigm.



By Calum Drummond

calum.drummond@csiro.au

Even in a time of global financial turmoil, Australia will never have a better opportunity to turn its present resources good fortune into sustainable wealth for the long haul. And it will never have a better chance to ensure our future prosperity against whatever happens in the wake of the global financial crisis, good or bad.

The opportunity involves converting today's resources returns into new knowledge – and then being smart in how we apply that knowledge across industry and society to create more wealth for tomorrow.

Organisations such as CSIRO specialise in creating new knowledge and technologies. I know that a huge part of CSIRO's planning involves the search for research areas where we will gain the biggest dividend for Australia – the greatest impact. But what is required is the will to use the new knowledge created by research and development to create innovative new products and industries.

We all know stories of Australian innovations that had to go overseas to be developed. It is time to retire that paradigm.

Those who visit the Outback will be familiar with the old mining ghost towns, abandoned after the ore gave out and the riches were spent. They are a visual parable for what happens if you don't invest in your present good fortune in the future – and even though Australia's resources wealth is immense, it is also finite and world markets are always fickle.

In the same way that you balance a cricket team, between those who can best bat, bowl and field, to do well over the long haul we need a balanced economy that can thrive no matter the circumstances. This is not an economy dominated primarily by resources – nor one wholly reliant on services – but rather one that combines resources, value adding export industry and services in a versatile 'team'. This has recently been recognised by the UK in a report that found Britons



had swung too far in the direction of a services economy and so become overexposed to the global financial crisis.

The other critical element of a balanced economy is that it has to be sustainable – environmentally, socially and financially – and that entails our investing more in Australia's natural strengths and abilities, as we do with our talented cricketers.

For example, Australia receives more photons per square metre than any other continent – a prodigious source of energy. Now, thanks to recent advances in technology, commercial very large scale solar thermal and photovoltaic energy is now within our reach. Likewise, we receive less reliable rainfall than any inhabited continent – and this too constitutes a national advantage, as it compels us to be smarter in how we manage water and cope with drought or flood. These two attributes are significant assets in a world that is likely to be both carbon-constrained

Made in Australia – a next-generation flexible organic photovoltaic device.

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

and short of fresh water, and point the way towards viable niche industries for the future. For an example we need look no further than Denmark, which diversified from butter and bacon to become a world leader in wind power.

Australian manufacturing has not enjoyed such a glamorous reputation as either minerals or services – yet it remains a solid growth sector employing a million Australians and, thanks to advances in technology, some very exciting new opportunities are opening up. To take a few, CSIRO has:

- developed a technique for direct manufacturing of products from metallic powders that promises a revolution in how things are made in the metals sector;
- come up with a way to dramatically lower electricity use in aluminium production, underwriting the future of one of our greatest value-adding industries;
- devised new catalysts that achieve spectacular reductions in factory emissions of noxious gases, paving the way for green industries that emit no wastes or toxins;
- set about building the 'green mobility' of the future that will help shield Australia from oil price spikes and fuel shortages through improved drive-trains, advanced batteries, supercapacitors, novel electric motors and ultralight components for the transport sector;
- devised nanomaterials of which a gram has a surface

area larger than three football fields, for use in novel drugs or optical devices; and

- set about developing next-generation inexpensive flexible organic photovoltaic devices.

These advances all represent opportunities to build the green, value-adding industries of the future in which Australia can be a leading world supplier. They clearly illustrate the sort of benefits to be gained from converting current resources wealth into knowledge that, in turn, will generate future prosperity – the innovation dividend. Most people nowadays understand the virtues of recycling – of packaging, water, metals, glass, food, etc. Now is the time for us to think about ways to recycle our wealth, so that each phase of prosperity is invested in building an even greater one in the decades ahead.

The multiplier in this formula is the addition of value, whether it is by processing a raw commodity, manufacturing or developing a knowledge product. For example, knowledge is now our sixth largest mineral sector export – a clear example of how good science and technology not only benefits the resources industry directly, but has generated a whole new technology export industry in its own right, worth \$2.7 billion a year.

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CONTENT MATTERS

Open innovation has impact potential

OI practice in Australia uses more targeted models rather than the truly open source type of innovation pioneered in the US.



By Leonie Walsh and Greg Smith

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Over the past two decades, several clear global trends in the management of industrially oriented R&D have emerged. In general terms, the goal of these initiatives was to move beyond the corporate technology and business unit technology group roles of the late 20th century as primarily company internal drivers of technology outcomes for innovation.

Initially, this transformation involved a broader, company or organisation-wide alignment towards the achievement of growth through innovation. Later, it changed to encompass extensive global outreach to achieve innovation-driven corporate growth through external resourcing and outsourcing through what has become known as 'open innovation' (OI).

As the world works its way out of recessionary pressures, most businesses have recommenced their search for sources of innovative concepts from all over the globe. Increasingly, pre-competitive research for certain industries is even being organised globally.

The OI concept has challenged organisations to take an even more networked approach. In some cases this has been transformational for companies, although in certain other cases it seems to have only resulted in reduced R&D capability and diminished innovation.

In Australasia, at an aggregated level, OI does not appear to have made a major impact on BERD or GERD levels and the recent AIRG conference discussed whether OI had helped to substantially change the way in which the public and private sectors interact. It concluded that the needs of various business sectors depended on many factors – the industry sector, the size and maturity of the business concerned, and the type of technology requirement (across the spectrum from breakthrough research to customer technical support).

OI is being practised across many of the Australian AIRG and AIC member organisations, but using more targeted models rather than the truly open source type of innovation, initially introduced by Proctor and Gamble in

New trends in R&D management approaches have enhanced our understanding of the complex game that is innovation management. The Australasian Industry Research Group (AIRG) held its 2011 Winter Conference – 'Next Generation Networked R&D' – arranged jointly with the Australian Institute for Commercialisation (AIC), in Brisbane in August. It sought to establish whether these initiatives have fully captured the scope of what it takes to succeed in technology innovation in Australasia. This article summarises the conference.

the US. Many attendees indicated that ideas were cheap and relatively easy to come by, while the hard part of the innovation process was in the translation and delivery of the idea into commercial application.

Several common themes emerged.

CRITICAL RELATIONSHIPS

There is a critical need to manage both the depth and breadth of relationships in OI-based projects, so finding the right partners to work with in the OI environment can be the greatest challenge, not only to technology requirements but to cultural fit and compatibility. Additionally, the availability of internal resources, time and funds can limit the effective management of external relationships, with face-to-face meetings desirable, but not always possible. It takes considerable time to stay well-connected.

EXCELLENT IP MANAGEMENT

IP management is a key element and there is a high level of complexity in managing intellectual property well, especially when multiple external partners are involved in a rapidly evolving field of IP. In some cases, IP can be the product that needs to be managed – such as a royalty revenue stream as the result of an effective biotechnology program – so effective IP management requires greater attention today than in the past. There are many emerging alternatives and novel approaches to the effective IP management and the capture of a return from IP as the product of innovation. While effectively managing complex IP can be costly and time consuming, wealth clearly

accrues to the owner of IP rights in the OI environment, so it is worth managing very carefully. Given the different requirements of different legal jurisdictions around the world, IP managers should avoid joint IP ownership wherever possible.

RAPIDLY EVOLVING MODELS

There are a number of different models, each with benefits and limitations, including: IP trading; 'speed dating'-related approaches; effective web portals; technology road-mapping; and business model innovation. The right strategy and OI model needs to be considered for each project and a simplistic universal model of how OI should operate is not appropriate.

GAPS AND DISCONNECTS

In Australasia, the current low availability of suitable funding for proof of concept has a snowball effect on the quality of downstream activities. Conference speakers from the venture capital (VC) community said the quality of proposals for corporate or venture capital funding needed improvement, as well as the level of connectivity between universities, industry, SMEs and VCs. They cited lack of alignment in measurements and language across the different elements of the innovation sector as a deficiency.

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Finding smart ways to recycle our wealth

Instead of seeing our economy as segments – primary, secondary and tertiary industry – a more mature approach is to regard the whole as a single value chain, the aim of which is to invest returns made early in the chain in systems and processes that will yield greater value higher up the chain. Such an approach will provide better protection against the boom/bust cycles that affect individual parts of the chain, give future Australians more rewarding and highly paid jobs, a stable platform for growth and, most importantly, provide sufficient wealth to deliver on our social and environmental aspirations.

Australians are by reputation a nation of gamblers who delight in a high-stakes throw followed by an instant result, and a splurge if successful. What I am advocating requires the patience and foresight to cash in part of our winnings now and reinvest it, in order to breed and feed the winners of the future. ▶

DR CALUM DRUMMOND FTSE is CSIRO Group Executive for Manufacturing, Materials and Minerals, which comprises 1300 researchers and research support staff and an annual budget of US\$230 million. Immediately prior to this appointment, he was Chief of CSIRO Materials Science and Engineering (CMSE) and held an Australian Research Council (ARC) Federation Fellowship. Prior to this he was seconded from CSIRO to be the inaugural Vice President Research at CAP-XX, which manufactures supercapacitors for consumer electronic products. His personal research interests are in the area of advanced materials, including application to energy storage and biomedical products. He also has a strong interest in and passion for the commercialisation of research outcomes.

Key speakers noted that the comparison of US and/or European examples of successful OI directly with the Australasian experience was not easy and could lead to erroneous conclusions due to the very different marketplaces, each with different strengths and weaknesses.

OI opportunities exist

Significant players in Australasia are leveraging off models that have been seen to be working well already – for example the University of Queensland's in-house commercialisation advisory services, Uniquist, in the university sector.

A number of Australian companies are clearly positioning themselves correctly to take advantage of the next growth phase through the use of OI approaches – perhaps in more limited OI approaches than taken overseas.

Key Australasian companies have been seeking to build virtual centres of expertise around some of their core areas of technology, to better access and utilise global expertise – BHP Billiton a strong and highly strategic example.

There is a clear need for more facilitators and translators who can bridge the gap from research outcome/early technology definition out to commercialisation. This gap still exists between the commercial and research (especially public research) environments.

Greater OI involvement globally might result from considerably better marketing of Australia's talented researchers into specific global markets for new technology.

There is an obvious need for more and better education on innovation, entrepreneurship and technology commercialisation and that this should commence at high school. ▶

MS LEONIE WALSH holds the position of President of the Australasian Industrial Research Group in addition to her role as Commercial Manager for South East Water Ltd, responsible for all current and future commercial opportunities throughout the organisation. She holds a BSc and MSc from Swinburne University, and an MBA (Exec) from the Australian Graduate School of Management. She has accumulated more than 20 years of technology and business leadership experience across a range of industries, both locally and internationally.

DR GREG SMITH is a Co-Founder and Director of Melbourne-based venture capital company, SciVentures Investments. Before returning to Australia, he worked as Director of the Alcoa Technical Centre in Pittsburgh and, previously, as Vice-President of AlliedSignal's Corporate Research & Technology New Jersey and Illinois-based laboratories. His technology innovation management experience began with Exxon Chemical working in Australia, the US and Belgium.



We can recycle CO₂ for profit

Could industry emissions be captured to produce large harvests of nutritious, oil-rich algae biomass? An Australian company has invested about \$30 million to prove they can.



By Andrew Lawson

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On the inside – interior of the algal synthesiser BAGS membrane.

Recycling atmospheric waste CO₂ and other greenhouse gases is not new. In fact, our planet's ecosystem was doing it millions of years before humans first appeared and is still doing so today by producing masses of abundantly diverse vegetation.

Next time you flick on a light switch, ignite a gas stove or fill your car's fuel tank reflect on the fact that all our energy reserves began with photosynthesis – nature's choreographed synthesis between sunlight, water, nutrients and plant life – especially algae.

During the volcanic age, the Earth's atmosphere was a thick soup of toxic gases that humans and other forms of life would have found very difficult to breathe. But, luckily for us, algae and other simple plants use CO₂ and other 'greenhouse' gases as essential nutrients for growth. That profusion of airborne nourishment created immense algal blooms, laying down the long-since buried sedimentary beds of the fossil fuels we still mine today, as well as helping clean up the atmosphere.

In the mounting global push for carbon abatement, talk of harnessing the Earth's natural carbon cycle as a

means of helping better manage levels of atmospheric CO₂ is not nearly as sexy as building wind towers, solar arrays and geothermal installations. But, based on history and all the current scientific evidence, it's likely to play a much bigger part than the rest put together. The combined capacity of our oceans, forests and other vegetation to sequester carbon dioxide is immense.

Now it appears that a way has been found for modern technology and ancient algae to work together, reducing a carbon cycle that might normally have taken millions of years to convert carbon into oil to just a single day.

As anyone who has owned a small fishtank with just one or two goldfish swimming about will attest, many species of micro algae grow extremely rapidly. The nutrient-rich water and sunlight can see the glass of your sparkling tank turn green quickly. Now consider this fact: each microscopic alga contains oil lipids, up to 30 per cent or more of their mass. The rest is nutritious solids – widely consumed by fish and the reason fish are so healthy in a human diet.

MBD Energy Ltd and a team of research partners at

James Cook University have been working intensively on harnessing the natural capacity of this primordial green slime to grow at break-neck speed into an industrial-scale emissions-abatement solution that recycles waste CO₂ and contaminated waste water into fuel, food, fertilisers and clean water.

The team recently hosted a World Algae Conference and one exciting revelation was that MBD's algae yields are about 100 per cent higher than the international benchmark for pond growth systems (about 20 grams per square metre per day).

MBD's proprietary 'BAGS' (Biological Algal Growth System) synthesiser utilises closely packed arrays of 50-metre-long opaque plastic membranes, which provide the algae with a controlled environment in which they flourish, ingesting CO₂ and other life-giving nutrients and doubling in mass in as short a time as 24 hours.

So, is farming algae the ultimate cash crop and a solution to emissions abatement? Realistically it's still too early to tell. But it's conceivable that each million tonnes of captured waste atmospheric CO₂ could generate about \$250 million in earnings from fuel and animal feed alone.

A public unlisted company chaired by former BHP Chairman Mr Jerry Ellis FTSE, MBD Energy is contemplating a future listing on the ASX and has a number of agreements with stationary industrial emitters, including three large Australian coal-fired power stations. In the first trial at a power station in south-east Queensland, MBD will inject captured flue gases into a one-hectare Algal Synthesiser.

The trials, due to commence when construction is complete early next year, will determine the most efficient pathway to large-scale algal synthesis of waste emissions and the production of commercial volumes of fuel and animal feed and other available products.

We know from approximately \$28 million of very intensive R&D work at James Cook University that growing and extracting large amounts of algae biomass is a viable concept. Now we need to prove that we have a sufficiently high-yielding and scalable low-cost platform on which to ramp up to commercial scale over coming years.

All the hurdles relate to doing known science better in order to achieve the highest possible level of efficiency at the lowest possible cost.

It's a bit like computers and mobile phones: big and clunky just 10 years ago – but look at them now. We know these processes work because nature is living proof of that – so we're very confident.

Increasing numbers of influential supporters of the technology are confident too. Boeing recently anointed algae as the perfect biofuel feedstock for a 'drop-in' replacement to up to 50 per cent of demand for conventionally

sourced jet fuel kerosene. The US Department of Energy has released a research paper estimating that about 18 per cent of America's demand for liquid fuels could be sourced from algae within the next decade or so.

These are bold forecasts.

What's compelling about algae is the range of potential benefits investment in algal synthesis may generate, including:

- reduced industrial carbon emissions liabilities;
- a smaller carbon footprint for important carbon-intensive industries;
- reduced use of fossil fuels by recycling of existing carbon emissions;
- improved capacity to wind back levels of atmospheric CO₂ to below 2000 levels;
- secure and sustainable new sources of renewable biofuels (liquid and solid);
- secure and sustainable new sources of renewable nutritious animal feed;
- secure and sustainable new sources of human nutrition;
- secure and sustainable new sources of fertiliser to boost agricultural productivity;
- reduced land-use competition between biofuel and food production;
- reduced demand for land clearing for grazing pastures; and
- greater water supply due to algal bioremediation of contaminated waste water.

The World Health Organization has identified the greatest threats to mankind this century as conflict and starvation due to diminishing food, water and energy security. Algal synthesis provides optimism that those challenges can be met.

MBD Energy soon hopes to export 'seaweed' products to tsunami-ravaged Japan, where food markets pay a premium for Aosa and Aonori, used as condiments in Japanese cooking. Apart from meeting a market need and gaining market presence this initiative would solve a waste water contamination problem for a Queensland prawn farm in the process. ◀

ANDREW LAWSON is a civil engineer with 20 years' experience in the public and private sectors in Australia. For the past 15 years he has held senior management roles across a number of major civil engineering infrastructure projects throughout Australia. He has been involved in MBD since its inception in 2006. As Managing Director he has been responsible for transforming MBD into a vertically integrated CO₂-to-energy company, integrating with major CO₂ emitters in Australia and internationally. MBD has a robust business model based on the sale of algae oil and algae meal products.

New avenues for raising private capital in Australia

The superannuation industry has been put under a number of pressures but encouraging it back into venture capital is the key to funding innovation adequately.



By Carrie Hillyard

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The capital-raising picture for start-up and small high technology companies is still gloomy. Traditionally, such companies rely on venture capital, which is in short supply internationally and very constrained in Australia, where the venture capital industry is still to mature.

Since 2008, very little capital has been raised to invest in early-stage ventures and spin-out companies from universities, and one of the options for biotechnology investments, raising capital through an initial public offering (IPO) through the ASX, has also been very difficult.

The end of this pipeline is still blocked and the venture capital industry is looking for new approaches to find investors.

On the brighter side, the biotechnology industry, in particular, is maturing. It lost a lot of momentum and about half its staff as a result of the loss of the Commercial Ready program and the global financial crisis (GFC), which followed very closely on the heels of the Commercial Ready announcement. However, the companies that were venture-funded and some of those which listed a few years ago have now developed products that are being marketed.

There is a strong list of biotechnology companies making profits and a few are even paying dividends. This should encourage investors to look more closely at such companies. However, this does not help the first stage, where companies are being spun out of universities and research institutes, looking for their first round of capital.

Australian venture capital (VC) relies heavily on Australian superannuation funds for capital. However, the superan-

nuation industry has been put under a number of pressures, including the GFC, which caused most funds to be overweight in alternative assets (these include private equity and venture capital), owing to the drop in value of their listed portfolios and, more recently, the Government focus on fees.

It seems that the Government did not realise that innovation funding would be collateral damage from this decision. On top of the more generally risk-averse climate, there are two issues making it harder for superannuation funds to invest.

1 The VC industry has yet to prove itself and make some reproducible returns. The VC industry in Australia is really little more than 12 years old. Until the GFC, institutions were increasing their commitments to fund managers with each new fund. No VC fund in Australia has reached what international studies have suggested is the optimum size – \$250–300 million – and there have not been sufficient exits to provide year-on-year track records. Of course,

**Manufacturing
Bronchitol at
Pharmaxis,
a late-stage
company
expecting
to launch
product into
the market
next year.**



a \$300 million fund may be able to charge lower fees as a critical mass is needed to manage early stage ventures effectively and smaller funds are less efficient.

2 Downward pressure on fees has caused the loss of the 'fund of funds' model, through which a lot of VC funding was distributed, and superannuation funds are merging for efficiencies – making the cheque sizes too big to support VC funds directly. Usually an investor will not take more than 15 per cent of a fund.

In its last few rounds, the Government's Innovation Investment Fund has offered licences to several managers who were unable to find the matching investment, thus limiting further the availability of early stage capital.

However, there is one new manager and two current managers who were awarded IIF licences in the last round, one of whose matching money came from China. This will likely bring other pressures on innovation here if the Chinese investors wish manufacturing and economic benefits to flow to China, rather than to Australia.

Other funding sources

Angel investors (who typically invest their own money) have become more sophisticated and are working together in local groups and through the Australian Association of Angel Investors to invest in early stage companies. In

the life sciences space, pharmaceutical companies are on the prowl for new drugs to fill a pipeline being depleted by patent expirations.

Some very novel ways to commercialise technology from universities are beginning to succeed, particularly in the US.

In the drug development field, there is still a considerable challenge in bridging the gap between innovative early stage biology and clinical stage assets. The Biopontis Alliance is a group of ex-pharma company executives, who have assembled an asset-based fund with a portfolio of potential products from a number of universities.

It incubates projects that could lead to drugs, moving away from the start-up company model, which is hard to finance in the current climate.

Its 'development engine' team works with scientists and clinical researchers and shares economic benefits. The agreements are structured to move from bench to clinic, with the academic group remaining involved throughout in return for success-based milestones. It has strategic investors that gain visibility and the opportunity – but not the right – to license technology and programs.

This model may be appropriate in Australia with the current shortage of venture funding for biotechnology companies and drug development projects from universities.

Even venture funds in the US are experimenting with new virtual company drug-development models to maximise use of scarce capital. In Australia, of course, we have used this model during the development of our biotechnology industry as, with less available funding, we have had to be more capital-efficient.

In the medical device field, the Coulter Foundation is supporting the development of new products and industry processes by putting executives, entrepreneurs and venture capitalists from the medical device industry into academia. Coulter provides \$1 million a year to each group and expects a commercialisation analysis and business plan, including the potential market, FDA and regulatory issues and IP, at the outset. Funding depends on progress against quarterly milestones and projects that do not meet milestones are halted. The Foundation has already had 60 successes.

GE Healthcare has developed a very focused model to accelerate innovation in metabolic imaging. It has launched Research Circle Technology Inc. (RCT) to create an alliance between its researchers and the world's leading universities. RCT is an open innovation model, in which GE is continuing to develop novel technology and provides tools, services and solutions, allowing the academic researchers to focus their investigations into the biochemistry of metabolism and speed the discovery of new knowledge, aiming to get from 'bench to bedside' more efficiently.

The solutions for Australia

One of the big issues is encouraging superannuation funds to invest again. Many have suggested that the Government should mandate a small amount – around one per cent – to be invested in these riskier ventures. Katherine Woodthorpe commented in the most recent issue of *ATSE Focus* that

A new glucose monitoring system developed by Universal Biosensors Ltd and launched by Lifescan Inc., a Johnson & Johnson company.



Letters to the Editor

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just 0.5 per cent from the major funds would be enough.

However, given the trustee structure and governance requirements of the funds, a government mandate is very unlikely and it may be that it is up to us, the superannuants, to direct the trustees of our funds and indicate that we would like to have a small amount focused on developing the technologies and industries of the future to provide employment for the next generation.

The mining boom will not continue forever and Australia needs to have new manufacturing industries replacing those that are becoming obsolete or at least less relevant to a low carbon future.

The Innovation Investment Fund scheme has been successful in developing a venture capital industry, but that industry is not sustainable without new investment from superannuation and institutional investors.

Australia has a very high proportion of its R&D performed by the public sector, spending about \$8 billion a year, but there is a significant underutilisation of taxpayer funds. Australia is missing out on realising the value, both in economic returns and in the provision of better therapies, of much of this public sector research, with many inventions never becoming innovations.

The Government expects that industry will reach into the public sector research organisations and pull out commercially valuable innovations. While this will and does work for the established big industries, the biotechnology and high technology sectors are just not mature enough

to have the wherewithal to do this without some government support, particularly for proof of technical concept and translation of academic research.

The new Tax Credit will help small companies with much-needed R&D funding, particularly after 2014, when it can be claimed quarterly, rather than annually in arrears.

Carefully leveraged government funds can help. The Medical Research Commercialisation Fund (MRCF), one of the latest IIF round licensees, seems to be a good model, where partner medical institutes pay a membership fee and state governments provide support (which offsets management fees) to translate inventions from the member medical institutes into the clinic and start-up companies.

However, encouraging the superannuation industry back into venture capital is the key to funding innovation adequately. ◀

DR CARRIE HILLYARD FTSE is a co-founder of CM Capital and led the Life Sciences practice for over 10 years, investing and taking an active role in pharmaceutical, diagnostics and medical device companies. She has served as a non-executive director on the boards of a number of investee companies, taking several public. She is the inventor of a number of patents and has been involved in the complete product lifecycle, including medical research in London and developing, licensing and marketing new products in Australia. Dr Hillyard has been a member of a number of Federal and State government boards and advisory bodies, providing advice on the development of the biotechnology and venture capital industries.

A PRODUCTIVE COUNTRY REPORT ARGUES UNIVERSITIES' ROLE

Better resourcing of universities could improve Australia's productivity, according to a new report – *A Productive Country* – released by Universities Australia (UA).

Noting that productivity underpins our standard of living – and that Australia's declining productivity growth has alarmed political and business leaders and economic advisers and commentators – UA says Australian universities can play a lead role in future productivity growth.

"Full implementation of the landmark Bradley Review of Higher Education can do more for GDP and living standards growth than any other single publicly identified and costed reform," says UA Chief Executive Dr Glenn Withers.

"Modelling for UA by KPMG Econtech estimates that this Bradley reform scenario would add some 5.6 per cent to national productivity by

2040 and some 6.4 per cent to Australia's GDP.

"Other reform proposals, ranging from tax reform and workplace reform through superannuation changes and free trade agreements to broadband and schools and health reform, are valuable but each adds less.

"It is time to build our national capability to compete and to work smarter through investing in the Australian people. Knowledge investment and infrastructure renewal can be the core of a new reform era for the 21st century."

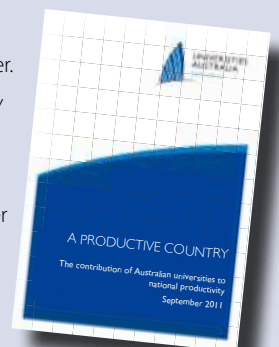
He noted that higher education also delivered on non-economic benefits in social, cultural, health and environmental fields; had the highest 'value-add' in sustaining economic activity in Australia for any industry sector; avoided and offset the dangers of the two-speed economy by delivering benefits Australia-wide;

and repaid its public funding many times over.

A Productive Country reports that higher education reform and resourcing would deliver a national budget surplus of \$325.5 billion higher than the no-reform path in the period 2011–40.

"This is the answer to the question, 'How do we pay for our pensions, health, roads, and national security for the future?'" Dr Withers says.

The report counsels, however, that these results will only occur if universities are resourced appropriately and managed efficiently.



PRODUCTIVITY, INNOVATION AND PROSPERITY

ATSE will hold a national seminar titled 'Productivity, Innovation and Prosperity – the Great Australian Challenge' at the Melbourne Convention and Exhibition Centre on 11 November.

This is a 'don't miss' event if you're part of – or interested in – the national debate about productivity and innovation. An information-packed, one-day forum will inform the national debate on productivity, the role of science and technology and their essential contribution to prosperity beyond the current boom – recognising the currently historic low pace of productivity growth in Australia.

Organised by the Victorian Division, it will be the third leg of a series of events mounted by ATSE this year focusing on various aspects of innovation and productivity.

"A key play in the Academy initiatives has been to sound the alarm about Australia's relatively poor productivity – and our need as a nation to embrace productivity and innovation as cornerstones of our prosperity and economic and social development, ATSE President Professor Robin Batterham AO FREng FAA FTSE said recently.

"Much of our Academy energy has been directed to influencing better understanding of the need for public policy that recognises what innovation is, its relationship to productivity and the essential linking of the two to drive a more competitive Australia."

The seminar will be held at the Melbourne Convention and Exhibition Centre and

the lead speaker will Dr Robert Atkinson, President of the Information Technology and Innovation Foundation (ITIF) in Washington, DC.

Dr Atkinson is one of the foremost thinkers in the US on innovation economics. He has an extensive background in technology policy, has conducted groundbreaking research projects on technology and innovation, is a valued adviser to state and national policy makers, and a popular speaker on innovation policy nationally and internationally.

He is the author of *The Race for Global Innovation Advantage and Why the US is Falling Behind* (Yale, forthcoming) and *The Past and Future of America's Economy: Long Waves of Innovation That Power Cycles of Growth* (Edward Elgar, 2005). Before joining ITIF, Dr Atkinson was Vice President of the Progressive Policy Institute and Director of PPI's Technology and New Economy Project.

He will be supported by an impressive card of other keynote speakers including: Dr Nicholas Gruen, prominent economist and Chair of Lateral Economics; Dr Terry Cutler FTSE, principal of Cutler and Co, CSIRO

Registration for the seminar **Productivity, Innovation and Prosperity – the Great Australian Challenge** closes 4 November and costs \$300. Online registration and information is available through the ATSE website (www.atse.org.au) or by emailing events@atse.org.au or phoning 03 9864 0902.



Robert Atkinson

Board member and Chair of the 2008 national innovation system review; Ms Deena Shiff, Group Managing Director, Applications and Ventures at Telstra; Mr Lance Hockridge, CEO of QR National; and Ms Patricia Kelly, Deputy Secretary of DIISR.

The lunch speaker will be Senator Stephen Conroy, Minister for Broadband, Communications and the Digital Economy, who will discuss 'Exploiting the opportunities from digital productivity'.

The Victorian Minister for Technology and Assistant Treasurer Gordon Rich-Phillips will open the seminar, which is sponsored by the Victorian Government, CSIRO, DBCDE and STC.

• The Academy held a successful international workshop in Sydney in May, 'Strengthening Links Between Industry and Public Sector Research Organisations', which engaged key speakers from industry, government and academia. In August, ATSE ran another keynote workshop in Brisbane titled 'Increasing the innovation dividend from emerging technologies', at which some of Australia's leading players in the impact of emerging technologies in small and medium enterprises explored ways of increasing the value of innovation and pulling new technologies through to successful commercialisation.

Experts tackle climate geoengineering

ATSE and the Academy of Science hosted a breakthrough symposium at the Shine Dome in Canberra in September that took a new look at climate change.

The two-day event – 'Geoengineering the Climate? A Southern Hemisphere perspective' – responded to discussion internationally about attempts to globally manipulate the Earth system through geoengineering as a possible strategy to counteract some of the effects of climate change.

Both the Royal Society in the UK and

the US National Academy of Sciences have recently called for research to explore how geoengineering approaches may impact on the Earth system.

In response to these calls for geoengineering research, the Academies held the symposium to help develop a Southern Hemisphere perspective on possible geoengineering interventions, addressing some of the implications, including opportunities and risks, of different suggested approaches to geoengineering the climate

and the possible impacts in the Southern Hemisphere. Topics included an overview of geoengineering, carbon dioxide removal, solar radiation management and governance, ethics, risks and uncertainty.

ATSE speakers included Dr Graeme Pearman AM FAA FTSE, Dr Neville Smith FTSE, Dr Mike Raupach FAA FTSE and Dr Peter Cook CBE FTSE.



Dr Graeme Pearman

Support for STELR grows

The University of Queensland and the University of South Australia have both committed substantial funding for STELR in 2012, which will support the program strongly.

At the same time, Charles Darwin University has purchased 10 STELR Equipment packs for rural or remote schools in the Northern Territory and Xstrata Coal has agreed to sponsor three schools in the region of the proposed Wandoan coal mine in Queensland to join the STELR Project for 2012.

In another development, STELR curriculum writer Jenny Sharwood is adapting 13 STELR hands-on science inquiry-based activities for use by Education Services Australia. Established in 2010 through the merger of Curriculum Corporation and Education.au, Education Services Australia is a national, not-for-profit company owned by all Australian education ministers. The company was established to support delivery of national priorities and initiatives in the schools, training and Higher Education sectors.

The STELR activities will be supplied

electronically to teachers in all states and territories to support the implementation of the Australian Science curriculum.

Jenny has also commenced work on a new STELR unit entitled 'Mining, Minerals and Metals'. It will be fully aligned with the Australian Science Curriculum, especially the Earth and Space Science stream, and it will be written for students in years 7 and 8. The unit will emphasise the relevance of science to students' lives and will feature hands-on inquiry-based learning activities.

At tertiary level, Dr Gerard Effenev, of the School of Education at the Queensland campus of the Australian Catholic University, is using STELR curriculum materials and equipment in his pre-service teacher-training course. Dr Effenev encountered – and was most impressed by – STELR in his former position as a science teacher at Marist College Ashgrove, in Brisbane.



Helene Marsh

Helene Marsh heads species committee

Internationally recognised conservation and environmental scientist Professor Helene Marsh FTSE has been appointed the chair of the Australian Government's Threatened Species Scientific Committee.

The Committee provides advice to the Federal Environment Minister on the amendment and updating of lists for threatened species, threatened ecological

communities, and key threatening processes and the development or adoption of recovery plans and threat abatement plans.

Professor Marsh, elected as a Fellow in 2010, is currently Dean of Graduate Research Studies and Distinguished Professor of Environmental Science at James Cook University.

A conservation biologist with more than 30 years' experience in the field of species conservation, management and policy development, Professor Marsh has made significant contributions to the science of dugong conservation in Australia and overseas.

Professor Marsh's experience and expertise will make a significant contribution to the work of the Committee and contribute to its ongoing high level of excellence in providing scientific advice, the Government's announcement said. Her appointment will run until July 2014.

Professor Marsh has received international awards for her research and conservation from the Pew Charitable Trust, the Society of Conservation Biology and the American Society of Mammalogists. She is President-Elect of the Society of Marine Mammalogy and Co-chair of the IUCN Sirenia Specialist Group. She is on the editorial boards of *Conservation Biology*, *Endangered Species Research* and *Oecologia*.

JAPANESE RESEARCHERS TO VISIT IN 2012

Eight mid-career Japanese researchers, who are emerging future leaders in Japan's science and technology community, will visit Australia for two weeks in February 2012 for exchange placements with leading Australian research institutions to study research opportunities in health and technology, ICT, nanotechnology and new materials.

The Japanese researchers will visit Australia under the Japan Australia Emerging Research Leaders Exchange Program (ERLEP) administered by the Academy and the Engineering Academy of Japan, with funding support from the Australian Government and the Japan Society for the Promotion of Science (JSPS).

The exchange program will give Japanese participants access to leading experts in Australia, contribute to advancing technological exchange and help transfer knowledge and establish institutional linkages – leading to

joint research projects and publication of joint scientific and conference papers.

These outcomes will contribute to the continued advancement of science, technology and economic development between Japan and Australia, which are major trading partners, according to ATSE and JSPS.

The importance of establishing closer collaboration between researchers of both countries is paramount as international collaboration enhances quality research and strong S&T collaboration offers greater opportunity for innovation and commercialisation to end-use products.

The ERLEP exchange provides a highly cost-effective 'accelerator' to international collaborations and ensures that both Australian and Japanese researchers and research teams have access world-leading partners and equipment in agreed priority S&T areas.

DRIVING FOR A GREENER FUTURE



Vanessa Paterson at work.

One of Australia's best young researchers, Dr Vanessa Paterson, is using neutron-scattering techniques at ANSTO to study new-energy systems, particularly for hydrogen and battery materials – something that could have huge benefits for our transportation industry.

Today, electric cars rely on batteries and their limited storage capacity can deter potential buyers, but Dr Paterson's work could hold the key to driving the electric cars of tomorrow further and making Australia's transportation industry cleaner and more productive.

Dr Paterson leads ANSTO's Neutrons for the Hydrogen Economy Project (known as the Energy Project), which is collaborating with experts from around the world to produce new-energy systems.

"This is not about nuclear energy and it's never going to be," she says. "This project is about using what nuclear science can tell us about the structure of atoms and molecules to improve the performance of renewable power sources.

"Our research studies the critical systems

that will reduce Australia's carbon emissions, through the development of lightweight batteries for transportation applications and hydrogen-based energy storage for extended range capabilities in hybrid fuel-cell electric vehicles. Using hydrogen to produce electricity results in water as the only by-product.

"Creating a global energy system that is both environmentally and economically viable is unquestionably one of the largest challenges facing the scientific and engineering communities. We are combining the expertise here at ANSTO with that of experts on alternative energy systems and materials from around the world. The result, hopefully, will be the discovery and development of materials that will improve the performance of renewable clean energy devices.

"In Australia, transport is responsible for significant CO₂ emissions and 40 per cent of energy consumption. So new and improved materials to provide energy for the industry could have a huge impact."

Anita Hill heads Process Science and Engineering

Dr Anita Hill FTSE has been appointed Chief of CSIRO Process Science and Engineering.

Dr Hill, a mechanical engineer, has been with CSIRO since 1996 and was formerly a chief research scientist with the Materials Science and Engineering division. She completed her Bachelor of Engineering and PhD at Duke University in North Carolina before joining Monash University in Melbourne as a lecturer in 1989.

A repeat winner of the CSIRO Medal for Research Achievement, Dr Hill has worked extensively with the mining industry. She serves on the boards of the Membrane Society of Australasia, Deakin University's Institute for Technology, Research and Innovation and the *Journal of Polymer Science* (editorial).

She says it is the ability of scientists and engineers to be creative in their problem solving that helps drive innovation. Much of this creativity derives from multidisciplinary teams that work together on practical solutions.

Dr Hill has conducted research that has

resulted in significant improvements to mineral separation techniques, focusing on solutions at the nanoscale. It was one of her first industry-based projects that shifted her research focus from traditional mechanical engineering to nanoscale problem solving, looking at how to improve sieving materials for iron ore.

"We started that project by approaching it from a failure analysis and polymer chemistry point of view, because the sieving screens were made of polyurethane," Dr Hill says. "We realised that the mechanical and wear properties of the polyurethanes were related to the structure on the nanometre and 100-nanometre-length scales. So in the first big industrial project that I did for the mining industry, the research took me straight to structure property relationships on the nanoscale.

"There's a lot of potential

to make a difference in industry and in the environment in which we live," Dr Hill says.

"We can improve the efficiency of processes, thereby adding value and reducing costs. The fact this improvement can happen through changes that occur at a scale the size of molecules is quite exciting.

"These processes are the fundamentals of separation science, which can include the enrichment of ores, remediation of polluted sites, refinement of metals or separation and storage of gases."



Anita Hill

UNDERGROUND BARRIERS TO PROTECT DRINKING WATER

Underground barriers – known as permeable reactive barriers, or PRBs – may provide a reliable and affordable way to prevent industrial and other forms of toxic pollution from entering water supplies – an increasingly important issue as the world's cities grow to depend increasingly on underground water for drinking and domestic use.

Mr Scott Warner, Vice President and Principal Hydrogeologist with the international engineering and project management company AMEC, which has offices worldwide and in Australia, told the CleanUp 2011 conference in Adelaide, hosted by the CRC for Contamination Assessment and Remediation of the Environment (CRC CARE).

"PRB technology was first applied commercially in California in 1994 and today there are more than 200 barriers installed across North America, Europe, Japan and Australia," Mr Warner said. "It is now an accepted and proven technology for passively treating a wide variety of chemicals, including organic solvents, metals and radionuclides."

PRBs usually consist of an underground barrier filled with material to neutralise contaminants, built across the path of a contaminated groundwater plume. They are designed to intercept and clean up the water before it can enter aquifers used for urban supply, wells, lakes or shorelines. The barrier operates using the natural flow of the groundwater, without the need for power to run it. It may contain a range of low-cost materials designed to absorb or immobilise contaminants from the groundwater as it passes through. These include bio-mulches for removing toxic metals and granular iron, which is used to destroy organic chemicals.

"Groundwater contamination continues to be a serious problem worldwide for urban, rural and undeveloped areas. Sources of contamination include not just industrial releases, but also runoff from agricultural lands, mining sites, landfills and urban zones. Many cities primarily rely on groundwater for drinking water and other potable uses and generally arid countries such as Australia have seen a rapid increase in the use of groundwater."

Mr Warner said a PRB could pay for itself in a few years, in contrast to more costly pump-and-treat systems for cleansing groundwater which require energy to run them. Over a lifetime, a PRB could save millions of dollars.

CleanUp 2011 incorporated the 6th International Workshop on Chemical Bioavailability in the Terrestrial Environment (7 to 9 September) and the 4th International Contaminated Site Remediation Conference (11 to 15 September).

WA'S SECOND DESAL PLANT OPENS

The first stage of WA's second major desalination system, the Southern Seawater Desalination Plant near Binningup, south of Perth, is now operating. It opened three months ahead of schedule and within the \$955 million budget.

The completion of the 50-billion-litres-per-year first stage of the plant means that, on average, more than 30 per cent of Western Australia's urban water supply will come from climate-independent sources. When the plant is expanded to 100 billion litres a year, in the summer of 2012-13, about half of Perth's water supply will come from desalination.

WA Water Minister Bill Marmion said construction of the plant and its associated integration works has been the largest and most complex infrastructure project the WA Water Corporation has ever delivered. ATSE Fellow Ms Susan Murphy is CEO of the Water Corporation.

The Australian Government's Parliamentary Secretary for Urban Water, Senator Don Farrell, said the Government contributed \$18.4 million during initial construction of the plant. The Australian Government's investment – through its Water for the Future initiative – is funding infrastructure works including the installation of an additional seawater intake tunnel and the structure housing the seawater pumping station.

He said the Australian Government was working with the WA Government to ensure the security of water supplies for the residents of south-west WA, providing \$140 million for water projects in the state including desalination, waste water recycling, stormwater harvesting and reuse and water efficiency measures.



Scott Warner at CleanUp 2011.



Launching the new desal plant – (from left) Senator Don Farrell, Ms Susan Murphy and Minister Bill Marmion.

Australia can be an energy superpower

Politicians who favour one energy form usually get beaten up by all the other lobbies, creating a perfect climate for indecision.



By Julian Cribb

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Could Australia become the world's next energy superpower? This is not an academic question. It's about how this country can drive not only its own but also economic development in Asia for centuries to come.

When it comes to energy, of all the nations in our region Australia is the one with the richest array of choices. We have the world's most concentrated sunlight, huge reserves of coal, gas, hot rocks, wind, wave and tidal energy, not to mention uranium, thorium, biomass, hydro and other interesting possibilities – in short, thousands of years worth of energy in sundry forms.

In the past we have found difficulty making decisions among this bounty of opportunities: politicians who favour one energy form usually get beaten up by all the other lobbies, creating a perfect climate for indecision. This has been going on for decades and will probably continue to paralyse national policymaking, leaving us in the dark ages – unless we find a way to make the choice between energies an easy one.

What Australia most needs, at this juncture in its history, is a level playing field, where all the energies can compete, each according to its strengths, for its share of the world's hungriest energy market – as Asia continues to grow while exhausting its local coal, oil and gas.

That level playing field could be created by the Australian Energy Superhighway.

The superhighway concept is a gigawatt DC transmission line starting in the bottom right-hand corner of Australia, extending across the deserts to the north-west, then heading north to Java, on up the South-East Asian peninsula and, ultimately, into southern China.

On the way, its various spur lines harvest energy from a multitude of sources – clean coal and gas from the eastern states, wind and wave from the Bight, sun and hot rocks from central Australia, hydro from the Snowies and Tasmania, gas and tide from the north-west. A national avalanche of Australian electrons, headed for Asia.

High voltage direct current (HVDC) power lines and cables are not new technology, first being tested in 1882. In their modern form they are cheaper to build than conventional lines, can carry more energy with far lower losses over longer distances, and can run both underground and under sea.

The longest operational HVDC line in the world is in China, and takes 6400 MW over 2100 kilometres to Shanghai. This will be surpassed next year by Brazil, with a 2500km energy highway running from the Amazon to São Paulo.

Europe has dozens of HVDC lines linking its member countries, and is looking to build a cable to import solar from the Sahara Desert. New Zealand has HVDC connecting its two islands and Australia has the 360km Basslink Connector between Victoria and Tasmania. Malaysia, Indonesia and most of the nations to our north are already building their own domestic HVDC lines: Australia can help link these together.

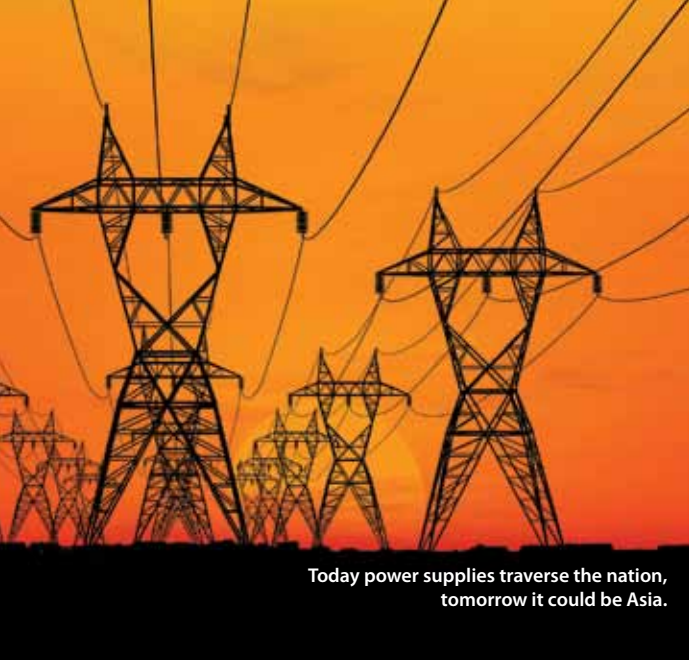
The advantages of low-loss DC lines is that they can 'average out' power from a multitude of sources – for example, wind, sun, hydro, coal or gas – and make it available to countries operating many different voltages and power systems.

The concept of an Australian energy superhighway has been advocated by, among others, the solar energy firm Desertec. Its significance is highlighted in a study by engineering firm Worley Parsons, which found all Australia's energy needs can be met by just 250km² of desert solar thermal – providing, of course, the power can be delivered to the coast.

An energy superhighway is the obvious way to deliver solar or geothermal electricity to coastal cities, and make these new industries viable. Extended to Asia, it would also provide the economic impetus for other forms of energy development, including clean coal, gas, photovoltaics and wind. Connecting to Asia is simply the logical way to make the investment pay for itself quickly, as well as exporting pollution-free, climate-friendly power.



PHOTO: CSIRO



Today power supplies traverse the nation,
tomorrow it could be Asia.

The cost of such a large piece of infrastructure is affordable. Based on European and Australian pricing, a backbone highway would probably require an investment of around A\$8-10 billion – a fraction of what we will pay for the National Broadband Network, or to replace our ageing coal-fired power stations.

Like any motorway, the traffic on an energy superhighway will expand to fill the available capacity and demand. It will open up new energy markets, both in Asia and across the heart of Australia, making it economic to operate power-hungry industries such as minerals processing, manufacturing or internet server farms, and to properly develop the interior of the continent. It can carry other services, such as broadband or gas (methane or hydrogen), in the same trench.

The Australian Energy Superhighway is a big idea, as

significant in its way as the Sydney Harbour Bridge or the Snowy Mountains Hydro-Electric Scheme in how they linked the nation and caused it to grow. We seem only to manage one of these ideas every half-century or so: maybe it's time for another.

It plays to Australia's strengths in engineering and our diversity of competing energy resources. It makes possible a smooth and profitable transition from existing energy systems to clean power and it positions us for a key role in the Asian Century – as regional powerhouse, exporting electrons instead of pollution, in a cable instead of ships.

If we are going to tax carbon, maybe we should invest the proceeds into something useful, like assuring our own energy supply and national income for the next few centuries.

Finally, an energy superhighway means anyone, large or small, can travel on it. While the Aussie family is at work or gathered round the barbecue, their solar home can be quietly earning export dollars, by keeping the industrial mills of Asia spinning. ◀

JULIAN CRIBB FTSE is a science and technology writer and principal of Julian Cribb & Associates, specialists in science communication.

From 1996 to 2002 he was Director, National Awareness, for CSIRO.

He was editor of the *National Farmer* and *Sunday Independent* newspapers, editor-in-chief of the *Australian Rural Times*, and chief of the Australian Agricultural News Bureau. For 10 years he was agriculture correspondent, science and technology correspondent and scientific editor for *The Australian* and still writes a regular column for the national daily.

AUSSIES ARE FREQUENT ONLINE BUYERS

Australians are world leaders when it comes to frequency of purchases made on the internet, with one in four buying online weekly, a new report shows.

In a submission to the Productivity Commission inquiry into the retail industry, Scott Ewing, Senior Research Fellow with the ARC Centre of Excellence for Creative Industries and Innovation (CCI) at Swinburne University, says the latest CCI survey has found a quarter of Australians are buying online at least once a week – and a further 53 per cent of Australians buy something from the internet at least once a month.

The findings are from the 2011 Australian component of the World Internet Project (WIP), which compares internet usage between countries worldwide. The study shows that 78 per cent of Australians are now regular web-

shoppers – a lower percentage than Americans, of whom 88 per cent shop online.

"However, when we looked at the frequency of purchases, we found 25 per cent of Australians were buying at least once a week, compared with 17 per cent of Americans and less than 10 per cent of Europeans, Israelis or Japanese," Mr Ewing says.

"This doesn't mean that Australians are necessarily spending more money online than in retail shops, or that it is the main cause of the present retail downturn as some have suggested, but it does indicate more people are going online to buy things, more often."

Australians were the world's second most avid internet searchers for information about consumer products, only a whisker behind the Americans, similar to the Swedes and well ahead of the Japanese.



Australians are doing more computer and card shopping.

One area of internet shopping that has grown strongly in the past two years is purchases by the over 50s. While online spending in younger age groups has remained steady or even declined in the past four years, shoppers aged 50 to 64 have increased their monthly spend from \$157 to \$258, and those aged over 65 have increased from \$105 to \$135 a month.

MORE FRESH SCIENTISTS ON SOME BIG ISSUES

Sixteen of Australia's top young scientists were recently named Australia's Fresh Scientists for 2011. 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 were selected from 80 nominations and were flown to Melbourne for a day of media training. After this they presented their work to the media, school students, the general public, scientists, government and industry over three days in a

science communication 'boot camp'.

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 more of the 2010 Fresh Scientists (see the previous edition, *Focus* 167, for five others).

Details of all winners are at <http://freshscience.org.au>

SEEDING NERVE REGROWTH WITH TAMARIND

Melbourne scientists have developed an injectable material that encourages nerves in the brain and spinal cord to regrow. Their work could lead to new ways of treating nerve-based injuries or conditions such as Parkinson's disease and Huntington's disease.

All damage to the nerve cells of the central nervous system – the brain and spinal cord – is considered unrepairable. This leaves sufferers of many diseases and injuries with permanent disabilities – a major economic and social problem worldwide. The lack of regrowth is due mainly to the toxic

environment left behind after nerve death.

PhD student Andrew Rodda and colleagues in biomaterials research at Monash University have been studying a plant-based compound derived from the seeds of the tamarind tree, known as xyloglucan, which can be injected into an injury site as a liquid and gels upon reaching body temperature.

Andrew was able to show in rats that the gel can cause nerve regrowth within an injured brain.

"Nerve cells are sensitive and will only grow in the most supportive of environments,"

Andrew says. "After injury, new cells cannot normally penetrate into the empty space left after mass cell death. Cells clump at the edges, forming an impenetrable barrier. This leaves the centre of the wound as a lesion, which contains chemicals that kill growing nerves."

However, Andrew and his collaborators found that the gel acts as a support structure through which cells can migrate and potentially reattach themselves to the nervous system.

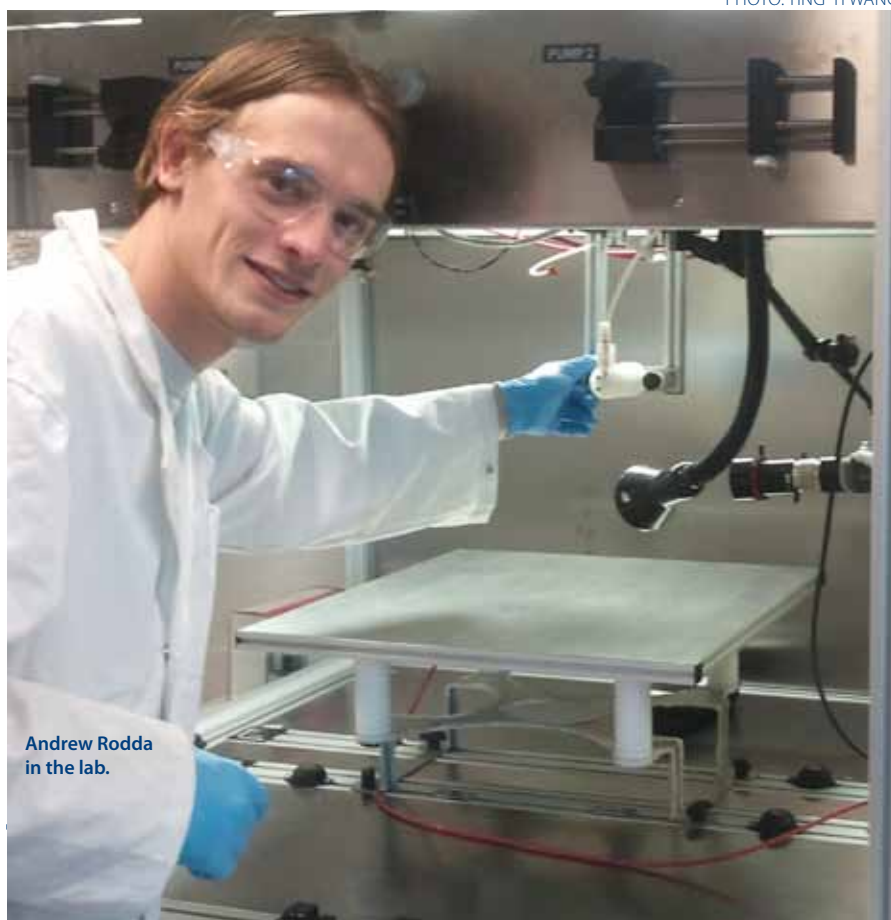
"The material provides a temporary scaffold on which new cells can grow and penetrate the lesion."

In Andrew's studies, the gel was chemically modified to support cell growth and then implanted into a rat brain. Not only did it encourage regrowth in the injured brain, but it also suppressed the post-injury inflammation around the edge of the wound, that goes on killing nerves long after the original damage has been done. Nerves and other cell types then entered and repopulated the empty space filled by the gel.

Significantly, it was the helper-cells known as astrocytes that were the first to move into the implanted gel. These cells secrete beneficial chemicals, which may have helped create an environment in which the delicate nerve cells can survive.

Andrew's study is part of a worldwide effort to encourage nerve regeneration in the brain and spinal cord. It builds on previous work at Monash University to understand and control nerve growth using biomaterials.

PHOTO: TING-YI WANG



Andrew Rodda
in the lab.

LUPIN IMPROVES THE STAFF OF LIFE

You can significantly lower your risk of heart disease just by using flour containing 40 per cent lupin beans in the place of conventional wholemeal flour, according to research by Victoria University dietitian Dr Regina Belski and colleagues from the University of Western Australia.

Over the course of a year, working with the Centre for Food and Genomic Medicine in Perth, the researchers monitored more than 100 overweight but otherwise healthy men and women to whom they provided everyday foods made either with wholemeal flour or incorporating lupin flour.

"Consuming lupin flour lowered blood pressure and reduced the risk of heart disease," Regina says. "It's as simple as that."

Lupins are legumes, often grown ornamentally in gardens for their flowers, but their beans have been eaten since Roman times. About 80 per cent of the world's commercial lupin crop is produced in WA, where it conditions the soil and is sold for livestock feed.

Recently, Regina says, there has been renewed interest in using lupin flour in regular foods, because of its unique high-protein, high-fibre composition and its ability to be incorporated easily into typical food products such as bread. But the WA Country Womens' Association produced a cookbook of recipes using lupin flour decades ago.

Those taking part in the study were put on a weight-loss diet and split into two groups. For a year, one group ate foods incorporating the 40-per-cent lupin flour, and the other group foods made solely with wholemeal flour. During the course of the experiment, Regina and her team monitored heart disease risk factors, including blood pressure, and the level of fats, sugar and insulin in the blood.

The foods provided to participants during the study included bread, pasta and biscuits. The researchers found that while both the lupin group and the wholemeal group lost similar amounts of weight, the lupin group displayed greater improvements in several heart disease risk factors.

"Simply consuming foods incorporating lupin flour can improve heart health in overweight people at higher risk of heart disease," Regina says.

The study suggested that lupin flour might also be good for those suffering from type 2 (adult onset) diabetes because even in non-diabetic individuals sensitivity to insulin improved during the trial.

Regina says in WA commercial food manufacturers have already begun making and selling products incorporating lupin flour.

PHOTO: IOURI BELSKI

**Commercial
foods using
lupins.**



PHOTO: DAVID WACHENFELD, DAVIDWACHENFELD.REDBUBBLE.COM



Barbara Wueringer has found that this freshwater sawfish uses its saw like an antenna to hunt down fish.

SAMURAI OF THE SEA

Scientists thought that sawfish used their saw to probe the sea bottom for food, but a Cairns researcher has found they use it differently.

Barbara Wueringer says these large (five metre plus) and endangered fish actually use the saw to locate and dismember free-swimming fish, using a sixth sense that detects electric fields.

Some of the subjects she studied in Cairns are now Melbourne residents – at the Melbourne Aquarium, the only aquarium in the world with freshwater sharks and sawfish.

The sawfish saw – an elongation of the head with teeth along its sides – provides this sixth sense, Barbara says. It is packed with thousands of tiny pore-like organs that can detect the minute electric fields surrounding living organisms. And it can be used to attack prey.

"Northern Australia is considered to be the last stronghold in the world for four species of sawfish," says Barbara, who works at the universities of Queensland and Western Australia and with Cairns Marine (an aquarium fish collecting company). "But if we do not understand these animals, we will not be able to save them."

Sawfish are beautiful and mystic ancient predators, Barbara says. They are regularly taken as bycatch in fisheries, and their fins and saws are traded as highly priced medicines, curios and culinary delicacies.

The saws are packed with sensors known as ampullary pores that can detect electric fields, the distribution of which is influenced by how the sawfish captures its prey. Barbara compared the distribution of ampullary pores in four species of sawfish, which all inhabit remote ecosystems in northern Australia. She found that sawfish have much more concentrated collections of pores on the upper side of the saw than their relatives the shovel-nosed rays. This indicates that they use their saw to detect prey in the three-dimensional space above the saw.

The number of ampullary pores in the different species of sawfish is related to the visibility of their habitat. So the species that inhabit the murkiest waters with the least visibility possess the highest concentration of pores.

Behavioural experiments showed that freshwater sawfish also attack fish with lateral swipes of their saw, which can be so powerful it splits the fish in half, Barbara says.

PLANET GOING BACKWARDS IS PUSHING KNOWLEDGE FORWARD



Daniel Bayliss in the telescope control room.

All planets move around their stars in the same direction as the star spins ... at least that's what we thought.

But now Australian National University astronomer Dr Daniel Bayliss and his colleagues – including the former Chief Scientist, Professor

Penny Sackett – have found that some planets break the mould.

Using one of the world's largest telescopes in Chile, Daniel and his collaborators discovered that a distant planet, WASP-17b, is moving in the opposite direction to the spin of the star around which it orbits. The discovery throws traditional theories about how planets form around stars into doubt.

Planets form from the same disk of rotating material that gives birth to the star around which they move. So it has been assumed that any planets orbiting a star would be moving in the same direction as the star's spin. This is certainly true in our own Solar System.

WASP-17b is quite different, Daniel says, and its backwards motion is somewhat of a mystery to scientists.

"It is possible that the planet underwent a close encounter with another giant planet billions of years ago, which altered its orbit so much that it began orbiting backwards."

It is not known what fraction of planets orbit their stars in this manner, but astronomers are now actively trying to monitor other distant planets to see how common it is. If it were common, this would not bode well for the chances of life around other stars. Close encounters between giant planets would most probably destroy any small Earth-like planet in that system, and wipe out any chance of life arising.

To date some 500 extra-solar planets have been discovered but we can only detect the orbital direction of a handful of them. Daniel is part of a project called HAT-South which is monitoring millions of stars in the Southern Hemisphere to see if they have orbiting planets. As part of this program, he runs a set of telescopes in Australia, the data from which is combined with those of identical sets of telescopes operated in Chile and Namibia.

This global enterprise should uncover dozens of new planets and reveal how common backwards movement is in our galaxy.

Daniel's original paper, 'Confirmation of a Retrograde Orbit for Exoplanet WASP-17b', was published in *Astrophysical Journal Letters* in 2010.

LINKING HIV AND DEMENTIA

HIV can hide in the brain, protected from the immune system and antiviral drugs, Dr Lachlan Gray and his colleagues at Monash University and the Burnet Institute have found.

Their discovery is an important step in understanding the link between HIV infection and HIV dementia, and is important for the eradication of HIV in general.

"The persistence of the virus in the brain compromises the brain's normal function, and leads to the death of neurons and to clinical dementia," Lachlan says. About one in five people infected by HIV end up with dementia.

"We believe our findings will aid the development of novel drugs that will prevent HIV using the brain as a sanctuary, and help to shape future eradication strategies."

Lachlan has been examining the life cycle of the virus to understand better how it survives within the brain. "We've identified changes in the way the virus reproduces, which allows it to keep a low profile and persist undetected in the brain."

At present, people living with HIV rely on the continued use of antiviral drugs to control their infection.

"Viral persistence is a major barrier to the cure of AIDS. Modern drugs are very good at controlling the virus, but they are unable to eradicate it from 'sanctuary' sites like the brain," Lachlan's supervisor, Associate Professor Melissa Churchill says. "Unfortunately, brain infection often leads to dementia, which can be very debilitating. Somewhat more concerning is that HIV is now the commonest cause of dementia in people under the age of 40 and is placing an extra burden on our mental health services."

Lachlan's research is part of a larger project that aims to trial new drugs which could potentially eradicate or even cure HIV.



Lachlan Gray in the laboratory.

PHOTO: CSIRO



CSIRO's Janardhan Vignarajan uses Remote-i to capture a photograph of the back of the eye.

REMOTE-i WINS TOP AWARD

Research helping to save the eyesight of people in rural and remote areas of Australia has won the top prize at the 2011 national iAwards, the information and communications technology (ICT) industry's peak awards event, held in Melbourne recently.

To develop the technology, called Remote-i, CSIRO's ICT experts developed a low-cost, high-quality eye screening system that gets around the problem of specialists travelling to the bush or patients trekking to the city. The technology includes:

- a web-based system that captures images from an easy-to-use camera and sends them to a central server;
- an offline system for data collection in areas with no immediate internet connection;
- an automated system to analyse captured images and support decision making by screening staff and medical specialists; and
- security and encryption techniques for transmission of patient data.

Remote-i won the e-Health iAward – the Victorian Government Inspiration Award – and was one of four awards received by CSIRO. Remote-i is already giving people in regional Western Australia easy access to specialist ophthalmological services. It was developed by the Australian e-Health Research Centre (AEHRC), a joint venture between CSIRO and the Queensland Government.

BIONIC DEVICES TARGET SHORTER HOSPITAL STAYS

A strategic relationship between the ARC Centre of Excellence for Electromaterials Science (ACES) at the University of Wollongong and Irish wearable sensor company Shimmer Research will focus on wearable bionic devices used post-operatively to improve patient recovery times and reduce the duration of hospital stays.

The collaboration brings together the new materials and fabrication expertise at ACES, with the wearable wireless communication

technology of Shimmer Research. A leading company in its field, Shimmer Research currently ships product to more than 50 countries.

With input from ACES members, including world-renowned orthopaedic clinicians from St Vincent's Hospital, Melbourne, this agreement will facilitate work on building bionic devices aimed to improve the quality of life for a large number of elderly people and those recovering from injury.

"The wearable devices will be used in post-operative and diagnostic applications to improve patient recovery times, reduce hospital stay times and enable patients to be proactive about their own care," said Dr Bridget Munro, ACES Associate Director of Strategic Development. "This will ultimately allow older people to live their dream of being healthy while living at home, reducing the strain on government resources."

UQ LINKS WITH CHINA ON BRAIN RESEARCH

The Queensland Brain Institute (QBI) and the University of Queensland Diamantina Institute (UQDI) will further strengthen their research ties with China following the opening in Shanghai of the Joint Sino-Australian Neurogenetics Laboratory (JSANL), dedicated to exploring how genes influence brain development and function.

The laboratory, opened by the Minister for Innovation, Industry, Science and Research, Senator Kim Carr, aims to uncover the genes that cause or make individuals susceptible to certain neurological and mental illnesses.

Researchers will initially focus on the neurogenetics of motor neuron disease (MND), schizophrenia, stroke and epilepsy, but expect to extend their investigations to other disorders such as depression and dementia as the laboratory develops.

The research program will also facilitate for the first time within the Chinese population genetic studies that have so far been conducted only in patient cohorts of European descent.

A collaboration with the Second Military Medical University (SMMU), JSANL is the second key collaboration between the two countries, following the 2010 opening of the Joint Laboratory of Neuroscience and Cognition between QBI and the Institute of Biophysics in Beijing.

QBI was established as a UQ research institute in 2003 and now operates out of a \$63 million state-of-the-art facility that houses 33 principal investigators with strong international reputations. QBI is one of the largest neuroscience institutes in the world dedicated to understanding the mechanisms underlying brain function.

UQDI was established in 2007 under the direction of Professor Ian Frazer FRS FAA FTSE, amalgamating the Centre for Immunology and Cancer Research and the Centre for Diabetes and Endocrine Research. A modern research facility where clinical and basic science converge in the translational research of cancer and disorders of immune regulation, the institute hosts more than 200 researchers, students and support staff. It lays claim to global, world-changing discoveries such as the world's first cervical cancer vaccine.

Is geoscience education turning the corner?

The resources boom has recently been the main driver attracting students into geoscience, but industry and the geoscience profession has also been galvanised into action.



By Trevor Powell

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The status of geosciences education in Australian universities has improved substantially over the three years to 2010, following a substantial decline since 1990. The situation of geoscience in Australia

Figure 1 Trend in Equivalent Full Time Student load (EFTSL) in geoscience at Australian universities 2003–10

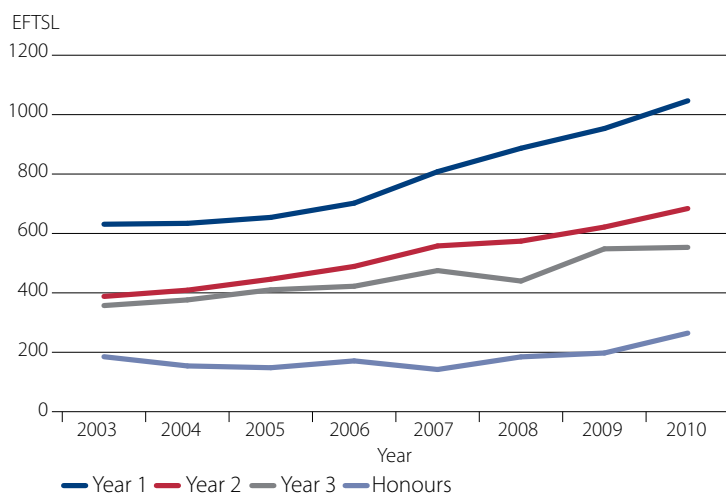
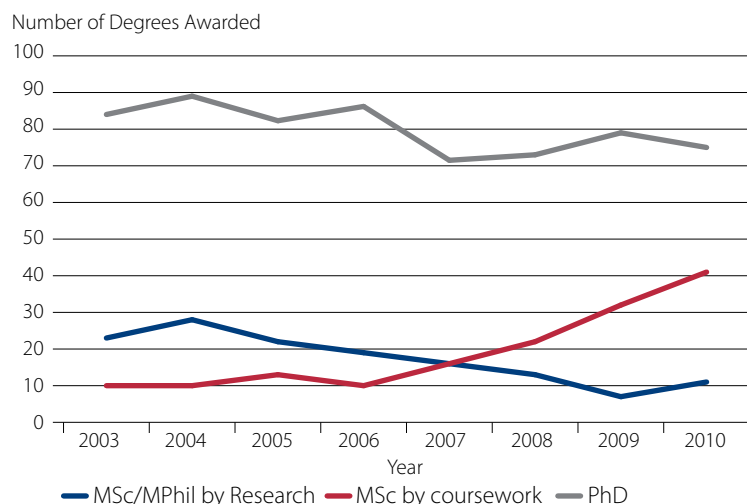


Figure 2 Output of higher geoscience degrees in 15 Australian universities 2003–10



lian universities is stronger now than at any time over the past 15 years.

A survey conducted earlier this year by the Australian Geoscience Council (AGC) – compared with a survey the Council undertook in 2007 – indicated that there had been a marked growth nationally in enrolled students (Figure 1) and academic teaching staff, reversing the decade-long decline to 2007. There has been a 13 per cent increase in staff engaged in both teaching and research.

The 2007 survey showed increases in enrolment had started in levels 1 and 2 in some universities and the 2010 survey showed this had extended to all levels (Figure 1), particularly honours, and to many institutions.

Honours enrolments had increased nationally by 73 per cent to 265 over 2008–10 compared with the nine per cent decrease in the previous five years – and the 60 per cent decrease in the 15 years leading up to 2007.

Seventeen universities (Table 1, page 34) now have the capacity to teach geoscience as a major in their undergraduate programs, with an additional university offering an earth science major as part of an environment degree. Of these, six maintain distinct geoscience schools. In the remainder, the geoscience discipline is amalgamated into schools of 'earth, geography and environmental science' or schools of 'physical sciences'.

The consequence for the structure of the undergraduate majors on offer varies. Some schools have created 'geoscience degrees' from a blend of physical geography or environmental courses and traditional 'solid earth science' courses. Others have maintained a clear distinction between degree types. The change in degree structures has been a major concern to potential employers.

Major changes

Whereas in 2007 it was not possible to discern any significant trends in postgraduate degrees, the addition of three years of data clearly shows some major changes (Figure 2). The output of MSc/MPhil degrees by research has de-

clined by more than 50 per cent, while the output of MSc degrees based on coursework has seen a dramatic increase, which appears to be accelerating – up 250 per cent in 2010 compared with 2007.

In the five years leading up to 2007, the output of PhD degrees had remained generally static, but since 2007 there has been a decline of about 15 per cent.

The 2007 survey had shown that there were two fundamental issues underlying the situation at that time, which comprised a balance of:

- demand by students for geoscience places at university, particularly for honours and/or postgraduate study – an issue of interest in geoscience and job opportunities for graduates; and
- capacity of universities to deliver a quality undergraduate degree – an issue of critical mass and appropriate levels of funding.

The 2010 survey showed a turnaround in undergraduate enrolment in geoscience and that it has been dramatic at the honours level. There is no doubt that the continuing resources boom and the skills shortage were the main drivers in attracting students into geoscience, but also the industry and the geoscience profession were galvanised into action by the previously dire situation.

The Minerals Council of Australia (Minerals Tertiary Education Council – MTEC) has contributed to strengthening some earth science educational capabilities by sponsoring courses in some departments, particularly as they relate to the minerals industry. Currently, eight universities teach courses into the Minerals Short Course Program at honours level and three universities operate the Masters of Minerals Geoscience program under the auspices of MTEC.

Since the early 2000s resource industry bodies and AGC member societies have become engaged in introducing earth science to school students and the wider community through various educational programs, including programs such as Earth Science Western Australia (ESWA) and the Teacher Earth Science Education Program (TESEP).

ESWA aims to get geoscience into 25 per cent of secondary schools and have 25 per cent of Year 11 and 12 students taking Earth and Environmental Science (EES) courses by 2011. It has included work on professional development for teachers and development of classroom and field materials in conjunction with the WA Curriculum Council.

TESEP was launched by the Petroleum Exploration Society of Australia to spark student interest and to motivate and educate keen science teachers and raise the profile of EES in secondary schools nationally beyond WA. It comprises eight professional development workshops for science teachers who teach Years 7 to 10, presented at

GEOSCIENCE EDUCATION MOVES POSITIVELY

In the early 2000s there was increasing concern within the resources industry and the geoscience community about the health of geoscience education in Australia and the demise of some earth science educational opportunities, university earth science teaching departments and staffing levels^{1,2}. In response to this concern the Australian Geoscience Council (AGC) undertook a survey in 2007 of Australian universities as a 'health check' on our national geoscience teaching capability³ and this survey was repeated earlier this year⁴.

From the 2007 survey, AGC identified the following systemic problems:

- The declining status of geoscience in Australian universities:
 - from a small but mainstream science pursued in 28 schools in 1990 it was reduced to five in 2007, with a further 11 schools having geoscience as a component along with geography, environmental science and variously linked to life sciences;
 - with a reduction in honours graduates nationally from an estimated 260 in 2000 to 142 in 2007;
 - with a reduction of tenured teaching staff of 34 per cent from 1990 to 2003, resulting in many schools with a lack of critical teaching mass to cover the discipline; and
 - with its share of national research funding declining by 22 per cent in the 10 years to 2007.
- Insufficient funding for schools with low student numbers to pay for the necessary infrastructure in expensive fields like geology and geophysics.
- The lack of awareness of geoscience in secondary schools limiting the flow of high quality students into geoscience.
- The lack of postgraduate students, particularly Australian nationals, and non-replacement of academic staff exacerbating the problem of providing staffing support for practical and field classes.
- Recruitment strategies and the previously cyclical nature of the resource industries not providing an attractive employment environment for potential graduates.

In contrast, the survey⁴ conducted earlier this year showed that the status of geoscience education in Australian universities has improved substantially over the past three years (2008–10).

NOTES

1 Minerals Council of Australia, *Back from the Brink: Reshaping Minerals Tertiary Education*, MCA National Tertiary education Taskforce, MCA, Canberra 1998.

2 National Committee for Earth Sciences, *National Strategic Plan for the Geosciences*, Australian Academy of Science, Canberra 2003.

3 Powell, T.G., 2008, *Australian Geoscience Tertiary Education Profile 2007*, www.agc.org.au/reports

4 Powell, T.G., 2011, *Australian Geoscience Tertiary Education Profile 2010*, www.agc.org.au/reports

multiple centres in all eastern/central states and territories from 2008.

Because attracting students into tertiary geoscience courses is crucial to the longer-term sustainability of many departments, the geoscience community has been proactive in proposing the introduction of EES into the Year 11 and 12 national curriculum.

The latest survey also shows the academic profile has changed considerably in some universities since 2007 and is likely to continue to do so as the retirement of the 'baby boomer' generation of academic staff proceeds. This represents both an opportunity and a threat.

The opportunity lies in the ability to think creatively about the way departments operate and arrange their affairs to deliver a better overall outcome. The threat is that university administrations may focus on capturing the sav-

ings obtained from retiring staff and may not focus on the opportunities presented in geoscience schools, which generally remain quite small in the context of the size of many academic disciplines in universities.

The decline in output of doctorate degrees is a concern, affecting both the financial viability of schools and reducing the supply of geoscience researchers. At the time when the baby boomer generation in the teaching and research workforce is retiring and the demand for appropriately qualified staff in industry has never been higher, the supply of early career researchers is tightening. This phenomenon is not confined to Australia. It is inevitable that both in the short and longer term there will be difficulty in recruiting appropriately qualified staff to fill academic and research positions either from overseas or Australia.

The 2007 question, 'What is the minimum economic department size that is sustainable in the longer run?', remains highly pertinent. This must consider government-funded student load, fee-paying students, academic staff numbers, service teaching to other degrees, external funding for teaching and research funding.

As the 2010 survey once again demonstrates, these considerations vary from institution to institution and are not easily compared, with staffing numbers indicating (Table 1) there is a wide variation in capability between schools. However, it is clear from this survey that some of the larger schools are thriving in comparison with many of the smaller schools.

In general the position has improved substantially since 2007, but it remains a truism that a critical mass of teaching and research capability that creates a vibrant and attractive educational experience is fundamental to retaining tertiary geoscience educational opportunities in Australia.

There is also a clear message for the profession and for potential employers to be engaged and interested in education to ensure a continued supply of appropriately trained graduates to meet industry and national needs into the future – which cannot be assumed. ◀

The survey results are available on the Australian Geoscience Council website (www.agc.org.au/images/stories/reports/agtep2010v31.pdf)

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The opportunity lies in the ability to think creatively about the way departments operate and arrange their affairs to deliver a better overall outcome.

Table 1: Australian universities offering Earth Science Degrees

University	School	Geoscience Staff*
Adelaide	School of Earth & Environmental Science School of Petroleum	34.8
Australian National	Research School of Earth Sciences	72
Ballarat	School of Science and Engineering	4.6
Curtin	Department of Applied Geology Department of Exploration Geophysics	38.9
James Cook	School of Earth and Environmental Sciences	17
Macquarie	Department of Earth and Planetary Sciences	14
Melbourne	School of Earth Sciences (includes ocean, atmospheric sciences)	35.6
Monash	School of Geoscience	22.7
New England	School of Rural and Environmental Science	2.5
Newcastle	School of Environmental and Life Sciences	13.1
New South Wales	School of Biological, Earth & Environmental Sciences	16
Queensland	School of Earth Sciences	26.6
QUT	School of Biogeoscience	10.5
Sydney	School of Geosciences (includes geography, environmental sciences)	25.5
Tasmania	School of Earth Sciences	31
Western Australia	School of Earth and Environment	43.4
Wollongong	School of Earth and Environmental Sciences	16

* Includes teaching and research staff in geoscience only at the time of the survey

STORYTELLING COULD BOOST SCIENTIFIC LITERACY

Storytelling could hold the key to engaging students in science, says the researcher leading a new Queensland University of Technology (QUT) research project that will examine how emotional learning through storytelling and other strategies designed with participating teachers could enhance scientific literacy.

Three Queensland secondary schools will take part in the \$200,000, four-year Australian Research Council (ARC) Linkage study being led by Professor Stephen Ritchie from QUT's Faculty of Education.

He said declining interest in senior secondary science courses had a flow-on effect to universities, contributing to skills shortages and a lack of understanding about science issues in society.

"What we hope to do is to provide the students with opportunities to engage emotionally in science activities. One way we have done so in the past is through writing 'hybridised stories', where technical, scientific information is merged with everyday language on topics relevant to students."

Professor Ritchie said students would write hybridised stories about issues such as biosecurity and organ transplants to fit into the Australian curriculum's Science as Human Endeavour strand. He said the stories would be uploaded online and be open to discussion with students from the partner schools, making it more interactive than formal teaching.

"Because they've invested a lot of effort into producing a published text, the text becomes a symbol of their emotional and cognitive engagement in the material," he said.

RENEWABLE ENERGY CONTRACTS FOR NEW DESALINATION PLANT

The Western Australian Government has finalised a historic deal that will see the WA Water Corporation purchase the entire output from Australia's first utility-scale solar farm to be built near Geraldton. Additionally, the Water Corporation will purchase 100 per cent of the output from the Mumbida wind farm, also to be established in the Geraldton area.

The output from these two renewable energy farms is planned to offset the energy requirements from the new Southern Seawater Desalination Plant (SSDP), to be built near Binningup, about 150 kilometres south of Perth.

The two projects, developed at a cost of about \$200 million, will add to the increasingly diverse mix of renewable energy generation in WA.

The Greenough River Solar Farm will be built on 80 hectares and produce 10 megawatts of renewable energy when complete. It is being built at a cost of \$50 million, with a \$20 million WA Government contribution. The Mumbida wind farm will comprise 22 turbines and generate 55MW of renewable energy.

The WA Government says the Greenough River Solar Farm will be one of the biggest in Australia when completed, while the Mumbida facility is expected to be the fourth-largest wind farm established in WA.

The developments will be commissioned in mid-2012 and late 2012 respectively.

The two joint ventures involved in the projects are Mumbida Wind JV and Greenough River Solar Farm. Greenough River Solar Farm is a partnership between Verve Energy and a private sector partner, while Mumbida Wind JV is a joint partnership between Verve Energy and Macquarie Capital.

GEO THERMAL ENERGY FOR TELFER?

University of Western Australia researchers will work with global gold giant Newcrest Mining Ltd to investigate using geothermal energy for expanding mining operations at Telfer in the Pilbara.

The WA Geothermal Centre of Excellence (WAGCOE), based at UWA, has completed an early stage study giving Newcrest expert information about the technology, pathways for resource identification, costs and opportunities for implementation. A second study is planned to assist Newcrest in its evaluation of the geothermal energy option.

Director of WAGCOE Winthrop Professor Klaus Regeneaur-Lieb claimed the project had good potential given that Newcrest had extensively used block caving, a technique similar to engineering for 'hot rock' enhanced geothermal systems (EGS).

"The company also has experience in geothermal application at Lihir Island in Papua New Guinea, albeit in a more conventional environment, but this gives them an advantage in terms of mapping this renewable energy technology," Professor Regeneaur-Lieb said.

ANU ROOFTOP REDUCTIONS

The Australian National University will reduce its carbon emissions by a further 19 tonnes a year with new solar panels installed on the rooftop of the university's Student Concessions Building.

The photovoltaic (PV) array of 60 solar panels, with 14-kilowatt capacity, will feed more than 21,000KW hours of green energy into the ANU electricity grid each year – the equivalent annual energy needs of five average Canberra households.

The installation of the PV array is a joint project between the Department of Sustainability, Environment, Water, Populations and Communities and ANU.

WEED CLEANS UP TOXIC CHROME

Using a noxious weed to clean up a toxic metal can rid the environment of two harmful substances, protecting people, water life, soil health and food crops, a new study shows.

Applying to soil black carbon made by incinerating the weed silver-leaf nightshade is a novel, low-cost method of dealing with chromium contamination, Professor Nanthi Bolan and Mr Girish Choppala from the CRC for Contamination Assessment and Remediation of the Environment (CRC CARE) and the University of South Australia told the CleanUp 2011 conference in Adelaide in September.

"While one form of chromium (Cr(III)) may be important to human health at low levels, another (Cr(VI)) is highly toxic to plants, marine life and humans," Professor Bolan said. "Approximately 3400 tonnes of (Cr(VI)) is used to treat (trellis) poles used in vineyards in Australia and is the most common source of this toxic metal.

"The best strategy we've found is to change the soluble, mobile and toxic (Cr(VI)) form to the insoluble and less toxic (Cr(III))."

The common sources of chromium, Mr Choppala said, were timber treatment sites, vineyards that use treated timber, the leather tanning industry and electroplating workshops, industrial centres and airbases – (Cr(VI)) is commonly used to protect timber and metals, but its mobility means that it can easily dissolve and leak into soil or water, where it can persist for years and get into the food supply.

"For example, timber is often treated with chromated copper

arsenate (CCA), as it prevents wood from being invaded by fungus and rotting, thus increasing its lifespan. However, the treated timber releases large quantities of (Cr(VI)) into the environment each year, not to mention when a vineyard replaces its timber trellis posts."

Silver-leaf nightshade is widespread and harmful to a wide range of crops, livestock production and the environment, as it competes for moisture and nutrients with other plants. The research team found that black carbon produced by incinerating this weed was highly effective in ridding sample soils of (Cr(VI)). Adding black carbon to the soil decreased (Cr(VI)) leaching by up to 10.5 per cent and 22.6 per cent within three days in acidic and alkaline soils, respectively.

The researchers recommend spreading the char on vineyard soil before inserting timber, or coating the wood with black carbon before using it in vineyards or parks.

e-TOXINS ESCAPING OUR LANDFILLS

Fourteen kinds of heavy metals and toxic flame retardants have been detected in contaminated water draining from landfill sites in Australia, Ms Peeranart Kiddee and Professor Ravi Naidu from CRC CARE and the University of South Australia told the CleanUp 2011 conference in Adelaide in September.

"Most of these materials have probably leaked from electronic waste, which includes old computers, mobile phones, refrigerators, televisions, batteries, wires with flame-retardant casings and more," Professor Naidu said.

CALL FOR GLOBAL ACTION ON LAND CONTAMINATION

Leading contamination scientists have issued a call for international action to tackle the growing risks that toxic contamination pose to human health and the environment across the planet.

Their call for an 'Adelaide Protocol' follows discussion by a group of some 500 eminent scientists at the CleanUp 2011 conference held in Adelaide in September. The 'Adelaide Group' of scientists states:

- Toxic contamination resulting from human activity is a worldwide phenomenon that affects all nations and poses a risk to the health of every individual on Earth, now and in decades to come. Almost every person, including many newborns, carries traces of this contamination in their body tissues and bones.
- Toxic contaminants are now found in most of the Earth's ecosystems – in the atmosphere, soils, fresh water, ocean sediments and polar

ice caps, as well as our homes, workplaces and food supply. Many hazardous substances are found in wildlife, even in areas far from human population centres.

- Contamination observes no national boundaries: the activities of one country often affect others and may become sources of trans-national friction. It must be seen as an international responsibility.

■ Many historic and (although less so) current industrial and waste disposal practices risk compromising the health of future generations. We have a moral responsibility to better protect the health of our land, water, air, food, environment and children.

- There are more than 83,000 man-made chemicals. Rapid growth in demand for goods and services is leading to the manufacture and dispersal in the biosphere of new chemicals,

including nanoparticles, electronic wastes and metals of unknown health risk potential.

- The uncontrolled use of phosphatic and nitrogen fertilisers to increase food production is now seen to be having a significant adverse impact on soils and water worldwide.
- Risk assessment and remediation should be based on effective doses of concern to specified human and ecological receptors.

The Adelaide Group proposes that transparent, locally relevant, risk-based thresholds or boundaries should be established for priority contaminants – including emerging contaminants – as a prelude to efforts to bring them within accepted safe limits.

It calls on governments around the world to enter into an international treaty or "Convention for the Protection of Humanity and the Environment from Toxic Contamination", acknowledging the Basel Convention and modelled on the success achieved by the Montreal Protocol, the Stockholm Convention and, more recently, progress since the Kyoto Protocol.

"As e-waste only came into the picture 10 years or so ago, we used to dispose of most of it in landfills. Approximately 84 per cent of e-waste was dumped, with only 10 per cent being recycled in those days.

"Up until 2006 there was three times more e-waste going to landfill, and no fewer than 234 million electronic waste items were sent to landfill in 2009. As many of our landfills are not actually designed to accommodate e-waste, we run a high level of risk if contaminated water escapes from them."

Toxic metals measured by the researchers included arsenic, cadmium, cobalt, chromium and zinc, and water leaching from landfills also contained PBDEs (polybrominated diphenyl ethers), which are flame-retardant chemicals found in many electronic products. PBDEs belong to the class of persistent organic pollutants (POPs) and can be highly toxic to both humans and the environment.

"The content of PBDEs found in Australian landfill leachates is much higher than those from Japan," Professor Naidu said. "One reason for this is that Japan incinerates its waste, decreasing the toxicity, while Australia disposes of them to landfill.

"Society's rising demand for and dependency on electric and electronic goods means the amount of e-waste will increase, especially as these products tend to have shorter lifecycles and are quickly replaced by new ones.

"The answer is to develop manufacturing systems that minimise contamination in the first place, and which close the loop by efficiently recycling materials back into electronics production pipeline," Professor Naidu said.

DDT 'CONSISTENTLY FOUND' IN HUMANS

Despite being banned almost 30 years ago, the pesticide DDT is still being widely found in human bodies, says Professor Tze Wai Wong of The Chinese University of Hong Kong.

He told the CleanUp 2011 Conference in Adelaide, hosted by CRC CARE, that in a study of 146 human milk samples, most of the persistent organic pollutants (POPs) found belonged to the DDT group, although there were also dioxins, other organochlorines and banned pesticides that were once widely used in agriculture.

"Finding them in human milk indicates that these pollutants are still present in food chain, which means that they're highly persistent and have a slow decline rate, or worse still, they are still being used in some countries in food production – neither of which is good news for consumers," Professor Wong said.

"We suspect that high concentrations of DDT will be found in communities which consume large amounts of seafood, dairy products, cattle and poultry, as animals tend to bioconcentrate these toxins.

"In this case, Western Europe, Scandinavia and Japan are particularly at risk. People in China and Japan may also have high concentrations of dioxin in their bodies, as waste is often incinerated, which release this compound into the environment."

DEEP OCEAN MOORINGS ON NORTHERN WATCH

Three deep-ocean moorings have been deployed to measure change in currents linking the Pacific and Indian oceans through the Indonesian Archipelago – a key factor influencing Australia's climate.

Up to 3000 metres tall and carrying an array of special marine sensors, the moorings are part of an international collaboration to monitor the Timor Passage and Ombai Strait – two strategic deep-ocean channels that act as 'chokepoints' in the global system of ocean currents.

Valued at more than \$1 million, the moorings were deployed as part of Australia's Integrated Marine Observing System (IMOS). They are one of several deepwater mooring arrays being deployed in a project led by CSIRO Wealth from Ocean Flagship scientists.

The moored instruments will enable oceanographers to see how warm, fresher tropical waters may influence Indian Ocean ecosystems and tropical weather systems that bring rain to Australia.

During a recent 12-day research expedition aboard the Australian Institute of Marine Science research vessel, *RV Solander*, scientists recorded numerous deep-ocean profiles of elements, including temperature and salinity, as a check against data gathered by the moorings' sensors.

Dr Bernadette Sloyan, a project leader, said the study area was an important pathway for the transfer of climate signals around the world's oceans. During their transit through the Indonesian Archipelago, Pacific waters were converted into a distinctly fresh Indonesian sea profile that was clearly observed across the South Indian Ocean.

"The ocean data collected by the sensors will increase the accuracy of ocean circulation and climate models and advances here will have beneficial outcomes for climate assessment in the Australian and wider region," Dr Sloyan said.

PHOTO: DANNY McLAUGHLAN/CSIRO



Sensors on the 3000-metre-tall mooring being deployed from the *RV Solander* next to sets of train wheels that hold the mooring in place.

PHOTO: CARL DAVIES CSIRO



Richard Richards (CSIRO), kneeling, explains the finer points of wheat breeding to (left to right) Richard Chambers, Dow AgroSciences Australia; Andreas Betzner, GRDC; Lindsay Adler and Jackie Wraight, CSIRO.

HUNTING FOR BETTER WHEAT YIELDS

With the world's population set to reach 8.9 billion by 2050, CSIRO scientists are hunting down and exploiting a number of wheat's key genetic traits in a bid to substantially boost its grain yield.

The rate of wheat-yield improvement achievable through conventional plant breeding and genetic engineering alone is not fast enough to compete with a rapidly growing global population, changing climates and decreasing water availability in the battle for accessible and affordable food and fuel.

"To avert future food security catastrophes we must accelerate the rate of wheat-yield improvement," says the leader of a CSIRO wheat research team dedicated to crop adaptation and improvement, Dr Richard Richards.

"Scientists need to quickly identify the traits and management practices responsible for capturing key resources, such as light, water and nutrients, and converting them to grain."

Locating genes of agricultural importance within the complex wheat genome is challenging but possible using new high-tech equipment such as that being developed by the High Resolution Plant Phenomics Centre (HRPPC) in Canberra.

CSIRO's Dr Richard Poiré is studying brachypodium – a type of grass similar in many ways to wheat – to identify the function and location of the genes responsible for important traits such as shoot growth, biomass accumulation, photosynthesis and root growth. By studying a model plant and applying the findings to cereals, scientists can accelerate the breeding of next-generation food and biofuel crops.

Another member of the team, Dr Anton Wasson, is investigating root growth in Australian and Indian wheat crops to identify new wheat varieties with faster-growing, deeper root systems that can capture more water during flowering and grain development.

CATTLE TICK VACCINE A STEP CLOSER

Australian scientists believe they may be closer to finding a cattle tick vaccine, which could save the national cattle and dairy industries about \$175 million per annum and reduce the need for pesticides.

Researchers have pinpointed tick vaccine antigens that will enable cattle to resist tick infestations. The vaccine antigens produce a bovine immune response that interferes with tick attachment and feeding (reducing tick numbers by up to 60 per cent) and also interferes with the ability of surviving ticks to lay eggs.

The research – led by the Queensland Alliance for Agriculture and Food Innovation (QAAFI), the University of Queensland and the CRC for Beef Genetic Technologies – recently recorded 50 to 87 per cent protection from ticks in cattle trials using pre-optimised immunisation conditions.

Partners in the tick research project include the Queensland Government's Department of Employment, Economic Development and Innovation (DEEDI), Murdoch University's Centre for Comparative Genomics, the US Department of Agriculture – Agricultural Research Services, and the Brazilian Agricultural Research Corporation (EMBRAPA).

Dr Heather Burrow, CEO of the Beef Genetic Technologies CRC, said that reduced productivity in the beef and dairy industries due to tick infestation was one of the most costly and difficult management issues with high impacts on cattle welfare.

"This work is novel science that has not been carried out anywhere else in the world. Together with our US and Brazilian partners, Australia stands to lead the way in safe and effective tick management," she said.

CLAY COMPOST LOCKS UP CARBON, IMPROVES SOIL HEALTH

Environmental researchers have developed a low-cost, novel solution for reducing carbon in the atmosphere while improving soil fertility, using natural materials.

Professor Nanthi Bolan from the University of South Australia told the CleanUp 2011 conference in Adelaide in September that adding compost containing clay materials to soil can help lock up carbon while increasing fertility.

"Traditional ways to lower carbon emission while increasing soil fertility include spreading organic wastes, such as composts and manures, on agricultural land, but research has shown that these degrade quickly," Professor Bolan said. "This results in the release of carbon dioxide."

Another popular method involves converting organic wastes to biochar by burning, which turns carbon into a form that cannot easily escape back into the atmosphere.

"However, biochar production, especially in large amounts, takes a

lot of energy. Burning it can also release other greenhouse gases such as carbon monoxide and methane into the air. At the same time, it will also destroy precious plant nutrients such as nitrogen.

"Our challenge was to come up with a method that will allow us to tie carbon added through manures and composts to the soil while keeping their fertiliser value. So we tried co-composting manures and composts with compounds such as iron oxide, aluminium oxide and allophane clay, and spreading this mixture on agricultural soils.

"These compounds are easily obtained from nature, especially allophane clay, which can be found in locations that contain volcanic ash."

The researchers found the compost enriched with clay not only locked up more carbon, it also contained more nutrients for crops.

IRRIGATION FLOW MODEL WINS PETER CULLEN PRIZE

Research into maintaining the resilience and health of river systems has won four university researchers the 2011 National Water Commission Professor Peter Cullen Eureka Prize for Water Research and Innovation.

The research – by Professor Quentin Grafton, Dr Hoang Long Chu and Professor Tom Kompas from the Crawford School of Economics and Government at the Australian National University, and Associate Professor Michael Stewardson from the Department of Infrastructure Engineering at the University of Melbourne – won the award for developing the world's first dynamic water model to economically optimise water allocations between extractions and environmental flows in real time. The model is calibrated to the Murray River but can be adapted to other catchments where there is adequate information on the hydrology and ecology.

The Prize, which honours the late Professor Cullen AO FTSE, is awarded to an individual, team or organisation for research and innovation that has made or has the potential to make an outstanding contribution to the sustainable use and management of Australia's water resources. Professor Cullen, a former NWC Commissioner and ATSE Fellow, died in 2008.

BOOST FOR HRZ WHEAT RESEARCH

Research into developing more productive wheat varieties in Australia has been given a major boost following an equity investment in HRZ Wheats Pty Ltd by one of the nation's leading agricultural disease and pest control companies, Dow AgroSciences Australia Ltd.

Established in 2003 specifically to develop hardy, high-rainfall-zone (HRZ) wheat varieties, HRZ Wheats' other equity partners are CSIRO, New Zealand's Plant & Food Research, Landmark Operations Ltd and the Grains Research and Development Corporation (GRDC).

"The Dow AgroSciences investment ensures that HRZ Wheats will continue to provide Australian growers with high-yielding, milling-quality, disease-resistant wheat varieties to meet the challenges of the high-rainfall zone," said CSIRO Plant Industry Chief, Dr Jeremy Burdon FTSE, who is a Director on the HRZ Wheats Board.

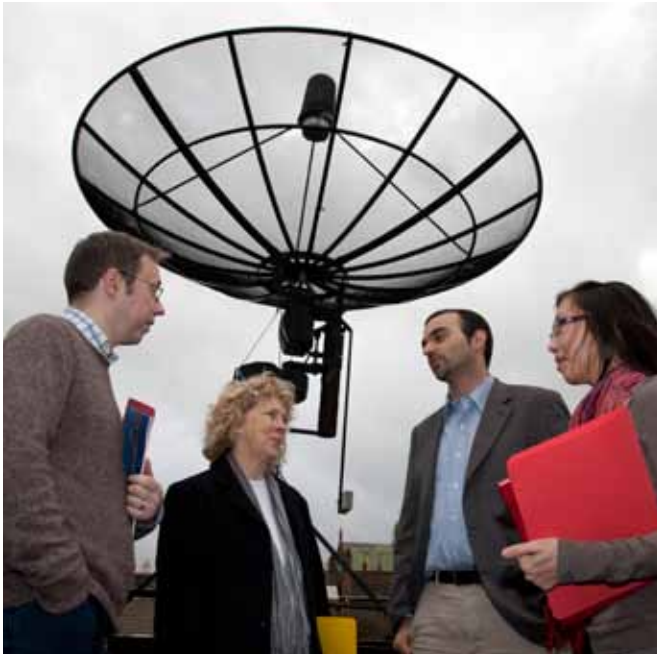
"Cutting-edge breeding technologies and novel germplasm – now available to HRZ Wheats as part of Dow's investment – will benefit the Australian breeding industry."

According to Dow AgroSciences' Managing Director for Australia and New Zealand, Peter Dryden, his company's research expertise will ensure that HRZ Wheats – the youngest of Australia's four main breeding companies – will remain competitive into the future.

PHOTO: SIOBHAN DUFFY, CSIRO

CSIRO scientists are hunting down and exploiting a number of wheat's key genetic traits in a bid to substantially boost its grain yield.





CAASTRO team members (from left): Associate Professor Scott Croom, CAASTRO Chief Investigator and ARC QEII fellow in the School of Physics; Professor Elaine Sadler, CAASTRO Chief Investigator; Professor Bryan Gaensler, CAASTRO Director and ARC Australian Laureate Fellow; Ms Kitty Lo, CAASTRO Phd Student.

A NEW WAY OF LOOKING AT THE SKY

The sky is no longer the limit, claims CAASTRO – the new ARC Centre of Excellence for All-sky Astrophysics – launched in Sydney in September.

CAASTRO is taking a revolutionary new approach to astronomy by using an all-sky perspective to answer the big questions about our universe. CAASTRO brings together unique Australian expertise across six Australian universities, along with local and international partners.

The new centre is led by the University of Sydney, in collaboration with the Australian National University, the University of Melbourne, the University of Western Australia, Curtin University and Swinburne University of Technology.

"CAASTRO is a major new initiative that is transforming the way we see the universe," said Professor Bryan Gaensler, Director of CAASTRO, who is based in the School of Physics at the University of Sydney. "The big unsolved questions in astronomy demand entirely new approaches, requiring us to look at the whole sky at once, rather than studying single objects in the sky in isolation.

"CAASTRO research will use wider fields of view, with bigger data sets, processed more deeply and more subtly, than anyone has attempted before."

AUSTRALIA-CHINA FUND SIGNED

Innovation Minister Senator Kim Carr and Dr Wan Gang, China's Minister of Science and Technology, formalised the new Australia-China Science and Research Fund in a Memorandum of Understanding signed at the

8th Australia-China Joint Science and Technology Commission meeting in Shanghai in August.

Senator Carr said each country would invest \$9 million in the fund and would establish five new joint research centres at up to \$2 million each and seek expressions of interest from the fields of biotechnology, geoscience, energy, engineering and materials science (including electric vehicles), ICT, mining, astronomy and the social sciences.

"We will also provide \$6 million towards research missions that will bring the best and brightest minds from each country together," Senator Carr said.

The Government's \$9 million investment in the Fund will be provided over three years from 2011-12.

Australia and China's research history includes discoveries and improvements in areas as diverse as biodiversity, water conservation, mining efficiency and safety, food security, disaster management, wireless communications, medical research, new alloys for manufacturing and cleaner energy.

Senator Carr said Australia and China celebrated 30 years of highly productive collaboration at the Shanghai World Expo last year and the Australia-China Joint Science and Technology Commission was an outstanding example of the two nations working closely together to continue this partnership into the future.

TELSTRA AND ACCENTURE LINK IN THE CLOUD

Accenture and Telstra have announced a new Product Innovation Lab in Melbourne to develop cloud computing solutions for customers in Australia and New Zealand.

The Lab supports the cloud computing alliance between Telstra and Accenture – the global management consulting, technology services and outsourcing company – and will be hosted in a Telstra facility. The companies say it will serve as an Australian innovation hub, enabling the development of business-oriented technology solutions for Australian enterprise and government organisations, employing the latest cloud computing technologies while delivering tangible business benefits.

Dr Hugh Bradlow FTSE, Telstra Chief Technology Officer, said the new Lab boosted Telstra's capabilities in providing locally hosted cloud services, backed by Accenture's global leadership in enterprise-grade cloud solutions.

"We know Australian organisations are increasingly looking to the cloud for their IT services and the Lab will prove a powerful tool to help us develop the best possible services for our customers into the future," Dr Bradlow said.



Hugh Bradlow

PHOTO: LONNI AYLETT/DREAMSTIME.COM



The magpie – Australian suburban icon.

WHAT'S LIVING IN YOUR STREET?

Within five kilometres of the intensely urban suburb of Surrey Hills in Sydney there are reports of at least 3500 different animal species and 2400 plant species and Melbourne's Southbank is a neighbour to more than 1200 animals and 519 plants, according to The Atlas of Living Australia.

"But to get a really comprehensive view of living Australia we need the help of the public," said Mr Donald Hobern, Director of the Atlas of Living Australia. "We're calling on Australians to re-engage with the natural world. We want them to report on their neighbours – not their human neighbours but on the plants and animals in their gardens, nature strips, paddocks and parks.

"Australia has a fine tradition of amateurs and enthusiasts contributing to scientific understanding. Rica Erickson, one of the foremost amateur natural historians in the 1900s, wrote extensively on botany and birds and made a significant contribution to the Australian scientific knowledge-base.

"Now, with modern web-based technologies, enthusiasts can build and share information like never before, allowing us to better understand species and monitor changes in species distribution and the environment." Mr Hobern said.

"Everyone can help to build a better picture of Australia's biodiversity by contributing sightings and photos to the Atlas website. Even a sighting of a common bird in your backyard, neighbourhood or paddock may increase our understanding of how that species is distributed across the country. The species may not have been recorded before in that location, or it may not have been recorded there for a long time or its

distribution may be changing.

"There are huge gaps in our knowledge of Australian biodiversity. The best estimate we have for the number of Australian species is 570,000, and nearly three-quarters of these are unknown or undescribed," said Dr Kevin Thiele, director of the IdentifyLife component of the Atlas, which provides a series of tools or keys to help people identify species.

The Atlas of Living Australia is a national initiative focused on making Australia's biodiversity information more accessible and useable online. It is a partnership between CSIRO, Australian museums, herbaria and other biological collections, the Australian Government and local communities.

The Atlas website already holds more than 23 million records on the distribution of Australia's fauna and flora, 170,000 species pages, descriptions, state-of-the-art mapping tools with more than 350 layers, photos, extensive data-sets, identification keys and heritage literature.

To see what's living in your area go to <http://biocache.ala.org.au/explore/your-area> and take a look. Then click on share to contribute your own observations or photos.

UQ TAKES THREE EUREKA PRIZES

The University of Queensland took out three awards in the 2011 Australian Museum Eureka Prizes – an outcome described as "excellent" by UQ Deputy Vice-Chancellor (Research) Professor Max Lu FTSE.

Professor Jian-xin Zhao, Mr John Cook and researchers from the AIBN Nanopatch Vaccination Team each won their category award and \$10,000 in prize money.

Professor Zhao, from UQ's Centre for Microscopy and Microanalysis, won the inaugural University of Technology Sydney Eureka Prize for Outstanding Mentor of Young Researchers for his mentoring of researchers in the field of geochemistry and geochronology. Five of Professor Zhao's recent mentees at the facility have received Australian Research Council (ARC) fellowships and many more have gained other ARC and competitive grant schemes.

Mr John Cook won the NSW Government Eureka Prize for Advancement of Climate Change Knowledge. Mr Cook is Research Fellow in Climate Change Communication at UQ's Global Change Institute and won the Eureka Prize for his work in communicating science to an online audience.

The Nanopatch Vaccination Team, led by Professor Mark Kendall from UQ's Australian Institute for Bioengineering and Nanotechnology – headed by ATSE Director Professor Peter Gray FTSE – was awarded the ARC Eureka Prize for Excellence in Research by an Interdisciplinary Team for its invention of a needle-free vaccine delivery system. The stamp-sized vaccination device could revolutionise immunisation programs in developing nations and has been described as "vaccine utopia".

Revolutionising internet speeds

A typical day for Professor Ben Eggleton FTSE may be spent working on ways to slow down the speed of light or develop technology that could ramp up internet speeds to 1000 times faster than today's networks – quite a step for a person who admits he drifted through school before discovering his passion in a first-year university physics lecture.

Now a Professor of Physics at the University of Sydney and founding director of the Australian Research Council's (ARC) Centre of Excellence for Ultrahigh-Bandwidth Devices for Optical Systems (CUDOS), Professor Eggleton is an internationally acclaimed optical physicist who has pioneered breakthroughs in the field of photonics (the science of light).

He and his team of more than 130 scientists are developing optical technologies that promise to change people's lives. In particular, the group

is developing a photonic chip that is faster, smaller, more energy efficient and smarter than traditional electronics options. Using light beams, it is already contributing



Ben Eggleton

to new science and technology in a host of areas ranging from energy-efficient communications and quantum information processing to environmental monitoring and astronomy.

For his leadership in establishing CUDOS and for the vast body of research he continues to contribute to the field, Professor Eggleton won the 2011 Eureka Prize for Leadership in Science, part of the Australian Museum Eureka Prizes.

"Professor Eggleton's research has

consistently pushed the limits of optical technologies in his experimental and theoretical contributions," says Frank Howarth, Director of the Australian Museum. "At the same time, his strong leadership of the CUDOS multidisciplinary research centre has seen it become a leading force on the international scientific stage, and means his impact on Australian science will be felt for many years to come."

Professor Eggleton's early career saw him establish important new principles in the field of optics and nonlinear wave physics while completing his PhD experiments at the prestigious Bell Laboratories, run by Lucent Technologies in the US. Becoming Lucent's youngest research director at the age of 30, the fibre-optic technology he developed there is now used in networks throughout the world.

In 2003, Professor Eggleton returned to Australia as an ARC Federation Fellow to become founding director of CUDOS and more recently to run the university's new Institute of Photonics and Optical Science (IPOS).

Under his leadership, the CUDOS team created Australia's first photonic chip which, by slowing the speed of light, is able to operate 1000 times faster than today's electronic equivalent and has broken the world record for optical switching. With the prospect of terabyte-per-second processing, this technology is set to transform the way we manage everything from medicine and defence to education and international business.

Craig Priest is a Tall Poppy

One of the University of South Australia's top young researchers – and a former ATSE nominee to Science meets Parliament and a 2009 Fresh Scientist – has been acknowledged for his work at the annual South Australian Young Tall Poppy Awards.

Microfluidic and interfacial chemistry expert Dr Craig Priest, 32, was a winner at the



Craig Priest

State's 9th Tall Poppy Awards, which recognise outstanding work by scientific researchers in the early stages of their careers who are already making significant scientific contributions.

Dr Priest, a research fellow at the Ian Wark Research Institute, works on ways to control liquids on different surfaces. He was nominated by Laureate Professor John Ralston AO FAA FTSE, the Wark Director, as an ATSE delegate to Science meets Parliament in Canberra in 2010.

Jack McLean

Professor Jack McLean, from the Centre for Automotive Safety Research, University of Adelaide, has received the 2010 David Dewhurst Award from the College of Biomedical Engineers.

The citation for the award read (in part): *"The knowledge generated by this research has been used to reduce significantly the road toll not only in Australia but throughout the world. It would be impossible to guess just how many lives have been saved through the implementation of road safety policies and programmes based on recommendations arising from Professor McLean's research. There is no doubt that he has played a major role in the impressive reductions that have occurred in the Australian road toll since his work began."*

The Award honours Dr David Dewhurst, one of Australia's first prominent biomedical engineers.

Technology and as a professorial fellow at the University of Queensland. He is a chemical engineering graduate of the University of Birmingham, University of Cambridge, UK, and McGill University, Canada.

Liangchi Zhang named Inventor of the Year

Professor Liangchi Zhang FTSE has been named UNSW 2011 Inventor of the Year by the University of NSW's commercialisation arm, Nsi, for a range of his inventions related to the cutting and polishing of materials.

He has developed a cutting tip for the rock and coal mining industry that dramatically improves wear resistance compared with existing designs, and reduces cutting force, energy consumption and dust generation.

The silicon polishing technique is for the semiconductor industry, which produces damage-free mono-crystals silicon wafers with surface roughness less than a nanometre without using any chemicals.

Fifteen UNSW staff and students were finalists in the annual competition, won by Professor Zhang. The category winners were nominees for the overall Inventor of the Year award.

The winner of the Student Inventor of the Year is Ly Mai. Her novel solar cell manufacturing processes have been implemented by major companies worldwide and have been used to produce record-breaking efficiencies in solar cells.

The awards acknowledge innovative technologies of UNSW researchers and students that benefit the community and the environment. This is the third year of the awards, which carry a total prize pool of \$28,000.



NSi CEO Kevin Cullen congratulates Liangchi Zhang

Professor Batterham presents Professor Zhou with his Fellowship certificate

Zhou Ji a Foreign Fellow

During his visit to Shanghai to attend the Australia China Joint Science and Technology Commission (JSTC) Meeting in Shanghai in August, Academy President Professor Robin Batterham AO FREng FAA FTSE met with the President of the Chinese Academy of Engineering, Professor Zhou Ji, and presented him with his certificate of Fellowship.

The May Assembly elected Professor Zhou as a Foreign Fellow.

Professor Zhou is a specialist in mechanical engineering and was born in 1946 in Hubei Province. He graduated from Tsinghua University in 1970 and received his PhD degree from State University of New York at Buffalo in 1984.

He served as the Minister of Education of the People's Republic of China from 2003–09 and was previously President of the Huazhong University of Science and Technology (HUST), Director-General of the Hubei Provincial Department of Science and Technology and Mayor of Wuhan city.

He was elected Member of the Chinese Academy of Engineering in 1999.

During his professional career, Professor Zhou was actively involved in research and development of optimal design, computer-aided design and numerical control technology. Dr Zhou has published 11 books and more than 200 papers and was honoured several times with the Chinese State Award for Science and Technology Progress.

Professor Zhou visited Australia in November 2010 and addressed the

Academy's AGM in Sydney. This was his first overseas visit to a Learned Academy following his appointment as President of CAE.

Kelly joins team at CO2CRC

Professor Kelly Thambimuthu FTSE has been appointed Emeritus Scientist at the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC).



Kelly Thambimuthu

Professor Thambimuthu is the Chairman of the IEA Greenhouse Gas R&D Program and has more than 30 years of low emission technology R&D experience.

CO2CRC is an internationally acclaimed carbon capture and storage (CCS) research centre. CCS is essential to meeting greenhouse gas emission reduction targets and a critical tool in the transition to a clean energy future.

"Kelly's experience and skills are a perfect fit with CO2CRC," said Dr Peter Cook CBE FTSE, Chief Executive of CO2CRC. "His understanding of new technology development and his skills in building international collaborations will be a highly valuable addition to the CO2CRC team."

"As CCS projects around the world ramp up, Australia must maintain its position as a world leader and innovator in CCS technology and research. Kelly's appointment is an important part of keeping our competitive edge."

Professor Thambimuthu's previous roles have been as scientist and program director at CANMET Energy, Natural Resources Canada, as CEO of the Centre for Low Emission



Gordon Wallace

Gordon Wallace named ARC Laureate Fellow

Professor Gordon Wallace FAA FTSE is one of 17 Laureate Fellows named to receive 2011 Fellowships worth a total of \$44 million.

Presenting what he described as “the world’s best and brightest researchers” with the Fellowships, Innovation Minister Senator Kim Carr said the Government was investing in quality research and researchers to deliver a richer, greener and fairer nation for all Australians.

The Laureate Fellows hope to help us understand the implications of our ageing population, how the first galaxies formed and find new ways to detect and control epilepsy, he said.

“Professor Gordon Wallace hopes his fellowship will help to revolutionise medical treatments, specifically for epilepsy and bone disorders,” Senator Carr said.

Senator Carr said all 17 researchers had distinguished research careers and these fellowships would help them strengthen their research efforts, leading to developments and discoveries that could benefit the lives of all Australians.

Professor Wallace, NSW Scientist of the Year (Chemistry) in 2009, is the Director of the Intelligent Polymer Research Institute (IPRI)

and Australian Research Council Federation Fellow at the University of Wollongong. He is also Executive Research Director of the ARC Centre of Excellence for Electromaterials Science (ACES) and Director of the Australian National Fabrication Facility (ANFF) Materials Node in Wollongong. His current research interests include organic conducting polymers, nanomaterials and nanobionics.

Professor Wallace’s project aims to provide a platform to revolutionise medical treatments such as nerve and muscle regeneration, which will impact on neural prosthetics. The advent of the next generation of medical bionic devices is critically dependent on advances in multifunctional organic materials that, like living systems, provide spatial and temporal control.

Professor Wallace will use the knowledge accrued in developing these bionic devices to progress collaborative projects (with St Vincent’s Hospital in Melbourne) to produce materials for detection and control of epileptic seizures and bone regeneration.

“The Australian Laureate Fellowship will enable us to continue to build a world-leading Nanobionics research team here in Wollongong – covering all aspects from biomolecules to bionic devices,” Professor Wallace said.

“We are developing innovative approaches to bionics, including new material composition, new fabrication methods, new nano visualisation methods and innovative approaches to energy storage for bionics.”

Professor Wallace’s award will result in funding worth more than \$3 million over the next five years for expansion of the research team at the Intelligent Polymer Research Institute, lead node of ACES. The funding will build on Professor Wallace’s Federation Fellowship program and on the highly integrated activities of the ACES Bionics programs.

Professor Wallace completed his PhD at Deakin University in 1983. He was also awarded a DSc from Deakin in 2000. Professor Wallace lectured at University College in Cork before returning to Australia in 1985 to take up an appointment at the University of Wollongong. In 1990, he established the world’s first intelligent polymer research laboratory.

He has received numerous awards including the Inaugural Polymer Science and Technology award from the Royal Australian Chemical Institute (RACI), the 2009 NSW Scientist of the Year Award (Chemistry), a Science Foundation Ireland Walton Fellowship, RACI HG Smith Medal and RACI Stokes Medal for research in Electrochemistry.

The University of Queensland, ANU and University of Melbourne each received three of the 17 awards. Open to academics of international repute, the scheme aims to build and strengthen world-class research in Australia by supporting and attracting outstanding Australian and international researchers.

More information:

<http://electromaterials.edu.au/index.html>

Lindsay Falvey

Professor Lindsay Falvey FTSE has been appointed a Director of the Qatar-owned Australian company, Hassad Australia Pty Ltd, which is one of the largest investors in Australian agriculture and the use of agricultural technology on its various properties.

Ken Webster – the man behind the Ord River Dam

Mr Kenneth Campbell Webster AM FTSE, who died in Perth in July, aged 82, was a former Chairman of the Western Australian Water and Rivers Commission and earlier head of the WA Water Authority.

Earlier in his career he oversaw the planning and design of the Ord River Dam in WA's Kimberley region, one of the biggest

and most controversial projects in Australia's water history.

Completion of the Ord Dam in 1972 was a remarkable legacy for the former RAF pilot and oil refinery engineer, who grew up in difficult conditions in Scotland

and graduated as a civil engineer from the Robert Gordons College, in Aberdeen in 1949.

Following two years' service in the RAF, he worked with consulting engineers Sir Alexander Gibb & Partners in London on construction of hydro-electric schemes in Scotland before migrating in 1955 to work as a civil engineer at the BP Refinery at Kwinana, near Perth (1955–57), and marry Australian schoolteacher June Winter, who he had met in London.

He spent two years working as a design civil engineer with the Tasmanian Hydro Electric Commission, working on the detail design of Catagunya Dam, the first pre-stressed dam in Australia.

He then returned to Perth in 1959 to join the Public Works Department and spent six years leading a team of engineers planning and designing the Ord River Project, including the Diversion Dam, completed in 1967.

The Ord River Dam, completed in 1972, retains the water of the Ord River, creating Lake Argyle, which holds up to 18 times the volume of water of Sydney Harbour, has a

catchment area of more than 46,000km² and is the largest body of fresh water in Australia. The lake is regularly refilled by the monsoonal rains that cross the northern part of the country each year and the area is home to abundant wildlife and some 25,000 freshwater crocodiles.

From 1965–85 he was in successively more senior roles, including Chief Engineer Water Resources and Assistant Director Engineering with the PWD, before becoming Director Water Resources and then Acting Managing director of the WA Water Authority until his retirement in 1989.

In 1990 he was appointed Chairman of the Water Authority and later Chairman of the Waters and Rivers Commission. He was a Fellow of the Institution of Civil Engineers and a Fellow of the Institution of Engineers, Australia, and won a Churchill Fellowship in 1968.

Kenneth Ferguson headed animal and food sciences



Kenneth Ferguson

Dr Kenneth Adie Ferguson, who died in Newcastle in April 2011, aged 90, had a distinguished career in animal and food sciences.

A fellow since 1976, Dr Ferguson

trained as a veterinary scientist, graduated from Sydney University and spent most of his working career with CSIRO.

He was an Associate Member of the CSIRO Executive (1976–78) and Chairman of CSIRO's Animal Research Laboratories in Canberra (1973–78). From 1978 until his retirement in 1986 he was Director of CSIRO's Institute of Animal and Food Sciences. He was later a consultant to Peptide Technology Ltd.

Following graduation in 1942 he was engaged on a Directorate of Scientific Manpower project at Sydney University researching milk production and later researched the influence of nutrition on wool growth at Sydney University on a Walter and Eliza Hall Research Fellowship.

He joined CSIRO in 1947, gained his PhD from Cambridge on a CSIRO overseas

studentship (1948–51) and lectured part-time (1952–54) at Sydney University. He spent the rest of his career at CSIRO, apart from a spell as a visiting professor at McGill University, Montreal (1967–68).

Dr Ferguson was a Fellow of the Australian College of Veterinary Scientists, President of the Endocrine Society of Australia (1972–74) a member of numerous scientific societies.

John Radcliffe chairs water recycling committee

Dr John Radcliffe, who currently chairs the Academy's Water Forum, has been appointed chair of the Australian Water Recycling

Centre of Excellence Research Advisory Committee.

Dr Radcliffe is a Council member of the University of Adelaide and chairman of the Commonwealth Department of



John Radcliffe

Agriculture, Fisheries and Forestry's Eminent Scientists Group.

Previously a commissioner with the National Water Commission, Deputy Chief Executive of CSIRO and South Australian Director-General of Agriculture, Dr Radcliffe was chair of the board of the SA Research and Development Institute from 1993–98.

He is author of *Water Recycling in Australia*, published by ATSE in 2004, as well as an update on water recycling in Australia published in *Water Science and Technology* in 2010.

Dr Radcliffe said he was delighted to be asked to take up the role, which he began in July. "I believe that the Centre of Excellence has an important part to play in progressing water recycling research and development in Australia," he said.

"The centre can help the nation both prepare for its own growth and potentially contribute to greater international adoption of water recycling, including among other things, to meeting an expanding world food demand."

Min Gu wins Steel Medal

Professor Min Gu FAA FTSE, Australian Laureate Fellow and Director of the Centre for Micro-Photonics at Swinburne University, has been awarded the 2011 W. H. (Beattie) Steel Medal of the Australian Optical Society – the highest award in optics in Australia.



Min Gu

Professor Gu, a fellow of the Australian Institute of Physics, the Optical Society of America, the International Society for Optical Engineering and the Institute of Physics (UK), was appointed Pro Vice-Chancellor (International Research Collaboration) at Swinburne in 2009.

Previously, he was Special Advisor to the Vice-Chancellor (Staff Development), Dean of Science, a Deputy Dean of the Faculty and a member of the University Council, Academic Board and Board of Research at Swinburne.

He is also the Director of the Victoria-Suntech Advanced Solar Facility that he initiated and established in 2010.

Professor Gu is a pioneer and an internationally leading authority on three-dimensional optical imaging science. He is a sole author of two standard reference books, has more than 800 publications in photonic crystals and devices, nanophotonics/biophotonics, micro/nanofabrication, confocal and multiphoton microscopy, laser tweezers, optoelectronic imaging through tissue-like turbid media, laser trapping and near-field microscopy, multi-dimensional optical data storage and photovoltaics.

He was President (2002–04) and is Vice President (2004–12) of the International Society of Optics within Life Sciences. He is Vice President of the International Commission for Optics (2005–11).

Ian Frazer

Professor Ian Frazer FRS FAA FTSE will be a member of an independent review of health and medical research in Australia, which will recommend a 10-year strategic health and

medical research plan for the nation.

Professor Frazer is the CEO and Research Director of the Translational Research Institute in Brisbane, a recently created research facility bringing together four established Brisbane research institutes.

Along with fellow researcher the late Dr Jian Zhou, he developed the technology to enable production of vaccines for the human papillomavirus (HPV), which causes 70 per cent of cervical cancers.

Professor Frazer won the 2005 CSIRO Eureka Prize for Leadership in Science, the Australian of the Year in 2006, an ATSE Clunies Ross Award in 2007 and the Prime Minister's Prize for Science in 2008.

Bogdan Dlugogorski

Professor Bogdan Dlugogorski FTSE, Director of the Priority Research Centre for Energy at the University of Newcastle, has been elected Chairman of the International Association for Fire Safety Science (www.iafss.org). He succeeds Dr Craig Beyler, Technical Director at Hughes Associates, in the US, as the first Australian to lead the association, which has more than 500 members worldwide.

IAFSS seeks to promote high standards, to encourage and stimulate scientists to address fire problems and to provide the necessary scientific foundations and means to facilitate applications aimed at reducing life and property loss.

Tom Biegler's son no cause for depression

ATSE Fellow Tom Biegler was modestly playing the proud father when the 2011 Eureka prizes were announced in September – his son was among the winners.

Dr Paul Biegler is exercised by the question – can doctors ethically prescribe depression-easing drugs if they know there is a drug-free option available that is equally effective?

His answer, argued in the book *The Ethical Treatment of Depression: Autonomy Through Psychotherapy*, is no.

In this work, Dr Biegler, from the School of Philosophical, Historical and International Studies at Monash University, argues doctors have a moral obligation to prescribe cognitive behaviour therapy (CBT) for patients with depression. His ground-breaking examination of the ethical treatment of the condition earned him the 2011 Australian Catholic University Eureka Prize for Research in Ethics.

One in six Australians will experience depression in their lifetime, a figure that is replicated worldwide. Of the three-quarters of this number who seek medical treatment, about 80 per cent will receive antidepressants.

Dr Biegler says antidepressants and CBT have been proven to be equally effective in treating the common lesser grades of depression, yet antidepressants are over-represented in treatment regimes by a factor of three to one.

The former medical practitioner argues that while drugs may ease depression, they fail in the moral domain because they simply treat the disease rather than the "whole" person. He argues that CBT gives someone who suffers from depression insights into the nature and mechanisms of the disease that drugs cannot. It also helps sufferers identify stressors, shown to be causal in about 70 per cent of depressive episodes, and teaches coping strategies focused on the stressor and the resulting emotional distress.

In giving patients insights and coping strategies, he says CBT promotes the autonomy of the patient and leads to greater wellbeing. A failure to offer such alternative therapy is, therefore, a dereliction of duty by the medical practitioner.



Tom Biegler

• Dr Benjamin Kile, son of ATSE Victorian Division Chair Dr Glen Kile FTSE, won the 2010 Science Minister's Prize for Life Scientist of the Year for his achievements in molecular genetics – unravelling the secrets of blood in his work at Melbourne's Walter and Eliza Hall Institute for Medical Research.



Melbourne Convention and Exhibition Centre
Friday 11 November 2011
8.30am – 4.30pm

Productivity, Innovation and Prosperity The Great Australian Challenge

This is a 'don't miss' event if you're part of – or interested in – the national debate about productivity and innovation

The aim of this forum convened by the **Academy of Technological Sciences and Engineering** is to inform the national debate on productivity, the role of science and technology, and their necessary contribution to prosperity beyond the current boom – recognising the currently historic low pace of productivity growth in Australia. The discussion will address three crucial questions we need to keep asking:

- 1. What is productivity and innovation, what does it actually involve, and how do we take stock of our performance?**
- 2. How does science and technology contribute to productivity growth?**
- 3. What are the emerging opportunities and the technology platforms that can drive renewed productivity improvement in Australia?**

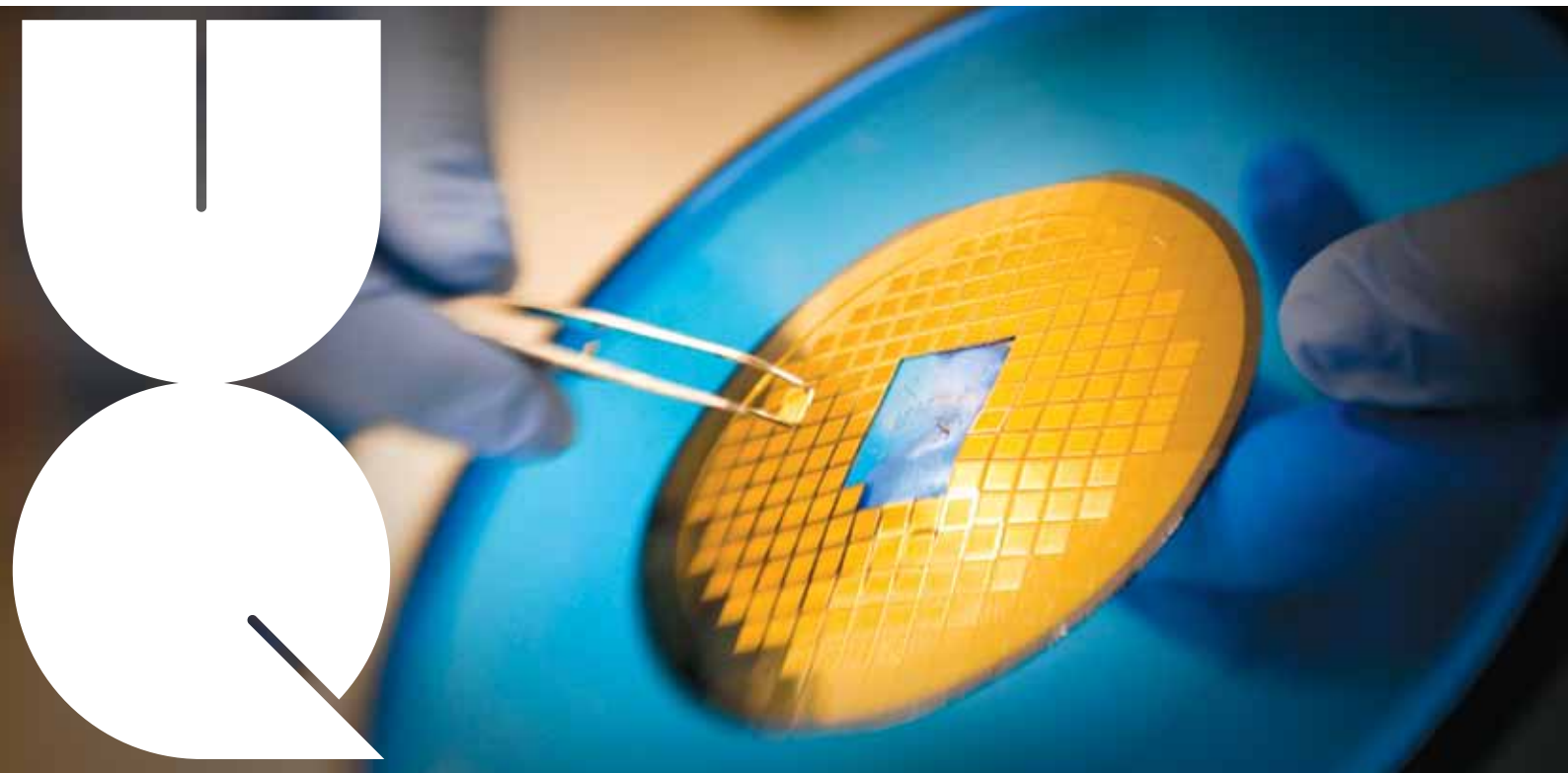
Lead speaker is **Dr Robert Atkinson**, the President of the Information Technology and Innovation Foundation in Washington DC, who will be supported by other keynote speakers including:

Dr Nicholas Gruen, CEO, LATERAL ECONOMICS
Mr Lance Hockridge, CEO OF QR NATIONAL
Dr Terry Cutler, CHAIR, 2008 INNOVATION REVIEW

Ms Deena Schiff, A GROUP MD AT TELSTRA
Ms Patricia Kelly, DEPUTY SECRETARY OF DIISR

REGISTER YOUR INTEREST TODAY

Registration by **4 November** is essential
Cost **\$300**
Earlybird registration (before 15 October) is **\$275**
Email: info@atse.org.au



INVESTING IN A NEEDLE-FREE FUTURE

Researchers at The University of Queensland are at the cutting edge of commercialisation.

One of Australia's largest investments in a start-up biotechnology company has been made with the aim of developing a revolutionary needle-free vaccine delivery system. The investment will enable Professor Mark Kendall from the Australian Institute for Bioengineering and Nanotechnology at UQ to continue his pioneering research and development of the Nanopatch.

The Nanopatch has the potential to dramatically improve patient convenience and reduce the complications associated with needle phobia, needle-stick injuries and cross contamination, which are key global health issues.

Early stage testing in animals has shown that the Nanopatch improves the efficiency of delivery, with much smaller doses required compared to a syringe. It is also designed for thermostability, making it easier and cheaper to transport to developing nations around the world.

The Nanopatch Vaccination Team, led by Professor Kendall, was recently awarded the Australian Research Council Eureka Prize for Excellence in Research by an Interdisciplinary Team.

The Federal Government's 2010 Excellence in Research for Australia (ERA) survey confirmed The University

of Queensland as one of the nation's top two universities, measured on a combination of research quality and breadth. ERA reported that research at UQ is above world standard in more broad fields than at any other Australian university: this reflects UQ's leading global role in many areas of discovery. UQ's outstanding critical mass offers researchers significant interdisciplinary capability.

Join more than 4000 students currently pursuing a research higher degree at UQ.

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