

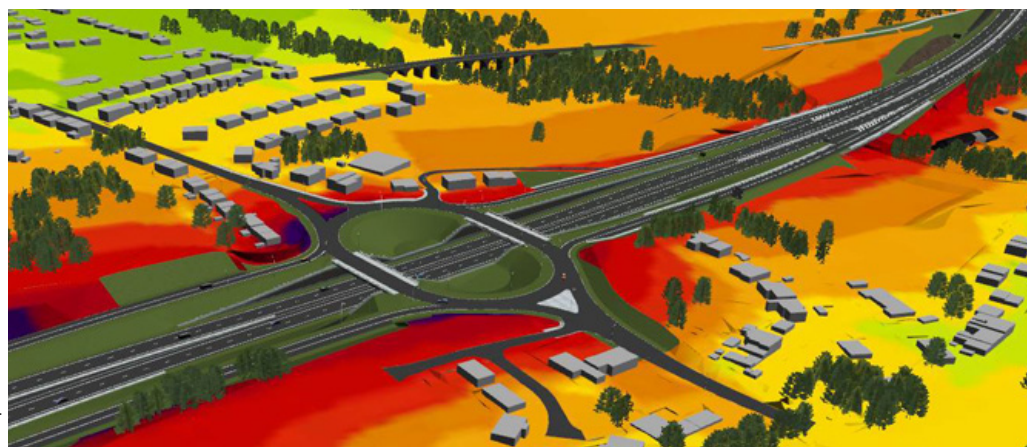
BOOSTING OUR SMEs

OPTIMISING INNOVATION AND TECHNOLOGY

Contributors discuss the impact of innovation and technology in small and medium enterprises (SMEs) and cross-fertilisation between SME sectors and big business

Innovation / Seeing is believing

1 October 2012 / 1 / Ben Cooper-Woolley



Do you digest data more effectively if it's presented graphically? Would you trust data presented outside of traditional tables and graphs to make important decisions on subjects such as your building maintenance, the cost of public transport or whether or not you object to a road being built?

I believe innovative visualisation of data can help us to engage with data and improve our decision making process. Quite simply, informative, engaging, graphical representations of data make for effective communication. Data visualisation can take many forms: from infographics that provide a concise visual representation of cumbersome pages of data or text to detailed interactive time series visualisations that enable users to navigate through spans of time at the click of a mouse, or explore virtual 3D digital environments.

We've used the latter successfully for several public consultations on major projects. Using innovative visual tools, users can explore existing and proposed locations in digital virtual environments and gain an understanding of the invisible infrastructure and information flows that keep them functioning.

I've been involved in a number of large-scale infrastructure projects for Arup where we've used data visualisation to help local residents and communities understand the impact the project will have on them. It is my experience that the greatest levels of engagement are achieved when people can use tools that they're already familiar with to discover and explore why we're doing something and how it will benefit them. For example, using widely used online, interactive maps (like Google Maps) or exploring virtual environments using an Xbox controller to see how a place or area will be affected.

For one project, we enabled people affected by a highway project (the A465 in South Wales) to interact with a 3D visual representation of our latest thinking on the project design. This gave them a much greater understanding of how it might impact the landscape familiar to them.

Live building information can also be displayed graphically to give people a simple summary of the building's current performance and environmental impact. Graphical visualisations can help people relate building metrics to real world equivalents – comparing current and historic electricity usage to the number of computers currently on, for example.

Would you rely on graphical data visualisations as part of your decision-making process, or do you think they're too far removed from the safety of the numbers they represent?

Contributor /
Ben Cooper-Woolley



I am based in Arup's Sydney office and have a background in geographical information systems (GIS). I work with teams from around the world to use spatial technology to facilitate the communication and better understanding of complex data.

I'm passionate about making information meaningful and relevant to the intended audience. On a daily basis I do this by creating interactive, data-driven experiences that range from web-based data visualisations to mobile applications and 3D real time digital environments.

Thoughts /

The best solutions can only come about by continually listening, learning and challenging. That's why we've created Thoughts - a place for experts, practitioners and enthusiasts to talk about the issues affecting the built environment now and in the future. Please join us.

www.arup.com/thoughts

3

Eat like a bird, poop like an elephant

By Erol Harvey

5

Collaborating to manage innovation and technology

By Adam Long

8

CA offers a three-tier support program

By Doron Ben-Meir



Front cover: A microfluidic DNA analysis card being developed by MiniFAB.
PHOTO: MiniFAB



Climate change – always in the headlines (page 20).

- 11 The keys to the cloud
- 13 CSIRO rolls up its sleeves with SMEs
- 16 Science meets Parliament means “unfiltered access”
- 17 Third ATSE Roundtable moves to Adelaide
- 20 The IPCC: “delinquent teenager” or disciplined guardian?
- 24 Let’s stop pretending and just do it
- 30 Energy productivity – how prosperity and energy are linked
- 34 Schaffer report targets global engineering lead for Queensland
- 41 ATSE in *Focus*

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 articles will be considered for publication. Items between 800 and 1400 words are preferred. Please address comments, suggested topics and article for publication to editor@atse.org.au.

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He's engineering ways to help others.

What would you like to achieve?

Darren Lomman, UWA Engineering graduate and CEO of The Dreamfit Foundation, with Shane Thompson, the inspiration behind Dreamfit.

Darren Lomman is a graduate from The University of Western Australia who is using his mechanical engineering knowledge and practical skills to help people with disabilities fulfil their dreams.

Through The Dreamfit Foundation, of which Darren is the founder and CEO, he works alongside volunteers and engineering students from UWA to design and re-engineer innovative recreational equipment.

"My connection to UWA has continued through Dreamfit's partnership with UWA. Engineering students can be involved in a range of Dreamfit's unique projects whilst receiving course credit for their work. It is a win-win situation for everyone concerned. The students gain vital practical industry experience under the guidance of mentors whilst helping people with disabilities to live their dreams."

UWA produces Engineering graduates that have industry experience, creativity and passion. Like Darren Lomman, many of them go on to be innovators in their chosen field.

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**THE UNIVERSITY OF
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Eat like a bird, poop like an elephant

Many surveys have shown the importance of external sources of innovation – clients, customers, buyers and competitors are sources second only in importance to internal employees.



By Erol Harvey
erolharvey@minifab.com.au

The headline is a quote from Guy Kawasaki in a talk I heard him give in 2002. He has since written on the idea in his book *Rules for Revolutionaries: The Capitalist Manifesto for Creating and Marketing New Products and Services*.

In relation to their body mass, birds eat a lot. Hummingbirds eat 50 per cent of their bodyweight each day. Elephants are famous for the volume of their output.

So the headline phrase is about how entrepreneurial SMEs should relentlessly consume and absorb knowledge about their industry, customers and competition, and then how this digested information should be shared in large volumes to employees, collaborators, the market and even to competitors.

Another approach to this challenge could be 'How to do everything when you have so little'. The answers are that you have to make a little go a long way, focus and depth are vital and collaborations are essential.

For any business, but particularly for a SME, the business environment extends well beyond the confines of the enterprise you are in, and being an active and contributing part of your business environment is critical to success.

Open Innovation is a term coined by Henry Chesbrough roughly 10 years ago and is becoming a mainstream strategy for both large and small companies. The concept of active participation in a broad innovation and entrepreneurial environment is increasingly common, independent of the size of the organisation.

This talks to the concept of sourcing ideas that drive innovation from a range of external agencies, including competitors. At MiniFAB we have built our business

model as a contract product developer and manufacturer of microfluidics and consumable medical devices, tapping directly into the trend to outsourced innovation. More than 80 per cent of our business is with clients outside Australia.

During a recent visit to a Science Park around the University of Twente in The Netherlands (*Focus* No. 173 August 2012, page 24) nearly everybody we spoke to referred to the "ecosystem" that existed around the Kennispark (a Dutch word for Knowledge Park). The participants in the Kennispark include two universities, the local and federal governments, agencies, consultants, firms and support businesses. Even the new football stadium is in the middle of the Kennispark and considered part of the ecosystem.

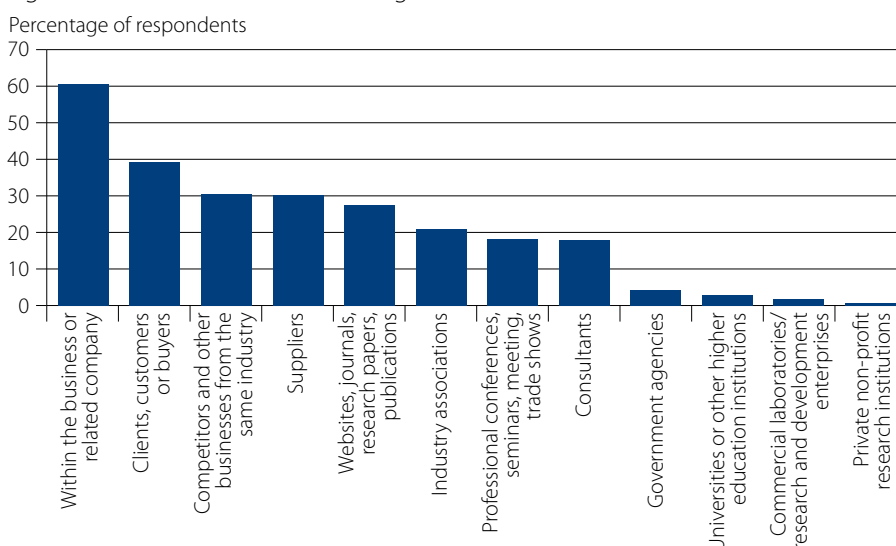
The range of networking events and collaboration opportunities that existed was impressive, from formal events and presentations to monthly 'boring-but-important' talks on in-depth

technical, legal and financial issues. All events are apparently well supported by the participants in the Kennispark.

Many surveys have shown the importance of sources of innovation that are external to the organisation concerned. Clients, customers, buyers and competitors are sources second only in importance to internal employees. So being in an active, dynamic and stimulating business environment is a critical element to success of any innovating SME. There are many elements to this environment, from the all-encompassing ecosystem referred to by the Dutch to the more modest regional cluster or even business incubator you find yourself in.

Current communication and social networking tools give Australian SMEs global access in a way that was formerly only afforded to large multinational organisations – so that now this entrepreneurial ecosystem can be truly international.

Figure 1 Source of innovation among innovation-active firms



SOURCE: ABS (2010) INNOVATION IN AUSTRALIAN BUSINESS 2008-2009, CATALOGUE NO B158.0

Professor Göran Roos, a consultant to the Prime Minister's Manufacturing Taskforce and the South Australian Government's Thinker in Residence, is a frequent speaker and commentator in Australia. He points out that there are nine key elements to success in the high-cost environment Australian businesses find themselves in:

- 1 Ambitious leadership** – we must aim to be the best in the world at what we do.
- 2 Skilled workforce** – our people are not a commodity, they are our investment.
- 3 Global** – the Australian market will never be large enough to support the specialisation needed – we must be global.
- 4 Focus and depth** – other words for niche, but with more impact.
- 5 Distributed business structure** – don't try to do everything yourself. Build valuable partnerships. This is the best way to contend with our geographical isolation from major markets.
- 6 Strategic alignment with client** – be an important part of their success and they will help address your challenges. Sensible intellectual property arrangements will make this work.

7 Products and services with value – compete on the basis of value and not on the basis of cost.

8 Innovation – make this part of the fabric of the company. It is a process that can be managed and will be the engine of competitiveness.

9 Linkages with research institutions that reduce business risk and drive innovation – research is a global industry and it is not hard to build connections to major research in Europe, North America or China. Building those connections in Australia is unnecessarily difficult for a variety of reasons and needs urgent attention.

Like all areas, the focus on commercialisation and innovation goes through cycles and has its share of fads. Over the past 20 years that I have been involved in SME innovation I have noticed that the fashion for commercialisation pathways has changed – and doubtless will continue to change.

For some time the Venture Capital process was seen to be the major driver of innovation and it was judged that too much involvement from governments or universities was a bad thing. Professors were seen to offer little to the process other

than to contribute to the initial idea. Certainly involving academics in the entrepreneurial team was regarded with suspicion by investors and commentators.

Since the Global Financial Crisis many of the Venture Capital investment models have collapsed and have been shown to have been over-hyped, perhaps even more so than some of the technologies they were investing in. Now the relative stability of public institutions such as universities is seen as attractive to helping shield new ventures from financial and technical buffeting.

There is another even more valuable contribution that I believe academic researchers have to

offer the innovative SME. That is one of global technology networking. Any good academic will be an active participant with his or her international peers in the development of the subject. High performance academics have extensive and trusted relationships that are both highly competitive for grants, confidential in the peer review processes that are used, and collaborative in terms of discoveries.

In MiniFAB's early days our commercial partners and competitors could not understand how internationally connected we could be even when our marketing budget was a fraction of theirs. The secret lay in tapping into and using the extensive global academic network that was our company's origins. Therein lies one of the value propositions that could encourage improved industrial and academic collaboration in Australia.

Once identified as being part of an entrepreneurial ecosystem, the next step to success lies in the SME being able to find value within that ecosystem. Tapping into innovation processes, facilities, infrastructure, experience, knowledge and networks all contribute to SME success.

The SME must have the ability to focus and build depth. Again feeding off the ecosystem helps and creates competitive value within the products and services offered.

The SME must – lastly – contribute back to the development of the ecosystem, the 'pooping' part of the equation. Only by being an active and valued contributor to the entrepreneurial ecosystem can the process be made sustainable.

At some times that means helping your competitors, but more often you will find they are helping you.

DR EROL HARVEY FTSE is CEO, MiniFAB (Aust) Pty Ltd, a product development company and OEM volume manufacturer of polymer-based microfluidic, lab-on-a-chip diagnostic devices for clients around the world. Originally trained in laser and plasma physics, he has been involved in commercial and academic development of micro, nano and bio-production techniques for more than 20 years. A former Professor of Microtechnology at Swinburne University, he served on the Australian Government's Future Manufacturing Industry Innovation Council (FMIIC) and is a Member of MANCEF, the global association focused on the commercialisation of small technologies, and the Victorian Manufacturing Hall of Fame.



Medical device manufacture at MiniFAB.

Collaborating to manage innovation and technology

Creating the right working environment is a critical part of a collaborative approach to innovation; creative and innovative people are attracted to autonomy and the freedom to explore.



By Adam Long

a.long@qsrinternational.com

While we may think of ourselves as a dynamic and innovative country, in truth Australia needs to turn its attention towards fostering innovation. We rank 22nd in the world for innovation and while we are very good at undertaking research we are far less successful at taking that research and applying it to commercial outcomes.

In the US for example, the alignment between research organisations, universities and commercial enterprise is especially powerful and through their collaboration many great inventions and solutions have been born.

Australia is home to many great companies, many great research organisations and many great ideas. There is however definitely more work to be done to foster collaboration between these organisations and improve our national innovation scorecard. Every business – and especially small business – has an important role to play in creating not only its own but a powerful national culture of innovation.

The good news, however, is that this is not as difficult as many companies imagine. While it does take a mind shift and often a culture change, there are a number of simple steps to applying a collaborative approach to managing innovation and technology.

Innovation requires an understanding of available and existing technology, an understanding of your industry – and it must produce a deliverable result

that generates value to a user. For QSR International, innovation is where an understanding of our users and technology meet, resulting in outstanding products for the research industry.

The other important thing to remember is that taking on board customer feedback is not a substitute for self-generated innovation. Yes, customer feedback provides invaluable insight into your market but the greatest inventions are borne out of innovation, which means the process for any organisation must begin with a strong product vision and strategy.

Product strategy

To set an agenda for the product development process you must have a formulated idea for how you will foster collaboration and innovation. It is this product strategy that will guide the specific activities the company needs to take in order to innovate.

For QSR it starts with technology and a platform strategy that outlines the big picture perspective on what technically we want to achieve. There is also a product feature roadmap that outlines the specifics of what part of the development process we are going to deliver when. We make sure we have incremental deliverables for every quarter, which allows us to make decisions around priorities.

The product strategy also includes competitor analysis and articulating how we will maintain our position as the market leader. We also analyse alternative industries and observe what they are doing and also what trends are becoming prevalent.

Creating the right working environment is a critical part of a collaborative approach to innovation. It's important to understand that creative and innovative people are attracted to roles that provide them with some autonomy and the freedom to explore.

At QSR we adopted a 'Development Days' policy, which we modelled on practices at leading innovators Google, 3M and Atlassian. This means that our employees can use a set amount of time to work on personal development or charitable projects. This includes everything from time to explore their concepts and ideas in more detail to attending training days, conferences and doing research work. This has helped not only with job satisfaction for the team, but also helped us significantly with our recruitment efforts.

It is also important to have fun together on non-work activities and to provide people with the flexibility to work in the most productive way possible for them personally. We have flexible start and finish times for different people within the development team and also offer weekly work-from-home days and part-time opportunities for those who need it.

Project management

Project management is at the heart of any business' product development and rigid methodologies can often be key factors in restricting innovation. By adopting a flexible approach – such as the agile method – the important outcomes of the project are not just delivery on the scope, cost and schedule but also the value and

**LETTERS
TO THE
EDITOR**

ATSE Focus welcomes letters from readers in response to published article or on technological science and related topics.

PLEASE KEEP LETTERS BRIEF. LONGER LETTERS MAY BE RUN AS CONTRIBUTED ARTICLES.

Please address to editor@atse.org.au

Harnessing business and technology to develop sustainable community enterprises.

Improving collaborative Australia-Asia research, industry and community partnerships to assist in the development of economic prosperity, environment and well-being of Asian communities is just one of the research concentrations of The Australian Centre for Asian Business (ACAB).

In a recent collaboration with Renmin University in China, the ACAB participated in a Group Mission project with support from the *Australia-China Science and Research Fund*. Led by Professor Ying Zhu, Dr David Ness, and Dr Ke Xing, the group has conducted research into how social entrepreneurship and community enterprises can help rural and regional communities in Australia and Asia to transform and cope with challenges, as well as capitalising on emerging opportunities in relation to government and business initiatives.

One focus of this research project, is to investigate synergistic innovation and business models for utilising information and communications technology infrastructure via mobile and broadband networks, as well as platforms such as internet portals, cloud technology, EFTPOS devices and mobile phones.

These innovative financial and technological service products support social entrepreneurship and supply/value chain collaborations for small-medium sized community enterprise development.

Building on the project's success the ACAB have secured further funding for a project, entitled 'Building bilateral relationships of ICT systems for remote communities in Australia and Malaysia' which has been funded through the Department of Foreign Affairs and Trade (DFAT) in partnership with the Australia-Malaysia Institute.

These projects highlight how the ACAB is continuing to empower local entrepreneurship within rural and regional communities by engaging with businesses and securing Asian investment. These opportunities are directly transforming and sustaining communities by introducing infrastructure systems that provides a positive impact today and for future generations.

For more information about research at the University of South Australia please visit unisa.edu.au/research

From left to right: Dr David Ness, Professor Ying Zhu and Dr Ke Xing (all from the ACAB) are pictured with a woman from the ancient Bulong ethnic group, in Mangjing Village China. One of the areas where they have spent time working with rural and regional communities to introduce technological and business infrastructure systems.



**University of
South Australia**

the quality of what is delivered. Agile is the methodology used by QSR to great success because it is highly flexible and interactive.

Using this method we have come to value collaboration more than ever. For example, every day the team spends 15 minutes in a stand-up meeting talking through what they worked on yesterday, what they are working on today and what challenges they are facing. The rest of the team then contribute with advice and we re-adjust our priorities on the go as a result.

We also rank all the pieces of work as critical, important, desirable or 'out of scope' to prioritise delivery times. In addition, we focus on short iterations for design and development with each to be implemented in two weeks at the most, minimising the 'work in progress' by ensuring each element is completed.

All of these elements help us to achieve and provide value. Achieving quality on the other hand comes through a combination of defect tracking, performance tracking, unit tests and continuous integration.

Another important part of a collaborative approach to innovation is knowing what is possible for your company to achieve and knowing when you should look to bring in existing ideas or technology. The most innovative companies often stick exactly to their area of expertise but choose to add best-of-breed existing technology to enhance their products.

At QSR this step is about maintaining our innovation focus on inventing in our own technology space by not unnecessarily reinventing good technology in other areas. We prefer to license some technology, which reduces our development and maintenance effort and increases our speed to market with products.

While we've established that customer feedback is no replacement for innovation, it has a vital role to play in quality product development. At QSR International we set our product vision based on input from customer surveys, customer interviews and even customer observations.

We combine this with our knowledge of industry best practice, gathered at conferences, in interactions with competitors and from research collected from journal articles and the media to map the ideal customer experience. The next stage for engaging our customers is beta testing through focus groups, forums and application analytics.



WHY SHOULD YOU BETA TEST?

- To validate your objectives and confirm that the market is there for your product. It also ensures the product delivers value to customers and is of high quality.
- To collaborate with beta testing customers to improve outcomes through refinement.
- To improve your product marketing. Beta testing means the interaction with customers has been constant and they are at the ready to become product champions once it is launched.
- To optimise your product plans, identify gaps and future opportunities.

Once established in your business, this collaborative approach to managing innovation and technology can only be maintained through strong leadership. As with any shift in your business, innovation as a culture must be fostered from the top down. At QSR we have achieved buy-in and support for our collaborative approach not just from the product development team but also the marketing division, the management team and the Board of Directors. This ensures we not only walk the talk, but most importantly deliver valuable products to our customers.

Adam Long is the Chief Technology Officer at QSR International and is responsible for the vision and development of QSR's software products, including the world's most popular qualitative research software – NVivo. Adam is passionate about innovation and technology, especially where it is applied to create value for organisations and delight customers. He has held a range of software development roles over 20 years, including previous positions at Aviva, IBM Global Services and the ANZ Banking Group. Adam holds an Honours degree in Business Systems and a Master's degree in Information Management and Systems from Monash University.

VALE NANCY MILLIS

The Academy regrets to advise that Academy Stalwart Emeritus Professor Nancy Millis AC MBE FAA FTSE died on 29 September aged 90 at Epworth Hospital, Melbourne, where she had been convalescing following a recent car accident. Professor Millis had an illustrious career, which commenced with the pioneering study of biotechnology in Australia and culminated in her appointment as the Chancellor of La Trobe University from 1992, a position she held until her retirement in 2006. She had continued her work at the University of Melbourne since, working a full day in the Department of Microbiology and Immunology, until her recent accident. She joined the Academy in 1977.

CA offers a three-tier support program

Entrepreneurial success turns IP into a product, process or service that people want to buy. It requires technical understanding, market insight, financial resources and execution talent.



By Doron Ben-Meir

doron.ben-meir@innovation.gov.au

There is clear consensus that innovation is an essential component of modern, growing economies. Less clear is precisely what we mean by 'innovation'.

Many equate innovation with invention and consequently look to our research and development (R&D) efforts for insight into our national innovation performance. There is a correlation between the two, but to equate them neglects the fundamental reason why innovation is so economically important.

When we innovate we look to create a better (faster, more efficient or cheaper) way of doing things. For those benefits to flow through the economy, many people and/or organisations must derive those

benefits. Put simply, if people don't use the innovation, there is no economic benefit.

It is more appropriate, therefore, to think of innovation not simply as invention, but invention plus adoption. And the most common mechanism by which people adopt an invention for their day-to-day use is through commercialisation – in other words, they buy it.

This semantic argument matters because the assumption that good inventions will somehow sell themselves (i.e. invention = innovation) lies at the heart of our relatively poor track record in commercialisation.

Our challenge, therefore, is not simply to invent better ways of doing things

(R&D), but to successfully commercialise them so that the economic benefits flow through society, creating new jobs, new industries and higher productivity.

Entrepreneurial endeavour involves turning raw intellectual property (IP) into a product, process or service that people want to buy. Success requires a combination of technical understanding, market insight, financial resources and execution talent.

The essential skill of the entrepreneur is to harness all of these to enable full realisation of the commercialisation opportunity. That's what inspires optimism and attracts the smart money.

Few Australian researchers and inventors have the entrepreneurial talent the investment community seeks.

Figure 1 Value of grants by key technology

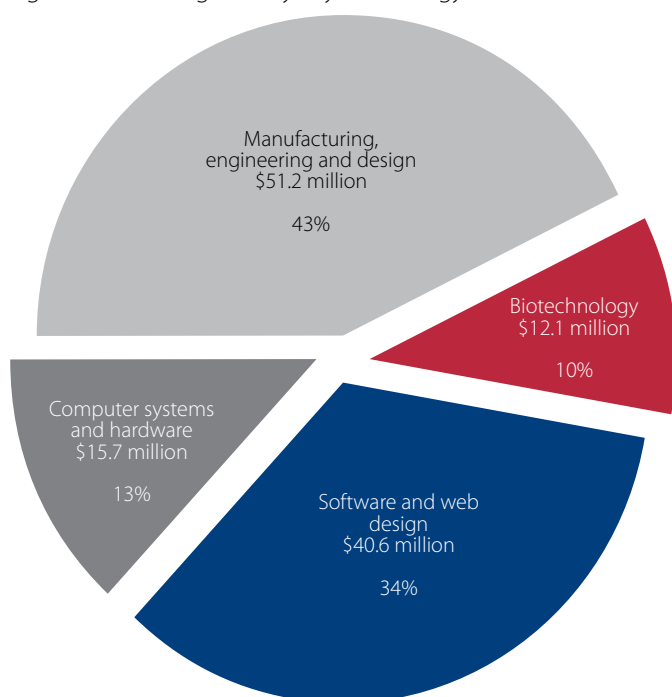
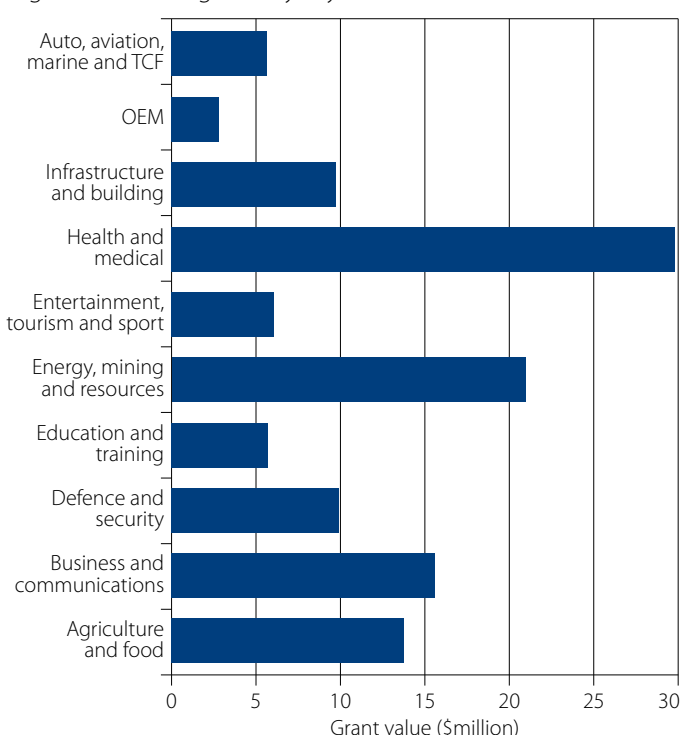


Figure 2 Value of grants by key market



As at 1 August, 2012, 303 participants have been supported with grants valued at \$119.6 million

The limited availability of risk capital makes it doubly difficult to attract the right people to help build investable propositions. This 'catch 22' is largely to blame for what is termed the 'valley of death' – a place where many early stage businesses with promising IP end up, after running out of capital before they can establish traction in their target market.

For the most part, successful commercialisation is the result of founders relying on their own resources or being able to secure investment from angel investors, strategic corporations or family and friends. To take fuller advantage of our substantial investment in R&D and our inventive talents more generally, we need to consider mechanisms by which talented people may be brought together and better resourced so that more quality opportunities make it across the valley of death and emerge as viable businesses.

Commercialisation Australia (CA) addresses this challenge with a three-tiered program designed to grow an effective early stage commercialisation ecosystem that feeds on its own success and provides an environment which encourages and supports entrepreneurial endeavour at its grass roots. Established by the Australian Government in January 2010, it comprises grant funding, Case Managers and Volunteer Business Mentors.

Grant funding

CA has been allocated \$278 million from 2010 through to 2014 with an ongoing allocation of \$82 million a year thereafter. Funding is available through competitive grants under four components:

- Skills & Knowledge – up to \$50,000;
- Experienced Executives – up to \$350,000 (over two years);
- Proof of Concept – up to \$250,000; and
- Early Stage Commercialisation – \$50,000 up to \$2,000,000.

Funding for each component is highly competitive and all applications are assessed by the CA Board across five criteria:

- need for funding;
- market opportunity;
- value proposition;



CA Participant FirstPhysio's new tool, HALO, is a handheld digital goniometer for physical and occupational therapists that measures angles digitally in three planes of movement.

- management capability; and
- national benefits.

Subject to a bona fide need for funding (that is, the applicant neither has nor could reasonably be expected to obtain the necessary funds from other sources to progress the project without Government assistance), these criteria aim to identify viable and sustainable business opportunities with attractive value propositions.

Case Managers

Each applicant is allocated a Case Manager (CM) to provide feedback during the application process. The CM is also required to analyse each application and provide a written assessment to the CA Board providing detailed commentary on each of the merit criteria.

Once an applicant successfully enters the program, CMs provide ongoing non-executive assistance for the duration of the grant term.

CMs are successful business builders and advisers in their own right, with direct experience in commercialising IP and the ability to provide substantial assistance to participants in developing their entrepreneurial capabilities and business networks. While participants work closely with an assigned CM, they also have access to the collective skills, experience and domain expertise of the entire CM network (currently 26 around the country).

Importantly, CMs are incentivised to work with each other to deliver value addition to CA participants, ensuring every participant may potentially gain

**CONTRIBUTIONS
ARE WELCOME**

Opinion pieces on technological science and related topics, preferably between 600 and 1400 words, will be considered for publication.

They must list the full name of the author, if a Fellow of the Academy. Other contributors should provide their full name, title/role and organisation (if relevant) and email address.

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advantage from the combined skills and experience of the team. Many participants are already enjoying the benefits of such fruitful collaborations.

Expert network

Effective entrepreneurs know that building a business is all about reaching the right people at the right time. To further catalyse this activity CA has established an expert network (currently known as the Volunteer Business Mentor – VBM – network). The network reduces the degrees of separation between participating companies and the people they ideally should meet.

Importantly, only CA CMs have access to the expert network, to protect members from unwanted or inappropriate communication. Once the facilitated meeting concludes, experts and participants are free to develop whatever relationship (if any) they choose. There are no commitments on mentors, participation is entirely at their discretion and they may opt out of the network at any time.

Experts highlight their areas of interest within CA's database so that CMs can

source experts with particular experience and skills. This information is treated in strictest confidence and is only accessible by CMs and CA administrative staff.

The system also works in reverse. Experts have access to the full list of CA participants and can request introductions to companies of interest. The CMs then qualify this interest with the participants before making the introduction.

Over time the network will grow in depth and breadth, providing all CA participants with a significant resource for adding value to their businesses. This infrastructure provides for a virtuous circle as successful entrepreneurs look to give back and can channel their interest through the CA participant base.

CA is keen to attract new members who fall into one or more of the following categories:

- successful entrepreneurs who have commercialised new IP;
- domain experts with specific market and/or technological expertise; and
- professional investors with a focus on early stage, innovative business.

To date CA has supported more than 300 businesses and invested \$120 million. A number of outstanding portfolio companies are now generating solid revenues and securing significant private investment.

The story is really only just beginning but the results to date, and the interest generated within the entrepreneurial community, auger well for significant achievements in the years to come.

DORON BEN-MEIR, Chief Executive Officer of Commercialisation Australia, has extensive experience in commercialisation, innovation, technology and the venture capital industry. Over 20 years he has been involved in numerous venture capital organisations and founded six start-up companies, as well as been an investor, investment manager and/or adviser to several others. He has been involved in identifying and assisting innovative companies to commercialise their intellectual property and transition through various stages of business development. He holds a BSc and a Bachelor of Electrical and Computer Systems Engineering and has built a substantial network both domestically and internationally.

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CONTENT MATTERS

The keys to the cloud

Even if your cloud data could be secure, it may never be truly private – because your data on someone else's disk isn't yours!



By Rick Harvey
rick.harvey@lock-box.com

So you want to use the Public Cloud for sharing information? Perhaps you are working on a cross-company project or you are a business that needs to interact with clients.

There are plenty of choices: Dropbox, Google Drive, (Microsoft) SkyDrive, Apple iCloud and numerous others. All are tempting: cheap, easy, convenient and scalable.

Unfortunately, cloud services also have risks, especially if information is confidential, sensitive or private. These risks are real as evidenced by frequent news of data leaks, security breaches, and hackers or rogue administrators compromising people's data.

Though cloud sharing providers promote lots of 'trust us' marketing and make reassuring promises about security and privacy risks, their fine print says otherwise.

For example, the Google Drive terms of service give Google a "worldwide license" to use your data as it pleases, while disclaiming all liability if your data is compromised. This is typical for all large cloud sharing providers – all care, no responsibility!

So even if your cloud data could be secure, it may never be truly private. Essentially, this is because your data on someone else's disk isn't yours!

Market dilemma

There is no doubt that individuals and companies dealing with sensitive information want data privacy.

But along with the benefits of cloud sharing, comes significant security and privacy risks. So what are the choices?

■ If you are a small business or consumer, you may choose to 'take the risk' in order to enjoy the benefits

of the Public Cloud, such as low cost, convenience and flexibility.

■ If you are a large organisation, then the risks may be too high, so you may choose to keep your systems in-house or incur the expense of building and operating your own Private Cloud.

In a perfect world, you would have both: the benefits of the Public Cloud along with some way to ensure your data is under your complete control, independent of the cloud sharing provider.

The answer to the privacy and sharing dilemma is encryption and keys. Encryption can lock down data wherever it resides. Keys can control who is able to unlock the data and thus limit sharing to only those who have been given appropriate keys.

So why isn't everybody doing this? After all, encryption is as old as the ages. The obstacle is how to manage and share the keys.

Lockbox's solution

Lockbox's new way of thinking arose from deep domain experience in security, privacy and cryptography. The lead developers behind the Lockbox technology also founded and have led the development of one of the world's best regarded open source cryptographic projects which is being used by over 10,000 organisations around the world including Google (in Android), NASA, Visa and Coca-Cola, just to name a few.

The Lockbox key management platform makes use of a lightweight automated key agent on each user device. From the users' perspective, the act of storing or sharing data is as simple as

dropping it into a folder on their device.

Behind the scenes, the Lockbox key agent is managing all the encryption, the creation and distribution of keys and certificates to other agents, checking digital signatures and more. The user does what he always does, while the Lockbox key management platform makes it happen using the highest standards of security and privacy.

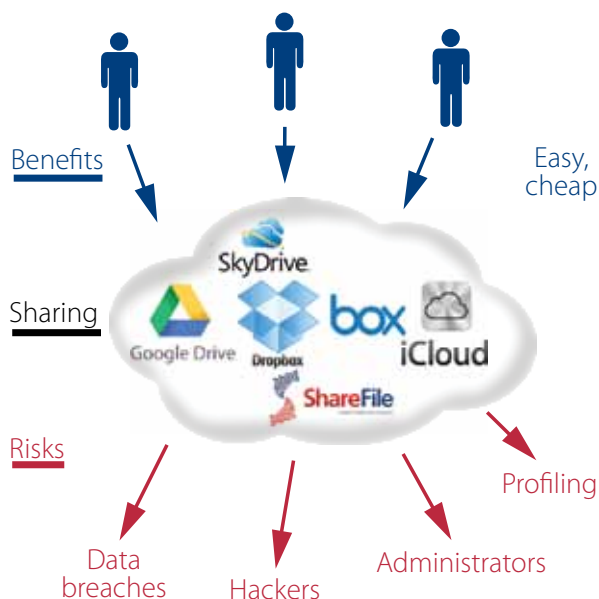
The technology is truly unique. A portfolio of patents has been filed for innovations in security, privacy and key management. Recent awards include the 2012 Australian iAward for security and at the 2012 Security Network conference (US).

Growing the business

The market rewards technology when it produces easy-to-use products with quickly realisable value. Lockbox has released a range of products that allow organisations to save real money by using Public Cloud services to store and share data with all the advantages of high security and privacy, and without the need for dedicated IT infrastructure or staff.

Most of the many thousands of Lockbox users today are non-IT professionals – accountants, lawyers, doctors, financial brokers and more. In many cases they have a statutory responsibility to preserve the privacy of client data which is now assured by their use of Lockbox. The fact that these non-technical users are using Lockbox for secure and private data sharing is significant validation of Lockbox's approach and strategy.

The Lockbox key management platform makes use of a lightweight automated key agent on each user device. From the users' perspective, the act of storing or sharing data is as simple as dropping it into a folder on their device.



CLOUD DILEMMAS

Public Cloud sharing and privacy are almost mutually exclusive. Cloud storage offers great convenience and cost savings, but offers no guarantees about the privacy or security of data. Melbourne-based Lockbox has recently launched a new product claimed to allow any user to share information privately and securely in the Public Cloud. Lockbox says its innovation solves the Public Cloud's sharing and privacy dilemma by protecting data with encryption and controlling how it is shared with keys. Lockbox says this brings the highest levels of security and privacy to cloud sharing and has the potential to open a vast new world of privacy-enabled applications.

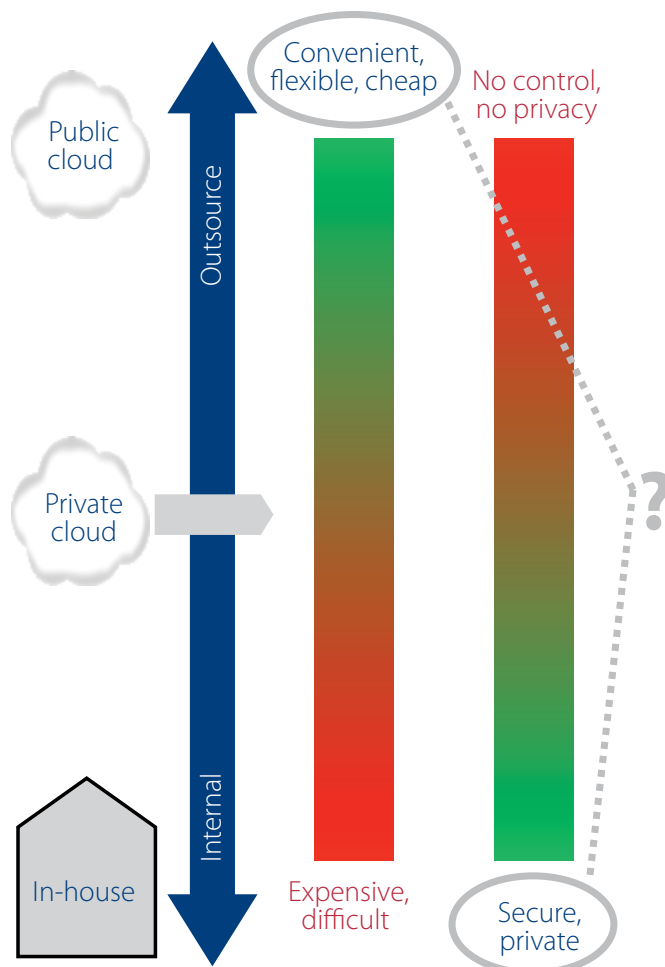
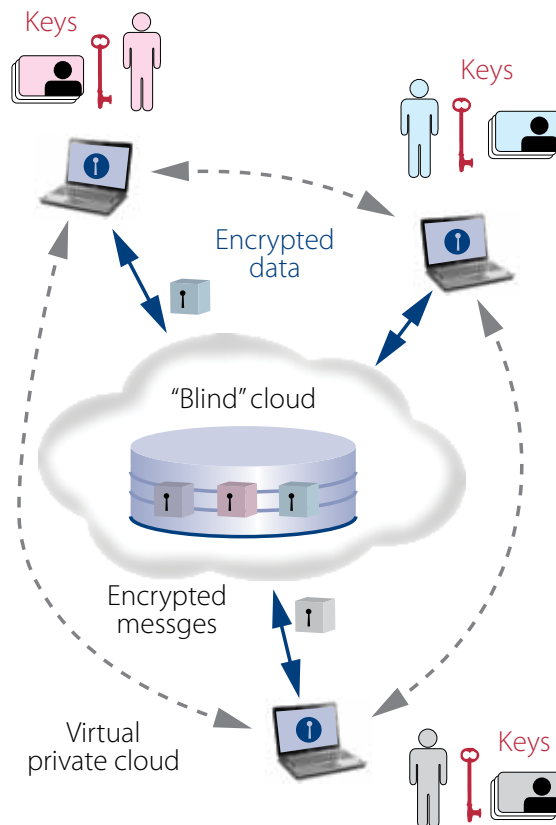
Lockbox is now in the stage of building significant growth, moving from early adopters to mass market. The timing is good as there is growing concern about the continual erosion of privacy. The longer-term plan is to use the Lockbox technology to enable true privacy and security for a vast array of applications, from totally private social networking to private communications and collaboration.

The Lockbox vision is for any person or organisation to easily share information using the cloud, whilst keeping full control of their privacy. All you need is your keys to the cloud!

RICK HARVEY FACS FIEAust CPEng is a well regarded technologist, executive and entrepreneur. He has 25 years' experience developing world-class security products and running international R&D teams. Currently, he is CTO at Lockbox having previously been SVP/Distinguished Engineer at CA, VP Development at Platinum Technologies and CTO/Founder of a highly successful Australian security start-up in the mid-1990s. He has filed 40 patents in distributed management, security and privacy, and is a regular industry presenter and advisor to start-ups, VCs and government. Mr Harvey has an honours degree in Electrical and Computer Systems Engineering and is a Fellow of both the Australian Computer Society and the Institution of Engineers Australia.

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CSIRO rolls up its sleeves with SMEs

It's tough and it takes resilience, nerve and courage. It takes positive people who can work together to develop ideas, to see and seize an opportunity.



By Michael Egan
michael.egan@csiro.au

The world is about to change, as it does every year. Spring comes and is followed, hopefully, by a good summer. Yet every year is different.

How do we know a good year from bad? Is it the taste of the fruit, the brightness of the flowers, or is it by size, weight or price that we measure a good season? Does a good season come about by chance, because of environmental influences or when someone does something new, different or more timely?

What matters is what delivers value.

For Botanical Resources Australia (BRA), a Tasmanian small-medium enterprise (SME), another harvest will come, and the company has taken steps to provide value beyond the production of nature's insecticide, the Pyrethrum daisy.

Today, BRA produces more than 60 per cent of the world's supply of Pyrethrum. It's also a company that has been working with CSIRO to develop new knowledge. While it has R&D activity, the company recognised it didn't have the resources or equipment to rethink its techniques and needed access to other capabilities.

So, together with Dr Jack Ryan, a synthetic organic chemist from CSIRO, BRA worked to develop new techniques for more efficient production of new products that are set to expand the company. And now, as a result of more interaction with CSIRO scientists, BRA has identified an opportunity to use its waste product to develop new revenue streams.

These links are not obvious – if they were, every country would be delivering research and invention to innovation and competitive advantage. However, it is broadly acknowledged that Australia could be doing this much better than it does now.

CSIRO is trying to address this with its SME Engagement Centre. The aim of

the SME Engagement Centre is to facilitate SMEs seeking to gain a competitive advantage through the use of the problem-solving capabilities and intellectual horsepower that research institutions such as CSIRO can provide. Ideally, we aim to find those businesses we think we can help before they come in search of us; helping to break down barriers, build trust in the research community, and help SMEs understand the value research can provide.

Companies may come to CSIRO for all sorts of reasons, perhaps legislation has changed and the company can't continue using the same methods, the product needs to be improved to make it more competitive or the company has reached the point where it needs to diversify its product in order to expand.

Already we know the SMEs that have experience in collaborating with research scientists. Some sectors

are more sophisticated in terms of collaboration, such as IT and biotech. They exist on their technology and have knowledgeable people who know how to engage in the research community.

CSIRO is also very aware that there are other domains, such as food or general manufacturing, where there are a vast number of companies but many are small – with little, if any, research capability. We understand that there are many businesses that work under short-term pressures and don't have the time, contacts or knowledge to seek out the research to be more competitive in the long term, either from areas that are familiar to them or to make the links to research from other areas that have application for their business.

Since 1949, when CSIRO was set up under the *Science and Industry Research Act*, with the post-war impetus to advance technology and reach to a



Dr Jack Ryan holding an image of the structure of Pyrethrum.

better future, CSIRO has had a primary function to encourage or facilitate the application or utilisation of the results of its research. Making sure our science is used is even more relevant now.

Today CSIRO delivers well in research terms and is the only Australian R&D organisation positioned in the world's top10, with 14 research fields in the top one per cent of global research organisations.

CSIRO is diverse and widely dispersed, with about 6500 staff, a \$1 billion budget and interests across five broad areas: food, health and life science industries;

projects there is a tacit knowledge exchange where the researcher works in industry and can experience first-hand the pressure SMEs are under and decisions they face.

The company, in turn, develops more sophisticated technical knowledge.

AW Bell, for example, is a family-owned Victorian company that has been supplying metal parts for Australian industry for more than 50 years and has 100 staff. It needed new technology to tap into an international market opportunity in the aerospace sector. Working with CSIRO researchers it

CSIRO wants to do more with Australian SMEs and find the new ways of working that will deliver to SMEs and support the development of sustainable business. One way to do this is increasing the interaction between researchers and business.

energy; environment; information and communications; and manufacturing, materials and minerals. CSIRO works with more than 1000 SMEs each year, as well as having deep links to many large Australian companies and about 375 multinational corporations.

In addition to all this, CSIRO executes around 80 new commercial licences every year, has spun out more than 150 companies and holds an interest in 34, which have a market capitalisation of \$1 billion and generate \$120 million in annual sales.

CSIRO wants to do more with Australian SMEs and find the new ways of working that will deliver to SMEs and support the development of sustainable business. It sees one way to do this is increasing the interaction between researchers and business where there is an expectation that researchers spend time in and out of industry. This builds understanding between people, so they can see where they can provide value, with a flow of knowledge in both directions.

This is already happening with the support of the Enterprise Connect Researcher in Business (RIB) program. The CSIRO SME Engagement Centre has facilitated more than 50 of these projects, where almost half of these use research capability outside of CSIRO. The goal here is to identify the best capability to support the needs of the SME and its market.

This program supports researchers working in the SME on a technical challenge faced by the company. In these

developed a new aluminium casting technique that virtually eliminates materials waste and produces lightweight, high-strength, complex precision parts for the North American market.

Axxin is a small biomedical design and development company of about 25 staff founded in 2007 that saw a need to develop new products and engaged CSIRO researchers to help on a new equipment design for drug detection. From early negotiations to engagement took less than two weeks.

While every case is not usually that quick, especially where IP is complex, CSIRO does want to come up with solutions that make companies effective. There needs to be clarification around risk and reward to get this to work, so it's a question of working out that balance together.

CSIRO's Australian Growth Partnerships program helps it work with Australian SMEs it believes in and supports with investment funding.

Direct Nickel (DNi) is another SME that engaged in the RIB program and has developed its engagement to a significant AGP project that will demonstrate DNi's nickel extraction technology in a purpose-built pilot facility in Western Australia.

There are others:

- Dyesol is developing a highly efficient application in building-integrated photo-voltaic materials;
- Biofiba is working on the production process of eco-friendly export shipping pallets;

■ AQ1 is developing new marine sensing technology with applications in prawn farming; and

■ MDI is developing a new manufacturing process to increase throughput by five times at half the cost, to support its growth in international markets.

Each one of these SMEs is achieving positive impact with CSIRO and there are plenty of examples, but neither invention nor innovation is easy. It is tough and it takes resilience, nerve and courage. It takes positive people who can work together to develop ideas with business and technology, to see and seize an opportunity where others may not. It needs people who take action on knowledge.

SME Engagement is about getting the right people together with the best possible support and advice to develop their skills and take that leap. The links that we build here will help SMEs engage with our strategy in precincts that are looking to leverage the research capability of Australia and good industrial links need to start now.

"Watching the daisies grow" was an expression Alan Turing, born 100 years ago and considered one of the pioneers of the computer, coined to describe morphogenesis, the biological process that creates cellular patterns and determines an organism's shape.

We are working on how best to build the links and networks between humans that will help us form clusters of people who share a common ambition in innovation.

And for this to happen there needs to be an alignment of mutual incentives, there needs to be shared projects that will help research organisations and SMEs understand each other, work together and build trust. How do we measure the value of that?

MICHAEL EGAN is the Corporate Manager of the CSIRO Small & Medium Enterprise Engagement Centre. He previously spent 14 years in industry covering material processing, metrology and semiconductor production in Europe, the Middle East, Japan and the US. Using core technology from Imperial College London, Michael was a founding member of a successful company making solid state high power lasers specialising in applications in the materials processing and microelectronics markets. This company now enjoys 233 per cent year-on-year growth and was listed as the fifth fastest growing venture capital backed company in the UK in April 2006 and third fastest in 2007.

STELR-API solar cars running

THE AUSTRALIAN POWER INSTITUTE (API) has sponsored a new STELR thrust to extend the solar section of ATSE's STELR (Science and Technology Education Leveraging Relevance) renewable energy program now running in 300 schools nationwide.

API's \$30,000 sponsorship has enabled 900 solar car kits to be distributed to participating schools across Australia on the basis of population.

API's support means 60 schools have each received 15 basic solar car kits on which they can build their own version of a solar car. The kit includes a chassis, two PV cells, a four-speed gearbox and motor, basic wheels and axles, plus a 10-Farad supercapacitor.

The challenge for each school – eagerly grasped by students – is to design a fast vehicle with plenty of style.

One of the first schools to get the program going was Brentwood Secondary College in Melbourne. Teacher Robin Gamble had his Year Nine class very involved in the program, and said the winning vehicle included LED lights and some well-designed wiring to include the capacitor.

As a bonus to the program, API bursary coordinators in each state/territory are allocating API bursary holders one or more of the 60 schools to visit and encourage students to consider engineering, in particular power engineering, as a career.

The first to visit was Matt Thomson, studying power engineering at Queensland University of Technology, who was invited by teacher Wendy Clark to visit Immanuel Lutheran College at Buderim, south of Brisbane. He reported a very successful visit with plenty of design ideas being worked up by the students.



PHOTO: BRETT WORTMAN/APN

API Bursary holder Matt Thomas (centre) from QUT watches (from left) Lishan Collins, Mayumi Chamberlain and Ryan Johann put their alfoil reflector ideas together at Buderim.



Lishan, Mayumi and Ryan cheer on their winning combination, which uses reflector-boosted PV cells.

MYER GRANT BOOSTS STELR

The Trustees of the Sidney Myer Fund have provided a grant of \$55,000 for the deployment of the STELR educational initiative in 10 targeted financially disadvantaged, rural or remote Australian schools that would otherwise be unable to participate in the program.

The grant will provide the hands-on solar and wind power kits, curriculum materials, specialised training for teachers and ongoing support for the schools.

ATSE will work with State and Territory Education Departments to identify and recruit schools that would otherwise be unable to take up the STELR program, targeting at least one school from each state and territory.

Funding will help leverage the best educational outcomes for young people in the targeted communities by demonstrating the relevance of science to their lives, engendering a greater enthusiasm for science and revealing study pathways to careers where there is a shortage of trained engineers, technologists and trades people.

Top universities choose Focus

The recently released Shanghai Jiao Tong University Academic Ranking of World Universities named five Australian universities in the top 100. Three of these leading academic institutions advertise in ATSE Focus – The University of Melbourne (57), The University of Queensland (90) and The University of Western Australia (96). Another advertiser, the University of South Australia, was one of the five ATN universities that were ranked in the top 300 of the subsequently released Quacquarelli



Symonds rankings. We acknowledge their support. Advertising inquiries should be directed to editor@atse.org.au.

Tertiary Education Minister Senator Chris Evans said Australia now had the third highest number of universities in the top 100.

"This is an outstanding result when you consider that the top two countries have significantly more universities than Australia's 37. There are 4495 universities in the US and 115 in the UK."

ATSE prominent at CAETS meetings in Zurich

A four-Fellow team represented the Academy at the 2012 CAETS (International Council of Academies of Engineering and Technological Sciences) meetings in Zurich in August, hosted by 2012 CAETS President – and former Swiss Academy of Engineering Sciences (SATW) President Professor René Dändliker and current SATW President, Professor Ulrich Suter.

The ATSE delegation to Zurich consisted of Professor Robin Batterham (President), Professor Mike Manton, Dr Vaughan Beck and Professor John Zillman, a former President of ATSE and CAETS.

From the Australian perspective, the CAETS meetings were successful and productive. The ATSE-led low-carbon energy group, led by Dr Beck, has been transformed into a standing committee of CAETS and there is considerable opportunity for further useful inter-academy collaboration on energy research and related issues over the next few years.

The 2012 program – excellently organised by Dr Hans Hänni who represented SATW at the 2005 CAETS

Convocation in Cairns – consisted of:

- meetings of the CAETS Executive Committee and Board of Directors (including Professor Manton) on 29 August and an evening welcome from the Swiss Government and the Mayor of Zurich;
- an all-day symposium on ‘Urban Development and Public Transportation: Improved Understanding of their Interdependencies’ on 30 August; and
- an all-day meeting of the CAETS Council on 31 August, which included a number of general business items and briefings and formal approval of a new CAETS Statement based on the outcome of the Symposium.

The Executive and Board meetings on Wednesday 29 August dealt mainly with preparations for the Council meeting and a range of administrative matters including the sensitive issue of encouraging the smaller-contributing academies to increase their annual support for the CAETS Budget. The meetings were efficiently organised by long-serving CAETS

Secretary-Treasurer Bill Salmon, of the US.

The symposium was opened by Dr Mauro Dell’Ambrogio, Swiss State Secretary for Education and Research, with about 100 participants including senior figures from the Swiss transport, urban planning and general industry sectors, in addition to the 50-odd CAETS participants. It included technical sessions on:

- urbanisation, land use and transport;
- planning and implementation of public transportation systems;
- innovation in transportation systems; and
- intermodality and integration in transportation systems.

There were many excellent presentations, which provided a good overview of modern developments in transportation in several countries, including especially the impressive and far-sighted Swiss system of public transport. The conference was followed by a dinner for participants at the Guild House of Blacksmiths in downtown Zurich with some short speeches and traditional Swiss music.

Science meets Parliament means “unfiltered access”

The Academy – as a sponsor of Science meets Parliament 2012 – supported two early career scientists to attend the event in Canberra in September. Dr Hamish Innes-Brown is a research scientist at the Bionics Institute in Melbourne, who was nominated by Mr Gerry Moriarty AM FTSE, and Dr Jasmin Craufurd-Hill, a Senior Reactor Systems Engineer at ANSTO, who was nominated by Mr Martin Thomas AM FTSE.

Hamish is a research scientist at the Bionics Institute in Melbourne who is interested in all aspects of how the mind perceives and builds up a representation of the outside world. He has a Bachelor of Cognitive Science from the University of Western Australia, and a PhD in neuroscience from Swinburne University. Currently, he is working to improve the way that vital but subtle sounds are transmitted via a bionic ear to the brain. Perceiving these sounds properly is crucial for communication and function in complex social, education and work environments.

Jasmin was the first person to drive OPAL, Australia’s only nuclear reactor, at its full potential of 20 megawatts thermal heat. Now onto her third reactor operator licence, she is the only female currently qualified to drive it. She is also a lead

systems engineer in charge of radiation monitoring systems, the outgoing president of Women in Nuclear Australia and is on the board of the international body of Women in Nuclear.

“The most dangerous thing I do each day, without a doubt, is drive to work,” Jasmin says. “And the most common spills in this workplace are from coffee.” In the 10 years that she’s worked at ANSTO the highest exposure to radiation she has experienced was from a CT scan she received after being hit by a car and from a bone scan she had after breaking her wrist.

Reporting on the event to ATSE, Hamish noted that 188 scientists ascended Capital Hill to mix with Senators, Members, political advisers, journalists and a host of other people involved in policy-making and politics.

“We were given unfiltered access to the machinery that drives the nation. The result was an impressive whirlwind of organised chaos, with an emphasis on as much interaction between the scientists and politicians as possible,” Hamish says.

“One of the main themes that came out of the exercise was the need for greater communication of Australian science to our policy-makers. There are currently only 12 Senators and Members

The Council meeting on Friday, August 31 was chaired by President René Dändliker with support from Bill Salmon and active participation from most academies. The highlights included:

- formal election (according to the CAETS rotation system) of Board members for 2013 including incoming CAETS President for 2013, Professor Janos Ginsztler, President of the Hungarian Academy of Engineering (HAE);
- a report on CAETS links with other international organisations (including UN System organisations, the World Federation of Engineering Organizations (WFEO) and the International Council for Science (ICSU)) by Professor Manton as chair of the CAETS Committee on International Organisations (CIO);
- a briefing from ICSU representative Professor Rik Leemans on ICSU's Future Earth program, including discussion of various avenues for CAETS-ICSU cooperation on disaster risk reduction and other issues;

- a comprehensive presentation by Dr Beck on the CAETS project he has led for the past few years on low-carbon energy technology;
- two lively Council discussion sessions led by Professor Manton (with Professor Batterham as a key commentator) and former CAETS President, Achiel van Cauwenberg of Belgium;
- a constructive review of the draft CAETS Statement 'Urban development and public transport', including its five key recommendations, for consideration by governments, national transport and urban planning authorities and other public and private sector organisations involved in the planning and implementation of urban development and transportation systems over the next 50 years. The statement was formally approved by the Council for national and international promulgation by member academies.

The Council also previewed next year's CAETS meetings and symposium planned for 26 to 28 June 2013 in Budapest

(on 'Current Innovative Approaches to Engineering Education') and the 2014 Convocation planned for late May/early June 2014 in China on the theme of 'Engineering and the Future of Mankind'.

The brief closing ceremony included presentation of certificates of appreciation to outgoing Board members including Professor Manton. With the completion of his two-year term, ATSE is not due for election to the Board of Directors again until 2016.

The formal CAETS events were followed by an informative Saturday bus trip for Academy delegates to inspect progress on the new Gotthard Base Tunnel through the Swiss Alps which, when completed, will be the world's longest (57km) and deepest railway tunnel. The tour included a late-afternoon visit to the Operations Centre of a private Swiss Rail Company.

ATSE was one of the five founding academies of CAETS in 1978 and the CAETS membership now stands at 26 engineering and/or applied science academies, all but three of which were represented at Zurich.

of Parliament who have science degrees, and thus it is vital that scientists themselves are able to stand up and communicate effective messages to politicians on the issues that matter.

"As well as improving our own methods of communication, it's also important to try and educate policy-makers on what science can and cannot provide.

"Thinking in science continually changes as new evidence is gathered. In the political landscape, this is all too often called a 'back-flip.' We need to work towards

an understanding that policy should be changed according to the prevailing balance of evidence and where a change in policy doesn't result in an erosion of trust in the evidence.



"Events like Science meets Parliament are a fantastic way to start this process. I feel enormously privileged to have been able to attend, and hope that the event continues to grow."

Third ATSE Roundtable moves to Adelaide

THE THIRD IN THE SERIES of ATSE Industry Roundtables, held in Adelaide in September, brought together leaders from business, government and universities in South Australia.

Convened by ATSE Vice President Professor Susan Pond AM FTSE and the ATSE SA Division Committee Chair, Mr David Klingberg AO FTSE, the Roundtable was hosted by Mr Rob Chapman, Chairman, Bank SA Advisory Board.

The other industry participants were Ms Jane Kittel (Managing Director, Bank SA), Mr Geoff Knight (CEO, Department of Manufacturing, Innovation, Trade, Resources and Energy), Mr Stephen Young (Executive Chairman, E&A Ltd), Mr Stephen Ludlam (CEO, ASC Pty Ltd), Mr Frank Seeley AM (Chairman, Seeley International), Mr Rob Stobbe (CEO, ETSA Utilities), and Robert Chalmers (MD, Adelaide Research & Innovation, University of Adelaide).

ATSE President-elect Dr Alan Finkel AM FTSE, Vice President Professor Mary O'Kane FTSE, University of South Australia Chancellor Dr Ian Gould AM FTSE, Bionomics CEO Dr Deborah Rathjen FTSE and Flinders University Vice-Chancellor Professor Michael Barber FTSE represented ATSE.

With science, engineering and technological innovation central drivers of productivity growth across the whole economy, the purpose of the ATSE Roundtables is to understand through the discussions with influential business leaders what Australia needs to do to improve its position in sectors where the country is already strong and diversify into and develop greater strength in others.

A subset of these discussions is Australia's capacity to attract and retain SET talent, including from the underutilised pool of female talent.

The Adelaide Roundtable agreed that:

- innovation and automation are the keys to Australia's future in manufacturing;



At the Adelaide Roundtable (from left, foreground) Susan Pond, Rob Chapman and Alan Finkel.

- improving scientific literacy in the Australian population is key to unlocking productivity growth; and
- changing corporate culture to embrace diversity, to promote women, to incorporate time sharing, flexible hours – for both men and women – leads to shareholder benefits.

Earlier Roundtables were hosted in Sydney in September 2011 by Telstra Chair Dr Catherine Livingstone AO FTSE and in Melbourne in March by Qantas Chair Mr Leigh Clifford AO FTSE.

The Roundtables are planned to lead to a set of recommendations on which ATSE and its industry partners can take action.

The Roundtable, which included lunch, was followed the same evening with a dinner briefing to SA parliamentarians and staff, which focused on 'Public Policy for Innovative Technology Industries'.

It was hosted by The Speaker of the House,

the Hon Lyn Breuer, and attendees included the Hon Gail Gago, Minister for the Status of Women, and some 20 other Members and guests. ATSE was represented by Directors Dr Finkel, Professor Pond, Professor O'Kane, Professor Mike Miller AO FTSE and SA Division Fellows Dr Meera Verma FTSE (SA Secretary) and Dr Gould.

The dinner discussed public policy actions that might be taken to address the decline in innovation and productivity in technology industries, the deepening of skills shortages and the lack of progression of women in these fields to senior ranks.

Minister Gago commented on the SA Government approach to improving the status of women, and the discussion addressed possible future actions that could contribute to addressing the challenges for innovative technology industries.

Science is "crucial" to policy development

Science is crucial to policy development because it is relevant to almost every decision we make, it is a process by which the best decisions can be made and it is inherently international, according to Australia's Chief Scientist, Professor Ian Chubb.

He told a Canberra audience recently that scientific evidence was often seen as a source of unimpeachable authority that should dispel political prejudices. Its appeal was as an objective rock that could ground the bias and interests of politicians.

"But scientists develop theories to explain the evidence. And as new facts emerge, or new observations made, theories are challenged – and changed

when the evidence stands scrutiny. Science rarely yields unequivocal facts. It can however, give you the best possible understanding on the best available evidence. It works in the realm of probability.

"It is for this reason that the idea of involving science in policy development is gaining traction worldwide. Good science will encompass global issues and it will add to the knowledge we need to solve or mitigate global problems.

"Now more than ever, governments rely on the perspective of science – the product of science, the evidence, for guidance. The problems they have to grapple with appear ever more complex."

GE's \$10 million for cleantech innovation

GE and five venture capital partners have pledged \$10 million to find, fund and bring to market breakthrough ideas for reducing the carbon footprint from Australia and New Zealand.

GE's local 'ecomagination Challenge' is an open innovation competition which calls on businesses, entrepreneurs, innovators and students to submit real ideas for low-carbon solutions and technologies.

The Challenge is part of GE's global ecomagination initiative, a commitment to imagine and build innovative solutions to today's environmental challenges while driving economic growth.

Selection of five \$100,000 Innovation Award winners will be based on the most progressive ideas that represent entrepreneurship and innovation around technologies, processes and business models. In addition, GE and its Challenge partners will seek to pursue commercial relationships with promising Challenge entrants.

Leading Australian and New Zealand venture capital firms including Southern Cross Venture Partners, MH Carnegie & Co, Cleantech Ventures, CVC Limited and Greenhouse Cleantech are supporting the Challenge.

GE says it will support winning ecomagination Challenge entrants through:

- investment – a \$10 million capital pledge from GE to be invested into promising start-ups and ideas;
- validation – evaluation of entrant's business strategy through in-depth discussions with GE's technical and commercial teams;
- distribution – exploration of partnership opportunities with GE to scale a business and create global reach;
- development – leveraging GE's technical infrastructure and GE Global Research Centres to accelerate technology and product development; and
- growth – exploring opportunities to use existing GE customer relationships for your go-to-market strategy.

Submissions close 30 November with winners announced in early 2013. Submissions to <http://challenge.ecomagination.com/anz>

CSIRO WORKING ON VIETNAM CLIMATE

Australian and Vietnamese climate scientists are working on developing higher-resolution climate change projections for Vietnam, to help in industry and government in Vietnam better understand the likely effects of climate change in their country.

Funded by the Australian Government's aid program, AusAID, the project is delivered by CSIRO in collaboration with Vietnam's Institute of Meteorology, Hydrology and Environment (IMHEN) and Hanoi University of Science. CSIRO has undertaken similar downscaled projections to support climate change planning in the Pacific and in Indonesia.

The CSIRO scientist leading the project, Dr Jack Katzfey, explained that improving knowledge of climate change impacts will help identify the people and sectors at risk and, in doing so, will support Vietnam in the challenging task of prioritising its climate change response.

"Vietnam is one of the countries most vulnerable to climate change, particularly in the Mekong Delta, where rising sea levels, salt water intrusion and flooding are already impacting on vulnerable coastal communities," said Dr Katzfey, adding that the project builds on existing



PHOTO: CSIRO

The Mekong Delta region of Vietnam is already experiencing climate change impacts of increased inundation.

relationships between CSIRO and scientists from Vietnam's Ministry for Natural Resource and Environment and the Hanoi University of Science.

Throughout the project Australian scientists and Vietnamese scientists will work together to share knowledge of the Vietnamese climate system and to ensure that Vietnamese scientists are able to develop future climate projections for their country.

CLIMATE INSTITUTE SAYS WE'RE CONFUSED

Australians are confused about climate science and unconvinced about carbon pricing solutions, but are still 'up for grabs' on both, according to key findings from *Climate of the Nation 2012*, a public climate attitudes research report, released by The Climate Institute.

Climate of the Nation 2012 starts an annual mid-year benchmarking research into public attitudes. It is a mix of national qualitative (focus groups) and national quantitative (poll) research conducted in April and May 2012.

Other key findings included:

- almost two-thirds (64 per cent) agreed that climate change was occurring, but 19 per cent were unsure – a fifth agreed that humans were the main cause, with 49 per cent saying it was due to a mixture of human causes and natural cycles;
- a majority of Australians (54 per cent) are concerned about climate change;
- climate impacts of highest concern were: a more polluted Australia and destruction of the Great Barrier Reef (79 per cent each), more droughts affecting crop production and food supply (78 per cent), and animal and plant species becoming extinct (75 per cent);
- four in five (81 per cent) placed solar energy within their top three preferred energy options, followed by wind power (59 per cent);
- two-thirds (66 per cent) placed coal in their least preferred three options, slightly more than nuclear (64 per cent). Opinion on gas was divided, with 28 per cent having it in their top three and 31 per cent in their bottom three; and
- two-thirds (66 per cent) thought there are too many conflicting opinions for the public to be sure about the claims made around climate change.

The IPCC: “delinquent teenager” or disciplined guardian?



By John Zillman

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The Intergovernmental Panel on Climate Change (IPCC) has now been operating for almost 25 years as the primary international mechanism charged with providing policy-neutral but policy-relevant assessments of the contemporary state of knowledge of the science, impacts and policy implications of climate change.

Although its four major assessments (1990, 1995, 2001 and 2007) have been widely accepted by governments as the definitive source of expert, up-to-date

information on climate change, the IPCC has also been strongly criticised by a significant minority of scientists and other stakeholders who disagree with its procedures or who seek to discredit its conclusions or the greenhouse gas reduction policies based on them.

The criticism intensified in 2009 following the discovery of a Himalayan glacier-melt error in one of the underlying authored chapters (albeit not in the approved Summary for Policy Makers) of the 2007 Fourth Assessment Report,

a media frenzy over leaked email exchanges between a number of IPCC Lead Author scientists, and allegations of conflict of interest against some participants in the IPCC process.

It prompted the IPCC Chairman and the UN Secretary-General, in early 2010, to commission an independent review of IPCC procedures by the non-governmental Inter-Academy Council (IAC), one of the peak bodies of the world's science academies.

While the IAC Review Committee

ATSE'S PARTICIPATION IN THE IPCC PROCESS

The Australian Academy of Technological Sciences and Engineering (ATSE) has a long-standing investment in efforts to ensure the integrity of the IPCC process. Fellow Greg Tegart, then Secretary of the Australian Science and Technology Council (ASTEC), led the Australian delegation to the first session of the IPCC in 1988, chaired the intergovernmental consultations which determined the basic structure and modus operandi for its first assessment and served as Principal Delegate of Australia until 1993.

In 1994, he led a major joint Academies study, funded equally by industry and government, under guidance of a Steering Committee chaired by then ATSE President Sir Rupert Myers and including the presidents of the other Learned Academies and senior representatives of industry and environment organisations, to produce an expert Australian assessment of *Climate Change Science: Current Understanding and Uncertainties* in parallel with, and as input to the Australian government response to, the IPCC's 1995 Second Assessment.

The joint Academies report, launched by Sir Rupert's successor as ATSE President, Sir Arvi Parbo, in March 1995 (ATSE *Focus*, No. 86) provided the scientific foundation for the Academy's October 1995 Invitation Symposium on Greenhouse Abatement Measures – 'No Regrets Action Now', which was immediately preceded by the 1995 Oration by Ian Plimer on 'Geology of Greenhouse' and opened by the then President of the Business Council of Australia, Ian Salmon.

In 1996, ATSE joined with the other Learned Academies in a National Academies Forum (NAF) workshop on 'Australians and our Changing Climate' (in which I made a presentation on 'A Critical Review of the IPCC Second Assessment') and, in 2002, Fellow Jerry Ellis and I convened a further workshop to update the 1995 joint Academies conclusions in the

light of the IPCC's 2001 Third Assessment Report (ATSE *Focus*, No. 124).

The Academy subsequently issued a short Policy Statement on Climate Change in 2004 (ATSE *Focus*, No. 132), which reaffirmed its support for the IPCC assessment process. As the national climate change debate intensified through 2005-06, with increasingly extreme misrepresentation of the IPCC mechanism and its conclusions by both greenhouse activists and sceptics, I felt bound to re-state the essentials of the IPCC process and explain its strengths and weaknesses via a short note in the March 2006 issue (No. 140) of ATSE *Focus*. I argued that, despite the enormous pressures under which it had operated, the IPCC had, thus far, done its job very effectively and served the world well.

I have not been centrally involved in the IPCC assessment process since the completion of the Fourth Assessment in 2007 (my earlier role as South-West Pacific member of the IPCC Bureau from 1994 to 2004 is now carried by ATSE Fellow Neville Smith) and I take no position, here, on either its scientific conclusions or their policy implications. Nor do I consider myself as an apologist for the IPCC, having been, from time to time, among the sternest internal critics of particular aspects of its operation. But I did serve as the only significantly IPCC-knowledgeable independent reviewer of the draft of the 2010 IAC report and I did participate in the October 2010 session of the Panel at which IPCC Member governments determined their initial response to the IAC recommendations. Against this background, I feel it necessary, for the information of those who may be interested, to make clear that I disagree with the basic conclusions of Donna Laframboise's book and I consider that it gives a highly misleading impression of almost every aspect of the IPCC process.

– JOHN ZILLMAN

“found that the IPCC assessment process has been successful overall”, it also offered 22 recommendations for improving the process and enhancing the authority of IPCC reports. Most of the IAC recommendations were accepted by the IPCC Bureau (its elected office bearers) and the more than 100 governments participating in the October 2010 32nd session of the Panel. But the IAC Review also produced a comprehensive file of IPCC stakeholder responses to a Review Committee questionnaire, which has provided a rich source of critical commentary and quotes in support of renewed attack on IPCC personalities, processes and conclusions.

One such recent no-holds-barred attack on the IPCC – which makes extensive use of IAC review material – has been launched by Canadian journalist Donna Laframboise in her 236-page ‘IPCC exposé’ with the unlikely title of *The Delinquent Teenager who was Mistaken for the World’s Top Climate Expert*.

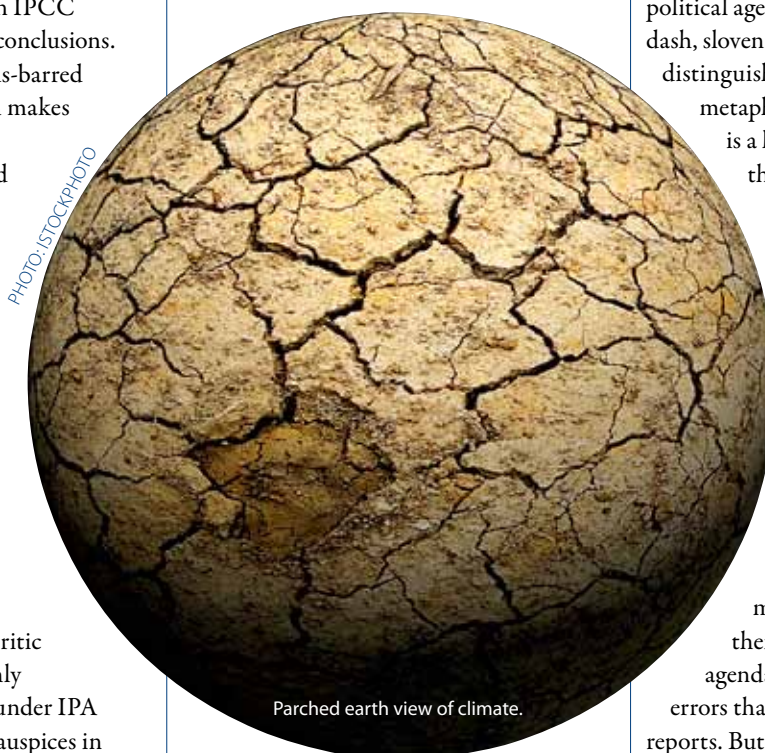
In July 2012, she introduced the Australian edition (published by Connorcourt), with a foreword by ATSE Fellow and climate change science critic Professor Ian Plimer, to highly receptive sell-out audiences under IPA (Institute of Public Affairs) auspices in Melbourne, Sydney, Brisbane and Perth.

Her ‘exposé’ of the IPCC, which is quoted with approval in recent (March, May and June 2012) *Quadrant* critiques of the IPCC by journalist Tony Thomas, relies heavily on denigration of the qualifications, motives and integrity of individual participants in the IPCC assessments to discredit both the assessment process and its findings. It does not deal in any detail with the science of climate change, but its arguments invite detailed response from those with a broader understanding of the climate change issue and a less ideologically shaped perspective on how the IPCC process works.

The Delinquent Teenager is certainly not the first book to attempt to use criticism of the operation of the IPCC as a basis for discrediting its findings on

climate change. Bill Kininmonth’s *Climate Change: A Natural Hazard* (2004), Garth Paltridge’s *The Climate Caper* (2009), Ian Plimer’s *Heaven + Earth* (2009), Bob Carter’s *Climate: The Counter Consensus* (2010) and A W Montford’s *The Hockey Stick Illusion* (2010) all criticise the IPCC assessment process as part of a broader attack on various aspects of the mainstream consensus on the state of knowledge of climate change science.

But the Laframboise book is the first to focus its attack primarily on the IPCC itself and the first to base its arguments so heavily on the qualifications, motives



and integrity of individual participants in the IPCC process. While it provides persuasive advocacy for the sceptic position on human-induced climate change and can be seen, from the sceptic perspective, as a timely counter to the (in my view, comparably conspiratorial) Oreskes and Conway *Merchants of Doubt* (2010), the Laframboise book is full of factual errors, selective quotation and misrepresentation of the IPCC process, which cannot but give the unwitting reader a seriously biased impression of the objectivity and reliability of the IPCC findings on the science.

This is not the place for detailed review and rebuttal of the 36 individual chapters of Donna Laframboise’s book but, because it draws on and reinforces many of the common misunderstandings about the

IPCC process, I feel obliged to explain the basis on which I believe it should be rejected as a credible critique of the IPCC.

In summary:

■ The IPCC is a scientific assessment process not a group of people with a political agenda

Ms Laframboise explains that “This book is about a spoilt child” that “has been admired, flattered and praised” and given little “honest feedback or criticism”. She has formed, or at least presents, an image of the IPCC as an individual or a group of individuals pursuing an irresponsible political agenda, indeed as “a slapdash, slovenly teenager who has trouble distinguishing right from wrong”. The metaphor is ridiculous. The IPCC

is a highly disciplined process through which hundreds of eminent scientists and senior representatives of most of the world’s governments go to enormous lengths to ensure the accuracy, objectivity and integrity of their reports. In such a large, complex, scientific-political process involving thousands of individual experts with different backgrounds, skills, values and motivations it is inevitable that there will be occasional hidden agendas, omissions or scientific

errors that will creep through into its reports. But to suggest that, collectively, the participants in the IPCC process should be characterised as an “obnoxious adolescent” seems slightly bizarre. After several thousand hours of involvement in most aspects of its operation over 25 years, I have never seen anything approaching the IPCC for professionalism, rigour and objectivity in its assessment of the state of knowledge of climate change or of any other field.

■ Most of the most widely quoted sources of criticism of the IPCC are ill-informed, selective or factually wrong

It is difficult to tell how widely read the author really is on the IPCC beyond her quoted references because most of her three pages of description of her own “evidence” focuses on criticism of IPCC sources and what she regards as

the inaccessibility of material in scientific journals. She claims a “more accessible approach” than the IPCC’s reliance on published (mostly peer-reviewed) journal articles and her text notes make extensive use of websites and blogs. While she includes several quotes from the current IPCC Chairman, Rajendra Pachauri, and includes two quotes from his predecessor, Bob Watson, she provides no evidence that she is aware of any of the definitive books and articles on the operation of the IPCC by its first Chairman (Bert Bolin), the long-serving Co-Chair of its Working Group on Climate Change Science (Sir John Houghton) or any of the many other authoritative sources on IPCC procedures and operation. But, most disconcertingly, with little familiarity with the key individuals and issues to guide her, she makes extensive use of selective and mostly anonymous quotes from the hundreds of IPCC-knowledgeable and IPCC-ignorant respondents to the IAC Review. She also relies heavily on quotes from the relatively small band of legitimate scientific critics of the IPCC and from a few disenchanted scientists whose findings have not been accepted or not included in IPCC reports. Her referenced sources are narrow, biased and selective. It would require considerable generosity to suggest that her three years of work on the book provided her with sufficient understanding of the IPCC to offer informed comment on many of the complex issues she attempts to address.

■ Belittling of participants in the IPCC assessment process is not a sufficient basis for discrediting the process or its findings

Through chapters with titles like “Twenty-something graduate students”, “The right gender or the right country”, “Activists” and “Moral midgets”, Ms Laframboise seeks to undermine the credibility of the IPCC by naming and belittling four young scientists who served as Lead Authors before gaining their PhDs, anonymously quoting claims that some Lead Authors were selected primarily on the basis of gender or country of origin, identifying half a dozen Lead Authors with connections to environmental organisations and highlighting some sharp personal clashes that have developed amongst participants in the assessment process. While, in my view, the IPCC has been remarkable for the number of distinguished senior scientists who have agreed to take on the onerous Lead Author responsibilities for one or more assessments, the responsibilities of Lead Author are to review, assess and summarise the published expert literature rather than to write their own views of the science. Some of the best literature summaries in many rapidly developing fields have been written by doctoral students and the best experts on the climate of a country often come from the country concerned. And it would be surprising, indeed, if the intensity of the IPCC process did not

generate some vigorous disagreements and some disillusioned scientists who feel incensed when their views are not accepted by the majority of their peers. Selection of a set of Lead Authors who will provide the best balance of expertise to assess the literature even in the narrow field of an individual IPCC chapter is not straightforward and I have seen Working Group Bureaux spend days working carefully through metre-high piles of CVs of potential Lead Authors nominated by governments and organisations. It is rarely easy to distinguish between many very-well-qualified nominees. I consider that it is more a strength than a weakness of the IPCC process that it has included some promising young scientists as Lead Authors and that, other things being equal, it has sought to achieve a reasonable balance of gender and geography. And I do not accept that scientists with environmental (or business) affiliations are incapable of providing thoroughly professional assessments of the literature in their own fields of scientific expertise.

■ It is important to distinguish between advocacy and analysis

Ms Laframboise explains, in an appendix, that “I marshalled my evidence and ordered my argument in the way that seemed to me to have the greatest chance of persuading a reasonable person with an open mind that this organisation (the IPCC) wields an inappropriate level of influence over our lives – and that it has a credibility score of zero”. If the applause for her Melbourne IPA presentation is a guide, there is no doubt that she is a compelling advocate for the sceptic perspective on human-induced climate change. While she makes no claim to present a balanced picture and is prone to sweeping journalistic dismissal of the many eminent climate scientists whose views she seeks to discredit, it is, in my view, important to make much clearer than she does that *The Delinquent Teenager* is unambiguously a work of advocacy rather than of objective analysis. As a proponent for the sceptic view, Ms Laframboise provides an impressive array of quotes and anecdotes but it seems to me to border on the dishonourable to do this, as she largely does, through personal denigration of IPCC scientists and office-bearers who I know, from observation and

PHOTO: ISTOCKPHOTO



Climate change – always in the headlines.

interaction over many years, to be people of professionalism, honour and integrity.

While this is not the place, either, to take issue with what I regard as the serious misunderstanding, or at least misrepresentation, of substantial areas of climate science in Ian Plimer's recent books on climate change, I feel bound to comment on his foreword to *The Delinquent Teenager*. In particular, I contrast his assertion that "Climate science is a very recent scientific discipline that had an ideological consensus before it was invented" with the, in my view, far more insightful 1975 observation by the late CHB (Bill) Priestley, founding Chief of CSIRO Meteorological Physics and a harsh critic of premature public warnings of climate change, that "it (climatology, climate science) is the oldest science we have".

And I reject Ian's claim that "The IPCC was established to prove pre-ordained conclusions contrary to a huge body of existing validated evidence". As one of those who were intimately involved in both the scientific and intergovernmental

discussions that led to the establishment and initial *modus operandi* of the IPCC, I can assure him that that was not so. The IPCC was established, rather, because governments collectively were not willing to take, on faith, the warnings of the then still relatively small group of very eminent climate scientists who, by the 1980s, had become convinced that enhanced greenhouse warming could present major problems for humanity in the 21st century.

In summary, although I felt that the IAC Review itself was not as insightful or well-informed as might have been hoped, I believe that the overwhelming weight of evidence supports the IAC's conclusion that the IPCC assessment process has been successful overall.

And I believe that, despite the pressures under which it operates, it has served the world well.

I have no problem with Donna Laframboise's advocacy for the opposite conclusion but I think that the reasonable person with an open mind to whom she addresses her book needs to be reminded that her 'evidence' is highly selective and

that the book itself is a work of advocacy rather than analysis. In my view, many of her arguments are invalid and most of her main conclusions are wrong.

A more accurate and informative account of the origin and operation of the IPCC can be found in Bert Bolin's *History of the Science and Politics of Climate Change* published by Cambridge University Press in 2007.

PROFESSOR JOHN ZILLMAN AO FAA FTSE is a Vice Chancellor's Fellow at the University of Melbourne. He was Director of the Bureau of Meteorology (1978 to 2003), President of the World Meteorological Organization (1995 to 2003) and headed the Australian Delegation to the 1987 World Meteorological Congress which led to the establishment of the IPCC. He represented the South-West Pacific on the IPCC Bureau (1994 to 2004) and chaired the international Steering Committee for the Global Climate Observing System (2006-09). He was President of ATSE (2003-06), President of the National Academies Forum (2005-06) and President of the International Council of Academies of Engineering and Technological Sciences (CAETS) in 2005.

Australia needs carbon levy, nuclear energy

ONE OF THE WORLD'S noted energy experts has urged the Australian Government to impose a "carbon duty" on imported goods and services from countries that do not have a carbon tax.

The Director of Energy Research at Oxford University, Professor Sir Chris Llewellyn Smith FRS, says a carbon levy would serve to redress the balance for the absence of a carbon tax among many of Australia's trading partners.

He said he would also like to see Australia introduce a significant amount of nuclear energy into its clean energy mix.

"Of all the major forms of power production, nuclear energy remains the safest. Australia has substantial solar and wind energy resources, but there is no reason why it can't also use nuclear, as well as taking what it can from geothermal and wave energy sources," he said ahead of the clean and renewable energy conference and exhibition 'All-Energy Australia' in Melbourne in October.

"Despite the hysteria it is unlikely anybody will be killed by radiation released as result of the Fukushima nuclear disaster."

Sir Chris was formerly Chairman of the Council of ITER, the international nuclear fusion research and engineering project, which began construction in 2007 in southern France of the experimental ITER reactor, which is hoped to pave the way for a demonstration power plant. He was also Director General of CERN – the European organisation for nuclear research – where he obtained approval for the start of construction of the Large Hadron Collider.

La Trobe tackles tyres to lower emissions

LA TROBE UNIVERSITY is tackling campus carbon dioxide (CO₂) emissions by targeting tyre pressures through an innovative tyre pressure station at its Melbourne campus.

The tyre pressure station, designed to encourage students and staff to ensure their tyres are optimally inflated, communicates data via blue-tooth technology, tracking information on the number of tyres inflated and calculating by how much CO₂ emissions are reduced over time.

Data generated from the system will be used to help reduce La Trobe's carbon footprint. It is an initiative of La Trobe's Department of Electronic Engineering and the Office of Sustainability.

"There are an estimated 6500 staff and student vehicles that come to La Trobe University," says the project's principal investigator, Electronic Engineering PhD candidate Edhem Custovic. "If we can target at least a percentage of these vehicles we're looking at a saving of hundreds of tonnes of carbon emissions per year."

Underinflated tyres have been shown to increase vehicle fuel consumption by up to three per cent and can significantly increase tyre wear. A UK survey found that 72 per cent of tyres on the road were underinflated.

"If there are similar numbers in Australia, up to 12 million cars could have underinflated tyres on our roads, leading to almost a million tonnes of extra carbon emissions emitted every year," Mr Custovic says.

Let's stop pretending and just do it

Universities are an Australian success story but for years we have been busy constructing what is now a dysfunctional, smothering array of regulation



By Fred Hilmer
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What would you think of a nation that had a really successful area of activity but so regulated and constrained the activity that its full potential was not realised, and its competitive position was threatened?

That is the story of universities in Australia today. Universities are an Australian success story. About 20 of our 40 or so universities are ranked in the top 400 universities world-wide. By way of comparison, only eight Australian firms are in the Fortune 500. Students from around the world flock here to obtain world-class qualifications. Education is now our major non-resource export.

Yet for years we have been busy constructing what is now a dysfunctional, smothering array of regulation. We treat our universities as if they were fly-by-night ventures rather than respected colleagues of the best universities

worldwide. And where in recent years universities have received more funding in total (reflecting welcome increases in participation), funding per student continues to decline, and our dependence on international student fees continues to rise. In business parlance, we are milking an area of social and economic strength rather than developing and investing.

If the situation is as bad as I have outlined, why have our rankings continued to be so strong? The answer is that university rankings are backward looking, reflecting work done 10, 20 or even 50 years ago rather than current performance. Nobel Prizes, which strongly influence rankings, are usually awarded for work done many years earlier. Citations and publications in top journals, another key ranking factor also reflect work done many years ago.

If we look forward, the picture for

Australian universities is not nearly as bright. US and UK universities, aided by currency movements, are aggressively recruiting international students. Our Asian neighbours are also developing first-rate institutions as national priorities and they are competing for the best academics and the best students. The best that can be said of policy development over the past 20 or so years is, to quote Mark Twain, "I just grewed". And what has "grewed" is currently a mix of rose-coloured aspirations, oppressive regulation and scrooge-like funding.

Sameness

The stand-out pretence to which we pay lip service in public, though rarely in private, is that all universities are the same. This fetish with sameness limits the benefits that universities could provide. Our students aren't all the same. Industrial and research challenges aren't all the same. Rather

TOP 100 UNIVERSITIES: FIVE, SIX OR SEVEN

Five Australian universities have for the first time been ranked in the world's top 100 in the recently released **Shanghai Jiao Tong** University Academic Ranking of World Universities – with 19 of Australia's 37 public universities making the Top 500. They are The University of Melbourne (57), Australian National University (64), The University of Queensland (90), The University of Sydney (93) and The University of Western Australia (96).

Commenting on the results, Tertiary Education Minister Senator Chris Evans said Australia now had the third highest number of universities in the top 100.

"This is an outstanding result when you consider that the top two countries have significantly more universities than Australia's 37. There are 4495 universities in the US and 115 in the UK.

Other Go8 universities' rankings were Monash University and The University of NSW (100-150) and The University of Adelaide (201-300).

The subsequent release of the **Quacquarelli Symonds** (QS) World University Rankings® showed 25 of Australia's 39 universities in its world's top 500 and seven in its Top 100 rankings – ANU (24), Melbourne (36), Sydney (39), UQ (46), UNSW (52), Monash (61) and UWA (79).

All five ATN universities made the QS top 300 – with RMIT University ranked 246 globally, Curtin University 258, Queensland University of Technology 281, University of Technology Sydney 284, and University of South Australia 293.

Six of the IRU group were listed in the QS Top 500 – with The University of Newcastle at 268, Flinders University 342, James Cook University 362, Griffith University 368, La Trobe University 375 and Murdoch University 448.

The final instalment of the annual rankings – the **Times Higher Education** version – listed six Australian universities in its Top 100 – Melbourne (28), ANU (37), Sydney (62), UQ (65), UNSW (85) and Monash (99). Adelaide (176) and UWA (190) were ranked in the next 100.

Details: www.shanghairanking.com,
www.topuniversities.com/university-rankings/world-university-rankings,
www.timeshighereducation.co.uk/world-university-rankings/2012-13/world-ranking/region/oceania

than sameness, we need differentiation.

The move toward sameness started around 1988 when John Dawkins (then Minister for Employment, Education and Training) restructured the system of universities, colleges of advanced education and institutes of technology into a “unified national system” of universities. All were to be funded the same way, use the same qualifications framework and produce graduates with equivalent degrees.

Since then we keep hoping for and aspiring to diversity, but reward everyone in the same way, referring to teaching, learning and research as if they are identical in each university.

What is the rest of the world doing? Exactly the opposite. China has selected nine universities as its global research flagships and funds them accordingly. And in Europe, there is now recognition that an undifferentiated system will not produce the research or graduates needed to rebuild the European economies. So France is prepared to allocate €1 billion to each of five to seven universities, with similar developments in Germany. These are hard-headed economic commitments in difficult times in Europe, not merely statements of aspiration. The situation is similar in Singapore, South Korea, Switzerland and Finland, to name a few other successful economies.

The US, home to far more leading universities than any other nation, has sharply differentiated public systems alongside a wide range of private institutions.

Why do these nations believe they need world-class universities? For exactly the same reason we do. Innovation is the single most important factor in enhancing productivity and competitiveness. According to the Australian Government’s own innovation blueprint, *Powering Ideas*, an internationally competitive Australian innovation system relies on world-class universities. Public research generates three-quarters of the world’s patents. If universities slip, innovation slips, and national economies follow.

Three reforms are needed to tackle the lack of diversity in Australia. First, we require substantial deregulation and a reaffirmation of the importance of university autonomy to the quality of teaching and research. Second, a new funding model incorporating fee deregulation is vital. And third, we

need a coherent national research strategy within which different types of institutions can play constructive roles.

So, if I were Minister for Education, what would I do?

1 Cut red tape and regulation, in particular:

- restructure the newly formed regulator, TEQSA (Tertiary Education Quality and Standards Agency), as a minimum standards compliance agency;
- make the Australian Qualifications Framework (AQF) advisory rather than a straight jacket to restrain innovation; and
- simplify and cut back reporting and other requirements that add little or no value.

2 Deregulate domestic undergraduate fees

with appropriate access safeguards, focusing on areas such as business and the professions where the education provides the student with high private benefit.

3 Adopt a long-term national strategy for research

recognising national needs as well as capabilities and excellence.

Regulation

By any standards, Australian universities are heavily regulated. The Commonwealth regulation of courses, programs and degrees, despite an avowed goal of differentiation, strongly reinforces sameness. TEQSA and the AQF illustrate the point. Recently the AQF Council proposed axing graduate certificates as not sufficiently “robust”. The consequence according to a number of university leaders is to “enforce a static narrow framework in which few providers go wrong but none can do well” and to limit the capacity of universities to develop innovative offerings.

There are hosts of other examples, including restrictions on one-year masters degrees – restrictions not found at good universities such as Harvard and Cambridge



– and regulation of honours years that is out of step with established practice.

TEQSA and the AQF are the wrong answer to what is, at its most severe, a minor issue of quality.

The Australian quality issue is not about the vast majority of universities, and certainly not about the 20 or so which are ranked internationally. It is about a small number of private and public institutions either in the market or about to enter that need to be held to a minimum standard so “brand Australia” is not tarnished. This could be readily achieved with a far simpler, less intrusive licensing regime. Meddling in the decision-making of what have historically been autonomous, self-accrediting organisations with sound academic and overall governance, if not stopped, will be a costly mistake. Diversity, innovation and autonomy go hand in hand. The incentive of the current regulation is: ‘Don’t change anything unless absolutely necessary! Innovate at your peril’.

Second, all this regulation adds cost with no discernable benefit. The cost of the regulator was the single largest area of increased funding in the

Commonwealth education budget. The costs within institutions are not readily measurable but also significant.

Funding

Every review of universities in recent years has found that we are underfunded and overly dependent on international student income. The need to review funding has become more acute with the demand-driven system recently introduced by the government for undergraduate study. With volume deregulated and price tightly regulated no one should be surprised by unintended and unwanted consequences.

Given the budget situation and substantial increases in cost to the Commonwealth from higher participation, a significant increase in government funding is unlikely. Hence, many Vice-Chancellors are now coming to the view that fee flexibility, with appropriate safeguards to provide access for students from low socio-economic backgrounds, is the best option.

The Government should allow universities to charge increased fees from students in degrees with high private benefit, such as business, law, engineering and medicine. The impact on these students is significantly ameliorated by the HECS system, which requires repayment of fees only when and if certain income thresholds are reached and could be further ameliorated by scholarships.

Research strategy

The third area in critical need of reform is research. We lack a coherent national research strategy that covers long-term funding and whether and where research should be concentrated.

What would it look like? First, it would provide for long-term, consistent funding for facilities, people and operating costs rather than the stop/start approach now in place. Second, grant periods would be extended from three to five years for projects and from seven to 10 years for centres. Third, it would outline priorities reflecting national needs, capabilities and excellence. Finally, it would cover allocation principles for funding such as competition and strategic grants (for example, for new areas of infrastructure) and how these should be balanced.

Such a strategy would allow us to be both more internationally competitive and more cost effective.

Tackling these challenges would be of enormous benefit to Australia.

Innovation and productivity would be stimulated. More students would successfully complete their studies. Contributions to the nation's cultural and social life would be even greater than is the case today.

Freed up to pursue excellence in its different forms, I believe Australian universities can continue to improve their

standing, leading the world in a number of areas and being competitive in others.

But we face a choice: do we milk the sector, living off past successes, or do we get our policy settings right and build on our strengths?

None of the proposed reforms should be hard to implement. Both major parties condemn unnecessary red tape. Both argue for the innovation that fee flexibility would provide, and both recognise the importance of a national research strategy.

All that remains is to "stop pretending and just do it".

This is an edited version of an address by Professor Hilmer to the National Press Club in July.

PROFESSOR FRED HILMER was appointed President and Vice-Chancellor of the University of New South Wales in 2006. Prior to that he was CEO of John Fairfax Holdings Ltd (1998 to 2005). Other previous posts include Dean and Director of the Australian Graduate School of Management at UNSW, a Director of Port Jackson Partners Ltd and a Director of McKinsey & Company, responsible for managing the Australian practice. Professor Hilmer holds a degree in law from the University of Sydney, an LL.M. from the University of Pennsylvania, and an MBA from the Wharton School of Finance, where he was appointed a Joseph Wharton Fellow. He was appointed Chair of the Group of Eight (Go8) in December 2011.

SYDNEY STUDENTS TO DRIVE MARS ROBOTS

Exploring Mars with roving robotics may become a virtual reality for remote and rural students as part of a program underpinning the National Broadband Network (NBN)-Enabled Education and Skills Services Program.

Students will be able to remotely control robots similar to those sent to Mars from their classrooms, says Professor Salah Sukkarieh, Director of Research and Innovation at the Australian Centre for Field Robotics at the University of Sydney.

Professor Sukkarieh and his team were awarded \$1.3 million to bring futuristic technologies to life as the centrepiece of the 'Education 2020: enabling learning in science, engineering and mathematics project', which aims to entice students to study science, engineering

and mathematics in early years at high school and to foster interest in careers in these areas.

"Our participation in the project involves building space robots, teleoperation software and designing new online engineering education curriculum material for high school and university students

across Australia" says Professor Sukkarieh, himself a former mechatronic engineering undergraduate at the university who now teaches space robotics.

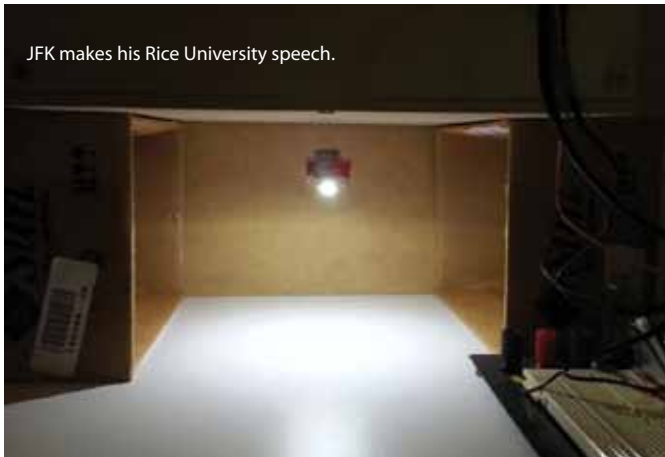
"Using the NBN, students will be able to control the robots, which will be located at the Powerhouse Museum (also in Sydney). We already have experimental Mars Rovers housed there and can already control them remotely via our labs on campus."

Education 2020 is one of several programs the university is involved in focused on encouraging study in science, technology, engineering and maths (STEM), including workshops for high school teachers to increase their knowledge and ability to teach computer science and computational thinking in classrooms. *Education 2020* will be delivered in conjunction with the University of NSW and Sydney's leading science, technology and design museum, the Powerhouse Museum.

Professor Archie Johnston FTSE, Dean of the Faculty of Engineering and Information Technologies, and chair of ATSE's Education Forum, acknowledges the importance of raising participation rates in STEM subjects. "We hope that initiatives such as *Education 2020* will capture the imagination of students and increase the uptake in these areas at school, creating a flow-on effect through to university and, ultimately, address the national skills shortage in these crucial fields," he says.



Professor
Salah Sukkarieh



JFK makes his Rice University speech.

UQ student's levitating light starts bulb buzz

A levitating light bulb invented by a 19-year-old student from the University of Queensland has been singled out as an exciting industry innovation by an American lighting firm.

Chris Rieger's 'LevLight', which hovers below a ceiling while glowing, has been viewed more than 330,000 times on YouTube, spawning features by Britain's Daily Mail and international technology blogs.

Now US lighting company BulbAmerica, the US's largest wholesale provider of quality lighting fixtures and light bulbs, says it is keen to see how the innovative project might shape up for commercial production.

"Rieger's innovative project clearly demonstrates the fact that there are innumerable possibilities when it comes to technological innovations in the lighting," BulbAmerica said on PRWeb, adding "We are really excited to see how this project shapes up for commercial production."

The LevLight combines wireless power transfer and magnetic levitation, a combination of the two technologies believed to be an industry first.

A second-year electrical engineering student, Mr Rieger said he worked on the LevLight for about six months while studying at university.

"What I found is that there are many existing projects of both wireless power transfer or magnetic levitation, but only a few have combined both these technologies," he said. "Once you have both working, it's really just a matter of overlaying them. The high frequency magnetic field generated from the wireless power transfer circuit does not affect the levitation aspect of the build."

The budding inventor has already begun work on an improved LevLight prototype featuring a new levitator designed to have greater strength and a better control system.

50 YEARS SINCE JFK'S RICE UNI MOON SPEECH

It is just 50 years since US President John F Kennedy made his famous "we're going to the moon" speech at Rice University in Houston, Texas.

"We choose to go to the moon," he told a large crowd at Rice University Stadium on 12 September 1962.

"We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organise and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to

postpone, and one which we intend to win, and the others, too.

"But if I were to say, my fellow citizens, that we shall send to the moon, 240,000 miles away from the control station in Houston, a giant rocket more than 300 feet tall, the length of this football field, made of new metal alloys, some of which have not yet been invented, capable of standing heat and stresses several times more than have ever been experienced, fitted together with a precision better than the finest watch, carrying all the equipment needed for propulsion, guidance, control, communications, food and survival, on an untried mission, to an unknown celestial body, and then return it safely to earth, re-entering the atmosphere at speeds of over 25,000 miles per hour, causing heat about half that of the temperature of the sun ... and do all this, and do it right, and do it first before this decade is out – then we must be bold."

Apollo 11 landed on the moon on 20 July 1969 – less than seven years after the Kennedy speech – and Neil Armstrong (who died on 25 August this year, aged 82) became the first person to walk on the moon.

• Thanks to Professor Brian O'Brien FTSE for reminding Focus of the anniversary. The JFK speech transcript and video is available at www.space-video.info/speech/19620912-jfk-rice.html

– Editor



JFK makes his Rice University speech.

We're losing our science connection – Chubb

The Australian community seems to have lost – or be losing – its connection with science, according to Chief Scientist Professor Ian Chubb.

Despite making extensive and productive use of science and its applications every day, the "Apple and Android generation" appeared to lack understanding or comprehension of the science and mathematics and engineering behind the things they focus on or use every day, he told the Science Industry Association recently.

In fact, he said, attitudinal studies of students last year showed what can be best described as a "perverse indifference" to science.

"It could be because humans are no longer worried about the future because we believe we will always have technology and innovation to get out of trouble, as is suggested in the 2010 book *The Rational Optimist*," he said.

"But we really can't take for granted that it will be there when we need it. Without more people studying the science, technology, engineering and mathematics disciplines, our capabilities will slip.

"After school retention rates stabilised in 1992, the proportion of Year 12 students taking physics, chemistry and biology fell by 31, 23 and 32 per cent respectively. And there has been a shift from advanced mathematics to elementary mathematics.

"Enrolments for university mathematics, engineering and a number of the science disciplines have flat-lined for about a decade and IT enrolments, for a number of reasons, have plummeted."

Professor Chubb said there were many reasons but the message that a science education can lead to interesting careers was not "out there" widely enough. "But we must remember that this generation of students has many, many more options open to it than were around when many of us were choosing our study paths, and that they exercise their right of choice.

"And they need to be helped to make the right one. It is up to us to explain science in ways that make the wonder of science clear for all to see."

CSIRO reviews its megatrends



Megan Clark

CSIRO has updated its megatrends forecasting with the release of *Our Future World 2012*, which updates the earlier version published in 2010.

Subtitled 'Global megatrends that will change the way we live', the 32-page report discusses the outcomes from a CSIRO global foresight project. It presents six megatrends that will redefine how the world's people live.

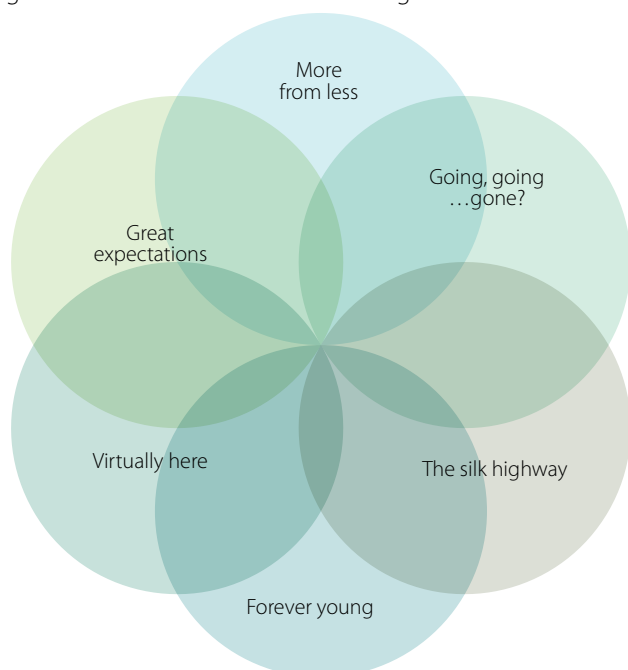
CSIRO describes a megatrend as a collection of trends – patterns of economic, social or environmental activity – that will change the way people live and the science and technology products they demand.

The six interrelated megatrends identified in the report are:

- 1 More from less** – the earth has limited supplies of natural mineral, energy, water and food resources essential for human survival and maintaining lifestyles.
- 2 Going, going ... gone?** – many of the world's natural habitats, plant species and animal species are in decline or at risk of extinction.
- 3 The silk highway** – coming decades will see the world economy shift from west to east and north to south.
- 4 Forever young** – the ageing population is an asset. Australia and many other countries that make up the Organisation for Economic Co-operation and Development (OECD) have an ageing population.
- 5 Virtually here** – what might happen in a world of increased connectivity where individuals, communities, governments and businesses are immersed into the virtual world to a much greater extent than ever before?
- 6 Great expectations** – this is a consumer, societal, demographic and cultural megatrend that explores the rising demand for experiences over products and the rising importance of social relationships.

The report's genesis was a CSIRO global foresight project started in 2009 to inform internal and long-range investment planning choices. The work attracted much interest and, responding to external demand for evidence-based strategy and foresight consulting, a new research team called CSIRO Futures was launched.

Figure 1 The six interrelated CSIRO megatrends



Our Future World is the flagship publication of CSIRO Futures. The 2012 edition follows the first version was released in draft form in March 2010 and notes that the CSIRO Futures team is building a comprehensive multidisciplinary trends database relevant to Australian industry, government and community organisations, with an approximate timeframe of 20 years.

CSIRO CEO Dr Megan Clark FTSE launched the report at the National Press Club in Canberra.

She said the six megatrends all had impacts on how we innovate, what we focus on and how we optimise our efforts.

"The centre of gravity is shifting to our region, economically and in a research and development sense. Australia can't meet the level of investment of our regional neighbours but we can be smarter and more focused about bringing the best we have together," she said.

"We know we cannot compete on sheer volume of investment but we can bring the very best that Australia has together and we can connect with the very best in the world to ensure our innovation is visible from Shanghai, London, Frankfurt, Jakarta and New York.

"One researcher can make a breakthrough but to have a profound impact on the challenges that face this nation and humanity it takes a team, or if you want to build the next Silicon Valley it takes a whole ecosystem.

"There is no reason why, as we head into what is undoubtedly the Asian Century, that Australia should not be a source of excellence in the region, in science, research and innovation," Dr Clark added.

CSIRO AND CHINA BOOST BORDER SECURITY

CSIRO and Chinese company Nuctech have commercialised a world-first cargo scanner that is now installed and in use at Abu Dhabi Airport in the United Arab Emirates and at Nikola Tesla Airport in Serbia.

The device incorporates CSIRO's novel neutron technology and Nuctech's proven X-ray systems and can detect illicit and dangerous goods in air cargo through rapid imaging.

The scanner was developed to solve an urgent global need for the rapid scanning of air cargo. It can also be adapted for scanning sea and truck cargo.

CSIRO's world-first technology combines neutrons and gamma-rays to detect the composition, shape and density of an object, helping identify suspicious materials such as explosives, drugs and other contraband.

Over the past five years numerous alterations to the design have been made to make the device ready for the commercial environment and less costly to manufacture. The latest 'Mark 3' model of the scanner has recycled rubber shielding, new detector systems, a decrease in radiation emissions during scanning and a 10-fold reduction in the neutron flux used during scanning.

Dr Megan Clark FTSE, CSIRO Chief Executive, recently visited the Nuctech facility near Beijing where the cargo scanners are built as part of a mission to deepen CSIRO's relationships with key Chinese partners in research and industry.



The air cargo scanner uses world-first technology to detect the composition, shape and density of an object, helping identify suspicious materials.

More efficient solar cells with quantum dots

DR BAOHUA JIA, from Swinburne University of Technology, is working with quantum dots in thin-film solar cells for increased efficiency – and her work has been awarded with one of three \$25,000 L'Oréal Australia and New Zealand 'For Women in Science Fellowships' for 2012.

The global race for high-efficiency, low-cost solar energy is fierce. Dr Jia and her team are front runners in that race, using her knowledge of nanotechnology. They have already created thin-film solar cells that increase efficiency by 23 per cent, and two patents have been lodged.

Thin-cells efficiently capture visible light but miss the ultraviolet light; quantum dots can convert UV to visible light. So Dr Jia is developing thin-cells with embedded quantum dots, working closely with Suntech Power, the world's largest producer of silicon solar modules.

Dr Jia participated in the April 2009 Australia China Young Scientist Exchange Program, which consolidated linkages with Suntech, leading to a team of researchers from Swinburne collaborating with the company.

Growing up near Beijing, Baohua was fascinated by optics. This led her to a degree in physics, a Masters in optical communications and, in 2002, the opportunity to do a PhD at Swinburne with a microphotronics research team led by Professor Min Gu FAA FTSE.

"Science is beautiful, that's why I love it. It tells you how the world works and the rules behind it," Dr Jia says.

The other two awardees are working in breakthrough areas in medical research. Dr Kylie Mason, a leukaemia survivor, from the Walter and Eliza Hall Institute/Royal Melbourne Hospital, is working on a new treatment for blood cancers. Dr Suetonia Palmer, from the University of Otago, Christchurch, is working on kidney disease treatment.

This is the sixth year of the Australian Fellowships and the first year they have been open to New Zealand scientists. The Fellows were chosen from 142 applicants by a panel of scientists that included CSIRO's Dr Cathy Foley PSM FTSE.

MATHS LEADER WINS FELLOWSHIP

Professor Nalini Joshi FAA, Professor of Applied Mathematics at the University of Sydney, has been named the 2012 Georgina Sweet Australian Laureate Fellow. This fellowship recognises her leading



Dr Baohua Jia

PHOTO: L'ORÉAL AUSTRALIA/SDPMEDIA.COM.AU

research role in science and technology and provides her with additional funding to help her mentor women in science.

"I applied for the Georgina Sweet Australian Laureate Fellowship because I needed a sustained period of time and support to focus on some difficult mathematical problems," she said.

"At the same time, I was very aware of the support my father had given me early in my life, which enabled me to become a mathematician. His philosophy in life was to give before you take. I wanted to support early career researchers, particularly women, to enter and establish careers in mathematics and science as he supported me."

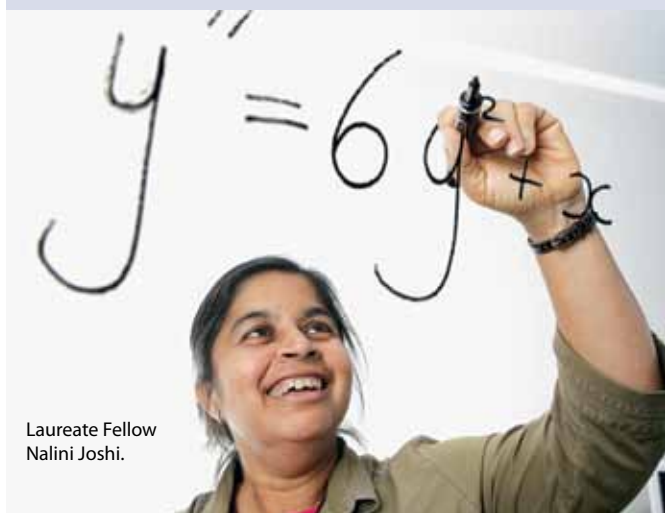
Professor Joshi's Fellowship will help her create new mathematical methods to describe critical solutions of nonlinear systems, which are ubiquitous in modern science. It will also help her increase the profile of women in science through workshops that will simultaneously promote women researchers and provide mentoring-style activities.

"As one of very few women in mathematical research in my early years, I found it incredibly empowering to meet and talk to other women in similar circumstances and hear about their solutions. I would like to bring about similar opportunities for others. I hope to hold two workshops a year, one primarily for early career researchers and one for more experienced researchers," she said.

In 1987, Professor Joshi was awarded her PhD in the field of Applied and Computational Mathematics from Princeton University in the US. Before moving to the University of Sydney in 2002, she held visiting positions at Princeton and was appointed an ARC Senior Research Fellow at the University of Adelaide. She has been a Visiting Fellow at the Isaac Newton Institute for Mathematical Sciences at Cambridge and President of the Australian Mathematical Society.

SUPPORTING WOMEN SCHOLARSHIPS

The Queensland Government has allocated \$10 million to its Supporting Women Scholarships program, which encourages women to enter the fields of agriculture, architecture, engineering, geology, building services and IT. Five hundred scholarships of up to \$20,000 will be available over four years, starting in 2013, for women wanting to study in these fields at Certificate IV through to postgraduate level. The scholarships are available to women of all ages, including school leavers, women looking for a career change and women who are currently out of the workforce and returning to study. Applications closed on 12 October and recipients will be notified in December.



Laureate Fellow
Nalini Joshi.

Energy productivity – how prosperity and energy are linked

Is the global economy like a giant heat engine chugging away at generating our wealth? Energy productivity data seem to say so.



By Tom Biegler

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A recent issue of *Focus* devoted to productivity, innovation and prosperity (February 2012, number 170) barely mentions energy. Yet most of us realise that energy and prosperity are somehow connected.

A standard economic indicator for the link is called 'energy productivity'. Economists watch its progress closely in countries like Australia but don't attach much significance to international comparisons. Complaints that Australia is lagging in productivity generally refer to growth rates, not absolute figures.

However, some intriguing data gathered for the 2009 ATSE report *The Hidden Costs of Electricity: Externalities of Power Generation in Australia* got me wondering: is there a quantitative connection between wealth and energy that has broad significance?

Energy productivity is simply economic output per unit energy input. For an economy it is measured in terms like gross domestic product (GDP) per gigajoule

(1 GJ = 10^9 J). The reciprocal, 'energy intensity', is perhaps more common but I like energy productivity better because it's a more descriptive term that sits well with the current political focus on productivity.

Here are some examples of energy productivity: World \$126/GJ, Asia \$149/GJ, Australia \$128/GJ, USA \$125/GJ, China \$130/GJ, Gibraltar \$131/GJ and Haiti \$120/GJ.

Surprised at how close they are? OK, I confess these were cherry picked, but the many similar numbers in a full global list demand a closer look.

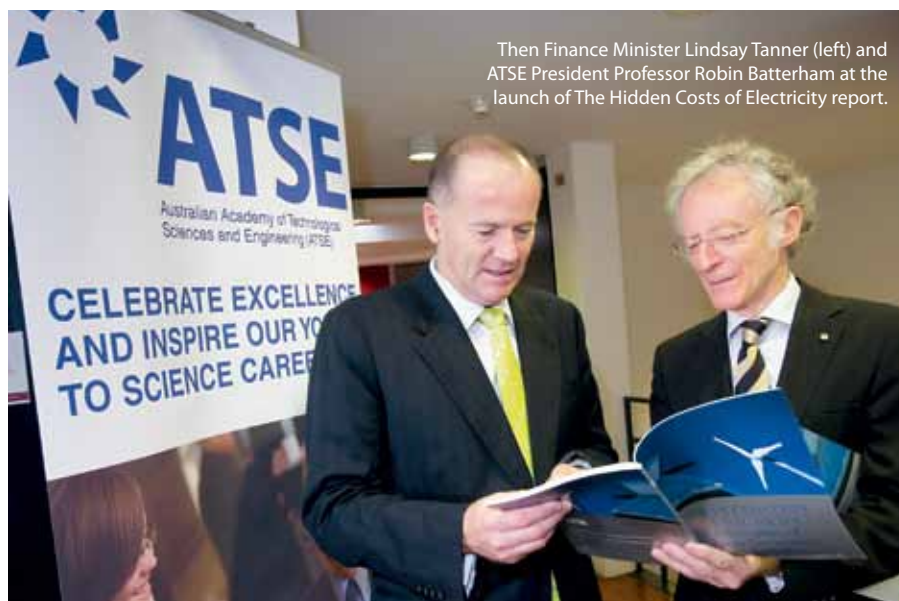
First, one needs to decide how to make valid comparisons between economies. A national economy comprises many goods and services that must somehow be summed. The only common measure is money, as in GDP. Energy creates goods and services, not money. So we need a consistent monetary measure of physical quantities of goods and services in different economies. The accepted methodology is the 'purchasing power parity' (PPP)

exchange rate, which converts currencies to, say, US dollars at rates supposed to produce equal purchasing powers. The PPP exchange rate, like the popular Big Mac Index, is not perfect but seems the best method available. Results for different years are adjusted using inflation factors. The US dollar in year 2000 is the reference currency unit used here.

As for quantifying energy, there are several possibilities. One could argue that energy's economic productivity occurs right where the useful work happens, like at a truck's wheels or within a furnace, and that's where it should be measured. But apart from being almost impossible to determine for every application, that method would miss a major objective, measuring and tracking improvements in the inefficiencies in raw fuel pathways and energy conversion.

The best practical choice looks to be the Total Primary Energy Supply (TPES). This is the total energy content of unrefined fuel, like coal and oil, at the source of energy conversion chains. Data are available for most economies. We know from thermodynamics that only a fraction of such energy performs useful work. So using TPES to compare different economies amounts to assuming that energy losses (mainly as heat) are not too different when averaged over every productive activity. This is a big assumption. The numbers should tell us how good it is.

The International Energy Agency (IEA) is a major source of data for TPES and energy economic indicators. Where the energy source is not a fossil fuel (like nuclear energy, hydroelectricity or wind energy) the IEA has conventions to standardise energy content to an equivalent TPES.



Then Finance Minister Lindsay Tanner (left) and ATSE President Professor Robin Batterham at the launch of *The Hidden Costs of Electricity* report.

To sum up, the ratio of an economy's GDP, expressed in constant purchasing power dollars, to its TPES, expressed here in GJ, should give an energy productivity figure usable for international comparisons. There are several assumptions in this calculation, so the results are approximate at best. Nevertheless it is useful to have the raw numbers as quoted here, to three significant figures.

A ranked list of energy productivities for the 137 economies tracked by the IEA (too many numbers to show here) presents a confusing puzzle. Perhaps this is why no-one seems to have bothered before. The range is large: Iraq \$23/GJ at the bottom and Hong Kong \$383/GJ at the top. This is a spread of about 16. The corresponding GDP spread is much greater, about 4000.

Further, there is no obvious pattern, though there is some clustering near the world figure of \$126/GJ. Most of the big oil producers fall at the low end but otherwise there are no clear correlations with factors like geography, climate, industry mix, education, or level of technological development, which one might expect to influence energy productivity.

But the most telling feature is the random distribution of poorer, developing countries. Do Albania and Bangladesh really have double the energy productivity of Australia? Can Cambodia's really be the same as the UK's? It seems highly unlikely.

So the credibility of these numbers is a problem, with PPP-adjusted GDP the most likely weak point in the data. The limitations of PPP methodology are well recognised by economists. It relies on price data collected by the International Comparison Program of the World Bank. For developing economies, national statistical capabilities are lower, prices less certain, the gap between normal and PPP currencies larger and conversion multipliers as used by the IEA also large (for example, Eritrea 5.7, Bangladesh 4.2). Everything points to lower reliability of GDP (PPP) data from developing economies. In addition, some of the economic production of poor countries comes from 'traditional' methods. These depend little, if at all, on energy but their contribution to GDP will raise apparent energy productivity.

Until the inconsistencies are resolved, it seems wise to concentrate on data from advanced industrialised economies, as represented by the Organisation

for Economic Co-operation and Development. The 34 OECD member states co-operate in programs specifically for improving data collection, their economic statistics are more credible and their smaller PPP currency adjustment factors ought to be more reliable.

Narrower band

The OECD numbers in the table, while not constant, lie within a much narrower band than the full list. The spread is exacerbated by the low outlier Iceland, \$48/GJ. This low figure seems to be an artefact attributable at least in part to Iceland's unique dependence on geothermal energy, which provides a quarter of its electricity. The IEA convention for calculating TPES is to assume 10 per cent efficiency for geothermal electricity generation. That convention has a big effect in raising Iceland's apparent TPES and hence lowering apparent energy productivity. However, simply by treating geothermal energy like hydroelectricity and equating its TPES to the electrical energy, Iceland's energy productivity rises to a more likely \$91/GJ, still at the bottom of the OECD range but perhaps consistent with its cold climate. The spread from top to bottom then falls to 2.6.

The Iceland example shows how tricky energy productivity determination can be. However, let's take the data at face value. Mean energy productivity in the OECD (2009) is \$162/GJ, median \$160/GJ and overall figure (weighted average) \$146/GJ. There is no point doing a statistical analysis. These are not samples with measurement errors. National differences are probably real.

So \$150/GJ can be taken as a rounded indicator of energy productivity for the whole OECD, looked at as one giant economy that represents all economic sectors of the industrialised world. This figure would relate to some kind of notional global average of factors

like energy mix, technology, geography and climate. The OECD's \$150/GJ offers a working benchmark for judging national energy performance. It's a better benchmark than the world figure of \$126/GJ because of the latter's significant content of dubious data. With enough information it ought to be possible to figure out why any economy does better or worse than \$150/GJ. The benchmark offers a potential energy policy tool.

Going a step further, the global economy could be imagined as a giant heat engine chugging away at, say, 30 per cent average thermodynamic efficiency and generating wealth at an overall rate of \$150 per gigajoule fed into it. This is surely a pleasurable thought for engineers. Another physical analogy is that energy acts like a lever to multiply the economic output achievable through human personal effort. The multiplier effect arises from the human inventiveness that has created energy-consuming engines, machines and other devices.

Let me turn to the topical subject of energy conservation.

Table 1 OECD Energy Productivities in 2009 \$ purchasing power parity (PPP) (US, year 2000)/GJ

Country	\$US (year 2000)/GJ	Country	\$US (year 2000)/GJ
Iceland	48	Norway	160
Canada	96	Netherlands	161
Estonia	96	Chile	163
Finland	111	Germany	168
Czech Republic	117	Japan	172
Korea	119	Luxembourg	185
United States	125	Portugal	190
Australia	128	Turkey	193
Slovak Republic	130	Austria	199
Belgium	133	Spain	199
New Zealand	141	Denmark	207
Hungary	142	United Kingdom	212
Poland	145	Israel	213
Sweden	151	Italy	214
Mexico	154	Greece	216
Slovenia	154	Switzerland	231
France	159	Ireland	235

One gets the impression that politicians and the public, while paying lip service to energy's essential role in creating wealth, treat it as an optional extra when it comes to setting high conservation targets. While governments can decree that private cars be smaller and clothes driers more efficient, 80 per cent of energy usage is in industry and commerce where economic incentives have long been in place and further savings will be harder won.

The robust link between prosperity and energy proves that it's no optional extra. But energy productivity is not some kind of universal constant. Indeed it is rising steadily at around one to two per cent a year. Also, differences between industrialised economies are real. Some of these rises are due to efficiency improvements driven by engineering innovation, as in the power generation industry, but some are also due to 'structural effects', that is, the changing international distribution of industry sectors. Often this amounts to rearranging the global deck chairs, with little or no net benefit.

The key message is that we cannot just give up energy without risking living standards. Energy productivity has to rise too, and that means increasing energy efficiency and/or reducing

wastage. How far we can take such improvements is presently a matter of speculation. I hope this analysis will help.

A critical issue is whether a country like Australia could reasonably aspire to the energy productivity of, say, Ireland, or that oft-quoted beacon for energy efficiency, California. Could we halve our energy needs by following such examples? I think not, but it's a subject worth further study.

An interesting consequence of using TPES in these calculations is that higher renewable electricity content will raise apparent energy productivity without any real change in energy efficiency. This distortion basically results from lumping in 'refined' energy (electricity) with primary energy in the TPES figure.

Finally, I am certainly not the first to think in physical terms about the connection between energy and prosperity. Joseph Henry, a physicist and first secretary of the Smithsonian Institution, said in 1873 that "the physical labor of man" is "ameliorated by expending what is called power or energy".

More recently (2009) Tim Garrett, another physicist (University of Utah), postulated a theoretical link, a kind of universal constant, relating economic production to rate of energy consumption. From thermodynamic first principles

he calculated the constant as 0.306 exajoules per trillion US dollars (1990) per annum (one exajoule = 10^9 GJ).

Garrett was lambasted (as I might be) for his venture into economics. One reviewer wrote: "I am afraid the author will need to study harder before he can contribute." Unfortunately that critic did not spot the real problem; Garrett's result translates to an energy productivity of \$4350/GJ (US\$2000), which is more than 30 times actual!

So, Garrett's bold attempt to use physics to calculate the energy/prosperity connection arrives at the wrong answer. But I do like the idea.

DR TOM BIEGLER FTSE has studied in electrode kinetics, electrocatalysis in fuel cells, electrochemical reactions of sulphide minerals, and electrowinning and refining of metals. He was Chief of the Division of Mineral Chemistry (later Mineral Products) in 1985 and then head of CSIRO's Corporate Business Department. After retiring from CSIRO in 1996, he consulted on fuel cell commercialisation and has worked to improve public understanding of energy issues. He was the author of ATSE's 2009 report *The Hidden Costs of Electricity: Externalities of Power Generation in Australia*. He is also a Fellow of the Royal Australian Chemical Institute and the Australasian Institute of Mining and Metallurgy.

CRCs get a strong report on benefits

Australia's Cooperative Research Centre (CRC) program will have produced some \$14.5 billion worth of technologies, products and processes by 2017, according to an Allen Consulting Group study released recently.

The Minister for Science and Research, Senator Chris Evans, said the report showed that CRCs had already made an \$8.6 billion impact on the economy with at least another \$5.9 billion to come in the next five years.

"It shows that Australia's world-class CRCs have the critical mass of resources to create new industries and improve Australia's competitive advantage," Senator Evans said.

"CRCs are helping Australian industries to produce globally competitive products that are being used in everything from new cars and the F-35 Joint Strike Fighter program through to agriculture and mining."

Senator Evans said the Government aimed to double the level of collaboration between business, universities and publicly funded research agencies over the next decade and over the next four years would invest more than \$625 million in CRCs to establish strong partnerships that could focus on delivering real impacts for Australia through the application of science and research.

This study estimated the economic, environmental and social impacts of the CRC program since it commenced in 1991 and out to 2017. Nearly 120 past and present CRCs contributed to the study.

It found that between 1991 and 2017 almost \$14.5 billion of direct economic impacts are estimated to have accrued from CRC-produced technologies, products and processes. This included \$8.6 billion of impacts already materialised from 1991 to 2012 and a further \$5.9 billion of imminent impacts estimated to occur over the next five years.

CRCs were asked to report estimates of their economic, social and environmental impacts and then assessed using a model of the Australian economy. This allowed for an objective comparison to a counterfactual case in which no CRC program existed.

Using this model, it was estimated that the program generated a net benefit to the economy of \$7.5 billion over the period, or around 0.03 percentage points of additional GDP growth each year – the majority of which came from increased export earnings.

Relative to the funds committed to the CRC program by the Australian Government, the

CRC program had generated a net economic benefit to the community, which has exceeded its costs by a factor of 3.1, the report found.

Nano-structures indicate hydrogen's potential

University of New South Wales engineers have demonstrated that hydrogen can be released and reabsorbed from a promising storage material, overcoming a major hurdle to its use as an alternative fuel source.

Researchers from the Materials Energy Research Laboratory in nanoscale (MERLin) at UNSW have synthesised nanoparticles of a commonly overlooked chemical compound called sodium borohydride and encased these inside nickel shells.

Their unique 'core-shell' nanostructure has demonstrated remarkable hydrogen storage properties, including the release of energy at much lower temperatures than previously observed.

"No one has ever tried to synthesise these particles at the nanoscale because they thought it was too difficult and couldn't be done. We're the first to do so, and demonstrate that energy in the form of hydrogen can be stored

with sodium borohydride at practical temperatures and pressures," says Dr Kondo-Francois Aguey-Zinsou, from UNSW's School of Chemical Engineering.

Considered a major fuel of the future, hydrogen could be used to power buildings, portable electronics and vehicles – but this application hinges on practical storage technology.

Lightweight compounds known as borohydrides (including lithium and sodium compounds) are known to be effective storage

materials but it was believed that once the energy was released it could not be reabsorbed – a critical limitation. This perceived 'irreversibility' means there has been little focus on sodium borohydride.

"By controlling the size and architecture of these structures we can tune their properties and make them reversible – this means they can release and reabsorb hydrogen," Dr Aguey-Zinsou says. "The new materials that could be generated by this exciting strategy could provide practical solutions to meet many of the energy targets set by the US Department of Energy. The key thing here is that we've opened the doorway."



Dr Kondo-Francois Aguey-Zinsou

STUDY SEES 10% ROLE FOR WAVE POWER

Australia's oceans hold a bounty of energy and could produce 24-hour power from tides, currents or waves, according to a CSIRO study.

CSIRO hopes the report, *Ocean renewable energy: 2015-2050*, will inform the ocean energy industry, government and investors about the challenges and potential for the technology.

Key findings from the study include:

- although wave energy could supply about 10 per cent of our energy by 2050, there are many economic, technological, environmental and societal challenges that will determine its place in Australia's future energy mix; and
- the areas that could benefit from wave energy technology include Perth, the southern coastline and, to a lesser extent, the east coast of Australia; tidal technology could supply niche areas such as north-east Tasmania and the Kimberley region.

The CSIRO study found that ocean waves could supply about 10 per cent of Australia's electricity by 2050 – the equivalent of powering a city the size of Melbourne. It was carried out by the Wealth from Oceans

and Energy Transformed Flagships and included an analysis of the resource, cost to market, technologies and future take-up projections by oceanographers, engineers and economists. The study also engaged the ocean energy industry and related sectors.

UQ and UNSW partner on solar farm research

The University of Queensland has been appointed the lead research organisation for two large solar photovoltaic (PV) projects that will be built in the next three years in western NSW. UQ will partner with the University of NSW in a \$40.7 million Education Investment Fund Research Infrastructure Program that will support the two projects, totalling 159MW.

AGL Energy was announced in June as the successful bidder for funding under the Australian Government's Solar Flagships program. First Solar, the US-based international solar solutions provider, will supply the PV modules and provide engineering, procurement and construction services for the projects. The companies will receive \$129.7 million of Australian Government support to develop the projects. The NSW Government will provide \$64.9 million to support the projects, which are due for completion in 2015 at an estimated capital cost of \$450 million.

First Solar will design and construct the solar power plants – 106MW at Nyngan and 53MW at Broken Hill – using its advanced, thin-film CdTe (Cadmium Telluride) PV modules.

The research program involves building a large PV pilot plant with research components focused on energy storage, plant optimisation, power systems and the impact of renewable energy on the national electricity market.

The research facility will be housed in UNSW's recently completed Tyree Energy Technologies Building, named for UNSW alumnus Sir William Tyree OBE FTSE, a successful innovator and businessman and a major philanthropic supporter of Australian engineering and educational research, who donated \$1 million to the centre and has pledged a further bequest of \$10 million. Sir William received the ATSE Clunies Ross Lifetime Achievement Award in June.

UQ's Senior Deputy Vice-Chancellor, Professor Max Lu FTSE, said it was significant UQ was forming a strategic partnership with UNSW, an international leader in photovoltaic research for almost 30 years.

"UQ is making a strategic push into energy research across the board and renewables are a significant component of that work, which is taking place across the university and its institutes," Professor Lu said. "We are also delighted to be working with AGL, First Solar and the NSW and Federal governments on this landmark, large-scale project."



UNSW's Tyree Energy Technologies Building where the research facility will be housed.

Schaffer report targets global engineering lead for Queensland

The resizing of the resources industry and the associated increase in infrastructure needed to service this growth is driving an increase in the demand for both engineering services and for professional engineers in Queensland, according to a new report commissioned by the Queensland Government.

Engineering underpins the Queensland economy, the report says. Mining, construction and manufacturing are engineering-intensive industries and they contribute the greatest share to gross state product.

With more than 33,000 professional engineers now employed in Queensland, the number of engineers as a proportion of all employment has increased by 40 per cent over the past decade and the unemployment rate for the engineering workforce is 25 per cent less than general unemployment.

The report – *Engineering Queensland:*

A proposal to build Queensland as a global centre of excellence for specialised engineering services – was prepared by Professor Graham Schaffer FTSE, Executive Dean, Faculty of Engineering, Architecture and Information Technology at the University of Queensland, in consultation with leading engineering, academic and government and industry authorities. It will be formally launched in November.

The report, initiated by the Queensland Chief Scientist, Dr Geoff Garrett AO FTSE and commissioned by the Government, proposes a vision and a plan to sustain and further develop engineering in Queensland.

The report notes the growth rate of engineering employment in Queensland has also outpaced the national growth rate. The majority of Queensland's engineering workforce is employed in Brisbane, which has the third highest number of engineers of Australian cities, behind Melbourne and

The Schaffer report.

Sydney and the second highest proportion of engineers, behind Perth.

Engineering provides resilient employment because engineering skills are transferable across industries and geographical locations and is therefore less susceptible than other occupations to changes in the business cycle. In addition, many of the engineering occupations are in areas which are highly knowledge-intensive, such as bioengineering, ICT, elaborate manufacturing and resource extraction. This provides opportunities for the accelerated growth of human capital.

It notes there is some risk that the engineering employment demand will decrease towards the end of the decade as the mines and gas fields mature because the engineering intensive portion of the resizing of the minerals industry is the early part, during feasibility, design, procurement and construction.

A second threat to engineering is the increasing capacity to procure engineering services from low-cost countries, although this applies more to the codified, less complex end of the engineering services spectrum and less to the high-value, ideation-intensive*, creative component that depends largely



Australia "must help" in groundwater depletion

A recent UNESCO report warning that the degradation and depletion of the world's precious reserves of groundwater was continuing unabated on a global scale has drawn a strong response from one of the nation's leading water scientists.

Professor Craig Simmons, director of the National Centre for Groundwater Research and Training (NCGRT), says Australia should take a lead in tackling the emerging global crisis in groundwater.

"There is undoubtedly a very serious situation emerging with respect to groundwater in certain parts of the world," he said.

"In the 1990s, the world extracted about 102 cubic kilometres a year, but in the 2000s this rose to 145km³ – and there is every indication it has continued to increase.

"In many situations groundwater is a finite resource and is not renewed at anything like the rates it is being extracted. This poses real risks for economic growth, the sustainability of huge cities and vital industries like food and energy production, especially in dry, heavily populated regions," he explains.

Professor Simmons says that as a technologically advanced country

when it comes to water, Australia has an obligation to help its neighbours come to grips with the silent menace of global groundwater depletion.

"One of the main reasons groundwater declines is simply that people don't know how much they have, or how long it takes to recharge. Thanks to significant research investment, these are matters that Australia is rapidly coming to grips with. We now have real knowledge and expertise that can be taken advantage of.

"As a leader in water management and technologies, we have an obligation to support our neighbours in relation to groundwater," he adds.

The UNESCO report, *Groundwater and Global Change*, emphasises that groundwater is the world's largest fresh water reserve. It warns that "current stresses on groundwater systems are without precedent in many parts of the world. These stresses are still increasing and produce considerable risk and uncertainty."

The UNESCO study lists among areas of significant groundwater decline as California and the High Plains in the US, the Mexico Basin, several river basins in Spain, the Arabian peninsula, Iran, the Indus basin in India, the North China Plain and the Great Artesian Basin in Australia.

on the application of tacit knowledge.

To be truly effective on a global scale, it is not feasible to be excellent at everything, the report notes, suggesting Queensland needs to build specialised strengths in fields where there is genuine comparative or competitive advantage.

"We need to be both discriminating and selective in the fields we specialise in and the expertise that we develop," Professor Schaffer says. "In essence, we need to be excellent, we need to be concentrated, we need to be global and we need to be specialised."

The report recommends the development of a cluster of companies, suppliers, universities and research organisations providing global scale, specialised engineering services in specific fields where Queensland can build a competitive advantage and compete internationally. It says this will deliver new knowledge-based jobs, exports and revenue for the State by building on the existing critical mass of engineering expertise and re-shaping it for the future.

It is proposed that specific fields where Queensland can build competitive advantage in specialised engineering services in order to compete internationally include:

- mining and minerals;
- unconventional gas extraction;
- infrastructure in the tropics and sub-tropics;
- bioengineering; and
- engineering education.

These five engineering fields need to be

supported by four core competencies in –

- technically grounded engineering design;
- computational engineering;
- sustainability; and
- project management.

Starting from the premise that knowledge and innovation are the basis of economic growth, the report recommends that the Queensland Government should partner with industry, the universities and the research sector to create a new, world leading, cluster of engineering expertise.

Specifically, the Government should:

1 Support the Queensland Investment Attraction Service

to retain tier one companies in the mining, minerals, unconventional gas, construction and biotechnology industries and to attract new companies to relocate to Queensland.

2 Procure to encourage innovation

through a demand-driven innovation policy for Government as an intelligent and demanding customer.

3 Establish a collaborative virtual network

– the Queensland Engineering Innovation Network – based on a robust business case to enhance collaboration between industry, the universities, research organisations and government.

4 Invest in people and equipment

to develop world-leading expertise in specialised fields and selected competencies.

5 Maintain the university engineering system

by providing essential teaching and research infrastructure on the

State's university campuses through the redevelopment of obsolete building stock.

6 Develop human capital

by investing in postgraduate coursework programs in each of the specialised fields.

An internationally recognised materials engineer, Professor Schaffer took on the position as Special Adviser for the Queensland new Smart Engineering State initiative, announced by the Government in January.

** Ideation – the process of forming ideas or images.*



Graham Schaffer

UQ studies CSG and water supplies

Measuring the impact of the coal seam gas industry on Australia's underground water supplies will be one of the initial research projects at the University of Queensland's Centre for Coal Seam Gas.

Researchers in the three-year project will analyse underground water chemistry, thereby improving conceptualisation and numerical modelling of the impacts coal seam dewatering has on aquifers at both regional and local levels.

"Incorporation of water chemistry data that is held by CSG companies into a unified database will greatly extend understanding of basin hydrology, aquifer interactions and processes controlling the water chemistry," said lead researcher Associate Professor Sue Vink.

"The project will result in publicly available databases that identify health and environmental

"Incorporation of water chemistry data that is held by CSG companies into a unified database will greatly extend understanding of basin hydrology, aquifer interactions and processes controlling the water chemistry."

– Associate Professor Sue Vink.

risk indicators, provide a baseline for assessing aquifer connectivity, and guide water re-use, treatment and re-injection options."

In two more technically focused projects, researchers will improve understanding of coal permeability and stimulation methods, including hydraulic fracturing, permitting better gas recovery, and establish how unwanted solid particles resulting from drilling and well operation can be reduced.

The Centre for Coal Seam Gas was established in 2011 as a research centre of the Sustainable Minerals Institute at UQ. It draws together the research capabilities of UQ, which has been conducting research into coal seam gas for almost two decades. The Centre has four key research areas: water, geoscience, petroleum engineering and social impact, as well as a focus on education.

ANSTO in global disease fight

The Australian Government has announced a \$168 million plan to position the Australian Nuclear Science and Technology Organisation (ANSTO) at the centre of the global fight against cancer and heart disease.

The plan will be delivered at ANSTO's Lucas Heights Campus and includes a new investment in nuclear medicine and treatment that will create about 250 jobs. The two key elements of the plan are:

- an export-scale nuclear medicine manufacturing plant, which will secure Australia's ability to produce Molybdenum-99 (Mo-99) and increase capacity to meet a significant proportion of the world's needs; and
- a collocated Synroc waste treatment plant, which will deliver a permanent, safe and economical way of treating waste from past, current and future manufacture of nuclear medicines.



Adi Paterson

Mo-99 is primarily used for diagnosis of heart disease and cancers. Applications include bone oncology, neurology and kidney and gastrointestinal tract disorders. In Australia each year 550,000 people receive a diagnosis using Mo-99. Current world demand is 45 million doses a year. Australian nuclear medicine is produced using low enriched uranium, which is part of the push toward nuclear non-proliferation.

Synroc is an Australian innovation that can also reduce the volume of nuclear byproducts by 99 per cent (compared to other methods such as cementation). The synroc-treated waste will be sent to the national radioactive waste management facility once it has been sited, constructed and licensed.

ANSTO's Chief Executive Officer, Dr Adi Paterson FTSE, said the plan was a major endorsement of ANSTO's Australian role and international standing.

"Already ANSTO produces half a million doses of nuclear medicine a year, which we distribute to more than 200 hospitals and medical centres," Dr Paterson said. "This is good and important work of which we are rightly proud – and today's announcement is nothing less than a stunning endorsement of ANSTO's role, its performance and its future."

"Through the expansion enabled by this plan, ANSTO will go from supplying the medicine one in two Australians need, to significantly contributing to the global nuclear medicine community along with its partners."

Planning for the nuclear medicine manufacturing plant and Synroc plant is underway, with construction to start in 2014 and be completed by the end of 2016.

CEDAR MAY HOLD KEY TO HENDRA VIRUS

Australian scientists led by ATSE Fellow Dr Linfa Wang FTSE have discovered a new virus in bats that could help shed light on how Hendra and Nipah viruses cause disease and death in animals and humans.

The new virus – named 'Cedar' after the Queensland location where it was discovered – is a close relative of the deadly Hendra and Nipah viruses, but CSIRO's initial studies have discovered one surprising key difference: the Cedar virus does not cause illness in several animal species

normally susceptible to Hendra and Nipah. This tantalising difference may help scientists understand how to better manage and control its deadly cousins.

The findings were announced in the journal *PLoS Pathogens*, published by the Public Library of Science.

Dr Wang, who heads the virology group at CSIRO's Australian Animal Health Laboratory at Geelong, said researchers were looking at structural and behavioural differences between the viruses and the way each virus interacted with its host. He said the discovery had wider implications because viruses that originated in animals were considered the most likely source of the next human pandemic.

Dr Wang is an internationally recognised leader in the field of emerging viruses. He is a member of the WHO SARS Scientific Research Advisory Committee and played a key role in identification of bats as the natural host of SARS-like viruses. His research achievements extend from the rapid discovery and characterisation of highly pathogenic viruses to the development of cutting-edge technologies with applications in novel diagnostics, vaccine and therapeutics to combat emerging viruses.

CSIRO bat virus researcher Mr Gary Crameri said the new discovery had significant potential implications for protecting animals and humans from the Hendra and Nipah viruses.

"The significance of discovering a new henipavirus that doesn't cause disease is that it may help us narrow down what it is about the genetic make-up of viruses like Hendra and Nipah that does cause disease and death," Mr Crameri said. "The more that we can learn about bat-borne viruses, the better chance we have of developing antivirals and vaccines to help protect human health, Australia's livestock industry and our export trade from the threat of current and emerging animal diseases."

"Over 70 per cent of people and animals infected with Hendra and Nipah viruses die. This ranks henipaviruses amongst the deadliest viruses in existence, yet little is known about just how such viruses actually cause disease or death."

PHOTO: CSIRO



CSIRO's Dr Glenn Marsh, research scientist on the Cedar virus discovery team, collecting samples from underneath a bat colony.



DSTO researcher Vivienne Wheaton operates the SPD-Smart glass display.

CAMOUFLAGE TO PROTECT ADF VEHICLES

Australian Defence Force (ADF) vehicle camouflage could be enhanced, based on research at a Defence Science and Technology Organisation (DSTO) laboratory. The work is focused on the development of electrochromic materials that change colour with subtle variation in applied voltage.

"An outcome is still some years off, but the ADF has expressed interest in the concept," explains DSTO researcher Vivienne Wheaton.

Currently, ADF vehicles are coated with a paint scheme, devised by DSTO, according to a standard specifying colours and near-infrared properties, but the effectiveness is limited by changing backgrounds and environments – in the past 50 years they have operated in Vietnam, the Gulf, East Timor and Solomon Islands, each requiring specific camouflage to suit respective environments.

In the DSTO laboratory a voltage supply is connected to five board-mounted polymer film panels, known commercially as SPD-Smart film – purchased samples of electrochromic material that can be deposited onto glass or other polymer surfaces. Within moments of being powered the densely coloured panels illuminate to a murky green – enough to visualise the potential of the energy transfer at play – as applied voltage changes the alignment of small particles in the film, to give a darker or lighter appearance depending on orientation of the particles.

The SPD-Smart film is a high-voltage system, but other types of smart materials exist that are low-voltage, low-power systems more suitable for camouflage applications.

"Applied voltages of less than 5V will generally initiate colour changes in electrochromic materials, where the change is a result of the chemical species switching between oxidation states," Ms Wheaton says.

"Most current implementations of electrochromics use materials like glass or shiny films that are not well suited to a camouflage application on military vehicles."

So DSTO is progressing a related PhD collaboration with the University of South Australia to investigate the science behind the panels, with the view to developing the concept into something that can go into the field.

"The collaboration is examining the challenge of developing electrochromics that can be packaged in a more robust, field-ready way," Ms Wheaton says. "If we can resolve these field issues for electrochromic materials, in the future we may be able to assist the ADF with adaptive improvements to their camouflage systems."

Fornax boosts computer research capability

A \$4 million terascale research supercomputer named Fornax (Latin for 'furnace') – the second of three supercomputers commissioned as part of the \$80 million Pawsey Centre project – has been launched at the University of Western Australia.

Fornax is operated by iVEC, a collaboration between CSIRO, UWA and Murdoch, Curtin and Edith Cowan universities. The system contains 6.9 terabytes of RAM, 672 terabytes of storage and 1152 CPUs, operating across 96 nodes. At peak performance, the system is capable of performing 62 teraflops, or 62 trillion (62,000,000,000,000) operations per second.

The computer, funded under the Australian Government's Super Science Initiative, was launched by the Minister for Science and Research, Senator Chris Evans, who said that, as part of the Pawsey Centre, Fornax would be at the heart of Australia and New Zealand's successful bid to co-host the Square Kilometre Array radio telescope.

"It gives Australian researchers access to the kind of computing power that is critical to astronomy signal processing needed for the international SKA project," Senator Evans said. "This is the second of two forerunners to the more powerful petascale Pawsey Centre supercomputer system being installed in 2013. Fornax and its partner Epic are helping researchers to develop the expertise needed to get the best out of the Pawsey supercomputer when it comes online."

"With these systems, we're building world-class supercomputing facilities, and expertise to match, that will put Australia at the forefront of research in radioastronomy, the geosciences and other high-end computational research."

The director of UWA's iVEC Centre, Associate Professor Paul Bourke, said Fornax had been designed to give researchers unprecedented access to both highly parallel processing and data-intensive computing. "These are critical in many areas of research, particularly for astronomy signal processing (including the SKA) and geoscience," he said.

iVEC Centre Director Paul Bourke deep in Fornax.

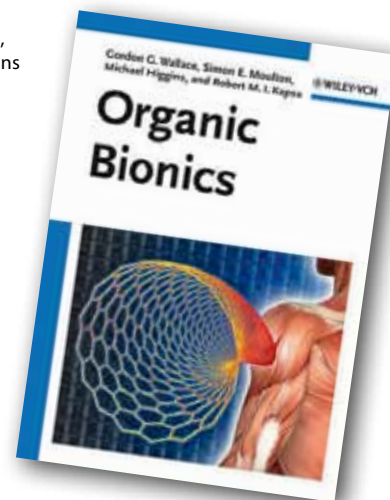


Is technology always interdisciplinary?



By Ian Rae
iandrae@bigpond.com

Organic Bionics, Gordon G. Wallace, Simon E. Moulton, Michael J. Higgins and Robert M.I. Kapsa (Wiley-VCH, 2012, xii + 226 pp. \$160.00).



Is technology always interdisciplinary? I think the answer is 'yes', and it's certainly what came to mind when I read Graeme Clark's introductory comment on this newly defined field that takes us "from the cold hard world of electronics to the warm but dynamic world of biology ... to bridge the electrode-cellular interface".

The authors of *Organic Bionics*, researchers in Wollongong and Melbourne, led by ATSE Fellow Professor Gordon Wallace*, take their inspiration from Clark, along with Luigi Galvani and Alessandro Volta (I hardly need to remind readers of

their contributions), Guillaume-Benjamin-Amand Duchenne (muscle stimulation in the 19th century) and Alan MacDiarmid (organic conducting polymers, for which he shared a Nobel Prize in 2000).

Following this Pantheon, the opening chapter covers experiments and devices, including prospects for bionic vision, and outlines the key elements of any medical bionic device.

Then comes a chapter on the nature, properties and production of carbon as it exists in four allotropic forms - diamond, graphite, carbon nanotubes and fullerenes. Amorphous carbon, grapheme (sheets

peeled from graphite) and ionsdaleite (a typo for lonsdaleite) are introduced in subsequent pages. The last of these is 'hexagonal graphite' discovered in a meteorite in 1967 and named after crystallographer Kathleen Lonsdale. The chapter has a whopping 241 references,

Derek Tribe – working on a broad canvas

Derek Tribe (1926–2003), as he emerges from this biography by Professor Lindsay Falvey FTSE, was a man who never stood still for very long, in either the physical or the metaphorical sense.

In the 1940s, while he was an undergraduate at Reading, then PhD student at Aberdeen while he worked on animal nutrition at its Rowett Institute, Tribe found time for student and national politics, music, sport (badminton, athletics, hockey) and courting Elizabeth. At Aberdeen, the travel bug began to bite but it was only Europe until, as a young staff member at Bristol, he went on a two-month tour of Australia courtesy of the Nuffield Foundation.

The upshot was that in 1955, at age 29, he was appointed Reader in the agriculture school of the University of Melbourne. Returning to Australia after a first sabbatical leave, Derek and Elizabeth published *Postmark Australia*, a collection of fictional replies to letters

from (British) friends considering migration to Australia, which was taken up by the Australian Department of Immigration as a handbook.

Shortly after returning he was promoted to Professor and later appointed as Dean in the faculty he used as a home base for 24 years before retirement and accession to Emeritus status.

In 1965 Tribe made a visit to East Africa as a consultant for the UN Food and Agriculture Organization and this began his move away from conventional academic life into consultancy in Africa and South-East Asia. Although his international work brought advantages to the university in terms of prestige, graduate students and his salary (foregone while he travelled), his absences rankled with his colleagues "who felt that they were left to clean up after his lightning visits home".

Tribe tried to deflect much of this criticism with skilful self-deprecation, sometimes referring to himself as 'the tarmac professor'. As well as his peripatetic

appearances, his apparent Englishness, sometimes perceived as patrician, did not go down too well, causing Falvey to reject this characterisation of his hero but to offer the rather backhanded compliment that "Tribe fitted into Australia because he was like an Australian".

Tribe's post-university career was displayed on an even broader canvas. In the mid-1970s he was active in the Australian Industry Research Group and was one of the founders of the Academy of Technological Sciences (ATSE's predecessor) and contributed significantly to international work over the next decade.

For four years he lived in Canberra while he headed the Australian-Asian Universities' Cooperation Program (later IDP). However, as at Melbourne, he was seldom home, travelling incessantly, managing in his last year, 1985, 35 trips to a dozen countries. His book *Doing Well by Doing Good* had its genesis in this period, although it was published later.

In the mid-1980s, the CGIAR

all but a handful post-2000 and none before 1997 as befits a truly new field.

Succeeding chapters cover organic conducting polymers such as polypyrrole, polythiophenes and polyanilines with more-or-less established structures but better-known electrical properties; biological applications of organic polymers including the need to sterilise them by irradiation or chemical methods before they can be implanted into living systems; and fabrication of devices from such materials.

The book concludes with a 'Where are we? Where are we going?' chapter and stresses the need for true interdisciplinarity "with parallel, integrated, and synergistic advances" in material design, synthesis and processing; device fabrication; and characterisation.

As is the case with a multi-author book, there are very few single-author papers among the 800-odd references. It is clear that skills and qualifications in chemistry, biology, and the cellular-materials interface – not to mention the will to collaborate – are necessary constituents

if there is to be progress in this field.

I found the index (six pages) a good way to see 'where we have been' and enjoyed reading about a research forefront where Australian scientists are leaders and the work receives generous support from the Australian Research Council.

**Professor Gordon Wallace FAA FTSE is an Australian Research Council Laureate Fellow, Executive Research Director of the ARC Centre of Excellence for Electromaterials Science and Director of the Intelligent Polymer Research Institute, University of Wollongong. He is Director of the Australian National Fabrication Facility, Materials Node. He is a Fellow of the Institute of Physics and the Royal Australian Chemical Institute and has won several awards from RACI.*

PROFESSOR IAN RAE FTSE, an Honorary Professorial Fellow at the University of Melbourne, is a former Technical Director of ATSE. He was President of the Royal Australian Chemical Institute (2006–08) and has served for more than a decade as a technical adviser to the United Nations Environment Program.

LETTER TO THE EDITOR

Theory and Practice of Innovation

I would like to make some comments on the realities of innovation. It would appear that it is easier to achieve results for people working within organisations than for lone originators. To many people innovation appears to mean securing a tested patent for some new device or process, a step which – in itself – is a marketable commodity – but nothing more than that.

Here is an example: I have secured a tested patent a year ago without the help of patent attorneys. It concerns a device which could be either a gym instrument or, in a more complex form, a means of travelling above the surface of the ground and be a basis for a new competitive sport. I am, by the way, not one of those 'mad professor' types of inventor and many of my patentable ideas were incorporated in guided weapons and drones (Jindivik, Malkara, Ikara and Turana).

Since, after the 2007-08 financial crash, I am not in a position to develop a prototype by my own means, I have tried to obtain either Government help in same, or to find a partner which would acquire equal rights to the patent by founding the development of same. Government help is granted to companies only and, as far as the apparently suitable individuals approached were concerned – the only outcomes were wishes for success.

I hope that there might be a Fellow of ATSE, with access to an MC machine shop, who would want to know more about the idea and contact me at bbaron333@yahoo.com.au.

– Stanley S Schaetzel FTSE FRAeS

(Consultative Group on International Agricultural Research), with whom Tribe had a close relationship, sought to develop national support organisations. Tribe seized the chance to involve the Academy in what was to become the Crawford Fund, but he struggled to gain support for his proposal and this section of Falvey's book makes interesting reading for those of us to whom it might seem that the Crawford Fund was always there. The initial focus on raising awareness of the need for research support was augmented by the development Master Classes for scientists, for which Bruce Holloway FTSE gets generous credit. Jan Jones, who had started as the Dean's super-secretary, is deservedly praised as the Executive Officer.

No small part of Tribe's success was his ability to attract influential supporters – "cultivating the elite", Falvey calls it – counting among them the grazier who opened his farm as a research venue for Tribe and his students, and another whose son became Prime Minister. Tribe could always get a crowd by engaging a prominent speaker for any event he organised.

Samuel Wadham, another agricultural

émigré, was important in Tribe's early years at Melbourne; later, politicians such as Doug Anthony (former Deputy Prime Minister) and public servants like Sir John Crawford were strong supporters he enlisted in the cause.

As well as covering dates, appointments and organisations, Lindsay Falvey provides a rich stream of anecdotes: Victorian Premier Henry Bolte, a farmer through and through, organised support for a pig centre; leaving a meeting, Tribe got a lift from another attendee, Governor-General Sir Paul Hasluck; on a flight to the US he hobnobbed with Sir MacFarlane Burnet; and after retirement he gave gratuitous advice to Melbourne's Vice-Chancellor which was "roundly rejected in the style reserved for meddling retirees".

– IAN RAE

Derek Tribe: International Agricultural Scientist, Founder of the Crawford Fund by Lindsay Falvey, 2012. Published by The Crawford Fund, in association with the Institute for International Development.



Capsule being inserted into a Parkinsonia trunk.

Pill-popping may end woody weeds



Associate Professor Victor Galea

A simple one-dose capsule could help end the scourge of woody weeds that are choking Australia's waterways, smothering native vegetation and encroaching on agricultural land.

Australia's first 'home-grown' commercial bioherbicide, being developed by Dr Victor Galea,

Associate Professor in plant pathology at the University of Queensland, involves inserting a single gelatine capsule containing pathogenic fungi into the weed's trunk, then letting the fungi do the rest.

This new biological agent, using native Australian fungi, promises to be a sustainable and long-term solution for invasive woody weeds such as Parkinsonia, Prickly Acacia, Mimosa and Athel Pine.

The first bioherbicide to be developed will be for Parkinsonia, which has spread across Queensland, the Northern Territory and northern Western Australia, with annual control costs of \$60 million. Weeds cost the Australian economy \$4 billion every year in lost agricultural production.

The fungi used in the bioherbicide being developed for Parkinsonia were isolated by Dr Galea in 2004 from Parkinsonia plants in the NT that were experiencing natural dieback.

"We isolated 200 local fungi and have further distilled this down to three strains that are most effective at causing Parkinsonia dieback," he says.

Dr Galea and his team from UQ's School of Agriculture and Food Sciences have developed a novel method to introduce the fungi into the plant in a mega-dose that causes the tree to die within six to 24 months.

"We have tested and refined a simple system with capsules containing millet that has been colonised by the fungus and is all packaged up and ready to go," Dr Galea says. "We simply drill a hole in the tree trunk, insert the capsule and then seal the hole with silicone."

"Parkinsonia creates a very large seed bank, which makes its control with chemical herbicides or manual removal ineffective because new plants pop up for years afterwards. But our fungal bioherbicide, once it is established in the trees, has the potential to remain in the soil and kill germinating seeds."

"We have also found evidence of lateral spread of the fungus to adjacent untreated trees via the plants' roots, which means that for thick clumps of Parkinsonia we may only need to inoculate one in five trees."

The technology has been licensed to BioHerbicides Australia Pty Ltd (BHA), a start-up company established by UQ's main research

commercialisation company, UniQuest, and a private partner in 2010. The commercial release is a step closer with new support from a \$451,775 Commercialisation Australia grant awarded to BHA, which will assist with registration, manufacturing and marketing activities. Registration of Australia's first bioherbicide Di-Bak Parkinsonia and the production of pilot batches are expected in 2013.

BEER DRINKERS HELP REDUCE METHANE

Australian beer drinkers are inadvertently helping cattle producers reduce methane produced by cows. Scientists have shown a byproduct of the beer-making process, brewers' grain, can reduce methane emissions in cattle by 15 to 20 per cent.

Associate Professor Richard Eckard, Director of the Primary Industries Climate Challenges Centre at the University of Melbourne, says the research project aimed to develop practical feeding strategies that dairy farmers could implement to curb methane emissions and maintain profitability.

The project had investigated several waste products that are high in oil, including whole cottonseed meal, cold-pressed canola meal, brewers' grains and hominy meal, as feed additives for dairy herds.

"One per cent of oil added to a ruminant's diet translates to a 3.5 per cent reduction in methane emissions," Associate Professor Eckard says. "In the case of whole cottonseed, it not only significantly reduced methane emissions but also increased milk production by 16 per cent, milk fat by 19 per cent and milk protein by 12 per cent."

The most effective time for the oil to be added was when pasture was limited in quantity and low in nutritional value: in summer, adding five per cent oil could reduce emissions by 15 to 20 per cent and increase milk production due to the slow-release energy provided by oil.

The project is part of the Reducing Emissions from Livestock Research program – a joint initiative of Meat & Livestock Australia and the Australian Government's Department of Agriculture, Fisheries and Forestry – is supported by the Victorian Department of Primary Industries, the University of Melbourne and Dairy Australia.

In another project, researchers have found that adding lime to soil or planting lupins can significantly decrease greenhouse gas emissions (GHG) from grain production. This is just one of the findings from the Nitrous Oxide Research Program (NORP) that is investigating ways to decrease carbon dioxide (CO₂) and nitrous oxide (N₂O) emissions from cropping systems.

Associate Professor Louise Barton from UWA's Institute of Agriculture said N₂O gas was emitted naturally from the microbial processes in the soil and nitrogen fertilisers, manure and burning crop stubble could all increase mineral nitrogen in the soil, in turn increasing the rate of N₂O emitted.

"Given that N₂O is around 300 times more potent than CO₂, we need to identify practical and affordable strategies that farmers can use to decrease the impact of nitrogen fertiliser use on GHG emissions"

Grain production is considered a net producer of GHG via fertiliser, herbicide and farm machinery use and production. Applying urea fertiliser can contribute up to 80 per cent of total on-farm emissions.

This project is a collaboration between the Australian Government, UWA, the Department of Agriculture and Food, WA, and the Grains Research and Development Corporation.

Brewers' grain can reduce methane.





ATSE
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OCTOBER 2012

Research centre named for Peter Cook

EMINENT GEOLOGIST AND FOUNDER

of the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) Professor Peter Cook CBE FTSE has been acclaimed by having a new carbon capture and storage (CCS) research centre named in his honour. The Peter Cook Centre for Carbon Capture and Storage Research at the University of Melbourne was launched by the Victorian Minister for Resources and Energy, Michael O'Brien.

CO2CRC will direct research at the new Centre, which has been sponsored by Rio Tinto with \$3 million in funding over three years. A further \$3 million in Rio Tinto funding over three years will support the CO2CRC Otway Project, Australia's first demonstration of geological carbon dioxide storage, as a field site for carbon storage research.

"The Peter Cook Centre for CCS Research will integrate CO2CRC research capabilities at the University of Melbourne, forming a world-class hub for research into this important technology," said Dr Richard Aldous, CO2CRC Chief Executive.

"The Centre brings together professors and researchers from a wide variety of disciplines, including the chemical and process engineering associated with capturing CO₂ from power plants, and the geology and geomechanics required for storage of CO₂ in deep rock formations.

"The complementary work at the Otway Project is helping develop the tools and methods to ensure CO₂ is safely stored and monitored.

"Building this kind of critical mass in an Australian research centre is vital to the national development and deployment of large-scale CCS, which will be a major part of Australia's and the world's drive to manage climate change."

Incorporating extensive research already underway at the University of Melbourne, the Peter Cook Centre for CCS Research will initially host more than 30 scientists working



At the launch (from left): Victorian Energy and Resources Minister Michael O'Brien, Dr Richard Aldous, Mr Doug Ritchie (Rio Tinto) and Professor Jim McCluskey, Deputy Vice-Chancellor (Research), University of Melbourne.



on CCS, including a recently funded Professor of Carbon Storage supported by the Victorian Government. The Centre will link researchers with the CO2CRC Otway Project Subsurface Storage Laboratory, which has been safely storing CO₂ deep underground since 2008.

KAREN REYNOLDS SA SCIENTIST OF THE YEAR

One of South Australia's leading scientists, Professor Karen Reynolds FTSE – a pioneer in the development of biomedical engineering – has been named SA's Scientist of the Year.

Professor Reynolds is Professor of Biomedical Engineering at Flinders University. She became a Fellow of the Academy in 2011 and is Deputy Chair of ATSE's Health Technology forum. Her achievement in bridging the gulf in the medical devices field between academia and industry was recognised by her award of Professional Engineer of the Year in the 2010 Australian Excellence Awards.

Her achievements include the establishment of spin-out companies and

commercialisation licences, coordination of multi-sector initiatives and placements for undergraduate and research students.

SA Science and Information Economy Minister Tom Kenyon said the award recognised Professor Reynolds' outstanding research work, both locally and internationally.

"Professor Reynolds' research aims to improve the understanding, diagnosis, treatment and monitoring of medical conditions with projects ranging from designing orthopaedic implants to virtual reality simulators for improved surgical training.

"Her development of the ground-breaking Medical Device Partnering Program has brought together industry, clinical and research partners across the country to bring innovative bioengineering solutions to the market and for the benefit of patients," Mr Kenyon said. "Biomedical engineering is one of the key strategic sectors of our economy and one contributing to economic growth all over the world.

"These awards highlight the contributions our scientists make to science and research and the ultimate impact on industry and community of this outstanding work. All the winners and finalists have made a significant contribution to their fields and are to be commended for their commitment to excellence."

The awards saw 10 of the SA's top scientists share in \$100,000, with Professor Reynolds taking home \$20,000.



(From left) SA Division Chair David Klingberg, Karen Reynolds and Vice Chancellor of Flinders University Michael Barber.



At the presentation (from left) Nicholas de Dear, Paula Mills and Mike Miller.

Prince Alfred teacher wins STEM award

DR PAULA MILLS OF PRINCE ALFRED COLLEGE has been acknowledged by ATSE for excellence in the teaching of science, technology, engineering and mathematics (STEM) in South Australian secondary schools.

Professor Mike Miller AO FTSE, an ATSE Director, presented the award to Dr Mills at the SA Science and Engineering Super Challenge held at the Adelaide Super-Drome in September. He also presented a \$2000 cheque for Prince Alfred College to Mr Nicholas de Dear, Head of the Senior School.

The ATSE SA Division award – its seventh annual award for excellence – recognises Dr Mills' outstanding performance as STEM Project Lead K-12 and Lead Physics teacher for the Senior School over the past five years.

During this time, the number of students continuing with physics and chemistry has increased to more than 50 per cent. Through her personal drive, the school has trialled ATSE's STELR program (Science and Technology Education Leveraging Relevance) and the Academy of Science's Science by Doing program. She has also introduced activities to illustrate important aspects of engineering and biological, environmental and geological sciences.

ATSE SA Division was a joint sponsor of this year's SA Challenge and Super Challenge competitions, which saw 71 teams of 2000 Year 9 and 10 students competing over nine days in Adelaide, Port Pirie and Mount Gambier. Next year the competition will be

expanded to Port Lincoln and an additional day in Adelaide to help meet school demand.

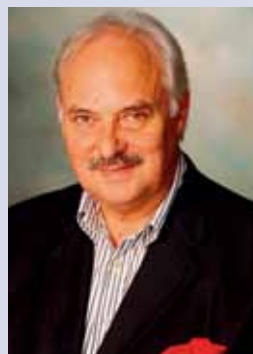
HALL OF FAME FOR TWO FELLOWS

Professor Craig Mudge FTSE and Dr Gregory Clark FTSE have been inducted into the Pearcey Hall of Fame for outstanding contributions to the ICT industry.

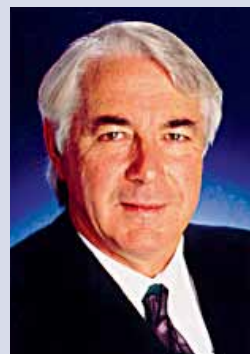
Professor Mudge has worked extensively in the US and Australia since completing his undergraduate degree at ANU and his PhD in computer science at the University of North Carolina.

He led the Xerox PARC computer science lab, the source of many technologies that are commonplace today. He was founding CEO of a semiconductor start-up, Austek Microsystems, and his company developed the world's first single-chip cache controller and other complex logic chips used by global PC manufacturers, as

Craig Mudge



Greg Clark



well as the first asynchronous logic VLSI chip.

He was a computer designer at Digital Equipment in Boston and founded and led microchip research at CSIRO.

He co-authored *Computer Engineering*, has published more than 60 papers and holds six patents. He has held faculty positions in Computer Science at Caltech, Carnegie Mellon University, Flinders University, Macquarie University and, currently, at the University of Adelaide.

He chaired an ATSE committee on Cloud Computing and was principal author of its 2010 report *Cloud Computing: Opportunities and Challenges for Australia*. He is currently working with the CSIRO ICT Centre and, from Adelaide and Silicon Valley, operates Pacific Challenge, a strategy consultancy working with both start-ups and established firms.

Dr Clark is perhaps best known for his 14 years at IBM (1980–94) where he published more 130 papers in archived journals and was granted 18 patents. This was preceded by stints at UK Atomic Energy in Harwell (1969–72), US Atomic Energy at Oakridge National Lab (1976–77) and then back to Australia at CSIRO's Mineral Physics (1973–80).

He balanced his scientific interest with an outstanding business record including presidency of News Corp's Technology Group and membership of News Executive Committee (1993–99). After his departure from News Corp he spent seven years in senior executive roles at Loral Space & Communications (1999–2001) and Knowledge Universe Corp (a private investment vehicle focused on technology, health and education verticals) before he returned to Australia in 2006.

Since then he has started KaComms, a small communications company focused on high-speed broadband communications services to rural and remote communities in Australia. In addition, his firm Clark Capital Partners advises on technology and the

technology market space.

Since 2006 he has also been a visiting professor at ANU and has initiated a number of major computing projects and developed many collaborative efforts between US and Australian researchers.

Dr Trevor Pearcey was a CSIRO research scientist who designed CSIRAC, Australia's first digital computer.

Alison Ord chairs IUGS commission



Alison Ord

**WA DIVISION
SECRETARY
PROFESSOR
ALISON ORD**

FTSE has been appointed chair of the International Union of Geological Sciences (IUGS) Commission on

Tectonics and Structural Geology (TecTask).

Professor Ord, based at UWA, is a researcher and consultant and was Chief Research Scientist, CSIRO Exploration and Mining.

Dr Ord is an internationally acclaimed structural geologist responsible for introducing computer modelling technologies emphasising hydrothermal systems into the Australian and international economic geology community.

IUGS works through its Commissions, Subcommissions, Task Groups and Joint Programs and with the support of its international affiliated bodies to address earth science issues of relevance to society. It recently upgraded the status of TecTask from a Task Force to a full Commission, in recognition of its continued growth in membership and activities.

Former WA Chief Scientist Professor Bruce Hobbs AO FAA FTSE is an Officer of TecTask.

IUGS is one of the largest and most active non-governmental scientific organisations in the world. Founded in 1961, IUGS is a member of the International Council of Science and has a global membership of one million earth scientists through some 120 member countries and almost 50 affiliated organisations.

IUGS promotes and encourages the study of geological problems, especially those of world-wide significance, and supports and facilitates international and interdisciplinary cooperation in the earth sciences.

IUGS fosters dialogue and communication among the various specialists in earth sciences around the world. It achieves this by organising international projects and meetings, sponsoring symposia and scientific field trips, and producing publications. Topics addressed span the gamut from fundamental research to its economic and industrial

applications, from scientific, environmental and social issues to educational and developmental problems.

Australia hosted the 34th International Geological congress 'Unearthing our Past and Future – Resourcing Tomorrow' in Brisbane in August. Among the 5000 delegates from more than 100 countries were Australian delegates Professor Ord, Dr Hobbs and former Geoscience Australia CEO Dr Neil Williams PSM FTSE.

BEN EGGLETON WINS 2012 LAUREATE FELLOWSHIP

Professor Benjamin Eggleton FTSE has been named a 2012 Australian Laureate Fellow.

Professor Eggleton is Director of the ARC Centre of Excellence for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS), an ARC Federation Fellow and Director of the University of Sydney's Institute of Photonics and Optical Science (IPOS).

His Australian Laureate Fellowship will allow him to open a new field of physics by building the first integration platform in which light and sound interact in non-linear nanoscale circuits. This interaction will be harnessed for new signal processing applications, leading to dramatic improvements in microwave technologies for radar, communications and sensing at the nanoscale.

The Fellowship will help him continue

his leadership roles, which include travel-intensive international liaison, that have been a crucial aspect of his success and the success of the CUDOS collaboration. It will provide him with the profile and resources to lead a major research program, in particular a research program that "will deliver transformational new technologies for Australia and the world," he said.

After receiving a PhD in physics from the University of Sydney in 1997, Professor Eggleton went to Bell Laboratories in the US, where he was head of Photonic Devices Research and Research Director of the Specialty Photonics Division.

The ARC Federation Fellowship scheme enticed him back to Australia in 2003, joining the University of Sydney to establish a new research group in the School of Physics. In 2003 he also began leading CUDOS.

"It is very exciting and great time in Australia now, in terms of the scientific frontier, the scale and excellence of our science, the calibre of our students and postdocs and vibrant collaborations," he said after his award.

As well as being an ATSE Fellow, Professor Eggleton is a Fellow of the IEEE Photonics Society, the Australian Institute of Physics (AIP) and the Optical Society of America. His awards include the 2011 Eureka Prize for Leadership in Science, 2011 AIP Walter Boas Medal, 2008 NSW Science Prize, 2007 Pawsey Medal from the Australian Academy of Science and the 2004 Prime Minister's Malcolm McIntosh Prize for research in Photonics. He was President of the Australian Optical Society and is Editor-in-Chief of *Optics Communications*.

Ben Eggleton



Ralph Slatyer “fathered” the nation’s CRC system

AUSTRALIA’S FIRST CHIEF SCIENTIST,

Professor Ralph Slatyer AC FRS FAA FTSE, who died in Canberra in July at the age of 83, will be remembered as the author of Australia’s Cooperative Research Centre (CRC) system.

He contributed a great deal to Australian science and left behind a lasting legacy. He delivered the Academy’s 1986 Oration.

An agricultural science graduate, he worked in the CSIRO Division of Land Research, as Professor of Biology at ANU, Australia’s Ambassador to UNESCO and Chairman of the Australian Science and Technology Council (ASTEC) and Chief Scientist.

Born in Melbourne and educated in Perth, Professor Slatyer – a Fellow since 1992 – graduated for the University of Western Australia with Bachelors, Masters and Doctoral degrees in agricultural science.

Beginning his career as an agricultural science graduate, he joined CSIRO in 1951, working in the Division of Land Research, of which he became Associate Chief in 1966. Professor Slatyer left CSIRO in 1967 to become a Professor of Biology at the Australian National University and was elected a Fellow of the Royal Society in 1975. He was a Visiting Professor at Duke University and the University of California. In the US, he was appointed a Senior Fellow of both the National Science Foundation and the Ford Foundation.

In 1978 Professor Slatyer became Australia’s Ambassador to UNESCO, which

took him to Paris for four years. On his return home in 1982, the Fraser Government appointed him Chairman of the Australian Science and Technology Council (ASTEC), which was a Government ‘think tank’ set up by then Prime Minister Malcolm Fraser in the 1970s.

During Professor Slatyer’s five-year tenure as Chair, ASTEC was instrumental in lobbying for tax concessions for research and development in Australia. In 1989 Professor Slatyer made Australian history when he was appointed as the first Chief Scientist for Australia.

As Chief Scientist, Professor Slatyer directly advised the Prime Minister on important issues relating to science and technology both in Australia and abroad for the next three years. During this period Professor Slatyer was largely responsible for the establishment of the CRCs in Australia – a system that still flourishes today, facilitating collaboration between business and researchers.

The role of Australia’s Chief Scientist continues today and while the job description and office has broadened somewhat, the original purpose of advising Government at its highest level still remains the primary focus due to the successful foundations laid by Professor Slatyer.

Professor Slatyer continued to take a strong



Ralph Slatyer

interest in CRCs and other organisations in retirement, chairing several and reviewing many.

The CRC Association named its annual oration The Ralph Slatyer Address on Science and Society in his honour. Professor Alan Robson AM FTSE, the former Vice Chancellor of the University of WA, delivered the first lecture in 2011.

Professor Slatyer was highly awarded – numerous honorary doctorates, foreign membership of the American Academy of Arts and Sciences, gold medal of the Ecological Society of Australia, ANZAAS Medal, Queen’s Silver Jubilee Medal, Australian Medal of Agricultural Science, Edgeworth David Medal (Royal Society of NSW), David Evans Memorial Prize (UWA) and honorary membership of many organisations.

“I had the pleasure of Ralph Slatyer’s support when I took on the role he had pioneered, Chief Scientist of Australia. He made himself available and his wise counsel helped me settle in to the task of a major review of Australia’s science. Ralph remained interested and enthusiastic to see change, especially to see better connection between our researchers and those in end-user land. He leaves a brilliant legacy in terms of the Cooperative Research Centre scheme, which still continues to deliver outstanding results in terms of connection and collaboration between researchers and end-users.”

– ATSE President Professor Robin Batterham

“Professor Slatyer was a remarkable man and an excellent ambassador for science. He has left behind a lasting legacy and I’m honoured to be working in a role that was originated by him.”

– Chief Scientist Professor Ian Chubb

FROM AUTOCRC TO RMIT

Professor Matthew Cuthbertson FTSE has become RMIT University’s Deputy Pro Vice-Chancellor, Research & Innovation, within the College of Science, Engineering and Health.

Professor Cuthbertson has a PhD in chemistry and a wealth of experience in research leadership, technology commercialisation, strategy and organisational development. He has held senior positions in the medical devices, defence, mining services and manufacturing sectors and has led successful CRC submissions.

He was previously CEO of the CRC for Advanced Automotive Technology (AutoCRC) and prior to that was Chief Executive of the CRC for Sensor Signal and Information Processing, and Vice President Research and Technology at SOLA International.

Professor Cuthbertson has an extensive national and international network of industry and government research linkages, and is experienced in managing researchers,



Matthew Cuthbertson

“I am a great admirer of the enormous contribution made by Ralph Slatyer to both science and science policy. In my view, the establishment of the Cooperative Research Centres was a masterstroke way ahead of its time. These Centres have enabled the development of great science with great application to industry, for the wider benefit of all. His genius was his ability to bring people together for the greater good.”

– Professor Alan Robson

“I know I speak for the whole CRC community in passing on our condolences to June Slatyer and her family. Ralph was intensely proud of his family and we wish them all the best at this very difficult time.”

– CRCA CEO Tony Peacock

Douglas Hilton is Eureka mentor

PROFESSOR DOUGLAS HILTON FAA FTSE,

Director of the Walter and Eliza Hall Institute and Research Professor of Medical Biology and Head of the Department of Medical Biology at the University of Melbourne, was named the winner of the Outstanding Mentor of Young Researchers category in the 2012 Eureka Prizes.

Professor Hilton took up this role in 2009, when he became the sixth director of the institute in its 94-year history. He became an ATSE Fellow in 2010.

Professor Hilton has been actively mentoring young researchers for almost two decades, many of whom have become leading researchers in their own right.

Professor Hilton has received many prizes and awards for his contribution to medical research, including the Amgen Medical Researcher Award, the inaugural Commonwealth Health Minister's Award for Excellence in Health and Medical Research and the GSK Australia Award for Research Excellence. In 2008, he was recognised as one of the NHMRC's 'Ten great minds in health and medical research'.

Throughout his career, Professor Hilton has been actively involved in the application of research through collaboration with industry. He is an inventor on more than 20 patent families, most of which have been licensed. He co-founded the biotechnology company Murigen and actively collaborates with CSL on a number of projects.

Together with Warren Alexander and Benjamin Kile (son of Victorian division chair Dr Glen Kile AM FTSE), Professor Hilton has established a new program using large-scale mouse genetics and genomics to identify which of the 30,000 genes in the genome regulate blood cell formation.

Professor Shi Xue Dou, Director of the Institute for Superconducting & Electronic Materials at the University of Wollongong, was one of the three finalists in the category, sponsored by the University of Technology, Sydney.

Professor Dou, a Fellow since 1994, specialises in energy and superconductor materials including high performance lithium ion batteries for electric vehicles and patented magnesium diboride superconductor wires for applications in



Doug Hilton

magnetic resonance imaging and electric power systems.

He was awarded three consecutive Australian Professorial Fellowships by the Australian Research Council in 1993, 2002 and 2007 and the Centenary Medal for his achievements in materials science and engineering in 2003. He received the Vice-Chancellor's Excellent Senior Researcher Award in 2008.

PETER ARLETT: FROM APPRENTICE TO PRO VC

Emeritus Professor Peter Arlett FTSE, who died in Townsville in July, aged 79, took a 40-year journey from Welsh apprentice to Queensland Pro Vice Chancellor – via Baghdad and Brazil.

Welsh-born, in Ogmore Vale, Professor Arlett started his career in 1950 as an apprentice with the Welsh Central Electricity Generating Board and worked in increasingly senior positions until he won a scholarship to study engineering.

He graduated with a BSc and PhD from the University of Wales before becoming an academic, working from 1963 to 1972 as a lecturer then senior lecturer in the Department



Peter Arlett

of Electrical and Electronic Engineering at the University College of Swansea.

He was Reader and acting department head at the University of Wales from 1972 to 1976, also serving as a Visiting Professor at the University of Baghdad and the University of Brazil.

He came to Australia to join James Cook University in 1976 as Professor of Electrical and Electronic Engineering and was appointed Pro Vice Chancellor (Research) in 1991. He was elected to the Academy in 1988.

During his 35 years in Townsville, he was a



Shi Xue Dou

Member of the Space Industry Business Advisory Committee, Chair of the Northeast Australian Satellite Imagery System, served on and headed various JCU committees, was a member and Chair of the North Queensland Electricity

Board, Deputy Chair of the Council of the Townsville College of TAFE and a Director of JCU Technologies Pty Ltd.

Professor Arlett was a Chartered Engineer, a Fellow of the Institute of Engineers Australia, a Fellow of the Institute of Electrical Engineers and a Member of the Institute of Mechanical Engineers.

Professor Arlett's nomination citation for Fellowship noted his department's close contact with industry, his leadership in remote sensing, the number of research contracts his department held with overseas organisations and its success in developing equipment licensed to industry for manufacture and export.

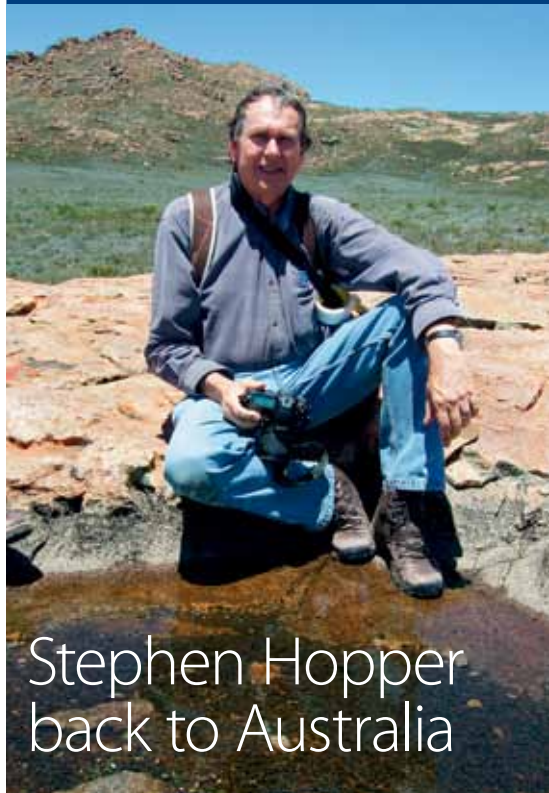
ANSTO CEO AWARDED ENGINEERING HONOUR

Dr Adi Paterson FTSE, the Chief Executive of the Australian Nuclear Science and Technology Organisation (ANSTO), has been named Professional Engineer of the Year in the Engineers Australia 2012 Sydney Division Engineering Excellence Awards.

As Chief Executive since 2009, Dr Paterson has overseen a major revitalisation of ANSTO, with several new projects across the site such as the construction of the Centre for Accelerator Science and major extensions to the Minerals Division and OPAL reactor building.

Most recently, a \$168 million plan was announced to build a nuclear medicine manufacturing plant at Lucas Heights that will help meet global health needs, along with a collocated waste treatment plant to showcase the Australian developed Synroc technology. This project alone will create around 250 new jobs.

"Engineering is the basis of all of our work here, from nuclear medicine production to radiocarbon dating. It is crucial for our infrastructure to be up to date and this is driving growth at ANSTO," he said.



Stephen Hopper back to Australia

INTERNATIONALLY RENOWNED plant conservation biologist Professor Stephen Hopper AC FTSE has stepped down as Director (CEO and Chief Scientist) of the World Heritage-listed Royal Botanic Gardens in Kew, UK, to take up a new Chair in Biodiversity at the University of Western Australia.

Professor Hopper's return from London to UWA, starting 8 October, is to enable him to devote more time to research, writing and teaching in biodiversity conservation, plant taxonomy and evolutionary biology. He will be based in Albany, on the south coast of WA, 400 kilometres from Perth.

Professor Hopper will explore opportunities at UWA to further develop a significant international research program, including ongoing collaborative links with Kew.

Professor Hopper has collaborated in the discovery, classification and description of 300 new plant taxa and, since 2006, has led the development of a 10-year Breathing Planet program at Kew Gardens, which aims to improve the quality of all life on Earth.

Professor Hopper has led new developments in Kew's science, including a concerted focus on restoration ecology aimed at restoring natural biodiversity. His publication in *Plant and Soil* in 2009 of OCBIL Theory dealing with biodiversity on old, climatically buffered, infertile landscapes is a recent career highlight.

"I came to Kew from the University of Western Australia with a simple aim – to ensure the world, biodiversity and the

Stephen Hopper – back to field work and research.

organisation were in a better place by the time I left. Like all such aims, my time is marked by achievement in some quarters and much more left to do in others. Biodiversity has an enormous role to play in helping moderate the worst aspects of global warming and in enabling people to live healthy, sustainable lives," Professor Hopper said, discussing his move.

He told ATSE *Focus* his new role is primarily a terrestrial biodiversity research post, with a bit of teaching (mostly in the field and for postgraduates, plus one undergraduate unit).

"After six years at the helm at Kew, I decided it was time to hand the reins to someone else so that I

could focus on research, writing and teaching where I can be most effective – working in the rich temperate flora of the Southwest Australian Floristic Region, using it as a model for the world's oldest climatically buffered infertile landscapes (OCBILs) where patterns of ecology, evolution, conservation and sustainable living appear different to those emphasised in the mainstream literature.

"I published a new body of theory on this topic in 2009, and I'm keen to test hypotheses through an active program of field research.

"Kew is travelling relatively well at the moment, despite the financial challenges in the UK, and I've had a dream run, full of opportunity to make a contribution to global science-based plant conservation aimed at enhancing the quality of life.

"I now look forward to shifting emphasis from a post that was 80 per cent administration to one that is 80 per cent research, and I'm grateful to both RBG Kew and to UWA for enabling this to happen."

Professor Hopper graduated from UWA and worked as a plant conservation biologist in the WA Government until appointed Director of Kings Park and Botanic Garden from 1992 to 2004. Following two years at UWA as Foundation Professor of Plant Conservation Biology, he was the 14th Director of the Royal Botanic Gardens, Kew in London from 2006–12.

He was awarded a Commonwealth Centenary Medal for service to the community in 2003, became a Fellow of the Linnean Society of London and a Corresponding Member of

the Botanical Society of America in 2007 and received the Nancy T. Burbidge Memorial Medal from the Australian Systematic Botany Society in 2008. He was elected an ATSE Fellow in 2011.

He is an active field biologist, widely travelled and published, interested in evolution, ecology, conservation and landscapes. He has specialist expertise in eucalypts, orchids, the kangaroo paw family (Haemodoraceae), plants of granite rock outcrops and old landscapes, botanic gardens, and exploring links between biodiversity and sustainable human livelihoods.

The WA Division will welcome Professor Hopper's return to WA at its Christmas event on 26 November, where he will address Fellows on Science, sabbaticals and songlines – lifelong learning by a Western Australian botanist.

ATSE INVOLVED IN ACSRF MEETING

More than 130 leading Australian and Chinese scientists, researchers and government representatives – including ATSE Fellows – met in Melbourne recently to foster greater collaboration and further strengthen research and industry links between the two countries.

They met at the Australia–China Science and Research Fund (ACSRF) Knowledge Exchange

Symposium, supported by the Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE).

Professor Thomas Maschmeyer FAA FTSE, Federation Fellow and Future Fellow from the University of Sydney, chaired a session on case studies in early-stage collaboration and Professor Neil Furlong FTSE, Research Manager, Australian Technology Network, presented on the ATN.

This year marks the 40th anniversary of diplomatic relations between Australia and China. The ACSRF has already funded 34 group missions to China covering fields ranging from green photonics, and childhood language disorders to quantum science. It is jointly managed by the Australian and Chinese governments and was established following the Prime Minister's visit to China in 2011.



Thomas Maschmeyer

Alan Hamer was an industry giant

MR ALAN HAMER FTSE, former Chair and Managing Director of ICI Australia Ltd and scientific adviser to the Federal Government, has died in Melbourne, aged 94.



Alan Hamer

Mr Hamer, a Rhodes Scholar who achieved first-class honours in chemistry at Oxford, was a brother of the former Victorian Premier (1972–81) Sir Rupert (Dick) Hamer and former Liberal MHR and Senator for Victoria (1977–90) David Hamer. Alan Hamer joined the Academy in 1983.

Mr Hamer had a long career with ICI. Joining the company in England, he worked on the neutralisation of carbon monoxide to save RAAF bomber crews from poisoning before working for ICI Australia in peacetime on the design and management of plants manufacturing explosives, sulfuric acid and ammonia to meet post-war demand.

He held the posts of chemical engineer, chemical group development manager and technical controller, becoming Executive Director (1959–68), Chairman and MD of the Group's Indian companies (1968–71) and MD and Deputy Chairman of ICIANZ (1971–79).

He was chairman and director of several listed companies, as well as Chairman of the Australian Industry Development Association and a member of the Australian Science and Technology Council and the Federal Government's Science Committee.

TIM BESLEY HEADS TRANSPORT BOARD

Former ATSE President – and former Chancellor of Macquarie University and current Chairman of the Science and Engineering Challenge Council with the University of Newcastle – Tim Besley AC FTSE has been appointed chair of the NSW Transport Advisory Board.

Mr Besley has had an extensive and successful career over the past 40 years as an Executive, Director and Chairman of public and private organisations and has previously held roles as Chairman of Leighton Holdings,

Commonwealth Bank and the Wheat Export Authority.

Mr Besley has been a Fellow since 1985 and was President from 1998 to 2002.

Announcing the appointment, the NSW Minister for Transport, Gladys Berejiklian, and the Minister for Roads and Ports, Duncan Gay, said the Board would be part of the NSW Government's commitment to drive change and deliver better transport outcomes for customers across the state.

Ms Berejiklian said the Transport Advisory Board would play an important role in providing high-level advice on transport issues to the Government and the state's new integrated transport agency, Transport for NSW.

Mr Gay said the NSW Government was delivering a huge transport agenda, from major infrastructure projects such as the North West Rail Link, the Pacific Highway duplication and the widening of the M5 West, to crucial plans for transport in the next 20 years.

"The Transport Advisory Board will provide high-level advice on strategic transport planning, delivery of transport projects and initiatives to ensure customers are being considered at the centre of transport planning and service delivery," Mr Gay said.

JIM PEACOCK IS 2012 RABOBANK AWARDEE

Internationally renowned scientist Dr Jim Peacock AC FAA FTSE has been named 2012 recipient of the Rabobank Leadership Award in recognition of his outstanding contribution to the food and agricultural industries.

Dr Peacock is Australia's former Chief Scientist and currently Fellow and Chair of CSIRO's Office of the Chief Executive Science Team and Distinguished Professor at the University of Technology, Sydney.

In addition to serving as Chief Scientist to Australia from 2006–08, Dr Peacock headed CSIRO's Plant Industry division for 26 years, pioneering research that led to numerous advances benefiting global agriculture.

Rabobank Australia & New Zealand Group Chief Executive Thos Gieskes said the work undertaken by Dr Peacock over more than 40 years had "resulted in a broad and deep impact on agribusiness in Australia and well beyond".

"Jim Peacock's career is exemplary of a



Tim Besley

successful marriage of science and industry. He is a visionary leader who has made not only an outstanding contribution to science in Australia and internationally, but to industry-partnered science that has been of enormous benefit to agriculture and agribusiness around the globe," Mr Gieskes said.

These achievements include:

- developing gene technology research programs to benefit Australia's important crop and pasture species, championing new approaches to wheat, barley and cotton breeding;
- facilitating the first commercial introduction of a transgenic crop – insect-resistant cotton – in Australia, which has been critical for the sustainability of the local cotton industry;
- initiating the development of a low-GI, high-fibre CSIRO barley variety, BARLEYmax, now available on supermarket shelves;
- founding the Gene Shears biotechnology company to commercialise ribozymes, a technology with potential in agricultural products and medical applications;
- establishing Grain Gene, an alliance to work on projects of importance to the wheat industry; and
- involvement in development of the High Rainfall Zone Wheat Alliance between New Zealand and Australian research groups and wheat-breeding companies to develop new high-rainfall wheat varieties.

In their most recent research, Dr Peacock and his colleagues have made fundamental advances in the molecular basis of plant hybrid vigour. With hybrids providing much greater yield to farmers than the parent varieties, this is an area of great potential for the challenge of providing food security for the world's growing population.

Dr Peacock is a recipient of the Prime Minister's Prize for Science and a CSIRO Medal for Lifetime Achievement, in addition to numerous international honours.



Jim Peacock

Susan Pond chairs Clean Technology committee

ACADEMY VICE PRESIDENT DR SUSAN POND AM FTSE

will chair an expert committee of seven leading business figures appointed to assist Innovation Australia deliver the \$200 million Clean Technology



Susan Pond

Innovation Program – and has joined the Board of Innovation Australia.

The committee will assess applications by businesses for funding through the Clean Technology Innovation Program.

Announcing the committee, Industry and Innovation Minister Greg Combet said there had been strong interest in the Program since it was launched last month and it would help businesses to find innovative ways of reducing greenhouse gas emissions.

"I am pleased we have been able to attract a committee of this calibre to help deliver the Clean Technology Innovation Program. They will play a vital role in assessing applications to this merit-based program," he said.

The \$200 million in Clean Technology Innovation funding enables firms to access matched grants ranging from \$50,000 to \$5 million to improve Australian industry competitiveness.

Dr Pond is Adjunct Professor in Sustainability, United States Study Centre, University of Sydney, and a Member of the Commercialisation Australia Board.

In 2010, Dr Pond was appointed to the Dow Sustainability Program of the United States Study Centre. The Program brings together academic and policy experts from Australia and the US to develop action-oriented solutions to a range of sustainability challenges concerning energy, water, food and biodiversity that are technologically innovative, commercially scalable and politically viable.

Dr Pond's area of interest is the development of the advanced transportation biofuels industry, including the critical success factors required for commercially viable production at scale.

Dr Pond is also a Director of the Australian Nuclear Science and Technology Organisation and a Board member of the Centenary Institute and Biotron Ltd.

Previously, Dr Pond was a senior executive with Johnson & Johnson, serving for 12 years as Director and Managing Director of its Sydney-based biotechnology company, Johnson & Johnson Research Pty Ltd.

NEIL TURNER GETS CHINA HONOUR

Winthrop Professor Neil Turner, from the University of WA's Institute of Agriculture, has been presented with the People's Republic of China's highest award for "foreign experts who have made outstanding contributions to the country's economic and social progress".

A dryland agriculture expert, Professor Turner has been selected by China's State Administration of Foreign Experts Affairs (SAFEA) as one of only 50 foreign experts to receive the national Friendship Award in 2012.

In 2011 Professor Turner received the prestigious Dunhuang Award from the Gansu People's Provincial Government as part of the 62nd anniversary of the foundation of the People's Republic of China. A provincial award is a prerequisite for being considered for the national Friendship Award, which is conferred as part of the celebrations of the National Day of the People's Republic of China on 1 October.

The awards recognise Professor Turner's outstanding service and contribution to the joint UWA and Lanzhou University (LZU) economic, scientific, academic development and education program in Gansu. The program includes the introduction of improved cultivars of wheat and barley and grain and forage legumes to increase cereal and legume production, while maintaining soil health to withstand wind and water erosion in the semi-arid region of the Loess Plateau of China.

Professor Turner is a former CSIRO scientist and Director of the Centre for Legumes in Mediterranean Agriculture at UWA. For the past 28 years he has worked with dryland farmers in WA, which has similar rainfall to the Loess Plateau.



Neil Turner

He first visited China in 1989 and has spent one month a year for the past five years at the Key Laboratory for Grassland and Arid Ecology at LZU, helping staff and postgraduates with their research and publications.

UWA and LZU are developing a joint Centre for Dryland Agricultural Ecosystems to further develop collaborative research, giving Australian researchers access to new facilities on root growth at LZU and giving LZU researchers access to specialist facilities and expertise for drought research at UWA.

STEPHEN POWLES IS A FINALIST IN WA SCIENTIST OF THE YEAR

Winthrop Professor Stephen Powles FAA FTSE, Director of the Australian Herbicide Resistance Initiative at the University of

Western Australia, has been named a finalist in the WA Scientist of the Year category of the 2012 WA Science Awards.

Professor Powles is as an international expert on herbicide resistance in crops and weeds and he has made significant contributions to Australian agriculture. He has strongly influenced Australian and global thinking on sustainable herbicide usage by reducing herbicide reliance and increasing diversity in agro-ecosystems.

The Awards citation notes that Professor Powles has made several ground-breaking discoveries. "He was the first to reveal the biochemical basis of multiple herbicide resistance in plants and the first to report glyphosate resistance evolution. At all stages (he) has ensured that his research outcomes have been communicated to end-users, resulting in practice change.

Owning a farm himself, he has demonstrated what is possible at the applied level."

Professor Powles' industry leadership has been recognised by the Grains Research and Development Council with a Seed of Light Award (2010) for his contribution to WA agriculture, and he is the only Australian ever elected as an International Honorary Fellow of the WSSA, USA.



Stephen Powles

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NETWORKS DRIVING INNOVATION



Do business networks have a role to play in supporting innovation in resource-strapped small and medium enterprises?

This is the question asked by The University of Queensland's Dr Martie-Louise Verreyne, Dr Tim Kastelle and Sarel Grönum.

The UQ Business School researchers recently conducted a study to understand the contribution of networks to innovation and firm performance in small and medium enterprises (SMEs).

Their research found that strong, diverse relationships improve innovation breadth in SMEs, providing more access to resources, complementary skills, capabilities and knowledge. These resources are essential to innovation and show the importance of purposeful relationships with other individuals, communities and societies.

The researchers recommend that SME owners and managers use their limited resources to establish diverse and strong network links, adopting an open innovation orientation. These networks should aim to increase innovation breadth – a mechanism that unlocks the performance value of networks.

UQ Business School is at the fore in break-through research, with work consistently cited in the world's top tier journals. In the last six years UQ Business School has generated over \$5 million in competitive research funding (Australian Research Council and other funds), published over 1,000 refereed journal articles, books and book chapters, and refereed conference papers.

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.

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