



FOCUS

NUMBER 181
DECEMBER 2013

WATER RECYCLING

TIME FOR A NEW PARADIGM TO PRESERVE A VALUABLE RESOURCE

Contributors discuss why Australia
must seriously consider direct recycling
as a drinking water option.

Real Opportunity. Real Responsibility.

At Orica, we are serious about graduate development.

So serious that our Graduate Program led to Orica recently being awarded the prestigious graduate recruitment industry award, the Will Spensley Memorial Award for Innovation. The award recognised the work of our Graduate Sustainability Committee, which was launched to develop Orica graduates' leadership skills and provide a forum for graduates to make a difference to Orica and the communities we operate in. Our graduates have raised funds and volunteered for not-for-profit environmental, health and social causes in Australia, Latin America and North America.

Orica is also serious about science education. As major and founding sponsors of ATSE's hands-on, inquiry-based, in-curriculum program – the STELR Project – Orica has helped more than 360 high schools in Australia become STELR schools. Our graduates and experienced professionals alike are working with the STELR team to support the growth of this outstanding program.

Satisfy your desire for diversity of work, travel and training on Orica's Global Graduate Program. To find out more visit www.orica.com/graduates

3

DPR can safely supply drinking water

By Stuart Khan

5

'Direct' may be the best way to go

By Jurg Keller

8

Where does Australia stand on drinking water recycling?

By Ian Law



Front cover: Clean water – the iconic resource.

PHOTO: AWRCE



Angela Moles: Rocking the ecological boat (Page 24).

- 10 A new paradigm for a valuable resource
- 13 Integrated water management can boost 'liveability' in cities
- 14 ATSE water report makes US impact
- 15 Taking STELR to Indonesia
- 17 Astronomy and astrophysics in China
- 17 ATSE elects top names to its Fellowship
- 17 ERF should be robust and transparent
- 18 Bigger role in water proposed for NWC
- 39 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.

Deadline for the receipt of copy for next edition of *Focus* is

17 January 2014.

COPYRIGHT

This publication contains copyright material. Some of the material is owned by Australian Academy of Technological Sciences and Engineering Ltd ACN 008 520 394 (ATSE) and some material is owned by others. All copyright and other intellectual property rights in the materials remain with the owner. No material in this publication may be copied (except as legally allowed) or further disseminated without the express and written permission of the holder of that copyright, with the exception of copying for educational purposes.

Copyright © ATSE 2013

PUBLISHER

CEO: Dr Margaret Hartley FTSE
Editor: Bill Mackey

AUSTRALIAN ACADEMY OF
TECHNOLOGICAL SCIENCES AND
ENGINEERING (ATSE)

Address:

Level 1, 1 Bowen Crescent, Melbourne

Postal Address:

GPO Box 4055, Melbourne, Victoria 3001

Telephone: 03 9864 0900

Facsimile: 03 9864 0930

Email: editor@atse.org.au

ACN 008 520 394

ABN 58 008 520 394

Print Post Publication No 341403/0025

ISSN 1326-8708

Design and production:

Coretext 03 9670 1168 www.coretext.com.au





University of
South Australia

Water recycling; conserving a valuable resource.

A revolutionary technology that drains water off roofs at velocities up to seven metres per second has been developed at the University of South Australia (UniSA).

Professor Simon Beecham, Head of the School of Natural and Built Environments, is leading the way in planning and designing drainage systems that integrate the management of the total water cycle into urban structures.

Siphonic roof drainage works very differently from conventional downpipe systems, as water is piped horizontally at roof level to almost any point in the building, before being brought down to a single collection pipe at ground level, states Professor Beecham.

Most downpipe systems have a very inefficient way of discharging water from roofs because water spirals down around the inner edges or walls of the downpipes. Siphonic drainage replaces these downpipes with a single large pipe full of water that discharges at a very high flow rate, which is all achieved with smart hydraulic design and requires no electrical or mechanical energy.

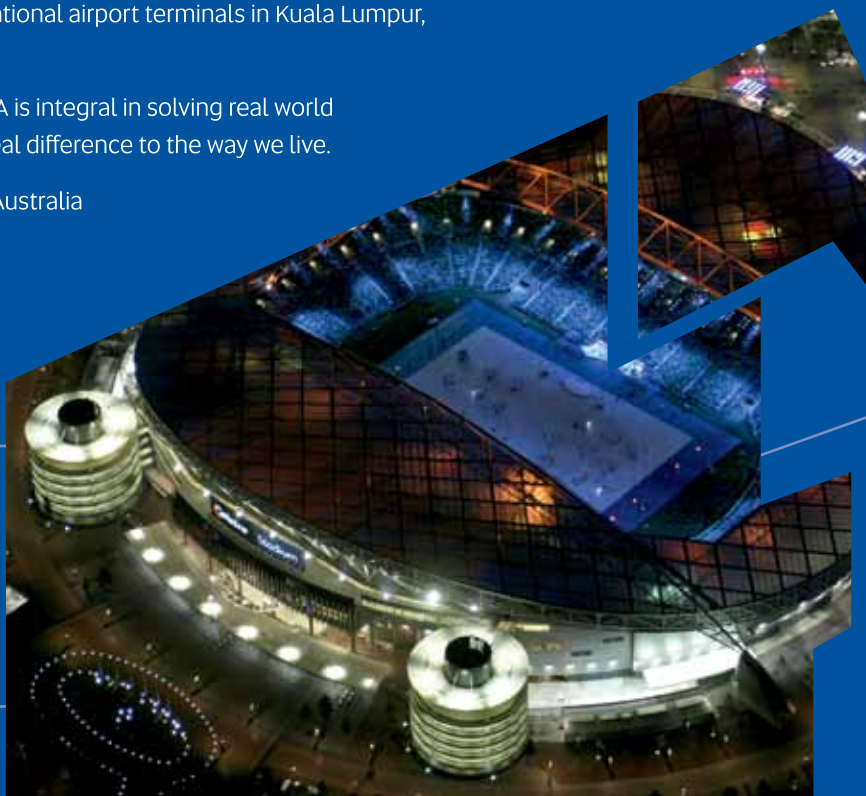
Every drop of rain that's fallen on the roof of the Sydney Olympic Stadium since its commissioning has been harvested and reused, thanks to innovative technology and software design delivered by Professor Beecham. The software has also been employed at other prominent buildings, including the Melbourne Cricket Ground and the international airport terminals in Kuala Lumpur, Hong Kong, Sydney and Adelaide.

This visionary research is another example of how UniSA is integral in solving real world challenges by using contemporary ideas that make a real difference to the way we live.

To find more about research at the University of South Australia visit unisa.edu.au/research

The siphonic system works like a domestic water supply. The pressure that has been built into the water supply system drives the flow of water out whenever a tap is turned on in any part of the house.

Sydney Olympic Stadium



DPR can safely supply drinking water

Advanced water-treatment membranes, such as used in potable water reuse projects.

The potential benefits of direct potable reuse (DPR), relative to indirect potable reuse (IPR), include significantly lower energy requirements and construction and operational costs.



By Stuart Khan

s.khan@unsw.edu.au;unimelb.edu.au

There are no direct potable reuse (DPR) water projects operating in Australia and no specific proposals for their development.

However, ongoing interest in sustainable water supply systems, advances in the science and engineering of water treatment and recent international developments in DPR have prompted consideration of DPR as a potential future component of Australian water supply systems.

Potential benefits of DPR, relative to indirect potable reuse (IPR), are likely to be highly case-specific. However, they include significantly lower energy requirements, construction costs and operational costs.

DPR can also provide an opportunity to allow potable reuse in situations where a suitable environmental buffer is not available for IPR. Potential obstacles or disadvantages for DPR, relative to IPR, are primarily related to public perception and acceptance.

Importantly, the ATSE Report *Drinking Water through Recycling:*

The benefits and costs of supplying direct to the distribution system, concluded that the scientific and engineering hurdles to implementing safe and reliable DPR are manageable.

However, a number of technical issues relating to the functions of an environmental buffer would need to be addressed to the satisfaction of the community generally. Key among these issues is the need to ensure consistent and assured levels of reliability.

It is apparent that existing frameworks for the planning, approval, management, and oversight of drinking water quality and recycled water in Australia could accommodate a well-designed and operated DPR project as a water resource

management option. In addition, there are a number of advanced risk assessment and risk management tools which can be considered for the implementation of DPR projects, relative to more established or conventional water sources.

The key findings derived from this work include:

- The science, technology and engineering associated with DPR have been rapidly advancing in recent decades. DPR is growing internationally and will be an expanding part of global drinking water supply in the decades ahead.
- DPR is technically feasible and can safely supply potable water directly into the water distribution system, but advanced water treatment plants

The Australian Water Recycling Centre of Excellence recently funded a study, undertaken by the Australian Academy of Technological Sciences and Engineering (ATSE) regarding the future of potable reuse in Australia. The report from this study focuses on direct potable reuse (DPR) systems, where treated water is returned immediately to the drinking water supply system. This differs from indirect potable reuse (IPR), where water is pumped into 'environmental buffers' such as rivers, lakes or aquifers for temporary storage.

are complex and need to be designed correctly and operated effectively with appropriate oversight. Current Australian regulatory arrangements can already accommodate soundly designed and operated DPR systems.

- High levels of expertise and workforce training within the Australian water industry is critical. This must be supported by mechanisms to ensure provider compliance with requirements only to use appropriately skilled operators and managers in their water treatment facilities. This will be no less important for any future DPR implementation and to maintain high levels of safety with current drinking water supply systems.
- Some members of the community are concerned about the prospect of DPR. Planning, decision-making and post-implementation management processes should acknowledge and respond to these concerns. Public access to information and decision-making processes needs to be facilitated.
- Individual recycling schemes, as with other supply options, will present unique opportunities and risks that need to be systematically identified and managed. In ATSE's view, the Australian Guidelines for Water Recycling provide an appropriate framework

for managing community safety and guiding responsible decision-making.

- Ultimately, water supply decision-making should be based on an objective assessment of available water supply options to identify the most economically, environmentally and socially sustainable solution. While optimum solutions will continue to be case-specific, ATSE is convinced of the technical feasibility and safety of drinking water supply through DPR when properly managed. ATSE considers there may be considerable environmental, economic, and community benefits of supplying highly treated recycled water direct to drinking water distribution systems in appropriate circumstances.
- ATSE therefore concludes that DPR should be considered on its merits – taking all factors into account – among the range of available water supply options for Australian towns and cities. Furthermore, ATSE is concerned that DPR has been preemptively excluded from consideration in some jurisdictions in the past, and these decisions should be reviewed.
- Governments, community leaders, water utilities, scientists, engineers and other experts will need to

take leadership roles to foster the implementation and acceptance of any DPR proposal in Australia.

Widespread media attention accompanied the successful launch of the report in October. This included segments on television news, broad radio coverage and articles in most of the capital city newspapers. This coverage was refreshingly intelligent and positive.

The headline in the Fairfax media was "Drinking recycled effluent 'inevitable' in smarter Australia" and the article was accompanied by a readers' poll on the question 'Would you drink recycled effluent?' Of the 1766 respondents, 63 per cent voted "yes".

While there is still more work to be done, it is apparent that the Australian community has come a long way in beginning to appreciate the significant potential advantages of potable water reuse, and coming to terms with some of the natural psychological barriers.

An object of this report was to identify key areas of change required of Australian institutions and communities in order to facilitate taking full advantage of the potential offered by DPR.

In order to do so, the report provides a series of recommendations regarding necessary improvements in regulation, oversight, research and development, and community engagement. The full report is available from the ATSE website (www.atse.org.au).

AusSMC launches 'Scientists in Residence' scheme

The Australian Science Media Centre (AusSMC) has launched a national effort to embed scientists within newsrooms around the country in a new program called 'Scientists in Residence'. Under the six-month scheme, funded by a grant from Inspiring Australia, Australian scientists in various disciplines will take up residence in TV, radio, print and online media outlets, helping mainstream media report on a range of issues from extreme weather, bushfires and coal seam gas to obesity and sleep disorders. The program aims to improve linkages between scientists and the media by encouraging them to generate collaborative content and build ongoing relationships. The first 'cab off the rank' was Dr Sophie Lewis, a Research Fellow at the University of Melbourne and the ARC Centre of Excellence for Climate System Science, who investigates extreme climate events in Australia. She spent three weeks at *The Age*, where she helped journalists report on the findings of the latest report from the Intergovernmental Panel on Climate Change (IPCC).

DR STUART KHAN is a Senior Lecturer in the School of Civil and Environmental Engineering, University of NSW, and an active water researcher with a focus on chemical contaminants in drinking water, wastewater and recycled water. He is the leader of the Trace Chemical Contaminants research stream at the UNSW Water Research Centre. He is a member of the Water Quality Advisory Committee (WQAC) to the National Health and Medical Research Council and led the revision of all aspects involving organic chemical contaminants in the 2011 revision of the Australian Drinking Water Guidelines. Dr Khan has also made significant contributions to other Australian water quality guidelines, particularly the National Guidelines for Water Recycling.

**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.

Please address to editor@atse.org.au

'Direct' may be the best way to go

We are increasingly recognising that water supply will not keep up with demand for much longer – at least not if we only use it once.



By Jurg Keller

j.keller@uq.edu.au

Water is undoubtedly one of our most important resources, but we take it for granted. We expect it to run, nice and clear, from the tap, then 'disappear' again from the sink or shower. But this major achievement of modern life is not without its limitations and challenges.

Through population growth, urbanisation and the growing variability of global climates, we are increasingly recognising that supply will not keep up with demand for much longer – at least not if we only use it once.

Therefore water recycling has to be a key consideration in the diversity of supplies into the future, together with alternative water sources such as seawater or stormwater (urban runoff).

Many cities have recognised this in recent years. Water recycling systems have helped to address the supply shortages and built up valuable experience and public confidence. The Singaporean 'Four Taps' approach is probably the best-known example of integrating various water sources from dams, seawater desalination, water recycling and stormwater harvesting into their long-term supply strategy.

The recycling of used water (aka wastewater) is by no means an obvious or 'easy to swallow' proposition, challenging the public and water professionals across the world. The very foundation of our remarkable improvements in public health and life expectancies over the past century or more has been the strict separation of clean drinking water from polluted wastewater – and now we are starting to connect the two systems deliberately, and calling this 'progress'.

It has been happening for quite a long time. There are numerous examples, also in Australia, where the water supplies of downstream cities along a river contain significant fractions of treated wastewater

PHOTO: ISTOCKPHOTO



High quality effluent from modern wastewater treatment plants provides an excellent basis for the advanced water treatment (AWT) processes to produce water for direct potable reuse.

Enhancing Australia's prosperity through technological innovation

The Australian Academy of Technological Sciences and Engineering (ATSE)

ATSE is made up of some of Australia's leading thinkers in technology and engineering. One of Australia's four Learned Academies, it's an eclectic group, drawn from academia, government, industry and research, with a single objective in mind – to apply technology in smart, strategic ways for our social, environmental and economic benefit.

To achieve that goal, ATSE has formed a variety of expert, independent forums for discussion and action – platforms to move debate and public policy on issues concerning Australia's future. These focus on energy, water, health, education, built environment and innovation – and the international collaboration necessary to ensure that Australia is abreast of world trends.

It's an open, transparent approach – one that government, industry and community leaders can trust for technology-led solutions to national and global challenges.

Each year, the Australian Government recognises the importance of the work we do by awarding the Academy an establishment grant to help with:

- Fostering research and scholarship in Australia's technological sciences and engineering;
- Providing and conducting administrative support, workshops, forums and similar events to enable the Academy and its Fellows to contribute on important national issues;
- Managing the development and execution of our programs; and
- Supporting relationships with international communities.

The Australian Academy of Technological Sciences and Engineering (ATSE)
1/1 Bowen Crescent
Melbourne Victoria 3004
Australia

+613/ (03) 9864 0900
info@atse.org.au
www.atse.org.au



discharged from upstream populations.

Despite its somewhat ad hoc nature, this *unintentional* water recycling has actually not caused serious water quality or human health incidences despite the widespread occurrence, particularly in highly populated areas such as central Europe or coastal areas in the US.

The key to this success is the fact that we have developed an excellent understanding of the important water quality criteria and how to maintain them, which has translated into well-performing treatment operations at both wastewater discharge and water intake.

In fact, the performance of our modern wastewater treatment processes has been pushed up continuously over the past decades, mainly to ensure environmental protection of downstream waterways, estuaries and bays. Given the considerable investments into these processes, the question can be raised how we could make better use of the treated water than simply discharging it into the environment.

AWT technologies

The development of *intentional* potable water recycling in recent years has been enabled by the application of advanced water treatment (AWT) technologies – mainly an extension of current water treatment approaches to include a multi-barrier train of different treatment processes, including membranes, activated carbon filtration and advanced oxidation processes.

These AWT plants are typically located directly after the existing wastewater treatment plants and generate a water quality that is at least comparable to, and in many cases far better than, the 'natural' sources we have for our drinking water supplies. Particularly in catchment areas with significant human or agricultural activities, or after major natural events such as floods or bushfires, the raw water quality running into our dams is often significantly compromised and difficult to control.

Despite these extraordinary advances in the treatment technologies used in the

The performance of our modern wastewater treatment processes has been pushed up continuously over the past decades, mainly to ensure environmental protection of downstream waterways, estuaries and bays.

AWT plants, most potable reuse systems still include an 'environmental buffer', such as an aquifer, dam or a river/wetland. These buffers in the indirect potable reuse (IPR) schemes provide time to react to potential incidences, may achieve some further treatment and potentially create a psychologically important separation of wastewater and water systems.

But are environmental buffers that important? The recycled water going into these buffers is usually far better quality than the 'natural' water there already. And with the extensive on-line monitoring and control systems in modern AWT plants, there is no real need for further reaction time. The control systems simply shut down a process as soon as certain 'critical control point' parameters are not met, therefore stopping the entire recycled water production.

It is therefore time to consider direct potable reuse (DPR) – without the environmental buffers – in securing diverse water supply options for our growing populations, both in urban and regional areas.

This is also the conclusion of the recent ATSE report that considered all aspects of DPR, including cost and energy/material requirements relative to alternative water supply options. DPR was often one of the best-ranked options for alternative water supplies, even compared to non-potable (dual pipe) recycling systems.

Significant advantage

Such direct potable reuse systems have a significant advantage over the indirect option in that they provide more flexibility in the overall water supply strategy, even in situations where the traditional surface water supplies may be compromised – for example, during floods or when there are significant water quality incidents in the dams, due to algal or bacterial outbreaks, the supply

of recycled water to the dam will not alleviate any possible supply shortages.

Conversely, the direct recycling of highly treated water, either to the water treatment plant or directly into the network, will ensure a reliable and safe supply even in such challenging situations.

This situation is not at all 'hypothetical', as was experienced during the 2011 and 2013 floods in Brisbane.

In both cases the poor raw water quality seriously affected the water treatment process capacities and only the supply from the desalination plant, and from other unaffected plants connected to the network, ensured an uninterrupted supply to consumers. The introduction of direct recycled water could further enhance the supply security in such cases and also reduce the pressure on the water treatment plants to get back to full capacity as quickly as possible. This, in turn, will improve the overall reliability and safety of our water supplies especially in such challenging situations.

DPR requires us to break the age-old tradition of not connecting wastewater and water systems, but with a careful and conscientious implementation strategy, it will provide at least the same (and possibly even better) public health protection as current drinking water systems do.

We may still have to deal with the psychological impacts, but humans have successfully adapted to far greater changes in the past.

PROFESSOR JURG KELLER FTSE is an IWA Fellow, Director of the Advanced Water Management Centre at The University of Queensland and Professor in the School of Chemical Engineering. He is a member of the Executive of the CRC for Water Sensitive Cities and has more than 20 years' experience in water industry research, particularly in biological wastewater treatment, environmental biotechnology, microbial fuel cells and resource recovery concepts.

**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

Where does Australia stand on drinking water recycling?

Water professionals and researchers have shown that direct potable reuse is a safe and sustainable water supply option that must be considered in the development of future water supply portfolios.



By Ian Law

iblaw@bigpond.com

Water recycling is playing a significant role in the diversification of water supplies in many countries of the world – including Australia – and we have seen tremendous growth in its application over the past few years.

As we strive to develop sustainable supplies for our cities into the future, there is increasing pressure to consider all options and in particular, the potable reuse (PR) option.

Planned *indirect* potable reuse (IPR) is the term given to a scheme in which the water produced by an advanced water treatment plant (AWTP) is first discharged into an 'environmental buffer', surface storage reservoir or an underground aquifer, before being again treated in a water treatment plant and then conveyed to communities.

Examples of such applications can be found in the US, South Africa and Europe, with the oldest one being that at the Upper Occoquan Sewerage Authority (UOSA) plant in Virginia, USA, which was commissioned in 1974. If one then adds the incidences of *unplanned* or *de facto* potable reuse – whereby one community discharges its treated wastewaters into a river that then serves as a water supply for a downstream community – then there are many more examples of potable reuse occurring around the world, including in Australia.

There is now a growing realisation that a more sustainable potable reuse option is to discharge the highly treated water from the AWTP directly to the drinking water distribution system – the direct potable reuse (DPR) option.

This concept is not new. The first DPR scheme in the world is located in Windhoek, Namibia, where a plant was commissioned in 1968 – 45 years ago.

Potable reuse has recently been enshrined in legislation in California. A Bill was passed by the Californian State Senate in October 2010 instructing that State's Department of Public Health to complete indirect potable reuse regulations and evaluate direct potable reuse. California thus views potable reuse as a viable option.

International developments

1968 TO 2000

The first DPR scheme started in 1968. The drivers for the commissioning of the world's first DPR plant in Namibia were:

- low rainfall, high evaporation rates and low runoff;
- all surface sources within 500 kilometres had been exploited;
- further sources were expensive and controversial;
- groundwater usage had been maximised; and
- demand management had already been implemented.

Thus there was no other feasible option but water reclamation.

These drivers are similar to those now being faced by cities and towns of the US, South Africa and India – as well as Western Australia. The Windhoek plant has undergone four technology changes since 1968, with the most recent being in 2002.

2000 TO PRESENT

There was very little interest in the DPR option over the period 1968 to 2000, but prolonged drought and climate change concerns in many parts of the world, together with the search for sustainable solutions for future water supplies, prompted DPR to be included in many evaluations. Many DPR schemes now being planned and in many cases implemented.

United States

- Cloudcroft, New Mexico (commissioned 2007);
- Aurora, Colorado (2010);
- Big Spring, Texas (2013);
- Wichita Falls, Texas (commissioning due 2014);
- Brownwood, Texas (regulatory approval January 2013); and
- San Diego, California (approval obtained for an IPR scheme but research is being conducted to determine feasibility of DPR by end of 2016).

South Africa

- Beaufort West, Western Cape (commissioned 2011);
- Durban, Kwazulu Natal (feasibility studies completed, under consideration);
- Hermanus, Western Cape (construction due to commence); and
- Cape Town (tenders submitted July 2013).

India

- Dehli (182ML/d – tenders called in 2014-15);
- Bengaluru (140ML/d – tenders called in 2014-15); and
- others in planning/evaluation stage.

Australia's stance

Australia has had guidelines in place since May 2008 for the Augmentation of Drinking Water Supplies with water reclaimed from municipal effluents – the *potable reuse* option – with these guidelines being produced by an eminently qualified working party of scientists and health regulators, subjected to international and national refereeing and subsequently accepted by the then Environment Protection and Heritage Council, the National Health and Medical Research Council and the

then Natural Resource Management Ministerial Council (EPHC 2009).

The Water Services Association of Australia (WSAA), representing Australia's major water utilities, in its Occasional Paper 25 of July 2010 (WSAA 2010) stressed the need for a diversified portfolio of water supply options to meet the future water needs of an increased population.

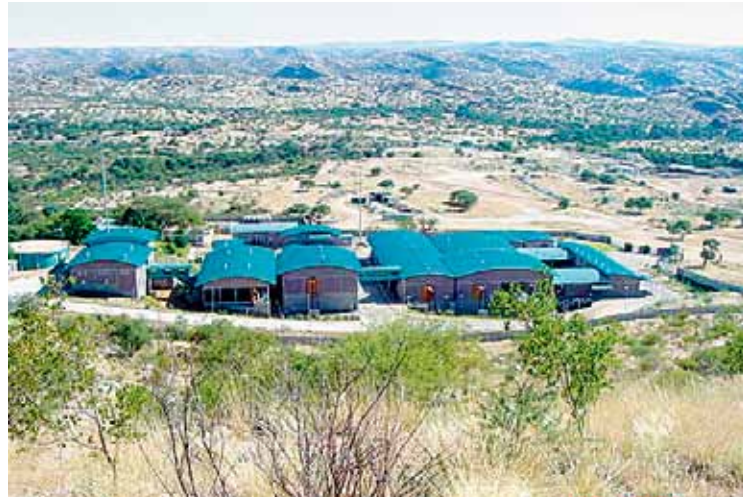
It noted: *"It is expected that the development of a diverse portfolio of water supply options including recycled water for non-drinking and drinking purposes, desalination, rural to urban water trading, rainwater tanks, groundwater, stormwater and dams will be required to mitigate the risks associated with population growth and climate change. There should not be any blocks to the different sources of supply and each case should be examined on its merits."*

Further, WSAA noted: *"It is imperative that there are no policy blocks in place that would preclude a source of water being considered for inclusion in a diverse portfolio of water supply options."*

The National Water Commission also strongly supports consideration of water recycling on its merits as an option to be reviewed when determining future water supply sources, and notes that *"water recycling – including for drinking purposes – can provide a significantly greater proportion of Australia's future urban water supplies. The Commission recognises there are intrinsic risks associated with recycled water. However, in our judgement, advances in science and improved regulatory arrangements mean that such risks can now be managed to levels of safety that are equivalent with other supply sources"* (NWC 2010).

Despite these opinions stressing the importance of considering all water supply options, South Australia and Victoria still have policies in place precluding the potable reuse option from consideration, despite the fact that Queensland and Western Australia have seen merit in giving the option due consideration in recent times.

It is suggested that these policies are driven by a lack of 'political will' which in turn results from advice based on sensationalised media reports and/or perceptions of community concerns. This lack of 'political will' is causing a growing frustration in the industry as it strives to ensure that future water supplies are developed on a sustainable basis, very much as recommended by WSAA and the NWC.



The New Goreangab Water Reclamation Plant, Windhoek, Namibia.

Water professionals and researchers in Australia and elsewhere have shown that potable reuse, and indeed direct potable reuse, is a safe and sustainable water supply option that must be considered in the development of future water supply portfolios.

This divide between water supply reality and 'political will' must be removed if cost-effective and sustainable water supplies into the future are to be realised.

The way forward

Given that 'political will' is driven by perceptions of community attitudes – as evidenced by the Western Corridor decision in Queensland – there would appear to be a clear need to focus on the community at large as, if it accepts the advantages of including potable reuse into the mix of options, the politicians will surely follow.

It was Mahatma Ghandi who said: "If the people lead, the leaders will follow".

The Australian Water Recycling Centre of Excellence (AWRCE) has taken up this challenge and is funding a project that will address one of its four goals: Goal 3 – overcoming the barriers to reclaimed water being viewed as an acceptable 'alternative water' for augmenting drinking water supplies.

This project has the objective of developing a National Demonstration, Education and Engagement Program that supports successful public engagement and addresses stakeholder concerns through the provision of contemporary scientific information on the urban water cycle and potable reuse.

It will involve leading edge methods of communication to overcome known social barriers to acceptance and adoption.

This project also covers research into governance and pricing practices with the aim being to identify the impediments to investment in potable recycling, compared to alternative water supplies.

References

- EPHC (2009) *Australian Guidelines for Water Recycling. Environment Protection and Heritage Council, the National Health and Medical Research Council and the Natural Resource Management Ministerial Council.* www.ephc.gov.au/taxonomy/term/39.
- NWC (2010) *Urban Water Recycling,* www.nwc.gov.au/__data/assets/pdf_file/0004/9724/Recycled_water_position_statement_23.11.101.pdf
- WSAA (2010) 'Implications of population growth in Australia on urban water resources'. WSAA Occasional Paper 25, Water Services Association of Australia, Melbourne, 5 July 2010, <https://www.wsaa.asn.au/FreeDownloads/Occasional%20Papers/Implications%20of%20population%20growth%20in%20Australia%20on%20urban%20water%20resources.pdf>

MR IAN LAW is a Chemical Engineer with a Masters Degree in Public Health Engineering from the University of Cape Town in South Africa who is an Adjunct Professor at the University of Queensland. He was, until March 2003, CH2M HILL's Technology Director for South-East Asia, Australia and New Zealand, and has since started his own business and trades as IBL Solutions. He has more than 30 years' experience in advanced wastewater and reuse projects in southern Africa, South-East Asia and Australia. Mr Law currently serves on the Research Advisory Committees for the Australian Water Recycling Centre of Excellence and the Urban Water Security Research Alliance.

A new paradigm for a valuable resource

Direct potable reuse is not being considered for the immediate future, but the AWRCE thinks, in some regions at least, Australia should be exploring the proposition.



By Mark O'Donohue

mark.o'donohue@australianwaterrecycling.com.au

The Millennium Drought impacted on the availability of urban water, raising the spectre of limited and unreliable water supply across all sectors of Australian society. Alternative sources of water needed to be identified to insulate us from the 'boom and bust' cycle of water supply driven by the vagaries of a variable climate. The need for energy efficient, climate independent drinking water sources will only increase over the coming decades.

Against this backdrop, in March 2010 the Australian Water Recycling Centre of Excellence (AWRCE) was officially launched with a grant from the former Australian Government Department of Sustainability, Environment, Water, Population and Communities (now the Department of the Environment) under the National Urban Water and Desalination Plan.

As one of a number of organisations

around Australia brokering outcomes between research investors (industry, state and federal governments) and research providers (universities, CSIRO and consultants), the mandate of the Australian Water Recycling Centre of Excellence is to work with the water sector to develop research and development (R&D) programs that improve water recycling efficiency, expand its use and increase its acceptance in Australia.

Although based in Brisbane, the AWRCE is a national research enterprise. We are implementing an applied research program that covers the full spectrum of water recycling opportunities in metropolitan, rural and regional communities, including water recycling for agricultural, residential, industrial and environmental purposes, and for potable use.

We believe the social, environmental and economic value of water recycling is

significant but is not yet fully understood or exploited. There is relatively little scientifically defensible information available on the merits of contemporary water recycling when applied to a range of end-uses, including industry, agriculture and the environment. Further, the opportunity to develop new or novel thinking, or to enhance existing approaches and technologies for various fit-for-use purposes, has not been fully developed.

Four research goals

The Centre's research portfolio includes projects which address social, economic, environmental and technical issues of water recycling.

After national consultation with utility, private enterprise, government and research sectors, the Centre released its Strategic Research Plan in July 2010, and reviewed it in 2012. The plan outlines an overview of water recycling in Australia and overseas, identifies a series of research needs, and establishes four research goals that guide the Centre's investment in industry-relevant research. These goals are strongly supported nationally, and align with globally identified research priorities:

- Goal 1 – The social, economic and environmental value of water recycling is demonstrated and enhanced;
- Goal 2 – Establish a National Validation Framework for water recycling;
- Goal 3 – Reclaimed water is viewed as an acceptable 'alternative water' for augmenting drinking water supplies; and
- Goal 4 – Establish a national knowledge, training and education program for water recycling.

The Centre's Research Advisory Committee comprises recognised leaders in water recycling infrastructure, management and research. The Research

PHOTO: SEQWATER



Water sampling at the Bundamba Advanced Water Treatment plant near Brisbane.

Advisory Committee guided the development of the technical scopes, funding calls and processes for evaluating research proposals submitted in the five nationally competitive funding rounds. Conscious of managing potential conflicts of interest between its members and the various proposals being evaluated, appropriate protocols were established and conflicted Research Advisory Committee members were excluded from evaluations.

To date, approximately \$50 million worth of research in priority R&D areas for water recycling has been funded, including projects which address complex social, economic, environmental and technical issues of water recycling. This includes commissioning ATSE to produce the recently released report *Drinking Water through Recycling: The benefits and costs of supplying direct to the distribution system*, under Goal 3. The aim of Goal 3 is to invest in projects that support successful

community engagement and address stakeholder concerns on supply and reuse of drinking water within Australia.

There is growing interest and investment in direct potable recycling (DPR) overseas, but all Australian investment to date is about returning recycled water to a reservoir, lake or stream prior to treating it again and reusing it for drinking. Direct potable reuse is not being considered for the immediate future, but we think, in some regions at least, Australia should be exploring the proposition of putting purified (recycled) water directly into a drinking water system.

We recognise this is a challenging space for Australians to discuss. The community, policy makers and industry have many questions that need addressing and we believe that the first step in this challenge is to have a credible, independent science and engineering team develop a peer-reviewed and internationally recognised

report that defines in objective, scientific, economic and social terms the potential place of direct potable reuse in the spectrum of available water supply options.

The Australian Water Recycling Centre of Excellence must ensure it derives optimal value from its research investment, and recognises the benefits of engaging early with research beneficiaries to develop, implement and adopt its research program. To ensure research outcomes are influencing policy, practice and planning the Centre has developed the frameworks and relationships necessary so that outcomes of projects will achieve maximum impact and adoption.

While the ATSE report focuses on direct potable reuse of recycled water, there are a number of other research projects the Centre is investing in under its Goal 3 with organisations in Australia and overseas, including water utilities, universities and private companies – including tools,

Australia should embrace recycled drinking water

Australia should embrace the concept of recycled drinking water, according to a new Academy report, and reap the benefits of reduced energy use and greenhouse gas emissions, lower capital and operational costs and a more robust, climate-independent water supply.

Direct potable reuse of water (DPR) – recycling water directly to the drinking water distribution system – should be considered as a viable water resources management strategy beside other water supply options, the report says. These are the key findings of a research project completed by the Academy for the Australian Water Recycling Centre of Excellence (AWRCE) and captured in an Academy report, *Drinking Water through Recycling: The benefits and costs of supplying direct to the distribution system*.

The report – written by University of NSW water specialist Dr Stuart Khan – was launched in Melbourne in October by The Hon Karlene Maywald FTSE, National Water Commission (NWC) Chair. The report calls for objectivity in decision-making about water supply and distinguishes between DPR and indirect potable recycling (IPR).

“Water supply decision-making should be based on an objective assessment of available water supply options, taking into account factors such as public safety, cost, greenhouse gas emissions and other environmental impacts – as well as public attitudes – to identify the most economically, environmentally and socially sustainable solutions,” the report says.

“Ultimately, leadership will be required from governments, community leaders, water utilities, scientists, engineers and other experts to foster the implementation and acceptance of DPR proposals in Australia.”

A seminar on several aspects of the report followed the launch – with Dr Khan providing a report overview, Professor Jurg Keller FTSE, Director of the Advanced Water Management Centre at The University of Queensland, discussing advanced water treatment for recycling and

Mr Ian Law, a member of the AWRCE Research Advisory Committee with more than 30 years’ international experience in advanced wastewater and reuse projects, providing international examples of DPR.

The launch was chaired by Mr Peter Laver AM FTSE, former ATSE Vice President, and guests were welcomed by Dr Alan Finkel AM FTSE, Academy President. A seminar on the topic followed, chaired by Dr John Radcliffe AM FTSE, former NWC Commissioner and retiring ATSE Water Forum Chair. The project was overseen by an Academy Steering Committee, co-chaired by Professor Paul Greenfield AO FTSE and Mr Laver, whose members included Mr Ken Matthews FTSE,

The Academy Report and a Short Guide to the Report are available on the Academy’s website, www.atse.org.au/water-reports



WHAT ARE DPR AND IPR?

Direct potable reuse (DPR)

of water is the supply of highly treated reclaimed (recycled) water directly to a drinking water distribution system.

Indirect potable reuse (IPR) of water involves the storage of treated reclaimed water in environmental buffers – such as a river, lake, reservoir or aquifer – before being recovered through drinking water treatment plants and distributed to consumers.

methods and materials that provide consistent, high-quality, relevant and evidence-based information for Australia.

These resources, developed to raise acceptance of using recycled water to augment drinking water supplies, will be accessible to community, government, media and industry groups under the banner of the National Demonstration Education and Engagement Program.

The future

Australia's water future offers communities the opportunity to develop a portfolio of water sources, quality and types. This portfolio will comprise water that is fit-for-purpose, cost and security, and managed to achieve the greatest social, economic and environmental benefit for our urban, regional and rural communities. Water recycling has a substantive and important contribution to this water portfolio, and while water recycling has been occurring in Australia for many years, the scale of opportunities for recycling schemes is now growing.

Recycling is not the whole solution,

but it is a critical part of our climate-resilient solution for Australia's future.

Planning for what, if anything, might replace the Centre of Excellence when the initial Commonwealth investment is expensed in mid-2015 has commenced. There will continue to be a number of organisations with similar roles, target markets and a focus on urban water; however industry organisations and State and Commonwealth governments do not see these organisations as competitors of the Centre.

Consequently, the Centre's future involves working with these organisations to develop a more efficient, effective and sustainable R&D investment framework for urban water in Australia.

Further reading

- *Australian Water Recycling Centre of Excellence, Strategic Research Plan 2012*, www.australianwaterrecycling.com.au/corporate-publications.html
- *Drinking water through recycling: The benefits and costs of supplying direct to the distribution system*, [www.atse.org.au/Documents/Publications/Reports/Water/drinking-water-](http://www.atse.org.au/Documents/Publications/Reports/Water/drinking-water-through-recycling-full-report.pdf)

[through-recycling-full-report.pdf](http://www.atse.org.au/Documents/Publications/Reports/Water/drinking-water-through-recycling-full-report.pdf)

- National Demonstration Education and Engagement Program for recycled water, <http://www.australianwaterrecycling.com.au/projects/national-demonstration-education-amp-engagement-program>
- Australian Water Recycling Centre of Excellence, Annual Report 2012-13, www.australianwaterrecycling.com.au/corporate-publications.html
- Australian Water Recycling Centre of Excellence, Project Progress Report 2012-13, www.australianwaterrecycling.com.au/corporate-publications.html

DR MARK O'DONOHUE is CEO, Australian Water Recycling Centre of Excellence. He is a researcher with a strong background in developing science policy partnerships for urban and environmental water. Prior to joining the Centre, he was the Director of Environmental Water Policy for the Department of Environment, Water, Heritage and the Arts in Canberra where he managed policy development and implementation for environmental water recovered as a result of the Commonwealth Government's \$3.1 billion investment through Water for the Future.

Excellence in delivering information


- AUSTRALIA'S LEADING AGRI-SCIENCE PUBLISHER
- PROFESSIONALLY WRITTEN AND PRODUCED PUBLICATIONS
- INFORMATION PRODUCTS THAT SHOWCASE R&D AT WORK
- TALK TO US IF YOU NEED TO: reach new audiences
create effective communications
explain, engage and convince



FISH, the industry magazine for the Fisheries Research and Development Corporation (FRDC), is now available for iPad. The new digital version of FISH makes the entire printed magazine available free of charge including industry analysis, fisher interviews and research news. Download the FRDC FISH Magazine from the App Store.



coretext
CONTENT MATTERS



City streetscape
'living wall'.

Integrated water management can boost 'liveability' in cities

PHOTO: ISTOCKPHOTO

Stormwater biofilters have been constructed at a high rate across Australian cities – 10,000 raingardens have been built in the heart of Melbourne alone to protect the Yarra Estuary.



By Ana Deletic

ana.deletic@monash.edu

A major challenge for our metropolitan societies is to become more resilient to climate change and rapid population growth. Moving beyond traditional approaches to managing urban water is essential. Raingardens, green roofs, green walls and living walls are affordable, attractive solutions, collectively called 'biofiltration'.

They act as natural filters – carefully selected soils and plants trap and clean water as it sinks through roots. At the same time they green and cool our cities. Because they are made from natural materials and are often gravity-fed, their costs are minimal.

Through research at Monash Water for Liveability and the Cooperative Research Centre for Water Sensitive Cities, both based at Monash University in Melbourne, we aim to develop low-energy, affordable biofilters for both stormwater

harvesting and wastewater recycling.

For example, we are currently developing living walls that can treat light greywater (from wash basins, baths or showers) for safe irrigation and, with minimal additional treatment, for non-potable uses such as toilet flushing.

Imagine a wall of plants – a vertical canopy – comprising two to three storeys, each with species chosen for their talents as organic filters. Deciduous climbing plants on upper storeys allow for sunlight to be screened in summer for cooling (wall-climbing vines can significantly reduce temperatures of buildings and adjacent areas) and captured in winter for heating.

On lower storeys, evergreen sedges and flowering plants enable greywater treatment in winter months. Living walls thus address both water supply and urban heat wave problems – a living wall for

greywater recycling installed at a typical residential apartment could save more than 20 per cent of the potable water needs of its residents, while reducing temperature of the building surface by more than 10°C.

At the same time, urban runoff from paved surfaces has never actually been used at all.

Rather, it drops from the sky, sweeps across roads or roofs and rushes through gutters into drains, picking up pollutants in its inexorable path to the ocean. On its way, it harms our waterways, such as rivers, streams, estuaries and bays – stormwater runoff is recognised as the largest source of coastal water pollution in the US (and very likely this is the case in Australia, although we still lack the evidence).

That is where wetlands and raingardens can present solutions as natural filters.

Stormwater biofilters have been

constructed at a high rate across Australian cities, as they have considerable scope for ecological protection. Around 10,000 raingardens have been built in the heart of Melbourne alone, for protection of the Yarra Estuary. The technology has been exported to Singapore and Israel, where the first stormwater biofilters have been built using Monash University designs.

The stormwater biofilters have been advanced to the level that urban runoff (gravity treated within a park or a street where systems are usually installed) can be used for non-potable uses, such as irrigation and toilet flushing.

We are working on various types of filtration media which make a substantial difference to the quality of water-cleansing that occurs – for example, developing zeolites media (treated with anti-microbial chemicals) that can reduce pathogen levels in stormwater. At the same time we are learning how different combinations of plants and media maximise nutrient and pathogen removal, as well as understanding the health of plants and how they can minimise clogging of the filters. The key challenge is to design systems that

can operate reliably over prolonged time with minimal maintenance.

Our colleagues are assessing impacts of these green systems on urban micro-climates. The findings are very encouraging, showing that green and open water stormwater treatment systems can reduce air temperatures and increase air moisture – both very important for human comfort during hot summer days.

Keeping cities green is an imperative in delivering on aesthetic values of urban landscapes.

Raingardens can be packaged as simple modular systems, which are tailored to designs catering for context, not only geological but social, because communities can determine if systems thrive. Understanding the community dynamics, cultural variables and interdependencies between communities and engineering practice is imperative in developing more sustainable methods of harvesting and treating water.

Professor Rebekah Brown, from Monash's School of Geography and Environmental Science, one of the leading Australian social scientists, said recently

we need novel urban water governance structures to support widespread adoption of integrated urban water solutions that can render our communities more resilient, liveable and sustainable.

From all perspectives – ecological, social, aesthetic and economic – green water treatment systems can support liveability of cities and towns.

Relevant reports:

- *Blueprint2013: Stormwater Management in a Water Sensitive City*, published by the CRC for Water Sensitive Cities, Australia.
- *Liveability and the Water Sensitive City* – Science-Policy Partnership for Water Sensitive Cities – Monash University Water for Liveability & Victorian Government Department of Sustainability and Environment, a report by Phillip Johnstone, Rachelle Adamowicz, Fjalar J. De Haan, Briony Ferguson and Tony Wong.
- *Australian Domestic Water Use Cultures: A Literature Review* by Sian Supski and Jo Lindsay, CRC for Water Sensitive Cities, an Australian Government Initiative.
- *Melbourne's Water Future – consultation draft strategy*, Office of Living Victoria, Department of Sustainability and Environment.
- *The National Water Initiative: Securing Australia's water future 2011*, assessment, National Water Commission (also see subsequent reports on water markets, discussion papers, strategic plans, trends, indicators & national performance).
- Department of Health's review of the public health regulatory framework for alternative water supplies in Victoria, *ibid*.
- 'The Changing Role of the Urban Water Sector', guest editorial by Professor Tony Wong, CEO, CRC for Water Sensitive Cities, 2013, in *Australian Water Management Review*.

ATSE water report makes US impact

Dr John Radcliffe AM FTSE, retiring Chair of the ATSE Water Forum, and Dr Paul Greenfield AO FTSE, ATSE Director, attended the WaterReuse Research Association's (WRRF) 2013 Direct Potable Reuse Specialty Conference in Newport Beach, California.

They accompanied the Australian Water Recycling Centre of Excellence (AWRCE) CEO, Dr Mark O'Donohue, who presented on Australian water recycling, encompassing the ATSE Report *Drinking Water through Recycling*.

They found the Report, commissioned by the AWRCE and released only a couple of weeks earlier, had already received significant recognition and respect from American water reuse scientists and water managers.

Dr Greenfield was chair of the Steering Committee overseeing the Report.

An MoU was signed after the conference between WRRF and AWRCE to develop complementary research relationships.

The CEOs of AWRCE and WRRF, Mark O'Donohue (left) and Wade Miller, signing the research collaboration MoU.



PROFESSOR ANA DELETIC FTSE is a Professor in Water Engineering at Monash University, Director of Monash Water for Liveability and was instrumental in establishing the Cooperative Research Centre for Water Sensitive Cities. She is the world leader in integrated urban water management. Commencing research in Yugoslavia and Scotland (1990s), she moved to Monash University (2003) to focus on removing pollutants from urban runoff, establishing the world's most published group on stormwater management, leading development of biofilters and raingardens. She is the incoming Deputy Chair of the ATSE Water Forum. In 2012, she won the Victoria Prize for Science and Innovation (Physical Sciences).

Taking STELR to Indonesia

STELR has been making inroads into Asia this year – most recently in Indonesia.

STELR Program Manager Peter Pentland and Dr Greg Smith presented two one-day workshops in Bandung in October. Dr Smith is a science education lecturer at Charles Darwin University and the mentor for STELR schools in the Northern Territory.

The first workshop was at the SEAMEO Regional Centre for QITEP (Quality Improvement of Teachers and Educational Personnel) in Science. QITEP was donated a class set of STELR equipment earlier this year through the sponsorship of Orica. This workshop was attended by 30 secondary science teachers from 15 local government schools, staff from QITEP and 6 doctoral students in science education.

The teachers enthusiastically embraced the STELR activities and were keen to use the equipment and activities in their schools. To facilitate this, the doctoral students will translate the activities into Indonesian. The QITEP centre will manage the loaning of the equipment packs to the schools.

With QITEP, ATSE will endeavour to produce career profiles in Indonesian language of Indonesian people working in renewable energy or sustainability industries as well as case studies. These will be published on the STELR web-site and will also be of use to Australian Students studying Indonesian as a language.

A second STELR workshop was presented at the Innovative Teaching and Learning of Science Through Inquiry-Based Science Education (IBSE) – a training workshop for science educators from the Asia-Pacific region. The workshop was attended by 50 delegates comprising teachers, science teacher educators and government advisors from Brunei, Indonesia, Iran, Malaysia, the Philippines, Sri Lanka, Thailand, Timor-Leste and Vietnam.

The STELR activities and equipment packs were enthusiastically received by all recipients.

STELR is part of the network established following the workshop, with several countries expressing strong interest in incorporating STELR into their science curricula. For example, Tongan students will prepare videos of interviews with the old folks from coastal villages on their observations of changes to climate and the consequences. The best of



Peter Pentland demonstrates the STELR equipment in Bandung.

these will be published on the STELR website if appropriate. STELR will be used as a part of Malaysian teacher training courses.

STELR is also doing well in Australia. By the end of 2012-13, the STELR program had been implemented in more than 340 schools nationwide and involved more than 34,000 students and 1200 teachers.

Peter Pentland presented the STELR program at a Sydney workshop in October planned to shape the NSW science and technology curricula. The purpose of the NSW Science Education Research Roundtable Workshop was to bring together teachers, government agencies, research institutions and

universities who are actively involved in science and technology education. Attendees included representatives from CSIRO, ACARA, Board of Studies, Prime Minister's Science Council, museums, the NSW Department of Education and Community, schools and universities.

STELR (Science and Technology Education Leveraging Relevance) is a national secondary school science program – the key education initiative of the Academy. STELR's primary aim is to address declining participation rates in science and mathematics at the upper secondary school level.

Science and research leaders meet Labor

Opposition Leader Bill Shorten and Shadow Minister Assisting the Leader for Science, Senator Kim Carr, met representatives from Australia's science and research sector in October – including ATSE, represented by its CEO, Dr Margaret Hartley FTSE and Senior Adviser, Mr Peter Laver AM FTSE.

They discussed key issues facing the sector such as creating a sustainable and strategic long-term approach to supporting research programs and infrastructure, and ensuring science does not lose its place among the nation's priorities.

"The role of science in the future lives of all Australians needs to be better understood, Mr Shorten said.

"We still see the science of climate change disputed. We still see parents resisting vaccinations for their children. We see far too little science informing public debates and under-representation in the press.

"Too few students are attracted to study science and maths and those who go on to higher degrees are not offered diverse and rewarding careers paths in Australia.

"Government has a critical role to play in promoting and supporting science and we should be using the best scientific evidence available to develop the long-term policies that will sustain us as a prosperous nation well into the future."

RD&D workshop explores low-emissions coal options

The Academy has been administering the Joint Coordination Group (JCG) Clean Coal Technology Fund on behalf of the Department of Industry, with the most recent engagement a workshop in Melbourne in October 2013, to coincide with the 7th annual JCG Meeting.

The RD&D workshop, funded by the Australian and Chinese governments and co-organised by ATSE and the China Huaneng

Group Clean Energy Research Institute (CERI), engaged with key stakeholders in Low Emission Coal Technology (LECT) from Australia and China.

The workshop was led by Dr David Brockway FTSE, as Australian Convenor, and Dr Xu Yue, Vice President of CERI, as Chinese Convenor. Ms Margaret Sewell, Head, Clean Energy and Energy Efficiency Division, Department of Industry, and

Mr Qin Zhijun, Deputy Director-General, Chinese National Energy Administration Electricity Department, opened the workshop, attended by more than 90 delegates. Dr Mike Sargent AM FTSE and Professor John Agnew FTSE played important roles.

The workshop included presentations by senior representatives from various organisations including Alstom Power, Shanghai Boiler Works, CERI, Monash University, CS Energy Ltd and CSIRO.

The Australian and Chinese Emerging Future Leaders, who have been awarded the Low Emissions Coal Technology Fellowships provided through the JCG Fund, also attended this meeting, allowing them to present on their research and network with the senior Australian and Chinese participants.

The workshop dealt with a range of issues including the development and deployment of LECT at large scale in both new and retrofit situations; the various technologies; the advances in modelling of systems and critical technology elements to provide an essential precursor to technology deployment; and an increasing focus on the end-to-end systems (compared with technology elements within the system).



David Brockway with the Emerging Future Leaders at the workshop.

ACADEMY'S LATEST ANNUAL REVIEW

The Academy's major achievements in the 2012–13 year are in the ATSE Annual Review, circulated to readers with this edition of Focus. It covers principal activities, with overviews by the President and the Chief Executive, and abridged audited annual accounts for the year. It also includes details of honours awarded to Fellows and noteworthy achievements, as well as acknowledging the passing of Fellows who died during the year.

It was provided to Fellows attending the Annual General Meeting on 22 November.



ATSE at CSIRO dinner for CAS

CSIRO and the Chinese Academy of Sciences (CAS) met in Melbourne recently for the 4th CAS-CSIRO Joint Steering Committee Meeting, during which CSIRO hosted an annual dinner.

CAS and CSIRO have a 35-year relationship, including a Memorandum of Understanding (MoU) for cooperation between the two organisations, signed in 1985 and renewed in 2008.

Both organisations have worked collaboratively, committing resources to two-way researcher mobility through various joint projects, in order to strengthen knowledge exchange and deliver significant social, economic and environmental benefits to both countries.

ATSE Senior Adviser and former Vice President Mr Peter Laver AM FTSE represented ATSE at the event.



(From left) Peter Laver, Professor Zhang Yaping (Vice-President, Chinese Academy of Sciences), Dr Megan Clark FTSE (CEO, CSIRO) and Ms Patricia Kelly (Deputy Secretary, Department of Industry).

Astronomy and astrophysics in China

The Academy played a leading role in the 10th Annual Australia-China Symposium in Nanjing, China, in November with a delegation led by Academy President Dr Alan Finkel AM FTSE and the official welcome by Professor Jinghai Li FTSE, Vice President of the Chinese Academy of Sciences and an ATSE Foreign Fellow.

The Symposium – *Astronomy and Astrophysics: Science and Technologies* – was preceded by a meeting of the three Academies: the Chinese Academy of Science, ATSE and the Australian Academy of Science.

The Australian workshop convenors were Professor Brian Boyle FAA and Dr John O'Sullivan FAA FTSE; and new Fellow Professor Peter Quinn FTSE, Director of the International Centre for Radio Astronomy Research (ICRAR) at the University of Western Australia, was a prominent participant.

Australian delegates visited the CAS Purple Mountain Observatory after the Symposium.

Welcoming delegates to the symposium Dr Finkel said it was a further expression of ATSE's long and valuable linkages with China through the Ministry of Science and Technology, the Chinese Academy of Engineering and the Chinese Academy of Sciences and noted that Professor Jinghai Li was a Foreign Fellow of ATSE.

Commenting on the theme of the Symposium, Dr Finkel said: "Stars and space spur the imagination, thus stimulating the science that enlightens us about the nature of our world and our existence."



(From left) Mr Kang Jincheng, CAE President Zhou Ji, Alan Finkel and CAE Vice President Xie Kechang when Dr Finkel visited the Chinese Academy of Engineering.

"This is as true today as it was 4000 years ago, when astronomical observations were first recorded in China.

"Writings by ancient Chinese astronomers have bequeathed a lasting, valuable resource to the world, being used today to mine information about comets, eclipses and supernovae," he said.

Dr Finkel said China's huge contribution to astronomy continued today, with large-scale projects and active participation at the cutting edge in numerous areas.

"And the 500-metre FAST radio telescope currently under construction in Guizhou Province will be both a marvel of engineering and a massive addition to the world's astronomy infrastructure, enabling sensitive observations across the spectrum from H1 neutral hydrogen to pulsars.

"Australia doesn't have an ancient astronomical history, but it has a long one in the modern sense, and can bring valuable resources to its relationship with China, both in equipment and expertise," he added.

ERF should be robust and transparent

The Government's proposed Emissions Reduction Fund (ERF) needs to be transparent, evidenced-based and subject to robust verification, particularly given the role of intermediaries and independent traders, according to the Academy.

ATSE is concerned that some applicants requiring significant capital expenditure to reduce their emissions may be deterred from applying due to delaying the payment until verifiable emission reductions have been achieved.

ATSE is also concerned that, given the significant funding opportunities that will be available and the manner in which applications are invited, it will be important to ensure that the scheme is protected from exploitation but also simple enough so as to not become so complex that it discourages applicants. These are key elements of the Academy's submission to government relating to the ERF, lodged in November.

ATSE also says the ERF must be geared towards enabling funding for new projects to be undertaken, not to fund projects that would have been implemented without the scheme.

The submission is on the ATSE website at Publications/Submissions.

ATSE ELECTS TOP NAMES TO ITS FELLOWSHIP

Key business names, leading academics, prominent commercial innovators and high-ranking public-sector figures – including eight prominent women – have been elected Fellows of the Australian Academy of Technological Sciences and Engineering (ATSE). The 26 new Fellows, elected by the Academy's Fellowship from a variety of fields, include some of the most prominent Australian women and men in the technology and policy fields.

The full list is in ATSE in Focus (page 42).

Bigger role in water proposed for NWC

The National Water Initiative (NWI) has played an important role in the progress of water reform in Australia, and will continue to do so in the future. But for the NWI to continue to achieve progress on water reform in Australia, the role of the independent and objective National Water Commission (NWC) should be expanded.

These are key points made by the Academy in its submission to the 2014 triennial assessment of water reform progress in Australia – Implementing the National Water Initiative – conducted by the NWC.

It said key issues requiring attention in water reform include: northern Australian water issues, particularly ground water resources; urban water issues; water science and better ways of setting the national research agenda; international collaboration; water infrastructure, both urban and rural; and reform of the current crowded, competitive, and sometimes dysfunctional institutional structures across Australia.

Significant progress was still to be made and a considered reprioritisation of the NWI was necessary, it said.

The submission noted that, despite water issues generally receding in public profile due to the relatively greater availability of traditional

water resources over the past few years, it was crucial to prepare now for the next period of significant environmental and economic constraints on water resource availability.

“NWI reforms have helped Australia to



Water reform – getting it to the tap.

PHOTO: ISTOCKPHOTO

better cope with the impact of water shortages,” it said

“Water trading in the southern Murray–Darling Basin, freed up under the NWI, delivered major economic benefits during the severe and prolonged Millennium Drought.”

ASTE said there was significant scope to improve the NWI’s effectiveness.

“A key weakness of the NWI is in the nature of State Government participation. Due to the voluntary nature of this participation, parochial interests can dominate to the detriment of the overall national reform goals. Systems to encourage greater participation and ownership by the States of the reform process through the NWI could include strategic incentive

programs to achieve NWI reforms while offsetting more problematic parochial considerations.

“Overall, there needs to be a more committed and less divisive approach to implementation and development of reform through the NWI from all participants. A coordinated and, most importantly, strongly collaborative process of NWI implementation will achieve the most progress in future water reform in Australia.

“This approach would be facilitated by a greater level of transparency of the scientific, technical, economic and social bases for decision-making, and the return to the NWC of the capacity to generate and explore options for future water policy initiatives in a consultative manner,” the submission said.

Assembly visits Braggs

A highlight of Assembly 11 in Adelaide in November was a visit by Assembly members to The Braggs, home of the Institute of Photonics and Advanced Sensing at the University of Adelaide.

Organised by Academy Vice President Professor Tanya Monro FAA FTSE, who is an ARC Laureate Fellow and Director of IPAS, Assembly Fellows visited the new facilities for glass development and processing, optical fibre fabrication, laser and device development, luminescence dating, environmental genomics, photonic sensor development, and synthetic, surface and bio-chemistry and offices to co-locate IPAS researchers and students from a broad range of scientific disciplines.

The Braggs, named after father and son joint 1915 Nobel Laureates Sir William Henry Bragg and his son, Sir William Lawrence Bragg, both Adelaide University Alumni, also incorporates a 420-seat lecture theatre and other teaching and research facilities.

The Australian Government, South Australian Government, DSTO, Defence SA and the University of Adelaide have invested more than \$40 million in The Braggs, which houses a unique suite of transdisciplinary laboratories.



Rethinking Australia's science policy



By Fred Hilmer
f.hilmer@unsw.edu.au

Research and innovation have allowed Australian companies to successfully develop leading global businesses from our minerals and energy – robotics, rail-bed technology and driverless trains, consisting of hundreds of cars.

Without the technologies for extraction, transport, logistics and processing that flow from years of research our global businesses would never have developed.

The same is true for almost every aspect of Australian life – medicine, agriculture, manufacturing, social policy, culture and our environment. And research and innovation will be even more important in the future.

University research is an integral part of this research effort and plays a critical role in our economy as our most significant non-resource export. Our ability to attract students from overseas depends heavily on the ranking of our top universities. On this measure, Australia punches well above its weight, with seven universities in the top 100 and 20 in the top 400 of the most recent ranking, the QS index – although the overall trend was down.

Research quality and volume are critical to these rankings, so if we fall behind in research our major export of services will be threatened.

Due to significant levels of investment in the past, Australia has a highly competitive research system. We are world leaders in many research areas and an active player in others, taking advantage of ideas and technologies developed elsewhere. It is critical that we maintain and build on this strong position, and we clearly have the capacity to do so. The real issue is whether we have the strategy and will.

Other countries are investing more – focusing their investment more strategically – and improving their higher education, research and research training practices. To continue as a world leader in our traditional areas and to stay in

touch with world developments in new and emerging knowledge fields, we need a coherent long-term strategy for research, something that seems to have been lost.

Examples of a lack of strategy include:

- stop/start funding for important programs – such as the Future Fellows scheme, which supports outstanding mid-career researchers and is due to terminate in 2014; and for major research infrastructure, due to terminate in 2015;
- support for new research buildings but not for the necessary staff, equipment and materials for work to be done in the building;
- establishment of major infrastructure, like a synchrotron with a life of 30 years but no funds to operate and maintain it;
- participation in a major international project like the Square Kilometre Array (SKA) without a clear case for continued operating funding; and
- significant funding for research in institutions rated as below world standard but underfunding for leading institutions.

The lack of a strategy is also evident from the gap between political rhetoric and action. For example, universities are expected to do more joint research with industry. Yet under the previous government the funding for 'linkage grants', the prime scheme to encourage university/industry collaboration, declined.

And too often our research and innovation programs are at the mercy of short-term political imperatives. Witness the cuts to research funding late last year and the bizarre decision to cut higher education to fund the Gonski school reforms – which particularly impacted on research.

Professor Hilmer delivered the 2nd Malcolm Chaikin Oration – and was presented with the Malcolm Chaikin Medal – at a dinner in September organised by the Academy's NSW Division. This is an edited version of his address. The Oration honours the late Professor Malcolm Chaikin AO OBE FTSE, an Academy stalwart and philanthropist.

A coherent strategy

First, while a coherent research strategy would outline broad priorities reflecting national needs and capabilities, it would allocate research funding largely on the basis of excellence and merit.

The essence of the strategy is to create, sustain and exploit competitive advantage to control a valuable scarce resource. Australian research cannot compete in terms of scale. Nor do national priorities confer advantage other than by focusing effort in areas others may ignore. However, being a welcome home to the best researchers can create sustainable competitive advantage, for outstanding researchers are a valuable scarce resource, one that cannot be replicated by dollars alone.

Second, it would provide for long-term, consistent funding for facilities, people and operating costs rather than the stop/start approach now in place. Consistent funding has a significant positive impact on research productivity. For example, governments could commit to fund research at a fixed percentage of GDP.

Third, the terms for research grants would be extended. There would be a huge increase in research productivity if ARC and NHMRC grants were routinely five years for projects and 10 years for centres

The essence of the strategy is to create, sustain and exploit competitive advantage to control a valuable, scarce resource. Australian research cannot compete in terms of scale ... however, being a welcome home to the best researchers can create sustainable competitive advantage, for outstanding researchers are a valuable scarce resource, one that cannot be replicated by dollars alone.

rather than the three years and seven years today, and if we adopted a strategy of rolling support for our strongest research groups.

The right balance

Finding the right balance between broad national priorities set by government and support for excellence and merit is always difficult. Governments invariably want to set priorities and allocate funds accordingly. Scientists, on the other hand, place more emphasis on excellence. Impact and relevance aren't included in the Nobel Prize criteria.

To this end, the recently completed report of the Chief Scientist nominated 15 priorities for strategic research that would replace the National Research Priorities set a decade ago. These are grouped under five broad areas that represent very significant challenges for Australia: living in a changing environment, promoting population health and well-being, managing our food and water assets, securing Australia's place in a changing world and lifting productivity and economic growth.

Professor Chubb has rightly pointed out that in an environment of tight budgets we need to prioritise our research spending. And I welcome the fact that the paper acknowledges the importance of early-stage basic research within those priority areas – enabling capability that can be mobilised,

focused and re-directed as necessary.

But we need to be cautious about this 'needs'-based approach. To the extent that it may discourage basic research outside these nominated areas, it could limit the possibilities of what research can achieve. It assumes that all wisdom resides in the centre, and that we can with some confidence predict the basic or even applied research that is going to deliver the 'next big thing'.



Martin Green: taking Australia to leadership in photovoltaics.

The next big thing

The difficulty of predicting the long-term outcomes of research is evidenced by technology forecasting exercises, which almost always miss the most important developments.

A recent paper on research investment, prepared by the Group of Eight, cited the example of a 1937 report of the

US National Resources Committee, which aimed to forecast technological developments over the next 25 years. Unfortunately it missed, among other developments, nuclear technologies, jet engines, antibiotics and DNA!

It is the serendipity of discovery that is so hard to predict. A prime example of technology developed from research where outcomes were not envisaged was Wi-Fi, which came from research into black holes, and laser technology.

Or take solar energy technology. In the 1970s the University of NSW backed a young scientist called Martin Green (Professor Martin Green AM FAA FTSE), who was able to garner research funds for his work in what was then the very young field of photovoltaics. As we know, Australia is now a world leader in this area, so important to our future. We didn't back Martin because of his field of research. We backed him because he was good.

As the Go8 paper notes: "Studies have demonstrated very clearly that research judged as excellent through peer review or citation measures is the research most likely to achieve significant benefits, even though the researchers themselves did not set out to achieve those benefits directly."

The emphasis must be on funding excellence. How can we rank research when the long-term impact is unknowable? By

REMOTE AUSTRALIA ONLINE LAUNCHED

A new online resource for worldwide, free use will unlock a giant vault of knowledge about remote Australia.

Created by not-for-profit company Ninti One and launched in Canberra by its Chair Dr Tom Calma AO, Remote Australia Online (RAO) includes thousands of studies into this important sector of the nation.

"This is an innovation that aims to bring the remote into sharp relief," Dr Calma said. "I think the majority of Australian businesses and industries that exist on the eastern seaboard miss opportunities across the broader continent because of what they don't know. Similarly, many remote areas miss out on much-needed attention by policy makers for the same reason."

"This new online resource will make a huge body of information freely available so that authoritative data and analysis can displace myth and ignorance."

Remote Australia covers 86 per cent of the continent, has three per cent of the population and contributes 45 per cent, or \$90 billion, annually to the nation's export earnings – which makes it one of the richest and least populated places on the planet. RAO delves into health, welfare, education, industries, environment, culture, transport, business, community, pastoralism, policy and people. It contains thousands of studies by universities, by Ninti One, its partners, and many other institutions both private and public.

COMING TO GRIPS WITH BIG DATA

With e-commerce transactions expected to reach more than \$320 billion by 2016, data is – in many ways – the 21st century's new currency.

Analysis and understanding of what data represents is increasingly vital for businesses, industry, governments and service providers globally, and managing and mining big data is emerging as one of those careers we never imagined would exist just 15 years ago – the 'Data Scientist'.

The University of South Australia has recently launched three programs designed to equip modern professionals such as business analysts and strategists, and informatics specialists to take on the challenges in the field.

Its Graduate Certificate, Graduate Diploma and Masters in Data Science are being sponsored by the world's leader in business analytics software and services, SAS, and the programs will be SAS-accredited.

"Being able to analyse economic and social trends by examining a number of disparate and large datasets has applications in some vital areas including health, security, social service delivery and infrastructure planning," says the head of UniSA's School of Information Technology and Mathematical Sciences, Professor Andy Koronios.

"We know that commercial operations are highly invested in using big data to help with product and service development and planning,

ranking researchers! Past performance is a good predictor of future success. This is judged mainly on well-established metrics – papers in what are regarded as the leading publications, citations, grants, research student completions. We may miss some funding winners, but we will miss more if we don't fund for excellence.

A matter for government

Basic research is usually performed in universities and depends on government funding. Business investment naturally tends to concentrate on the development end of the spectrum.

The basic research conducted at universities provides the expanding knowledge base needed to advance those outcomes, so it is absolutely vital that governments focus on supporting high quality, original, basic research. This investment is essential, and it won't come from any other source.

But there are worrying signs that the balance is beginning to tip away from basic research. Business expenditure has grown so that it is now larger than that of any other sector – higher education research expenditure is currently around \$8 billion per year compared to \$18 billion in the business sector. The problem is not that the business side is too large – it is the university side that is too small.

At the same time the proportion of applied research in the total higher education research effort has been increasing and now exceeds 50 per cent. A Go8 analysis shows a significant downward trend in the proportion of the national research effort devoted to basic research.

Our strengths

Australia cannot compete on research volume with its major competitors, but we can compete on quality. The question is 'How can we get more value from our investment in research?' This can only be achieved with a greater concentration of research investment on the basis of excellence and critical mass. Once again, this is the essence of a successful strategy – making choices that build and exploit competitive advantage.

The Excellence in Research for Australia Scheme (ERA), the only comprehensive assessment of the quality of university research, is not being used to its full potential to drive excellence and critical mass. For example, only a very small proportion of research block grant funding is based on ERA outcomes.

Almost 30 per cent of the research funded by government was assessed as below world standard in the 2012 ERA exercise. If funding to this level of research was cut back, substantial

increases could be made in areas where our research is judged to be world class.

Redirecting funding to areas of strength – wherever they are found – would be the stimulus needed to ensure we have a world-class research system.

Excellence must be the prime driver of science policy, and research policy more generally, in this country. We need research to be better funded if we are not to fall behind the rest of the world. Governments must use available resources more wisely and more strategically.

That means more selectivity and a greater concentration of research investment on the basis of excellence and critical mass should be the basis of our national research strategy.

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 (1998–2005). 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 LLM 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.

but there are a myriad of other applications from helping to decide new catchment areas for schools, right through to understanding a population's use of over-the-counter medications or the consumption of foods."

COMPULSORY MATHS AND SCIENCE "NECESSARY"

Urgent review of HSC policy, including the reinstatement of maths and science as compulsory subjects, is needed in order to curb a "disappointing" decline in the disciplines over the past decade, a new report by University of Sydney researchers has found.

The researchers analysed data from all Year 8 cohorts in NSW between 2001 and 2011, following trends in subject choices to reveal the percentage of students who go on to study maths/science combinations for their HSC.

The authors found that some 1043 fewer students completed a maths/science combination in their HSC, despite the overall student cohort rising five per cent over this same period. In 2011, just 16.2 per cent of students went on to study mathematics plus at least one science subject in the HSC, compared with 18.3 per cent in 2001.

The declines were most pronounced among female students, with the proportion of girls undertaking these subjects falling from 16.8 per cent in 2001 to 13.8 per cent in 2011. Gender disparity has increased, with

fewer female students undertaking maths/science combinations in their HSC now than in the 1980s.

Co-author Dr Rachel Wilson says the figures highlight wider issues of maths and science attainment inherent in the NSW education system. "This is just another disturbing element of what is a pretty depressing picture," she says. "Our paper shows there's a gender disparity, but there's complete stagnation of the male rate as well. The problem is more than one of gender."

Reintroducing compulsory maths and science subjects is necessary to help safeguard Australia's future prosperity, with these subjects at the centre of 21st century skills, Dr Wilson says.

"That seems like quite a steep requirement, but we must remember that it was in place until 2001. Even with the reinstatement of these subjects, we are still behind current international benchmarks in terms of the sorts of curriculum covered for high school graduation. If we're to remain economically competitive, we must make some tough decisions about this issue," she says.

She points to South Korea, Japan, China and Finland as examples of countries that require all university entrants to have mathematics ability.

The authors call for universities to reintroduce appropriate HSC prerequisites for normal entry into selected degree programs, as well as public education programs on the importance of these disciplines, as a way to redress the stagnation and decline in student participation rates.

ExxonMobil Award for chemical engineer

University of NSW Professor Martina Stenzel has won the ExxonMobil Award, presented at the Chemeca 2013 Conference in Brisbane in October, for her significant contributions to chemical engineering.

Professor Stenzel is an ARC Future Fellow and co-director of the UNSW Centre for Advanced Macromolecular Design, which uses polymer science to create new plastic materials with high-tech

biomedical applications. Her research group is focused on making plastic nanoparticles for targeted drug delivery, with a systems in development for pancreatic cancer and metastatic breast cancer.

The award citation says she is "the leading expert internationally in the area of synthesis of novel polymer architectures and an emerging authority in the area of polymer-based nanoparticles".

"She uses the latest

developments in polymer science to design nanoparticles that have been both tailored for specific drugs, and mimic the behaviour of natural carriers, such as viruses," it states.

Professor Stenzel was also named in the 2013 NSW Science and Engineering Awards, taking the trophy in the category for Excellence in Engineering and Information and Communications Technologies.

Professor Stenzel says people think polymer science is all about plastic bags and toys, when in fact novel polymers have very functional properties with high-end applications.

"The types of polymers that are developed at the moment are intelligent polymers that can respond to signals in their environment and do all sorts of creative things," she says. "They can respond to heat, light and pH, and change their properties. This can be quite useful in the body ... and is very much in contrast to more established materials such as metals or porcelain."

In the bloodstream the particles remain intact but once they reach the tumour they fall apart and release their drug, she explains; or the drug can be engineered so it only activates once inside diseased cells. "The inside of a cell is a very different environment to the bloodstream: it's like a mini nuclear reactor. It's a very aggressive and we can use this to trigger the release of the drug."

Previous winners of the ExxonMobil Award include Scientia Professor Rose Amal FTSE (2012), Scientia Professor Aibing Yu FAA FTSE (2010) and Scientia Professor Neil Foster FTSE (2008).

DSTO SCIENTIST JOINS ARC COLLEGE

DSTO scientist Dr Anne-Marie Grisogono has been selected by the Australian Research Council (ARC) to join its College of Experts.

College members are experts of international standing and are drawn from the Australian research community of higher education, industry and public sector research organisations.

The ARC College plays a key role in identifying research excellence, moderating external assessments and recommending fundable

proposals. It also assists the ARC in recruiting and assigning assessors and in implementing peer review reforms in established and emerging disciplines as well as interdisciplinary areas. There are fewer than 150 current members of the College.

During her three-year membership, Dr Grisogono will primarily be involved in assessing applications and assigning expert assessors to submitted grant proposals.



Dr Grisogono with Dr Len Sciacca FTSE, a former ARC College of Experts member.

ASTROINFORMATICS A TALL POPPY WINNER

Dr Tara Murphy, from the University of Sydney's School of Physics, has won the NSW Young Tall Poppy of the Year Award, held in each state by the Australian Institute of Policy and Science to recognise young scientists who are doing outstanding work in their field and actively engaging and educating the community about their work.

Nine young scientists received 2013 NSW Young Tall Poppy Science Awards, which Professor Mary O'Kane FTSE, NSW Chief Scientist and Engineer, said were "a great way of recognising the wonderful and high-impact emerging talent we have here in NSW, across a broad spectrum of scientific disciplines".

Other winners included Professor Renae Ryan, from the Bosch Institute in the University of Sydney's Faculty of Medicine, and Dr Sarah Perkins, a research fellow in the University of NSW Climate Change Research Centre, who is an expert on Australian climate extremes who studies observed trends in droughts and heatwaves.

Working in astrophysics, Dr Murphy is leading a major international project – VAST – that will run on the Australian Square Kilometre Array Pathfinder and an Associate Investigator in CAASTRO – the ARC Centre of Excellence for All-sky Astrophysics.

WOMEN SCORE HIGHLY IN NHMRC AWARDS

Women researchers scored highly among the 20 Excellence Awards made by the National Health and Medical Research Council.

Dr Katherine Howell, University of Melbourne, was the highest-ranked applicant in medical and dental postgraduate scholarships, winning the Gustav Nossal Scholarship. Dr Cinzia Cantacessi, James Cook University, won the Frank Fenner Early Career Fellowship.

Associate Professor Jane Butler, UNSW, won the Elizabeth Blackburn Fellowship as the highest-ranked female (clinical category) and the other two categories were won by Professor Melissa Wake, Murdoch Children's Research Institute (public health category) and Dr Gabrielle Belz, Walter and Eliza Hall Institute of Medical Research (biomedical category).

Other Excellence Award winners were Associate Professor Rebecca Guy (UNSW), Associate Professor Belinda Gabbe (Monash University) and Dr Julie Brown (UNSW).

"The Excellence Awards recognise and reward achievement in the highly competitive health and medical research field. This year's award winners represent the top 20 of the 5236 applications peer reviewed for funding in 2012," NHMRC CEO Professor Warwick Anderson said.

Ruth Bishop

Ruth Bishop wins CSL Florey Medal

Professor Ruth Bishop AO has been awarded this year's CSL Florey Medal for her life's work on rotavirus, for which she was also awarded a Clunies Ross Medal in 1998.

A co-discoverer of rotavirus in 1973, the discovery initiated a life's work for her – understanding the virus, working out how it spreads and fighting back with treatments and vaccines, advising WHO and the Bill and Melinda Gates Foundation.

The Florey Medal, a \$50,000 biennial award, honours Australian researchers who have made significant achievements in biomedical science and/or in advancing human health. The medal has been presented every two years since 1998 by the Australian Institute of Policy and Science (AIPS). It has been supported by CSL since 2007.

When they found the virus 40 years ago, the University of Melbourne's microbiology department researchers showed it was the cause of an acute gastroenteritis that hospitalised 10,000 Australian children every year and killed more than half a million children worldwide.

Vaccination against 'gastro' has been part of the National Immunisation Program for all Australian infants since July 2007, and the number of hospital admissions has dropped by more than 70 per cent.

By 2015, 50 million children in the poorest countries will have been vaccinated by GAVI, the Global Alliance for Vaccines and Immunisation, and its partners, supported by the Gates Foundation. Figures available from Bolivia, the first low-income country to take part in the program, show a drop of about three-quarters of all hospitalisations.

Professor Bishop is now in her 80s, and an Esteemed Honorary Fellow at the Murdoch Childrens Research Institute in Melbourne. She won't be fully satisfied until a new vaccine they're developing becomes available. It's intended for newborns, "the only time children in many developing countries are likely to be near a hospital," she says. The vaccine is currently being trialled in Indonesia and New Zealand.

DIETARY FIBRE TO BEAT STROKES

Dr Connie Wong thinks we may be able to prevent early deaths following stroke with a fibre-based diet.

She initially used innovative microscope techniques to determine how stroke weakens the immune system. Now she is studying how it also induces leakiness in the gut wall, leading to infection and an upsurge in deaths. And the solution may well lie in diet.

For her proposed ambitious and innovative research program, Dr Wong, of the Department of Immunology at Monash University, received this year's \$25,000 Centenary Institute Lawrence Creative Prize.

Dr Anne Abbott, also from Monash, won \$5000 as a finalist. She is transforming the prevention of carotid artery stroke. She has shown

that a healthy lifestyle and medication are now better than surgery or stenting for preventing stroke in patients with symptomless narrowing of the carotid artery.

Dr Will Ritchie, from the Centenary Institute, who has used statistics to unmask a molecular mechanism that cells use to regulate the levels of individual proteins, was the second \$5000 finalist. Future development of this work could lead to drug therapies for leukaemia, Alzheimer's disease, cardiac disease and liver cancer.

In a postdoctoral fellowship at the University of Calgary in Canada, Dr Wong showed that stroke triggers a release of compounds by the nervous system, seemingly to reduce the level of inflammation in the brain. But this is at the cost of weakening the response of the immune system to infection generally. In particular, she found that these compounds change the behaviour of the white blood cells known as invariant natural killer T cells.

As a result the body becomes increasingly susceptible to infection after stroke.

Now she wants to investigate a linked observation: that the gut wall becomes more permeable immediately following a stroke, allowing normally harmless gut bacteria to move into the body where they can initiate infection. She suspects that the combination of leakiness of the gut and reduced immune system capability may cause the increased vulnerability to infection after stroke. She wants to explore if this can be alleviated by an appropriate, fibre-based diet.

Dr Susan Pond AM FTSE, an ATSE Vice President, is a member of the Board of Governors of the Centenary Institute, which seeks to improve human health through excellence in medical research and awards the Centenary Institute Lawrence Creative Prize for creative biomedical research excellence

SUE MURPHY COMPLETES WSAA ROLE

Ms Sue Murphy FTSE, Chief Executive Officer of the Water Corporation of Western Australia, has stepped down after two years as Chair of the Water Services Association of Australia (WSAA), to be followed by Mr Mark Sullivan AO, Managing Director of ACTEW Water in the ACT. The role of Deputy Chair will be taken by Ms Louise Dudley, CEO of

Queensland Urban Utilities. Mr Sullivan thanked Ms Murphy for the strong leadership she had shown to WSAA and the industry as a whole. "Sue Murphy led the development of a vision for urban water services in 2030, and has left WSAA and the industry with a powerful set of outcomes to work towards," he said.

Sue Murphy

PHOTO: STEPPING STONE PICTURES

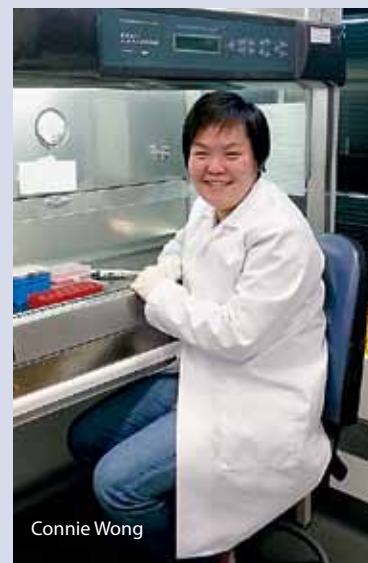


PHOTO: UNSW PETER MORRIS

Angela Moles



Rocking the ecological boat

If you were a pharmaceutical company searching for a natural plant compound to use as the basis for a new line of drugs, where would you begin?

Until recently, this question was a no-brainer. Everyone 'knows' that tropical forests contain the widest diversity of species, all fighting for survival and defending themselves physically and chemically against being invaded or eaten.

So the tropics should naturally provide the greatest selection of biologically active compounds – for instance, to provide natural plant compounds for use in pharmaceutical drugs.

Angela Moles disagrees. A pioneering ecologist from the University of NSW, Associate Professor Moles is transforming our understanding of the plant world and overturning some of the dogmas of ecology.

"Up in the Arctic tundra are 100-year-old willow trees that are just a few centimetres tall. They get to grow just a few leaves each year and they can't afford to lose them. So, as you get closer to the poles the chemical warfare intensifies."

Professor Moles doesn't just look at one or two plants or ecosystems. By searching the world's scientific databases she can study thousands of species at the same time. But she's not tied to the computer. In one study, she visited 75 different ecosystems, from African and Central American jungles to the tundras of Patagonia and Greenland.

With an army of global collaborators she measures everything and then, back in Sydney, she crunches numbers and changes paradigms.

She has investigated issues such as why plant seeds vary from the size of a coconut to a speck of dust; how introduced plants evolve and "go native"; and how ecosystems adapt as the climate changes.

For her work in establishing Big Ecology—the study of ecology at a global level—Associate Professor Angela Moles was awarded the 2013 Frank Fenner Prize for Life Scientist of the Year, in the Prime Minister's Prizes for Science.

BOARD STUDIES FOR FOUR WOMEN

The Minerals Council of Australia has awarded four scholarships to women for board studies, in conjunction with MCA member companies BHP Billiton and Downer EDI Mining.

The scholarships have been awarded to women working in the mining industry to enable them to complete the Australian Institute of Company Directors (AICD) Company Directors Course during 2014. The scholarship program follows the success of last year's program which saw three women complete the Company Directors Course in 2013.

The scholarship winners are:

- Andrea Maxey – VP Corporate Affairs and HR, AngloGold Ashanti Australia Ltd;
- Jacqui McGill – Asset President, BHP Billiton Mitsui Coal (BMC);
- Julie Shuttleworth – General Manager, Gold Fields Granny Smith Mine; and
- Miriam Stanborough – Project Manager, Iluka Resources Ltd.

The scholarships, for which there were 46 applications, are an MCA initiative to encourage more female participation on mining company boards. Each is worth \$9200.

MCA has also decided to assist another seven women to complete a board readiness e-learning module offered by the Australian Institute of Company Directors. They are:

- Deanna Lomas (MMG Ltd);
- Janette Hewson (Peabody Energy);
- Jo Barron-Perry (BHP Billiton);
- Lynn Olssen (Snowden);
- Helen Anderson (Seabed Geosolutions);
- Michelle Keegan (Incitec Pivot Ltd); and
- Andrea Marsland-Smith (Heathgate Resources).

FELLOWS ARE LEADERS IN CHAMPIONS OF CHANGE

Fellows Mr Alan Joyce (Qantas CEO) and Mr David Thodey (Telstra CEO) are among the Male Champions of Change group of 21 chief executives of major Australian companies.

The group announced in November a new "supplier commitment" aimed at putting pressure on suppliers to prove they have a commitment to diversity.

The supplier commitment aims to bring change to other organisations by penalising suppliers to their businesses who do not adequately promote and nurture the careers of women.

Conditions of the commitment include equal pay and carers' and parental leave provisions and a database of female-owned businesses will be established to increase procurement from these sources.

The proposals are in a new report by the group titled *Accelerating the Advancement of Women in Leadership*.

More information is on the Human Rights Commission website.



Alan Joyce



David Thodey

Groundwater “supports industry worth \$34B”

Australia's reserves of groundwater help earn the nation a steady \$34 billion a year from mining, food production and manufacturing, according to a new study by Deloitte Access Economics.

The report, commissioned by the National Centre for Groundwater Research and Training (NCGRT), highlights the key role the groundwater resource plays in the nation's economy.

The Deloitte Access Economics study is the first attempt ever made to quantify the value of Australia's groundwater. It found:

- groundwater directly contributes an estimated \$6.8 billion a year to the Australian economy;
- industries with production worth \$34 billion a year depend on groundwater;
- current average annual groundwater use is approximately 3500 gigalitres (GL);
- 60 per cent of this is used to grow food, 12 per cent is used in mining and 17 per cent in manufacturing; and
- 11 per cent is used for drinking water.

The report found that groundwater also supports landscapes, the forestry industry and acts as ‘water insurance’ to the nation in the event of drought.

There is currently 6544 GL (or billion litres) under licence for possible extraction from groundwater out of a total estimated sustainable reserve of 29,173 GL.

“To many people, groundwater is all but invisible, or there as a last resort when surface water runs short,” says NCGRT Director Professor Craig

PHOTO: NCGRT



Simmons. “In reality, it drives many of our most productive industries – and if carefully managed can be maintained as a sustainable resource.

“Ours is a hot, dry continent and more than 90 per cent of our fresh water is in fact underground. This is a resource with vast potential, however we do not as yet have a clear idea of its size or how long it takes to recharge. But in a world that is increasingly short of fresh water, it is a major strategic asset.”

According to the report, groundwater represents an important input into the Australian economy, larger in direct value terms than individual sectors such as forestry, fishing, poultry, motion pictures, gambling, heritage, creative and performing arts.

Groundwater testing.

SOUTHERN SURVEYOR UP FOR SALE

Australia's Marine National Facility research vessel *Southern Surveyor* is on the market, pending the arrival of its replacement, *RV Investigator*.

Since 2002 Australia's marine science community has relied upon *Southern Surveyor* for conducting research from the Southern Ocean to the waters off the coast of East Timor, and deep into the Indian and Pacific oceans, making a major contribution to Australia's blue-water research effort.

The 42-year-old *Southern Surveyor* was a former North Sea trawler converted into a research vessel and its ability to carry a wide range of scientific equipment and larger scientific teams was becoming limited, says the Director of the Marine National Facility, Ron Plaschke.

“It will be a sad day when *Southern Surveyor* is sold and departs from Hobart, but there is growing excitement about the upcoming arrival of replacement vessel *Investigator*,” Mr Plaschke says.

BIO-DOME UNDER THE ANTARCTIC ICE

Antarctic scientists are working to create a ‘future ocean’ in an underwater ‘bio-dome’, 20 metres beneath the sea ice off Casey Station.

In a world-first experiment, Dr Donna Roberts and Dr Jonny Stark will assess the impact of ocean acidification – caused by increasing amounts of atmospheric carbon dioxide (CO₂) dissolving in the ocean – on polar sea floor (benthic) communities.

To do this Dr Roberts, an ocean acidification expert from the Antarctic Climate and Ecosystems CRC and the University of Tasmania, will work with Australian Antarctic Division benthic ecologist Dr Stark and a team of Antarctic Division technicians, engineers and divers, to adapt ‘Free Ocean CO₂ Enrichment’ (FOCE) technology for Antarctic deployment.

The semi-enclosed underwater chambers will allow scientists to vary the water CO₂ concentration without changing light or nutrient conditions.

ATLAS LISTS 40 MILLION SPECIMEN RECORDS

The Atlas of Living Australia now provides access to over 40 million records, thanks to the addition of more than 700,000 specimen records from the Queensland Museum and 560,000 new and updated specimen records from Museum Victoria, including 23,000 images.

The records include specimens held in collections, field observations, molecular data, literature, maps, sound recordings and photographs.

The Atlas is calling for citizen scientists to upload their own photos and sightings of Australian species and is crowd sourcing digitisation of field notes, diaries and specimen labels held by museums and collections.

The Atlas of Living Australia is a partnership between CSIRO, Australia's museums and herbaria, biological collections, research organisations, universities and government departments. It has received Australian Government contributions of \$41.3 million, comprising \$8.5 million from the National Collaborative Research Infrastructure Strategy program, \$30 million from the Super Science Initiative and \$2.8 million from the Collaborative Research Infrastructure Scheme.

“With over half a billion records downloaded, the Atlas demonstrates the power of collecting biodiversity data once and reusing it many times over to benefit research, conservation and planning,” Atlas Director Dr John La Salle says. “There are still a lot of biodiversity records out there and we encourage organisations to come forward and share their data via the Atlas.”

More Fresh Science

This is the 16th year of Fresh Science, a national program sponsored by the Australian Government through the Inspiring Australia initiative to give Australia's up and coming early-career researchers a crash course in communication with the general public and the media to help promote Australian science and discoveries.

In this issue of *Focus* we highlight the work of four of the 12 Fresh Scientists for 2013, chosen from 58 early career researchers from across the country. Others were featured in *ATSE Focus* 180 (October 2013).

THE FASTEST SPERM MAY NOT BE BEST

Sydney sea squirts are showing that there's more to fertilisation and IVF than we thought.

For sea squirts, the key to a long and happy life is to be fertilised not by a fast sperm, but by one that stands the test of time, Dr Angela Crean, from UNSW's Evolution and Ecology Research Centre, has found.

Her discovery also shows for the first time that the influence of sperm extends well beyond the moment of conception. If further studies demonstrate the same effects in human sperm, the finding will change some of the assumptions used in IVF practice.

Sea squirts are small animals that live on the sea floor, including in and around Sydney Harbour. They attach themselves to rocks, piers and ships, and filter the surrounding water for their food. They are chordates – more closely related to humans and other vertebrates than to invertebrates such as sponges and coral.

Male and female sea squirts breed by broadcast spawning. Large numbers of eggs and sperm are released into the water, and sperm immediately race towards their targets. Fertilisation can occur within minutes, or within hours.

Dr Crean's research revealed that eggs penetrated within minutes by speedy sperm tended to be either non-viable or produced larvae that died young. The strongest, fittest, longest-lived sea squirts were those fertilised by sperm that swam for about an hour before reaching the egg.

"This is surprising because it suggests that a sperm's influence on offspring extends beyond just the DNA it carries," says Angela, an ARC Fellow.

"This finding has the potential to change the way we view and study inheritance. It is unknown how widespread this phenomenon is but, given the obvious implications for IVF technologies, it will be exciting to test if sperm and offspring quality are linked in other species."



The findings are potentially game-changing. Until now, the standard model of reproduction assumed that the influence of a sperm ended at the moment it transferred the male genome into an egg. The sea squirt study suggests that other characteristics of an individual sperm – in addition to the genes – can exert lifelong influence.

WORMS REVEAL LINK BETWEEN TAU AND AGEING

The discovery of a link between a gene and ageing in a species of worm could reveal valuable lessons for the treatment of Alzheimer's disease.

Low levels of the protein generated from the gene known as 'tau' – also present in humans – not only hastens age-related changes in the brain of the worm, but also shortens the worm's life, Sydney University PhD candidate Yee Lian Chew has found.

"We found that worms lacking tau lived almost one-third shorter than worms that have tau, providing startling evidence that the gene is important in regulating overall lifespan," Ms Chew says.

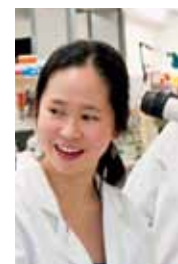
"One theory of dementia suggests that lowering the activity of this gene in a patient will lead to some degree of cognitive improvement. However, too little is also bad. It needs to be a balance."

Her work at the university's School of Molecular Bioscience uses a species of nematode worm called *Caenorhabditis elegans*, which is see-through and just a millimetre long. The worms are an exceptional way to study brain ageing, she says, as their transparency allows study of the changes that emerge in older brain cells and how fast the brain ages.

"Humans are certainly more complex than worms, but at a molecular level there are many striking similarities. The lack of complexity is also an advantage: the worms have 302 brain cells whereas humans have billions. It is much simpler to study brain ageing in an animal where individual cells can be easily observed."

In humans, ageing is associated with subtle changes in the brain. These changes are comparable to those observed in worm brains, such as the growth of structures called branches and beads along nerve fibres known as axons. "Our most exciting discovery is that worms lacking tau display these abnormal structures at early and middle age, while normal worms that have tau only show these structures late in life. This suggests that the lack of tau causes worm brain cells to age faster."

"Our research provides an important stepping stone towards the ultimate goal of improving diagnostic tools and treatments for those suffering from this condition."



Yee-Lian Chew

Angela Crean gets close to some sea squirts.



Aliaa Shallan holding the device.

PHOTO: AEMI ABDUL KEYON, UTAS

MONITORING DRUGS AT HOME, NOT HOSPITAL

A tiny Tasmanian invention could make personalised medication easy and affordable – for example, for the millions of people who should have their blood tested each day to check the level of prescription drug in their blood.

Some drugs are only effective within a very narrow range. Too little and the drug is ineffective, too much and the drug could be deadly. But the current blood tests mean a trip to hospital, well-trained analysts, toxic solvents and expensive instruments. Monitoring this way is not practical due to cost and the time involved.

Now, a team at the University of Tasmania has invented a mechanism that uses controlled lightning to accurately measure the concentration of a drug in blood within three minutes. The mechanism will form the heart of a device that could fit into one hand and cost just a couple of dollars per test, allowing millions to test their own blood at home, not in the hospital.

This invention is a big step forward in the global race to develop 'personal' medical treatments – in particular, by tailoring the dose according to the drug level in the blood to ensure optimum benefit. Generic technology to allow cheap self-monitoring of dosage levels has until now proved elusive.

The main challenge faced by Aliaa Shallan, a PhD student at the School of Pharmacy who is part of the team, was working out how to extract and measure the drug in the bloodstream without having the result compromised by blood cells and proteins.

"I created nanofilters using controlled lightning – an electric field applied across a thin part of the device," she says. "The cost is the lowest among existing nanofabrication techniques."

"Once it's fully ready, this device will have immediate application. The device has the potential to analyse other drugs like anti-psychotics and anti-epileptics."



Port of Brisbane aerial shot showing future reclaimed land expansion.

PHOTO: PORT OF BRISBANE

"We also care about the patient comfort. I am exploring the possibility of using saliva instead of blood."

"It is devices like this that will make personalised medicine affordable, dramatically change the quality of life of billions of people around the world, and save government money without increasing the load on hospitals," says Aliaa, who did the research as part of her PhD.

BUILDING ON MUD: WHEN CAN WE START?

Dr Julie Lovisa from James Cook University is using maths to determine when dredged soil is solid enough to build on. She has developed a mathematical model which will allow for greater accuracy in construction timelines and avoid costly structural failures.

"With the continual need for port expansions, we are left with reclaiming land from the sea, a process that can take decades," says Julie, who studied land reclamation as part of her PhD.

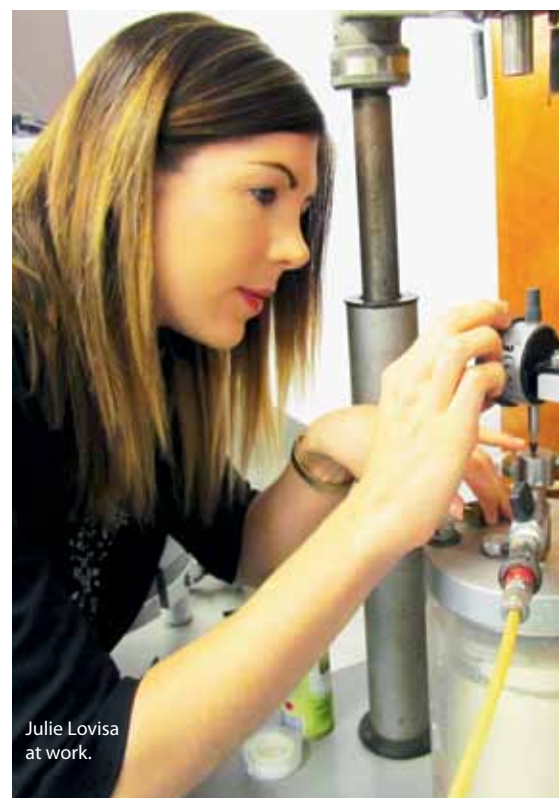
"But we need to be as accurate as possible in our land reclamation predictions. If we're out by just one per cent, this can mean the difference between starting construction in two or 20 years."

"At the end of the day, the bottom line is: 'When can we build on our new land?' We can now give an answer with greater accuracy."

To create new land, dredged mud is pumped into containment paddocks erected in the ocean and then dried out using a number of methods. Depending on the conditions, this process could take anywhere between three and 10 years. Knowing when the land is stable enough for building has been relatively hit and miss until now.

"Sometimes people will just load up the soil with sand fill and hope that they can build on it in a couple of years. But if we can nail down a date – that's invaluable for construction timelines," Julie says. Better predictions could save millions of dollars in construction milestones and prevent expensive failures from premature building, she says. "Often the soil settlement won't be uniform and some of the building will sink, and that will lead to structural damage."

By mathematically modelling how quickly the water is squeezed from the mud, Julie can more accurately measure the overall settling process of the dredged mud and its stability for building. Her model can be applied to any type of the soft saturated soils that can be found all along the Australian coast.



Julie Lovisa at work.



Trials cut sugarcane herbicide runoff

Spraying raised beds with shielded sprayer.

in temperate regions of New South Wales, Victoria and Western Australia.

"Our research showed that several varieties of sweet sorghum grew very quickly in field trials, reaching maturity in only 16 to 20 weeks, with fermentable sugar concentrations similar to those of sugarcane under optimal conditions," Associate Professor O'Hara says.

"Our research indicates there are significant short-term opportunities for the co-location of sweet sorghum and sugarcane production to increase feedstock availability for bio-ethanol production. In fact, we found that adding sweet sorghum juice to sugarcane juice resulted in higher

ethanol yields than fermenting sugarcane juice alone."

Associate Professor O'Hara says the research team also produced a range of sweet sorghum food and feed products including sweet sorghum flour, syrup, sweet sorghum-based breakfast cereal, fish and animal feed pellets, and human dietary fibre products.

"When we analysed the nutritional quality and economics of these products it was shown that there are significant opportunities for manufacturing food and feed products from sweet sorghum in Australia. These products include livestock feed from sweet sorghum grain, syrup or molasses feed supplements, stock feed from sweet sorghum bagasse, and the production of mixed animal and fish feed products incorporating all three residues."

A carbon footprint analysis of six biorefinery process options for the conversion of sweet sorghum to fuel and animal feed products under Australian conditions was also carried out and the results were positive.

GETTING MORE OUT OF CARBON FARMING TREES

'Best practice' carbon farming that considers more than just the carbon in trees is needed if the full benefits of trees in the landscape are to be realised by farmers, landholders, and the community, according to CSIRO.

Its research confirms that tree plantings on rural land have significant potential to remove carbon dioxide from the atmosphere and, if done well, can provide a stream of other benefits to farmers, local communities and the environment.

"Schemes which offer economic incentives for growing trees for carbon present an opportunity to reverse trends in land clearing but also to restore ecosystem services – such as pest control, pollination, soil and water conservation – that provide important benefits to farmers and the broader community," says CSIRO's Dr Brenda Lin.

"The ability of carbon tree plantings to restore some of these other benefits that support agricultural production may be a key factor in encouraging farmers and landholders to take up this type of carbon farming.

"Land-use models show that policies aimed solely at maximising carbon storage may not produce additional agricultural and environmental benefits and may even produce unwanted outcomes for farmers, landowners and communities."

A new approach to sugarcane plantation weed management has shown a 90 per cent reduction in runoff of highly soluble herbicides into waterways.

In Queensland's Lower Burdekin region, scientists from CSIRO's Water for a Healthy Country Flagship trialled a new technique for applying photosystem II (PSII) herbicides to raised beds of furrow-irrigated sugarcane by using a specially adapted shielded sprayer. The technique minimises the likelihood of PSII herbicides, such as diuron, atrazine, ametryn and hexazinone, coming into contact with irrigation water.

Many of the herbicides used in the region are PSII herbicides that are known to negatively impact reef ecosystems. These waters discharge into the Great Barrier Reef (GBR) World Heritage Area and subsequently into the Great Barrier Reef Marine Park.

"The conventional application of herbicides in furrow-irrigated sugarcane production is to broadcast spray across the whole field using boom sprayers, which applies herbicides to both beds and furrows. Irrigation water then carries the herbicides with the tail water into the drainage channels, into nearby creeks and rivers and potentially into the GBR lagoon," says CSIRO research leader Dr Rai Kookana.

"These trial results are extremely encouraging, and clearly demonstrate that the use of precision herbicide application technologies by the industry, including using shielded sprayers for furrow-irrigated sugarcane cultivation, can be highly effective in reducing herbicide runoff."

SWEET SORGHUM SHOWS HUGE POTENTIAL

A new Australian-based research study into sweet sorghum has shown the huge potential of the crop as a single source of energy, food and animal feed.

Conducted by the Queensland University of Technology in collaboration with industry partner AgriFuels Ltd and the Rural Industries R&D Corporation (RIRDC), the research looked at sweet sorghum's agronomy, its ability to be processed using existing processing infrastructure, its carbon footprint, using it to produce biofuels, and its use in food products for humans, fish and livestock.

The project's lead researcher, Associate Professor Ian O'Hara, says sweet sorghum has a wide potential cropping area, including tropical and subtropical Queensland, the Northern Territory, Western Australia and

GM issue flares again in Europe

A group of world scientists have released a statement saying there is no scientific consensus that genetically modified organisms (GMOs) are safe.

The scientists' statement was released by the European Network of Scientists for Social and Environmental Responsibility in the week after the World Food Prize was awarded to employees of the GM seed companies Monsanto and Syngenta and UK environment secretary Owen Paterson branded opponents of GM foods as "wicked".

"We feel compelled to issue this statement because the claimed consensus on GMO safety does not exist," they said.

"The claim that it does exist is misleading and misrepresents the currently available scientific evidence and the broad diversity of opinion among scientists on this issue. Moreover, the claim encourages a climate of complacency that could lead to a lack of regulatory and scientific rigour and appropriate caution, potentially endangering the health of humans, animals and the environment.

"Science and society do not proceed on the basis of a constructed consensus, as current knowledge is always open to well-founded challenge and disagreement. We endorse the need for further independent scientific inquiry and informed public discussion on GM product safety and urge GM proponents to do the same."

The Agricultural Biotechnology Council of Australia (ABCA) reacted immediately, saying the statement flew in the face of the consensus of an overwhelming majority of scientists.

"Every legitimate scientific organisation that has examined the evidence has arrived at the conclusion that GM crops and the foods they produce pose no risk to human health or the environment beyond those posed by their conventional counterparts," ABCA said.

It referenced more than 1700 studies on the safety and impact of GM food and safety, a 268-page EU Report, *A decade of EU-funded GMO Research*, and a list of 126 peer-reviewed studies with independent funding.

ABCA is the national coordinating organisation for the Australian agricultural biotechnology sector and was established to pursue recognition of the current and potential benefits of agricultural biotechnology. ABCA aims to ensure that the Australian farming sector

can appropriately access and adopt this technology for the benefit of national and global food security, the nation's farming sector, and the environment, thus helping to deliver a more sustainable and prosperous future for Australian agriculture.



GM cotton – looking great.

ABCA is an industry initiative with four founding members: AusBiotech, CropLife Australia, the Grains Research and Development Corporation and the National Farmers' Federation.

Professor Adrienne Clark AC FAA FTSE, Chancellor of La Trobe

University and former CSIRO Chair, and the Hon John Anderson AO, former Deputy Prime Minister and a Director of The Crawford Fund, are co-patrons of ABCA.

AUSTRALIA'S WILDERNESS BEING LOVED TO DEATH

With 28 million visitors camping, hiking, biking, 4W driving, riding and picnicking in them every year, Australia's iconic nature areas are at risk of being loved to death, challenging conservation managers.

"The trend towards nature tourism is increasing year by year," says Dr Kelly Hunt de Bie of The National Environmental Research Program's (NERP) Environmental Decisions Hub and the University of Melbourne. "There are more people, doing more travel and an urban culture that is keen to re-establish its links with nature. This all adds up to growing visitor pressure on our wild places, both managed and unmanaged, and the inevitable degradation of some of them."

Negative impacts of visitors include soil compaction and erosion, tree and vegetation damage, waste disposal issues and increasing pressure on rare and endangered species. Using Victoria's Grampians National Park and the intertidal-zone walking trails of Port Phillip Heads Marine National Park as case studies, Dr Hunt de Bie and her colleagues are investigating ways to help park managers ease the pressure on wild places of high conservation value, without diminishing the experience that visitors gain from them.

ECONOMICS AND MATHS HELP SAVE WILDLIFE

In a bid to save endangered animals from extinction by climate change, a team of Australian and New Zealand environmental scientists has pioneered a revolutionary way of deciding whether animals can safely be re-located.

The researchers developed a rigorous framework that can quantify whether the benefit of moving a species outweighs the ecological cost. The study is intended to help wildlife managers take the difficult decision whether to move animals into new areas – or leave them in places that may become uninhabitable for them.

"With the climate changing more rapidly than species can move or adapt, our only chance of saving some species may be to move them to more climatically suitable areas," says Dr Tracy Rout of the ARC Centre of Excellence for Environmental Decisions (CEED) and University of Melbourne.

"But introducing species to areas outside their historical range is a controversial strategy – and we have to be sure it will work, both for the animals themselves, and for other species in their 'new' habitat."

At present such decisions are already being taken by wildlife managers around the world using a mix of subjective judgement and scientific prediction. The research team has taken a lot of the guesswork out of this process by developing the world's first rigorous quantitative framework that combines scientific prediction with clear management goals.

"Our approach uses tried and tested tools from economics and applied mathematics to make smarter conservation decisions," explains Professor Hugh Possingham, co-author and director of CEED.

The approach is intended to support the revised "IUCN guidelines for re-introductions and other conservation translocations", which explicitly calls for structured decision-making frameworks for conservation introductions.

The study was funded by CEED, the Environmental Decisions Hub of the National Environmental Research Program (NERP), the Climate Adaptation Flagship at CSIRO Ecosystem Sciences, UQ, University of Melbourne, UWA and Massey University, New Zealand.

IMAGE: GLASSES.COM

Making new face scans



A 3D scan of a person's face using the CSIRO-developed algorithms.

Turning 2D images into a 3D scan of a person's face could have a big impact on online retailing as a result of new CSIRO research. CSIRO has filed a series of patents for its new Smart Vision research. Enhancing the 'virtual change room', the technology interprets 2D pixels from an image of a human face, such as the left eye corner or tip of the nose, and turns them into a real-time 3D face-sensing device.

"While pictures can tell us a thousand words, they certainly don't tell us the whole story," says Dr Simon Lucey, Group Research Leader for CSIRO's Digital Productivity and Services Flagship. "Our computer modelling experts have developed a more accurate and reliable way to create a 3D scan of a person's

face using newly developed algorithms that can turn 2D images from a mobile camera into a 3D model of the face. The technology calculates size so, unlike other virtual try-on technologies, customers can try on and view products from any angle – perfectly scaled to their face."

Through its Digital Productivity and Services Flagship, CSIRO has exclusively licensed the new Smart Vision technology to Glasses.com, an online eyewear retailer. Glasses.com has combined this research with other technology to create an interactive app that allows customers to accurately see how frames fit without ever stepping into a store.

The unique facial mapping software allows the app to produce a true-to-life 180° view of the user's face showing how each pair fits in 3D and letting shoppers compare side-by-side images of each style.

The Australian Retailers Association (ARA) says the new Smart Vision research is an example of why retailers needed to take action to transform their business models for the digital age by embracing new technologies.

"With predictions that by 2025, a leading retailer will make \$106 billion more in sales and sell 40 per cent of its goods online, it is becoming increasingly evident that success will be driven by how effectively retailers can harness the power of new technologies to deliver unique value to customers with the speed, efficiency and ubiquity they demand," says ARA Executive Director Russell Zimmerman.

CSIRO's Digital Productivity and Services Flagship is a \$48 million research initiative targeting productivity growth through frontier services innovation and by unlocking the value of a national broadband infrastructure. Through its research the flagship aims to help add value to the Australian economy by developing and delivering more efficient and innovative services that improve people's wellbeing and prosperity.

LEAD CONTAMINATION A RESEARCH PRIORITY

With almost 40 million tonnes of e-waste created worldwide each year, toxic lead contamination has become a research priority for Professor Mark Hoffman and his research team at the University of NSW. They are hunting for a viable alternative and he believes they are close to such a breakthrough.

It's a common sight in developing and developed countries alike: piles of electrical and electronic waste such as TVs, computers, mobile phones and toys. 'e-waste' is the world's fastest-growing waste stream,

according to a report last year by the International Labour Organisation. Of the bulk that is recycled, about 80 per cent ends up in countries such as India, China, Nigeria and Ghana. What can't be extracted and resold is incinerated or discarded in landfill.

One such component is piezoceramics – the unseen, yet powerful material that allows devices to convert mechanical energy into electrical power and vice versa. The commercial market for piezoceramics was an estimated US\$20 billion last year, led by applications in the biomedical, military, semiconductor, robotics and consumer electronics industries.

The material of choice for piezoceramics is lead zirconate titanate (PZT). When PZT is incinerated, lead oxide, a highly toxic substance, is released. Exposure can cause serious neurological damage.

"From a superficial point of view, e-waste is a recycling success story," says Professor Hoffman, Pro-Vice-Chancellor (Research), who leads a team of materials scientists and engineers in UNSW's Ferroelectric Materials Research Laboratory.

"But that ignores the potential hidden impacts on people and the environment. The world is making millions of these devices every day and the longer we delay, the greater the threats to health through direct exposure and downstream environmental pollution," he says.

The EU has already moved to regulate against lead-based piezoceramics, once a viable alternative is found. Other countries, including some of the biggest electronic manufacturers such as China and Korea, have followed suit.

One alternative is bismuth alkali-based piezoceramics. Attractively lead-free, the downside is their propensity for fatigue and degradation. Discovering and rectifying the causes will be essential to rolling out a prototype for industry testing.

TOXIC SEAL-OFF WINS AWARD

A pioneering method for safely sealing off a huge volume of contaminated soil under a Sydney car park while it was cleaned up has won the CARE Award for 2013.

The award went to Thiess Services for its innovative design of a sealed relocatable building that provided a controlled environment for the remediation of volatile contaminants left over from the manufacture of dry-cleaning fluids and coolants, ensuring the health of workers and the surrounding community.

The project involved excavating and treating 45,000 cubic metres of contaminated soil that was encapsulated in a synthetic liner underneath a car park at Botany. The soil was contaminated with byproducts from historical manufacturing of chlorinated solvents. The encapsulated waste was treated using a form of heat treatment named thermal desorption technology.

This building featured internal walls and pillars that could be progressively moved as excavation and clean-up progressed. The air-tight seal on the building had to trap any vapours or emissions so that workers on the site and nearby residents would not be exposed.

Thiess was responsible for the building's concept, functionality, layout, staged excavation concept, ventilation design and airtight design. GWH Build Pty Ltd was subcontracted by Thiess as the structural engineer and installer of the building.

The building's creation was the result of cumulative knowledge gained by Thiess over the past decade. The main innovation was the installation and relocation of the building's internal walls and columns as the excavation progressed to maintain air volumes compatible with the capacity of the building's Emission Control System.

Superbugs offer solvent solution

A world-first superbug will undergo field trials to clean up two of Australia's most polluted industrial sites at Port Botany in NSW and Altona in Melbourne in the coming year.

The microbe, the first in the world found to completely break down chloroform – a common industrial pollutant and carcinogen – in groundwater, was discovered by a team at the University of NSW in 2011, Associate Professor Mike Manefield told the CleanUp 2013 Conference in Melbourne.

In 2011 Professor Manefield and his colleague Dr Matthew Lee were examining sediment from the chemical works at the Botany Industrial Park and came across a species of bacteria which took in chloroform – the main pollutant of concern – and turned it into harmless hydrogen, acetate and carbon dioxide. Chloroform inhibits bioremediation of other chlorinated solvents at many heavily polluted industrial sites.

What had turned on the chloroform-munching bugs remains a mystery that Professor Manfield and his team are still striving to decipher – but for the first time, humanity has a feasible way to eliminate a serious and widespread cancer-causing pollutant at a relatively low cost.

Chloroform is a byproduct of the plastics industry and is still being produced globally in very large quantities, despite its known links to cancer. Perchloroethene is still used universally in the dry-cleaning industry. These substances pose a risk to human health via the global food chain – as more and more food is imported from countries where pollution controls are poor – and in urban groundwater used for household purposes.

CleanUp 2013 was hosted by the CRC for Contamination Assessment and Remediation of the Environment (CRC CARE).

UNISA MAKES BIONIC EYE BREAKTHROUGH

A team of University of South Australia researchers is using its augmented reality expertise to progress bionic eye research in Australia.

The Wearable Computer Lab at UniSA created a backpack wearable computer kit that will be used for vision simulation studies being undertaken by the Vision Processing team at National Information Communications Technology Australia (NICTA) and Bionic Vision Australia.

Co-Director of the Wearable Computer Lab, Dr Ross Smith, presented the system, with PhD candidate Thuong Hoang, to NICTA and Bionic Vision Australia recently. The wearable kit was positively received, with several systems ordered to be built for research with sighted participants.

"Using our system, Bionic Vision Australia will run studies allowing anyone to see as close as possible what someone with a bionic eye would be seeing," Dr Smith said.

"This is the second backpack design we have developed for NICTA. The new version was inspired with recent miniaturisation of electronics that allowed us to build a more usable, lightweight, reliable and effective solution.

"The new backpack provides more processing power, is reduced in weight and size, has advanced battery technologies and is a more robust design to support trials."

Bionic Vision Australia is leading the work on the bionic eye, currently working on three bionic eye devices. The bionic eye system will comprise a small digital camera, external processor and an implant with

a microchip and stimulating electrodes surgically placed in the back of the eye. It will be used to restore a sense of vision to people with retinitis pigmentosa and age-related macular degeneration.

BEES 'BELLY-UP' FOR FLIGHT

Honeybees use a combination of what they feel and see to streamline their bodies and gain maximum 'fuel efficiency' during flight, a world-first study has found.

Scientists at Australia's Vision Centre (VC) have found that bees use their antennae as well as their eyes to calculate the best position for swift flight.

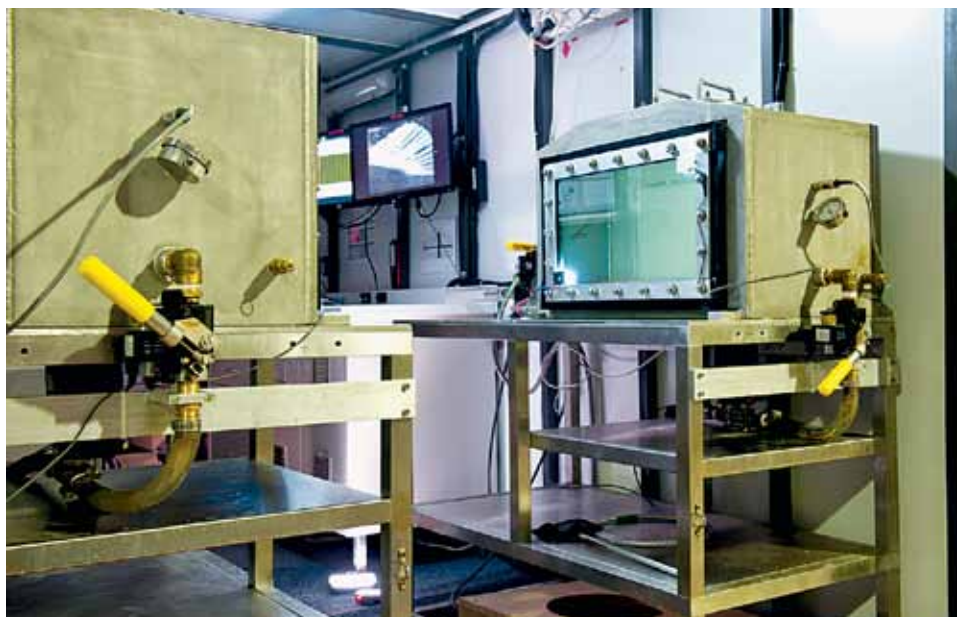
The discovery could help in the development of robot aircraft, such as insect-like flying machines, say Gavin Taylor and Professor Mandyam Srinivasan of The VC and The University of Queensland Brain Research Institute.

"Honeybees often have to travel very long distances with only a small amount of nectar, so they have to be as 'fuel-efficient' as possible," Professor Srinivasan says. "They achieve this by raising their abdomen to reduce drag so they can fly at high speeds while using less energy."

Previous research has found that honeybees use their eyes to sense the airspeed and move their abdomens accordingly, Mr Taylor says. "When we trick a honeybee into thinking that it's 'flying' forward by running background images past its eyes, the bee will move its body into a flying position despite being tethered."



Testing the wearable backpack computer kit.



The hydraulic chamber that simulates extreme pressure changes to test the decompression limits fish can safely endure.

Hydraulic chamber for fish survival

Australia's native fish could stand a better chance of survival when passing through hydropower turbines in major waterways thanks to an innovative mechanical chamber developed at the University of NSW.

When native fish migrate downstream they often pass through hydropower turbines and weirs. If they evade impact with the blades, fish can still suffer injury and even death due to extreme and rapid pressure changes when they go from deep water upstream to shallower waters.

These pressure injuries are similar to the expansion injuries scuba divers might experience when surfacing too quickly, and are known as barotrauma.

"The pressure change these fish experience is like going from 10 metres below the water to the height of Mount Everest in about half a second," says Mr Brett Miller, principal engineer and inventor from the UNSW Water Research Laboratory.

The Water Research Laboratory team has developed a pair of custom hydraulic 'barochambers' that can simulate those rapid pressure changes. These will measure the decompression limit that fish can safely endure and guide the design of more environmentally and fish-friendly water infrastructure.

The invention was a finalist in the 2013 Engineers Australia excellence awards.

TEACHING ENGINEERS TO BE GREENER

Engineering degrees will soon be greener thanks to a teaching resource package being developed by Australia's leading universities and industry partners.

Queensland University of Technology (QUT) is leading a consortium of Australian universities in the development of a set of innovative resources designed to help skill-up the next generation of engineers by equipping them with the ability to conduct energy efficiency assessments and improve energy performance across major sectors of the Australian economy.

The teaching and learning package, which will be made available to

all engineering educators, will include resources and aides that are course-ready and suitable for immediate use and will include: flat-pack modules, case studies and multi-media bites, which will be ready to splice into existing lecture material; and virtual reality experiences, which would allow students to navigate work-sites and conduct energy efficiency assessments from the classroom.

"Australia is in a unique position to lead this curriculum renewal with support from key bodies representing professionals, educators, and decision-makers in Australia, including Engineers

Australia, the Australasian Association of Engineering Education; and the Australian Council of Engineering Deans," says Dr Cheryl Desha from QUT's Science and Engineering Faculty.

The project aims to get tertiary institutions up-to-speed to give engineering undergraduates the most up-to-date knowledge and skills in energy efficiency opportunities, Dr Desha says.

Project partners include: QU, the University of Adelaide, the University of Wollongong, Victoria University and RMIT University. Industry support comes from: Engineers Australia, the Australasian Association of Engineering Education, the Australian Council of Engineering Deans, the Australian Sustainable Built Environment Council, the Australian Power Institute, Mining Education Australia and the NSW Office of Environment and Heritage. The project was funded by the Australian Government.

TRUCK SURVEY IMPROVES CARBON STORAGE PICTURE

A bright orange truck from Germany traversing minor roads in south-west Victoria recently was part of the latest research at the CO2CRC Otway Project carbon storage facility.

Vibrations from the truck bounce off the rock layers below and are picked up by sensors laid out on the side of the road, giving researchers a highly accurate picture of the shallow rock layers underground.

Seismic surveys are one of several methods used to assess potential storage sites and to confirm that stored carbon dioxide is safe and secure.

"We are always looking at new ways to improve the monitoring of deep, geologically stored carbon dioxide," says Dr Matthias Raab, Storage Program Manager of the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC).

"This latest survey is a joint effort with the Leibniz Institute for Applied Geophysics (LIAG), Hannover, and will give us an improved picture of the top 500 metres of the geology of the area."

Shear Wave seismic surveys can achieve a much higher resolution of subsurface structures than traditional seismic surveys using compressional waves. LIAG is one of the leading experts developing this methodology and applying the technique in a variety of settings. In this survey the technique is being used to validate seal integrity for the carbon storage formation.

Testing seeks the quietest hospital

A team of CSIRO scientists have carried out sophisticated acoustic studies in a quest to help create the quietest hospital in Australia.

The new Royal Adelaide Hospital, due to be completed in 2016, will have 800 beds and world-class facilities including a helipad atop its south-west corner.

While the helipad will assist in patient transportation, it does present one problem. From 20 metres away, helicopters create more than 100 decibels of noise (equivalent to being in the front row at a rock concert), which is not conducive to patient rest.

Facade manufacturer Yuanda Australia has been contracted by builder HYLIC Joint Venture to supply the hospital with its external windows (all 70,000 square metres of them). Yuanda's contract states that noise reduction must be considered when choosing glazing materials.

The team from CSIRO's acoustics lab in Melbourne has been working alongside Yuanda's engineers, measuring the performance of the windows to ensure that the South Australian Government's stringent sound-proofing requirements are met.

To undertake the measurements, the team custom-built a brick wall between two cavernous sound chambers to hold sample windows. A standardised sound source generated noise in one chamber, while sound intensity and pressure levels were measured on the other side of the glass. The results showed that Yuanda's glazing systems would effectively reduce the impact of helicopter noise on patients.

CSIRO's acoustic laboratory is one of the few facilities in Australia equipped to perform the low-frequency measurements required for this type of assessment. CSIRO's Infrastructure Technologies group is renowned for its work in facade systems, having assessed some of the world's most iconic buildings including the Chanel Ginza building in Tokyo and the Lucas building in Singapore. Locally, the acoustics team has conducted testing for the Sydney Harbour Tunnel, as well as Sydney Airport.

BATS CONFIRMED AS SARS ORIGIN

A team of international scientists has isolated a very close relative of the Severe Acute Respiratory Syndrome coronavirus (SARS-CoV) from horseshoe bats in China, confirming them as the origin of the virus responsible for the 2002-03 pandemic, which killed 774 of the 8094 people infected.

The research team, led by Professor Shi Zhengli from Wuhan Institute of Virology, Chinese Academy of Sciences, and including CSIRO and Duke-

NUS scientist Professor Linfa Wang FTSE, have just had their breakthrough results published in the prestigious journal *Nature*.

While researchers globally have previously used genetic sequencing to demonstrate that bats are the natural reservoirs of SARS-like CoVs, this is the first time that live virus has been successfully isolated from bats to definitively confirm them as the origin of the virus.

The team successfully isolated a SARS-like CoV, named SL-CoV WIV1, directly from faecal samples of Chinese horseshoe bats using the world renowned bat virus isolation methodology developed by scientists at CSIRO's Australian Animal Health Laboratory in Geelong.

EARLY TEST WARNS OF EYE DISEASE

A quick and simple eye test can now predict who is more at risk of age-related macular degeneration (AMD), a leading cause of blindness worldwide.

Researchers at Australia's Vision Centre (VC) have found that while people with early AMD can still see in fine detail, other parts of their vision may be damaged and this isn't revealed by current eye tests.

The new test, by revealing the damage, can show doctors or optometrists where to look and when to watch a patient more closely, helping them to lessen the risk of the disease and avoid total blindness.

Professor Ted Maddess, of The VC and The Australian National University (ANU), says AMD currently affects one in seven Australians over the age of 50, costs \$2.6 billion a year, and will rob the central vision of 1.77 million Australians by 2030.

In developed countries about 15 per cent of people over 40 show signs of early AMD, with about four per cent progressing to late stage AMD each year.

NANOPARTICLE DELIVERS, TRACKS CANCER DRUGS

University of NSW chemical engineers have synthesised a new iron oxide nanoparticle that delivers cancer drugs to cells while simultaneously monitoring the drug release in real time.

The result represents an important development for the emerging field of theranostics – nanoparticles that can treat and diagnose disease.

Magnetic iron oxide nanoparticles have been studied widely because of their applications as contrast agents in magnetic resonance imaging, or MRI. Several recent studies have explored the possibility of equipping these contrast agents with drugs. However, there are limited studies describing how to load chemotherapy drugs onto the surface of magnetic iron oxide nanoparticles and no studies that have effectively proven that these drugs can be delivered inside the cell.

With this latest study, UNSW researchers engineered a new way of loading the drugs onto the nanoparticle's polymer surface and demonstrated for the first time that the particles are delivering their drug inside the cells.

"This is very important because it shows that bench chemistry is working inside the cells," says Associate Professor Cyrille Boyer from UNSW's School of Chemical Engineering.



Testing engineer David Truett in CSIRO's acoustic laboratory.

Scientists strike gold in leaves

Eucalyptus trees in the Kalgoorlie region of Western Australia are drawing up gold particles from the earth via their root system and depositing it their leaves and branches.

But they are unlikely to start an old-time gold rush. The 'nuggets' are about one-fifth the diameter of a human hair and generally invisible.

Scientists from CSIRO made the discovery, which could provide a golden opportunity for mineral exploration, as the leaves or soil underneath the trees could indicate gold ore deposits buried up to tens of metres underground.

"The eucalypt acts as a hydraulic pump: its roots extend tens of metres into the ground and draw up water containing the gold. As the gold is likely to be toxic to the plant, it's moved to the leaves and branches where it can be released or shed to the ground," CSIRO geochemist Dr Mel Lintern says. "The leaves could be used in combination with other tools as a more cost effective and environmentally friendly exploration technique. Eucalyptus trees are so common that this technique could be widely applied across Australia. It could also be used to find other metals such as zinc and copper."

Using CSIRO's Maia detector for x-ray elemental imaging at the Australian Synchrotron, the research team was able to locate and see the gold in the leaves. The Synchrotron produced images depicting the gold, which would otherwise have been untraceable.

UNEVEN BENEFIT FROM FLY-IN/FLY-OUT CULTURE

The mining boom has brought considerable wealth throughout Australia but the benefits are not being distributed evenly, even in the communities most affected by it, according to a new study by the CRC for Remote Economic Participation (CRC-REP) and Ninti One.

The study of the impact of the fly-in/fly-out phenomenon on Australian society was conducted by Curtin University's Professor Fiona McKenzie and Dr Aileen Hoath.

Most Australian mining activities are in remote places where demand for labour usually exceeds local supply, requiring a long-distance commuting (LDC) workforce from source communities. These labour force arrangement include fly-in/fly-out (FIFO), drive-in/drive-out (DIDO) or bus-in/bus-out (BIBO).

Previous studies have focused on the impact of long-distance commuting on host communities where the mine is located. This is the

Eucalyptus leaves showing traces of gold.

first major study to investigate what happens to the communities who supply the remote workforce and targets two source communities in regional Western Australia – Mandurah and Busselton.

Although more than 1000 kilometres from centres of mining activity, both are now home to significant or growing fly-in/out populations, who enjoy their ocean aspect and lifestyle options, also favoured by retirees.

"As a rule, a lot more money flows into the community as a result of well-paid work in the mines – but not a lot of it stays there. One finding is that source communities have failed to capture the full benefits of the opportunity," the report says.

"There is also concern about the widening gap between the 'haves' and the 'have nots', and the pressures placed on local infrastructure due to population growth, which local government authorities, in particular, struggle to resource."

One of the risks is that these source communities could become victims of the classic mining boom/bust cycle, by depending too narrowly on their commuting workforce.

"A reasonable proportion of disposable income circulates locally, but we also found a fair bit of 'leakage', with people spending or investing much of their wealth elsewhere."

3D PRINTED HORSESHOE AIDS GALLOPERS

CSIRO scientists have custom made and 3D printed a set of titanium shoes for a Melbourne race horse in a first for the sport.

The horse, dubbed by researchers 'Titanium Prints', had its hooves scanned with a handheld 3D scanner and, using 3D modelling software, the scan was used to design the perfect fitting, lightweight racing shoe. Four customised shoes were printed within just a few hours.

Traditionally made from aluminium, a horseshoe can weigh up to one kilogram but the horse's trainer John Moloney says that the ultimate race shoe should be as lightweight as possible.

"Any extra weight in the horseshoe will slow the horse down. These titanium shoes could take up to half of the weight off a traditional aluminium shoe, which means a horse could travel at new speeds.

CSIRO's titanium expert John Barnes says that 3D printing a race horseshoe from titanium is a first for scientists and demonstrates the range of applications the technology can be used for.

The precision scanning process takes just a few minutes and shoes can be made to measure for each each hoof and printed the same day.

The titanium horseshoes.



PHOTO: DRAGONFLY MEDIA



CSIRO takes lead role in SKA R&D

CSIRO will play a lead role in the next stage of the development of the world's largest radio telescope, the Square Kilometre Array (SKA), to be located in Australia and in Africa. This follows the SKA Organisation (SKAO) announcement that it has allocated R&D 'work packages' to consortia from around the world. The consortia, involving science institutes and industry, will progress the design and validation processes of the SKA to a stage that will enable tendering and build of the telescope from 2017.

CSIRO will head the largest of these consortia, the SKA Dish Array Consortium, and be responsible for the design work relating to the SKA's 2500 antenna dishes and receivers, and the development of innovative receivers known as phased array feeds (PAFs). In addition, CSIRO will lead the Infrastructure Australia Consortium in charge of designing and costing critical SKA infrastructure at the Australian SKA site in Western Australia. This includes the provision of power, communications, buildings, water and access to the site.

"CSIRO's considerable expertise in the field of radio astronomy means we can make a real contribution to one of this century's most exciting scientific projects," says Chief of CSIRO Astronomy and Space Science Dr Lewis Ball.

CSIRO will also be a key partner in the Assembly Integration and Verification Consortium, which includes the integration of CSIRO's ASKAP and the South African MeerKAT precursor telescopes, into Phase 1 of the SKA telescope rollout. In addition, CSIRO will be involved in other SKA consortia, including those designing the telescope control system and its signal processing and data transport functions. It will receive \$9 million in funding from the Australian Government towards its SKA R&D activity.

Consortia have been formed that will undertake preconstruction work for 11 aspects of the world's largest science experiment, work valued at \$170 million. Australian industry and research institutes will participate in seven of the 11 work packages, with the Perth-based International Centre for Radio Astronomy Research (ICRAR) directly involved in three.

"The astronomy community has moved into the next exciting phase of work towards the SKA," says ICRAR Director Professor Peter Quinn FTSE.

ICRAR will collaborate with international colleagues in science and industry to help design the SKA's Science Data Processor, as well as the Central Signal Processor and the Low Frequency Aperture Array for the part of the SKA that will be located entirely in Australia, SKA-low.

When complete, it is expected that the SKA telescope will be able to operate thousands of times faster than the current best instruments. It will allow research into giant gas clouds, black holes and magnetic fields, as well as distant galaxies, and will address a wide range of fundamental

CSIRO's ASKAP radio telescope with its innovative phased array feed receiver technology.

questions in physics, astrophysics, cosmology and astrobiology.

The SKA will be a radio telescope made of thousands of dishes and millions of radio wave receptors (antennas), with a collecting area of about one square kilometre, linked together by high bandwidth optical fibre. The SKA involves 11 countries and is led by the SKAO, based at Jodrell Bank Observatory, near Manchester, UK. Construction of the first phase of the SKA will begin in 2018, with the second phase planned for the early 2020s

OUTBACK ROVER HELPS HONE SATELLITE SIGNALS

A prototype autonomous vehicle developed by CSIRO is helping scientists improve the accuracy of Earth observation satellites that provide valuable data to our mining and agricultural industries.

Just as the Mars Rover Curiosity is gathering information about our neighbouring planet, CSIRO's 'Outback Rover' is helping calibrate satellites that provide clues to Earth's soil condition, mineralogy and vegetation.

Accompanied by researchers from Japan, China, Israel and France,

CSIRO scientists recently took the rover prototype on a mission to Lake Lefroy – a huge salt lake in remote WA – to see if they could automate the satellite calibration process. Professor Arnold Dekker, Director of Earth Observation and Informatics at CSIRO, explains that this is where information

PHOTO: ADAM HARPER



The 'Outback Rover' sits on the edge of Lake Lefroy.

gathered by satellites is matched against measurements taken on-ground and compared for accuracy.

"Satellite data is used for resource exploration, environmental monitoring and agricultural management such as soil mapping. So it must be regularly cross-checked to ensure that observations are accurate," he says. "This process is called vicarious calibration and is undertaken by ground crews who walk in grids or transects, taking measurements with hand-held devices known as spectrometers as satellites travel overhead.

"With its bright and uniform surface, Lake Lefroy is the perfect location to carry this out." The downside is that the lake is a long way from any urban centres, meaning it can take scientists away from their other research for days on end.

Dr Alberto Elfes, CSIRO's science leader for robotics, says this could be about to change. He hopes the rover will be able to collect calibration data autonomously and send it wirelessly back to researchers.

"The ultimate goal is to have the rover operate alone, with scientists from all over the world able to retrieve data from it or control it remotely in real-time," Dr Elfes says. "Once we know we have acquired accurate data from satellites, it can be used for a range of applications."

IMAGE: SWINBURNE ASTRONOMY PRODUCTIONS



An artist's impression of a black hole.

Gravitational waves plot black holes

An Australian study has taken a new approach to the question of how supermassive black holes in the galaxies grew so big.

The study, led by Dr Ryan Shannon, a Postdoctoral Fellow with CSIRO, and Vikram Ravi, a PhD student co-supervised by the University of Melbourne and CSIRO, pits the front-running ideas about the growth of supermassive black holes against observational data – a limit on the strength of gravitational waves from pairs of black holes – obtained with CSIRO's Parkes radio telescope.

"For the first time, we've used information about gravitational waves as a tool in astrophysics," Dr Shannon says. "It's a powerful new tool. These black holes are very hard to observe directly, so this is a new chapter in astronomy."

When galaxies merge, their resident central black holes are doomed to meet. They first 'waltz' together then enter a desperate embrace and merge. "Theorists predict that towards the end of this dance they're growling out gravitational waves at a frequency we're set up to detect," Dr Shannon says.

Astronomers have been searching for gravitational waves with the Parkes radio telescope and a set of 20 small, spinning stars called pulsars. The Parkes Pulsar Timing Array (PPTA) project and an earlier collaboration between CSIRO and Swinburne University together provide nearly 20 years' worth of timing data.

"We haven't yet detected gravitational waves outright, but we're now into the right ballpark to do so," CSIRO's project leader Dr George Hobbs says.

Combining pulsar-timing data from Parkes with that from other telescopes in Europe and the US – a total of about 50 pulsars – should give us the accuracy to detect gravitational waves "within 10 years," Dr Hobbs says.

AUSTRALIAN CONCRETE KNOW-HOW GOES WORLDWIDE

Perth based Eden Energy Ltd has entered into an exclusive, world-wide licence to utilise technology and know-how developed by Monash University that enables carbon nanotubes produced by Eden to be effectively mixed into cement in order to produce stronger concrete.

Monash and Eden have been collaborating for the past two years, with Eden having supplied Monash with the carbon nanotubes that were used by Monash in developing the technology, with which Monash has achieved an increase in compressive strength with carbon nanotube-enriched cement paste of up to 30 per cent.

Eden has identified a possible immediate application for the product in the US for hardening the surface of concrete floors, roadways and paving on concrete bridges that are subject to heavy wear due to vehicle usage. It sees as particularly promising concrete roadways that are



Eden's carbon/hydrogen production reactors.

subject to heavy snowfall and are regularly cleared using snow-ploughs, causing abrasion and damage to the concrete surface.

The total annual concrete infrastructure maintenance bill in the US has been estimated at somewhere near US\$40 billion.

Subject to satisfactory results from a proposed trial in a US warehouse that is exposed to heavy vehicle and fork-lift activity, it is hoped that a commercial trial on a suitable roadway that is exposed to frequent clearing by snow-plough can be arranged in the US within the next 12 months.

Eden proposes to produce a product which will contain both carbon nanotubes that Eden currently produces, and a liquid identified by Monash that can be added with the cement during production of the concrete to produce a stronger, carbon nanotube enriched concrete.

Eden currently has the commercial capacity to produce 40 to 100 tonnes a year of the same relatively low-cost carbon nanotubes that Monash has tested, at its laboratory in Colorado.

The only byproduct of the process is hydrogen, which Eden plans to utilise for as a low-cost, zero-emission vehicle fuel – a blend of hydrogen and natural gas which it is developing in India, or for fuelling pure hydrogen powered fuel cell or internal combustion engines.

UNSW targets 29% efficient cells

Solar engineers from UNSW are partnering with a consortium of top US universities on next-generation silicon solar cells with targeted efficiencies of 29 per cent.

The current world record for conversion efficiency for silicon cells is 25 per cent – set by the UNSW solar photovoltaic research group in 2008 with its PERL cell.

Arizona State University (ASU) was awarded US\$3.5 million in October from the US Government's SunShot Initiative, which aims to make solar PV energy cost-competitive with other forms of electricity by 2020.

UNSW was listed as a collaborator on the grant, along with MIT, Caltech and the Swiss Federal Institute of Technology.

"These are the some of the most cutting-edge solar cell and physics groups in the US and Europe and we're delighted to be working with them," says Dr Richard Corkish, Head of the UNSW School of Photovoltaic and Renewable Energy Engineering.

The project will focus on demonstrating new device structures for ultra-thin silicon solar cells that can approach the theoretical limit for solar power conversion with silicon cells.

The project leader at ASU is Professor Stuart Bowden, who was previously a PhD student at UNSW and played a large role in developing the University's solar education and research programs. Another former UNSW academic at ASU, Professor Christiana Honsberg, is a project investigator.

UNSW's involvement will be led by Dr Anita Ho-Baillie, and will be coordinated through the Australia-US Institute for Advanced Photovoltaics (AUSIAP), which is led by UNSW Scientia Professor Martin Green AM FAA FTSE.

The Institute includes UNSW, the Australian National University, the University of Queensland, the University of Melbourne, Monash University and CSIRO.

CANADIAN CALLS FOR SOLAR AIR USE

A Canadian solar expert says Australia could benefit from using solar air technology, to reduce energy costs in heating both commercial and residential buildings and reduce greenhouse gas emissions.

Speaking ahead of All-Energy Australia 2013 in Melbourne in

October, Mr Wes Johnston, Vice President of the Canadian Solar Industries Association, said the technology was virtually nonexistent in Australia.

Solar air technology uses the sun to heat air which is then trapped in a metal facade or 'collector' on the side of a building and subsequently dispersed throughout it. Canada is a world leader and innovator in the application.

"Clearly Australia is a sun-kissed nation and the benefits of solar air technology are unassailable," Mr Johnston said, claiming solar PV used in conjunction with solar air was a better mix than solar PV alone.

AUSTRALIA AND INDIA COLLABORATE ON CLEAN FUEL

A new research partnership between Australia and India could provide a solution to a number of energy concerns and ultimately reduce the reliance of both countries on imported fuels.

The widespread introduction of a clean-burning synthetic fuel, dimethyl ether (DME), is a step closer following the announcement of a \$6 million partnership between CSIRO and its Indian equivalent, the Council of Scientific and Industrial Research (CSIR).

The project will focus on improving processes involved in the production of DME, which is a liquid fuel produced from natural gas (NG), coal, biomass, or even directly from carbon dioxide.

Both Australia and India are currently unable to meet demand for petroleum products with domestic production alone. DME could help meet demand and consequently reduce both nations' reliance on imported petroleum products.

"There are over half a million vehicles currently using liquefied petroleum gas (LPG) in Australia – all of which could be powered using DME," says CSIRO's Dr Nick Burke.

"The fact that DME can be used as a blend in existing LPG engines makes it an effective transitional fuel. Australia's heavy reliance on diesel could also be lessened with the added possibility of DME being able to replace diesel in the future."

The research will also assist in the development of small plants that may be suitable in remote and rural areas.

"More efficient processing of gas into transportable fuels at remote locations would make Australia and India's remote gas reserves more economically viable," says Professor Suresh Bhargava FTSE, from RMIT University.

In addition to CSIRO and the Indian Institute of Petroleum (CSIR-IIP), the project will draw on the expertise of the Indian Institute of Technology (IIT-Roorkee), Bharat Petroleum Corporation Ltd (BPCL), The Centre of Advanced Materials and Industrial Chemistry (CAMIC) at RMIT, and The University of Melbourne.

The three-year project is being jointly funded by the Australian and Indian governments, through the Australia-India Strategic Research Fund.



Suresh Bhargava

Wes Johnston



NICTA leader to head GroupX

Dr Karsten Schulz has been named as National Manager of GroupX, a collaborative initiative of industry, research, universities and government funded by the Australian Government's Digital Careers Program.

He will spearhead the roll-out of GroupX across Australia as a four-year program aimed at increasing the number of Australia's tertiary Information and Communications Technology (ICT) students and – subsequently – an increase in the number of ICT professionals in Australia, and promote ICT professions and careers.

Group X includes representatives from industry, the Australian Information Industry Association (AIIA) and the Australian Computer Society (ACS) along with professionals from the education and government sectors.

Dr Schulz joined NICTA in early 2013 as Commercial Manager in Infrastructure, Transport and Logistics.

GroupX will be working alongside numerous industry and university collaborators to promote a range of programs including RoboCup, Club KidPreneur, SAP Young ICT Explorers and the National Computer Science Summer School.



Karsten Schulz

Dr Schulz brings rich experience to the role, having founded SAP's Young ICT Explorers, an annual not-for-profit competition for school children aged 10 to 17 to inspire them to take up careers and studies involving information technology.

Within the technology space he has held senior roles at SAP AG, a market leader in enterprise software applications across Europe and the Asia-Pacific region, and has seeded and started several research centres for the company in Australia, China, India and Singapore.

DIGITAL CANBERRA CHALLENGE

Canberra's NICTA-led Australian eGovernment Cluster has launched a \$300,000 competition which will engage ACT innovators and SMEs in the development of new, improved digital government services.

The Digital Canberra Challenge is funded by the ACT Government as part of its Growth, Diversification and Jobs – Business Development Strategy for the ACT program, and has been developed to align closely with the ACT Government's broader Digital Canberra Agenda.

The eGov Cluster has been appointed by the ACT Government to run the DCC under the strategic guidance of the newly established DCC Program Board.

NICTA and the ACT Government launched the Government technology cluster in 2009.

The eGov Cluster has been appointed by the ACT Government to run the DCC under the strategic guidance of the newly established DCC Program Board.

NEW WAY TO CHECK LAND'S ENVIRONMENTAL HISTORY

A new way to check the environmental status of land before purchase is now available. Spatial Vision's site-specific CheckSite reports are now available through Landmark Information Group's Envirocheck international data collection service, where customers outside Australia can order CheckSite reports for land sites in Australia.

Australian companies will soon be able to order Envirocheck reports for UK land via Spatial Vision under a reciprocal agreement between the two companies.

The CheckSite and Envirocheck services provide valuable information for environmental consultants to assess the potential risks to a land site to inform a potential developer or purchaser of property. Landmark has pioneered digital mapping, property and environmental risk information since its inception in the UK in 1995. Spatial Vision, which developed CheckSite, is an Australian-based specialist in information and spatial technologies.

ANSTO LANDS NEW ACCELERATOR

ANSTO's new Centre for Accelerator Science at Lucas Heights in Sydney has taken delivery of the first of two new accelerators that will expand opportunities for the organisation and its partners. The new 1MV AMS accelerator system is designed specifically for accelerator mass spectrometry (AMS) and is custom-designed with the capability to perform high-efficiency, high-precision AMS analysis across the full mass range. It can measure rare radioisotopes from radiocarbon (for dating applications) to plutonium (for nuclear safeguards and forensics), and anything in between.

Accelerator science aims to characterise samples using ions accelerated to extraordinarily high kinetic energies in a particle accelerator.

Accelerator science aims to characterise samples using ions accelerated to extraordinarily high kinetic energies in a particle accelerator.

DSTO SIGNS ALLIANCE

The Defence Science and Technology Organisation (DSTO) has signed new strategic alliances with BAE Systems Australia and Thales Australia to enhance collaboration on defence technologies.

The DSYTO/BAE alliance will see the two organisations potentially work together on strategically significant areas such as submarines, cyber security, land vehicles, space, electronic warfare and passive radar, hypersonics and autonomous systems.

"No single scientific organisation can produce the advances in science and technology that are required in the rapidly evolving defence environment, says Chief Defence Scientist Dr Alex Zelinsky FTSE. "We are looking forward to the collaboration and commercialisation opportunities we expect to flow under the auspices of this alliance."

Dr Zelinsky said DSTO and Thales had a long history of research collaboration that has led to better protection for Bushmaster vehicles, the development of innovative minesweeping systems and next-generation fibre optic towed arrays for tracking maritime vessels.



ATSE

INFOCUS

NUMBER 181
DECEMBER 2013

Graeme Jameson is NSW's top scientist

Newcastle chemical engineer, Laureate Professor Graeme Jameson AO FREng FAA FTSE, has been named 2013 NSW Scientist of the Year.

His trailblazing technology has turned mineral processing on its head and proved an economic boon. His internationally renowned Jameson Cell is used in more than 300 mineral-processing plants across 20 countries – using floatation to remove oil, grease and other suspended solids from industrial wastewater and effluent.

The technology contributes more than \$3 billion in mineral exports to the Australian economy every year.

The NSW Chief Scientist and Engineer, Professor Mary O'Kane FTSE, said Professor Jameson was a worthy winner of the state's most prestigious science award.

"Graeme has a tremendous reputation as a world leader in fluid and particle mechanics," Professor O'Kane said. "His Jameson Cell was first used commercially in 1989 and has proved to be a real game-changer in the mineral processing industry – used successfully in the processing of base and precious metals, coal, oil sands, solvent extraction and industrial minerals.

"It's estimated the Cell adds between \$3 billion and \$4 billion in mineral exports to the national economy annually, and it could well be the most financially successful Australian invention in the past three decades.

"Graeme is indeed a worthy recipient of this high honour, which is the latest in a very long list of awards recognising his tremendous achievements in science and engineering."

Professor Jameson is Director of the University of Newcastle's Centre for Multiphase Processes – a major Australian



Graeme Jameson with the NSW Governor, HE Marie Bashir AC CVO FTSE, who presented Professor Jameson his award at a reception at Government House, Sydney.

centre for research and research training in the science and technology of fine particles and bubbles.

Earlier this year he received The Antoine M. Gaudin Award, which is considered the world's most important prize in the field of engineering science and industrial technology.

The technology used in the Jameson Cell continues to evolve and is now being applied to other industrial practices, including the extraction of oil from tar sands in Canada and the removal of blue-green algae from waterways in Central Australia.

The NSW Scientist of the Year receives \$55,000 in prize money.

Professor Jameson, a Fellow since 1991, spent 13 years in the Department of Chemical Engineering at Imperial College London, before joining the University of Newcastle as a professor in 1978.

ANDREW HOLMES TO HEAD AAS

A pioneer of research in organic electronics, Professor Andrew Holmes FRS FAA FTSE, has been elected as the next President of the Australian Academy of Science and will assume the role after the Academy's next Annual General Meeting in May 2014.

The presidency alternates between the physical and biological sciences and the term lasts for four years.

Professor Holmes has been Foreign Secretary of AAS. He is a Laureate Professor of Chemistry at the University of Melbourne's Bio21 Institute, a CSIRO Fellow and Distinguished Research Fellow in the Department of Chemistry at Imperial College London.

Professor Holmes graduated in chemistry from the University of Melbourne and pursued PhD studies at University College London. He then moved to Cambridge University, where he had an illustrious career, becoming Professor of Organic and Polymer Chemistry and Director of the Melville Laboratory for Polymer Synthesis.

In the 1990s, Professor Holmes achieved international prominence when, in collaboration with Cambridge physicists in England, the team developed a new class of light-emitting polymers. These polymers transformed technology for televisions and computers with lightweight, super-thin, flexible video screens bright enough to be viewed even in direct sunlight.

Professor Holmes returned to Melbourne in 2004 as a Federation Fellow to establish a laboratory at the then newly established Bio21 Institute. He was

instrumental in forming the Victorian Organic Solar Cell Consortium. He became an ATSE Fellow in 2006.



Andrew Holmes

Fifty years of UTas agriculture

Former ATSE Victorian Division Chair Dr Glen Kile AM FTSE was a speaker among alumni who attended the celebrations of the 50th anniversary of the University of Tasmania's Faculty of Agriculture in October.

Past graduates and the Tasmanian community attended an Open Day, at which graduates from four decades talked about their career highlights, tours of teaching facilities and laboratories were conducted and a festive dinner held.

Dr Kile's topic*, 'From *Malus* to *Eucalyptus*', reflected his career since graduating in agricultural science in 1968 and earning his PhD in 1973 – the department's first PhD.



Glen Kile

Tom McMeekin

He became Chief, CSIRO Forestry and Forest Products from 1992 to 2001, Executive Director of the Forest and Wood Products Research and Development Corporation, 2002–07 and Managing Director of Forest and Wood Products Australia 2007–08.

As a plant pathologist he has been involved in biosecurity and forest health matters over a long period and was member of the Board of Plant Health Australia 2007–11. He is the author or co-author of more than 100 publications, past Chairman of the Standing Committee of Forestry (2001) and winner of the 2007 NW Jolly Medal (Institute of Foresters of Australia).

The Faculty has strong links to ATSE.

Emeritus Professor Tom McMeekin AM FTSE was Dean of the Faculty of Agricultural Science from 1985–87 and Chair of the Board of Studies in Agriculture from 1994–97.

Acknowledged as one of the world's leading food microbiologists, whose proven expertise has impacted on food safety internationally, Professor McMeekin pioneered the development of predictive microbiology and established the university as the world leader in predictive modelling of microbial behaviour in foods.

He was instrumental in the establishment in the Australian Food Safety Centre of Excellence. The work he and a group of scientists did established new systems of predicting food safety around the world. He is a former Tasmanian Division Chair and ATSE Councillor.

Emeritus Professor Bob Menary OAM FTSE, a member of the organising committee for the celebrations, joined the faculty in 1967 to teach horticultural science, following his earlier career as a plant physiologist with the Queensland Department of Primary Industries.

He served as Head of the Department of Agricultural Science (1986–88) and is recognised for his significant contributions to hop physiology and chemistry and to the technical development of table wine grapes, essential oils and pyrethrum industries in Tasmania. He is Tasmanian Division Secretary, ATSE Councillor (1999–01) and has been a Fellow since 1995.

Emeritus Professor June Olley AM FTSE is a Foundation Fellow who graduated from University College London in 1944 and completed her PhD in 1950 at the London School of Hygiene and Tropical Medicine.

After working at Torry Research Station, Scotland, on various aspects of fish technology, Professor Olley joined CSIRO in 1968, working at the Tasmanian Food Research Unit, and remained with this organisation throughout her working life. She started as an experimental officer and retired as a senior principal research scientist and leader of the unit. She contributed to numerous publications in different areas of fish and shellfish technology and enjoyed a long professional

association with Academy Foundation Vice President Dr Keith Farrer who died in June 2012 (see ATSE Focus 173, August 2012).

After retirement from CSIRO, Professor Olley became an Honorary Research Associate at the University of Tasmania, where she continues to pursue her research into aspects of fish technology and microbiology.

**Malus, apple, is a genus of about 30 to 55 species of small deciduous trees or shrubs in the family Rosaceae, including the domesticated orchard apple.*

VEGEMITE TURNS 90

Vegemite, the Australian icon, celebrated its 90th birthday in October, which would have been a proud day for late Foundation and Life Fellow Dr Keith Farrer OBE FTSE.

Australia has been home to Vegemite since 1923, around the same time construction started on the Sydney Harbour Bridge and (Old) Parliament House, so it has a special place in the nation's history.

Dr Farrer spent 43 years with Kraft, the Vegemite company, becoming Chief Scientist and acknowledged as a giant in the food technology industry. He is widely acknowledged for his work in developing Vegemite as an important source of vitamin B1 and a component of Australian troop rations during World War II.

Dr Farrer was a driving force behind the establishment of the Academy and was its Foundation Vice President.



FRED HILMER AWARDED CHAIKIN MEDAL



Professor Chaikin's daughter Gwen presents the Chaikin Medal to Professor Hilmer, as NSW Division Chair Dr David Cook looks on (see 'Rethinking Australia's science policy', page 19).

Bill Tyree led nation's power engineering

Visionary power engineer Sir William Tyree OBE FTSE died in Sydney in October, aged 92.

A Fellow since 1988, he received an ATSE Clunies Ross Lifetime Achievement Award in 2012. Mr Peter Tyree FTSE, a member of the ATSE Audit and Remuneration Committee, is one of his three surviving children.

Born in New Zealand, Bill Tyree enrolled in a diploma at Sydney Technical College and in 1947, after completing his diploma, he borrowed funds and, with the help of his wife Joyce, set up a small electrical engineering business in makeshift rented premises in Camperdown, Sydney.

From those modest beginnings, Tyree Holdings grew to become one of the largest electrical transformer manufacturers in the Southern Hemisphere. He sold the company in 1969 to Westinghouse, but remained at the helm for another 10 years.

He was a philanthropist who understood the importance of education. In the 1970s, Sir William established the A.W. Tyree Foundation, through which he donated funds to universities for scholarships to advance engineering and education, focusing on the growing needs of the power industry. The Foundation continues its work to this day.

Sir William's philanthropy is evident at one of the University of NSW's most significant buildings – the Tyree Energy Technologies Building. His contributions helped UNSW build the state-of-the-art building, which was completed last year and is now home to groundbreaking energy research.

"Bill Tyree was one of the real pioneers of Australian industry – a great pacesetter," said UNSW Vice Chancellor Professor Fred Hilmer.

"I think Bill will be most remembered for opening up new vistas for us in energy and engineering, and doing it in such a way that he developed many warm friendships and strong personal associations."

"I spent quite a bit of time with Bill in his last few weeks and right at the last visit he was still talking about development projects and national priorities, and how we needed to get nuclear going if we were ever going to become less dependent on coal."

Sir William recently provided more than half a million dollars to the Faculty of Engineering towards the establishment of Australia's only graduate program in Nuclear Engineering, co-funded with ANSTO.

UNSW Dean of Engineering Professor Graham Davies FEng FTSE says he found a wonderful collaborator in Sir William.

"Bill has given me great support all the way through and I'm indebted to him personally. It has been wonderful to know him. He had a real passion for engineering and a drive to get things done. As well as his support for philanthropy he was a huge ideas person and I'd often get emails from him about new proposals. He did it all with great warmth and humour."

In Sir William's own words, his commitment to education was simply an investment in Australia's future. "I want to try and improve the education of the people coming on to replace us old blokes because unless that happens, Australia will simply not achieve what it should," he said.

Sir William was also a pioneer in breast cancer screening, and he combined his engineering expertise with medicine to support breakthrough research into cochlear implants to treat deafness and the development of the bionic ear.



Sir William Tyree receives his Lifetime Achievement Award in 2012 from Academy President Professor Robin Batterham.

Married to Joyce for more than 60 years until she passed away in 2006, Sir William always said that her support was the vital foundation on which he built his career.

Sir William was awarded an honorary Doctor of Science by UNSW (1986), the Peter Nicol Russell Medal (1985) and the James N Kirby Gold Medal (1980).

DETERMINATION, SELF-FAITH AND THE WILL TO ACHIEVE

Sir William Tyree (Bill to his many friends) was one of those rare people who could not fail to influence you. Agree with him or not, his immense self belief, his enthusiasm, his ability to cut directly to the core of the matter in hand could not but leave one inspired, persuaded, moved or even angered – but ignore him? That was not possible!

I was privileged for several years to be a director of the Tyree Group of Companies, his life's work, coming to know and respect him as well as one could get to know such an intensely focused, determined and yet remarkably private man. Not for him the small talk of conventional social interaction; nor the diversion of corporate boards or professional societies, although the latter universally accorded him their highest honours.

Bill was ever directed to the future; how

perceived problems could and should be made opportunities. Never did he start with "the trouble is ..." That was pointless; he always faced his challenges – heavyweight competitors, canny politicians, failed collaborators and more – with determination and self-faith. National development opportunities, like uranium enrichment and high-speed rail, enjoyed his inspired leadership. The title of his biography, *The Will to Achieve*, sums up this lifetime commitment in one succinct phrase.

I was privileged also to know Bill's wife Joyce, his strength and inspiration, as well as his children and their families, especially his son Peter. While Bill was a unique individual his abiding legacy is his gifted family and his numerous philanthropic beneficiaries in engineering, education, health and more. He will be well remembered.

– MARTIN THOMAS AM FTSE

Eight women elected ATSE Fellows

Key business names, leading academics, prominent commercial innovators and high-ranking public sector figures – including eight prominent women – have been elected Fellows of the Australian Academy of Technological Sciences and Engineering (ATSE).

The new Fellows, elected by the Academy's Fellowship from a variety of fields, include some of the most prominent Australian women in research and technology:

- Dr Mary Ann Augustin FTSE, Research Program Leader (Food Science), CSIRO;
- Dr Susan Barrell FTSE, Acting Deputy Director, Bureau of Meteorology;
- Ms Kathryn Fagg FTSE, Board Member, Reserve Bank of Australia;
- Ms Denise Goldsworthy FTSE, consultant and former Chief Commercial Officer, Rio Tinto Autonomous Haul Trucks, Rio Tinto Iron Ore Pty Ltd;
- Dr Bronwyn Harch FTSE, Chief, Computational Informatics Research Division, CSIRO;
- Professor Hua Kun Liu FTSE, Professor, Institute of Superconducting Materials, University of Wollongong;
- Emeritus Professor Maria Skyllas-Kazacos AM FTSE, Emeritus Professor, Chemical Engineering and Industrial Chemistry, University of NSW; and
- Ms Catherine Tanna FTSE, Chairman, BG Australia.

Leading business figures include:

- Mr Peter Coleman FTSE, Chief Executive Officer, Woodside Petroleum Ltd;
- Mr John McGagh FTSE, Global Head of Innovation, Rio Tinto Ltd;
- Mr Steve Sargent FTSE, President and Chief Executive Officer, GE Australia and New Zealand; and
- Mr David Thodey FTSE, Chief Executive Officer, Telstra Corporation.

High-impact academics include:

- Professor John Beynon FREng FTSE, Executive Dean, Faculty of Engineering, Computer and Mathematical Sciences, University of Adelaide;
- Professor Graham Davies FREng FTSE, Dean of Engineering, University of NSW;
- Professor Christopher Greig FTSE, Professor Energy Strategy and Director, UQ Energy

Initiative, University of Queensland;

- Professor Yingjie Jay Guo FTSE, Director, Australia-China Research Centre for Wireless Communication and Research Director, Smart and Secure Infrastructure, Digital Productivity and Services National Flagship, CSIRO;
- Professor Robert Henry FTSE, Professor of Innovation in Agriculture, University of Queensland;
- Professor Ross McAree FTSE, Professor of Mechanical Engineering, University of Queensland;
- Professor Peter Quinn FTSE, Professor of Astronomy and Astrophysics, University of WA, and Director of the International Centre for Radio Astronomy Research (ICRAR);
- Professor Robert Short FTSE, Pro Vice Chancellor, Information Engineering, Technology and the Environment, University of SA;

Leading innovators include:

- Dr Silviu Itescu FTSE, Chief Executive, Mesoblast Ltd;
- Dr George Morstyn FTSE, Deputy Chair, Victorian Comprehensive Cancer Centre; and
- Dr John Ness FTSE, Managing Director, EM Solutions;

Public sector leaders include:

- Dr Ian Oppermann FTSE, Director, Digital Product and Services Flagship, CSIRO; and
- Dr Robert Vertessy FTSE, Director and CEO, Bureau of Meteorology.

The Academy elected one Foreign Fellow – Professor Liang-Shih Fan FTSE, from Ohio State University, a world leader in chemical engineering.

ATSE 2013 FELLOWS

Dr Mary Ann Augustin FTSE

RESEARCH PROGRAM LEADER (FOOD SCIENCE), CSIRO (VICTORIA)

Mary Ann Augustin has made outstanding contributions to food science and the food industry through initiating and leading excellent research and working to apply the outcomes to creation of an impressive array of commercially successful food ingredients, products and processes.

Dr Susan Barrell FTSE

ACTING DEPUTY DIRECTOR, BUREAU OF METEOROLOGY (VICTORIA)

Sue Barrell is a world leader in weather and climate observation technologies and a widely respected authority on international climate change monitoring and research. She has been the driving force in the modernisation of Australia's meteorological observing systems and networks involving automatic weather stations, ocean buoys, advanced Doppler radars and satellite ground stations. She has led the introduction of many new cutting-edge observing technologies.

Professor John Beynon FTSE

EXECUTIVE DEAN, FACULTY OF ENGINEERING, COMPUTER AND MATHEMATICAL SCIENCES, UNIVERSITY OF ADELAIDE (SA)

John Beynon has made a major contribution to metallurgical research, academic leadership and developing links between research and industry. His research has had important applications in the manufacture of steel and in the development of railway track systems. He is a leader in the development of engineering education in Australia, at a time when the sector is evolving rapidly.

Mr Peter Coleman FTSE

CHIEF EXECUTIVE OFFICER, WOODSIDE PETROLEUM LTD (WA)

Peter Coleman has an outstanding record of leadership in the petroleum exploration and production industry with particular expertise in oil and gas production. Before being appointed to lead Woodside in 2011, he had 27 years' industry experience with the ExxonMobil group, filling a variety of senior roles in Australia, Africa, Asia and the US with responsibility for oil and gas developments around the world.



Dr Mary Ann Augustin FTSE



Dr Susan Barrell FTSE



Professor John Beynon FTSE



Mr Peter Coleman FTSE

Professor Graham Davies
FEng FTS

Ms Kathryn Fagg FTSE



Ms Denise Goldsworthy FTSE

Professor Christopher Greig
FTSEProfessor Yingjie Jay Guo
FTSE

Dr Bronwyn Harch FTSE

Professor Graham Davies FEng FTSE

DEAN OF ENGINEERING, UNIVERSITY OF NEW SOUTH WALES (NSW)

Graham Davies has achieved an international reputation for his research into opto-electronic circuits for telecommunications applications, and for advances in the growth of semiconductors for these devices. Distinguished for 30 years of innovative leadership of research at British Telecom, he also led the development of sophisticated tools for research management.

Ms Kathryn Fagg FTSE

BOARD MEMBER, RESERVE BANK OF AUSTRALIA (VICTORIA)

Kathryn Fagg has a broad range of experience particularly in the industrial sector. A graduate in chemical engineering, her early career was with Esso where she led the planning for the innovative use of technology in new oil fields in Bass Strait. She went on to lead large businesses in logistics, manufacturing and banking in Australia, Asia and New Zealand. Ms Fagg is an active and public advocate for women in leadership, particularly in engineering and operational roles.

Ms Denise Goldsworthy FTSE

CHIEF COMMERCIAL OFFICER, RIO TINTO AUTONOMOUS HAUL TRUCKS, RIO TINTO IRON ORE PTY LTD (WA)

Denise Goldsworthy was until recently a senior executive at Rio Tinto with an outstanding reputation for leadership in various aspects of the mining industry. As a metallurgist at BHP Steel for 17 years, she made significant contributions in a number

of areas including sinter plant, blast furnace and steelmaking operations. She subsequently was appointed a General Manager at Rio Tinto where she has been an outstanding leader of a number of Rio Tinto companies and subsidiaries in mining and resources areas.

Professor Christopher Greig FTSE

PROFESSOR ENERGY STRATEGY AND DIRECTOR, UQ ENERGY INITIATIVE, UNIVERSITY OF QUEENSLAND (QUEENSLAND)

Chris Greig is an innovator and business leader who has made outstanding contributions in the sugar, mining and energy industry sectors. His patented inventions in the sugar and kaolin processing industries have had enduring industrial impact. His engineering project management skills have had significant economic impact within Australia and abroad. He is also internationally recognised for his vision and leadership in low-emissions energy, especially carbon capture and storage.

Professor Yingjie Jay Guo FTSE

DIRECTOR, AUSTRALIA-CHINA RESEARCH CENTRE FOR WIRELESS COMMUNICATION AND RESEARCH DIRECTOR, SMART AND SECURE INFRASTRUCTURE, DIGITAL PRODUCTIVITY AND SERVICES NATIONAL FLAGSHIP, CSIRO (NSW)

Jay Guo has had a sustained and outstanding impact in wireless and mobile systems innovation and development in Australia and internationally. He is recognised as a leading expert in antennas and wireless communications systems, and as an industrial innovator with major industrial impact. As Research Director, Wireless & Broadband, at CSIRO, he provided strategic leadership

in the development of R&D through to commercialisation in international markets.

Dr Bronwyn Harch FTSE

CHIEF, COMPUTATIONAL INFORMATICS RESEARCH DIVISION, CSIRO (QUEENSLAND)

Bronwyn Harch has had an outstanding career in CSIRO where, after joining initially as a postdoctoral research statistician, she is now heads its Computational Informatics function. She works in partnership with the organisation's National Research Flagship program to address key national challenges across the information and decision-making value chain for government, industry and the innovation sectors.

Professor Robert Henry FTSE

PROFESSOR OF INNOVATION IN AGRICULTURE, UNIVERSITY OF QUEENSLAND (QUEENSLAND)

Robert Henry is a distinguished researcher whose innovations in agricultural biotechnology together with a strong commitment to industry engagement have significantly enhanced Australia's competitive agricultural market advantage. Professor Henry is renowned internationally for the quality and influence of his work spanning biotechnology, plant biochemistry and molecular biology and has earned the accolade of being one of the most highly cited scientists in agriculture in the past 20 years.

Dr Silviu Itescu FTSE

CHIEF EXECUTIVE, MESOBLAST LTD (VICTORIA)

Silviu Itescu is a medical researcher who has made the transition from being a global leader in his research field to be

a highly successful entrepreneur. He has a distinguished record as a researcher in a search for effective therapeutic agents involving the use of adult stem cells which avoid rejection by the recipient. He formed Mesoblast, a \$2 billion market capitalisation biotechnology company engaged in late-stage clinical trials of his products.

Professor Hua Kun Liu FTSE

PROFESSOR, INSTITUTE OF SUPERCONDUCTING MATERIALS, UNIVERSITY OF WOLLONGONG (NSW)

Hua Kun is an international leader in the development and commercialisation of new superconducting and other materials. She has established an international network of academic and industry partners, contributing to commercialisation and industry development via technology transfer, and spin-off companies. Professor Liu has also worked tirelessly to promote women postgraduates in science and technology and has trained many dedicated leaders in the clean energy field.

Professor Peter Ross McAree FTSE

PROFESSOR OF MECHANICAL ENGINEERING, UNIVERSITY OF QUEENSLAND (QUEENSLAND)

Ross McAree is a significant academic and engineer who made a major contribution at Oxford University to developing tele-robotic systems for the nuclear industry and rapid prototyping systems for the manufacturing industry. His current, and most profound contributions, have been with the Australian mining industry and global mining equipment manufacturers. Professor McAree's research team at CRCMining and the

University of Queensland is an internationally recognised pioneer in the rapidly growing field of mining equipment automation.

Mr John McGagh FTSE

GLOBAL HEAD OF INNOVATION, RIO TINTO LTD (QUEENSLAND)

John McGagh has led the development of important research and development centres in universities that are addressing key technical issues for the global mining industry, covering automation of surface mines, the advanced recovery of minerals, the reduction of energy required for crushing and grinding processes, and technologies for massive underground block-cave mines – with considerable benefits to the mining industry.

Dr George Morstyn FTSE

DEPUTY CHAIR, VICTORIAN COMPREHENSIVE CANCER CENTRE (VICTORIA)

George Morstyn has provided exemplary leadership and outstanding contributions to translating basic science discoveries into medically and commercially important clinical practice. As a researcher he was responsible for the discovery of a means of eliciting haemopoietic stem cells in the blood, which is now used worldwide in place of bone marrow transplantation. As a senior executive of Amgen he played a foundational role in the implementation of this and other significant medical and commercial products to global markets.

Dr John Ness FTSE

CHIEF TECHNOLOGY OFFICER AND FORMER MANAGING DIRECTOR, EM SOLUTIONS

(QUEENSLAND)

John Ness has been at the forefront of developing innovative designs for microwave components including antennas, amplifiers and filters that are now used in wireless systems such as microwave radios and satellite terminals around the world. He has been the co-founder and head of three start-up companies. His creative design contributions have demonstrated excellence in technical innovation. His legacy is the creation of a significant Australian industry sector in wireless and microwave systems.

Dr Ian Oppermann FTSE

DIRECTOR, DIGITAL PRODUCTIVITY AND SERVICES FLAGSHIP, CSIRO (NSW)

Ian Oppermann has contributed to the core technology base of broadband wireless communications systems, and to the collaborative evolution and business deployment of mobile communications globally. He has led CSIRO's initiatives in information and communications technologies (ICT), contributed to the formation of the Flagship, been an active initiator of national collaborative initiatives in ICT-based innovation and been a strong contributor to university, industry and government advisory bodies.

Professor Peter Quinn FTSE

PROFESSOR OF ASTRONOMY AND ASTROPHYSICS, UNIVERSITY OF WESTERN AUSTRALIA AND DIRECTOR OF THE INTERNATIONAL CENTRE FOR RADIO ASTRONOMY RESEARCH (ICRAR) AT UWA (WA)

Peter Quinn is a world leader in data-intensive science; the design, development and



Professor Robert Henry FTSE



Dr Silviu Itescu FTSE



Professor Hua Kun Liu FTSE



Professor Peter Ross McAree FTSE



Mr John McGagh FTSE



Dr George Morstyn FTSE



Dr John Ness FTSE



Dr Ian Oppermann FTSE



Professor Peter Quinn FTSE



Mr Steve Sargent FTSE



Professor Robert Short FTSE



Emeritus Professor Maria Skyllas-Kazacos AM FTSE



Ms Catherine Tanna FTSE



Mr David Thodey FTSE



Dr Robert Vertessy FTSE

operation of super-science facilities; the theory of galaxy formation and the search for Dark Matter. He is ranked by Thomson Reuters as one of the top 250 astronomers in the past 25 years. Professor Quinn has worked closely with global data companies towards the design and development of the SKA data processing systems.

Mr Steve Sargent FTSE

PRESIDENT AND CHIEF EXECUTIVE OFFICER,
GE AUSTRALIA AND NEW ZEALAND (NSW)

Steve Sargent has worked overseas and in Australia for GE – a company with industry initiatives in energy, water, oil and gas, locomotives, aviation, and healthcare. With revenues of \$6.7 billion, GE Australia and New Zealand is the second largest component of GE in the world behind its US companies. He was appointed a member of the Australian Treasurer's Financial Sector Advisory Council and has recently been appointed a member of the Prime Minister's influential Australian B20 group, a body to advise the government on policy to promote global economic prosperity and jobs in the lead up to Australia's presidency of the G20 summit in 2014.

Professor Robert Short FTSE

PRO VICE CHANCELLOR, INFORMATION ENGINEERING,
TECHNOLOGY AND THE ENVIRONMENT, UNIVERSITY
OF SOUTH AUSTRALIA (SA)

Rob Short has exploited outstanding new science to develop products with profound impacts on human health and wealth creation. He pioneered the deposition of polymer coatings from electrically-excited gases and their use in medical devices and founded two successful spin-out companies. He oversaw the development of six commercially successful, patent-protected, products. As inaugural director of the Mawson Institute at the University of South Australia, he built a world class research institute at the manufacturing/biotechnology interface, nurturing technologies with demonstrable global impact.

Emeritus Professor Maria Skyllas-Kazacos AM FTSE

EMERITUS PROFESSOR, CHEMICAL ENGINEERING
AND INDUSTRIAL CHEMISTRY, UNIVERSITY OF
NEW SOUTH WALES (NSW)

Maria Skyllas-Kazacos is an internationally acclaimed researcher in the area of energy storage. Her pioneering work on the Vanadium Redox Battery is already having a major impact on the electricity sector and renewable energy industry world-wide. The technology that she pioneered is internationally regarded as the foremost battery technology for large-scale energy-storage applications. It is being used to remove inherent instability problems of wind and solar energy (via load balancing), allowing large-scale penetration of renewables into the 'smart grid' of the future. It is now being manufactured by several companies in Europe, the US, Japan and China.

Ms Catherine Tanna FTSE

CHAIRMAN, BG AUSTRALIA (QUEENSLAND)

Catherine Tanna is a globally acknowledged leader in the gas resources industry, having forged an outstanding career internationally with BHP Petroleum and Shell before returning to join BG Group in Australia. In a professional career of more than 20 years in the natural gas production industry she has a remarkable record of achievement and impact including European, Asian and African countries. She currently oversees the leading coal seam gas-to-LNG project in Australia. She is one of Australia's most influential businesswomen.

Mr David Thodey FTSE

CHIEF EXECUTIVE OFFICER, TELSTRA CORPORATION
(VICTORIA)

David Thodey was formerly Chief Executive Officer of IBM Australia/New Zealand before taking his current role at Telstra, Australia's largest telecommunications company. Through his widely acclaimed record of leadership and public influence, he has had outstanding impact on Australia's information technology and telecommunications industry. He has recently been designated as 13th in a list of the

top 50 most influential Australians and 3rd in the top 50 most influential people in business.

Dr Robert Vertessy FTSE

DIRECTOR AND CEO, BUREAU OF METEOROLOGY (ACT)

Robert Vertessy has provided outstanding national scientific and technological leadership in the meteorology field. This has included achievements including the marshalling and coordinating of Australia's efforts in hydrological modelling, the design and scientific development of a national water resources observation network, and the design of the water information component of the \$10 billion National Plan for Water Security.

2013 FOREIGN FELLOW

Professor Liang-Shih Fan FTSE

DISTINGUISHED UNIVERSITY PROFESSOR AND C.
JOHN EASTON PROFESSOR OF ENGINEERING, OHIO
STATE UNIVERSITY (USA)

Liang-Shih Fan has an international reputation for his pioneering research and development in the chemical engineering fields of particulates, multiphase reaction engineering and clean fossil energy technology. His prolific body of work includes multiple research papers and books that are referenced widely in academia and industry, and 39 patents of which a majority have been licensed or commercialised. He is also recognised for his achievements in facilitating and diversifying cross-cultural international exchanges. He is a Fellow of the US National Academy of Engineering, and a Foreign Fellow of the Chinese Academy of Engineering.



Professor Liang-Shih Fan FTSE

WA agriculture leader honoured in China

Hackett Professor Kadambot Siddique AM FTSE, Chair in Agriculture and Director of UWA's Institute of Agriculture, has been honoured with a prestigious award by China's Gansu Provincial Government for his outstanding contribution to research and leadership within Gansu Province, especially Lanzhou University.

Professor Siddique, one of just three foreign experts to win the Dunhuang



Kadambot Siddique

Award in 2013, has 29 years' experience in agricultural research, teaching and management in both Australia and overseas.

He has been collaborating with Lanzhou University in dryland agro-ecology since 2006, playing an important leadership role in academic capacity building, research and internationalisation of agro-ecology.

An acclaimed agricultural scientist whose mission is to "feed the world", he has developed a national and international reputation in the fields of crop physiology, production agronomy, farming systems, genetic resources, and breeding research in cereal, grain and pasture legumes and oilseed crops.

According to the award citation, Professor Siddique's leadership covered three main areas: promoting close bilateral collaboration between the universities and earning high recognition from their presidents (vice chancellors); improving capacity building for Lanzhou University; and enhancing internationalisation and international impact for Lanzhou University.

A visiting Professor at five other Chinese universities, Professor Siddique has published

more than 250 scientific papers, review articles and book chapters and is on the editorial board of a number of international scientific journals. He has also trained many MSc and PhD students.

He has developed an extensive network of scientists in Australia and Europe and in countries including China, India, Turkey, Syria, Iraq, Iran, Saudi Arabia, Oman, Malaysia, East Timor, Nepal, Bangladesh, Pakistan, Canada and the US.

In 2013 Professor Siddique was elected as a Fellow of the Australian Agricultural Institute (FAAI). Last year he was awarded the prestigious Hackett Professor of Agriculture Chair at The University of Western Australia. He has been a Fellow since 2005.

ARVI PARBO GETS AICD HONOUR

Sir Arvi Parbo AC FTSE was named by the Australian Institute of Company Directors in October as its 2013 Distinguished Fellow – an honour bestowed on Mr Hugh Morgan AC FTSE in 2012.

The Distinguished Fellows Award was established by the Australian Institute of Company Directors Victoria Division Council to recognise excellence in contribution, dedication and leadership by a Victorian Fellow.

Sir Arvi, President of the Academy from 1995–97, was born in Estonia, became a refugee in Germany, and migrated to Australia in 1949. He graduated from the University of Adelaide with a BE (Hons) in 1955 and joined Western Mining Corporation as a mining engineer, becoming Managing Director, Chairman and Managing Director, Executive Chairman and non-executive Chairman, retiring in 1999.

Sir Arvi was also for varying periods Chairman of Alcoa of Australia, director and Chairman of The Broken Hill Proprietary Company and Chairman or a director of a



Sir Arvi Parbo

number of other corporations in Australia, the US and Germany.

Mr Morgan was also head of WMC and is a strong advocate of nuclear energy for Australia. His appointments have included the Board of the Reserve Bank, the Executive Board of the CSIRO and Alcoa, President of AMIC (now the Minerals Council of Australia), Chairman of the World Gold Council, President of the Australia Japan Business Co-operation Committee and President of the German Australian Chamber of Industry and Commerce.

TRANSFIELD ROLE FOR KATHY HIRSCHFELD

The Board of Transfield Services has appointed Ms Kathy Hirschfeld FTSE as an independent non-executive director.

Ms Hirschfeld, a chemical engineer, also serves as a non-executive director on the Boards of Toxfree Solutions, ASC Pty Ltd and Snowy Hydro Ltd.



Kathy Hirschfeld in her BP days.

Ms Hirschfeld worked for around 20 years with BP in a variety of roles, rising from the position of Refinery Operations Superintendent in Perth, through exploration, production and refining commercial management positions in the UK, to Managing Director of the company's Anatolian Refining Company in Turkey.

She returned to Australia in 2005, managing BP's Bulwer Island refinery in Brisbane as well as being an Executive Director of BP Australasia from 2009–10.

"I am pleased to welcome Kathy to the Board, particularly given her deep and broad international operational experience in the oil and gas sector," Chairman Tony Shepherd said.

"She also has extensive experience in understanding and managing process safety and business risk, which are two important areas of focus in our industry."

Women take lead roles at ATSE

Three Academy Divisions and one Forum will be led by women Fellows from 2014 – and ATSE will have four women on its Board.

Professor Kaye Basford FTSE will join Dr Susan Pond AM FTSE and Professor Tanya Monro FAA FTSE (both Vice Presidents) and Dr Leanna Read FTSE on the Board.

Professor Karen Reynolds FTSE has been elected Chair of the ATSE Health and Technology Forum from 1 January 2014. Professor Reynolds is Professor of Biomedical Engineering at Flinders University, was named SA Scientist of the Year in 2012 and listed as one of Australia Top 100 Engineers in 2012 and 2013.

Professor Judy Raper FTSE, Deputy Vice Chancellor (Research), University of



Anita Hill

Wollongong, will be Deputy Chair of the Education Forum and Professor Ana Deletic, Director of the Centre for Water Sensitive

Cities with the Department of Civil Engineering at Monash University, will be Deputy Chair of the Water Forum.

Dr Anita Hill FTSE has been elected Chair of the Victorian Division for 2014. Dr Hill is Chief, CSIRO Process Science and Engineering and guides its processing and metal production activities, with a staff of more than 350 people across five Australian sites.

Dr Carrie Hillyard FTSE is Chair of the Queensland Division. She is a partner and co-founder of CM Capital and has led the Life Sciences practice at CM Capital for more than 10 years. She has more than 25 years' experience in medical and diagnostics research, development and commercialisation and is a former Director of ANSTO

Dr Meera Verma FTSE is Chair of the South Australian Division and has been elected Deputy Chair of ATSE's Assembly. Dr Verma is known widely for her biotechnology company management and operation of commercial biological manufacturing facilities.

Queensland led the way more than a decade ago, when Mrs Else Shepherd AM FTSE was Chair of that Division in 2002–05. Mrs Shepherd, an electrical engineer, is Chair of Powerlink Queensland and a Director of the National Electricity Market Management Company (NEMMCO).

Professor Alison Ord FTSE has been elected Deputy Chair of the WA Division, with Emeritus Professor Lesley Parker AM FTSE as Secretary. Professor Ord is a Winthrop Research Professor at the University of WA, formerly Chief Research Scientist, CSIRO Exploration and Mining, and is also leading the Academy's Mineral Resources Working Group. Professor Parker is a former Chair of ATSE Education Forum and received the 2008 Australian Learning and Teaching Council's career achievement award in recognition of her outstanding contribution to higher education over a sustained period.

Women will play a strong role in next year's Division Committees.

Professor Basford will be Membership Development Coordinator for the Queensland Division. She is Professor of Biometry at the University of Queensland and President of its Academic Board.

Dr Joanne Daly PSM FTSE and Dr Sue Meek FTSE are members of the ACT Division Committee. Dr Daly is a CSIRO Strategic Advisor with responsibility for advising the Executive on CSIRO's collections and facilities. Dr Daly is a past Group Executive, Agribusiness (2007–11) and Chief of CSIRO Entomology (2003–07). Dr Meek is Chief Executive of the Australian



Carrie Hillyard



Lyn Beazley

Academy of Science and the former Australian Gene Technology Regulator.

WA Chief Scientist Professor Lyn Beazley AO FTSE is a member of the WA Division Committee and Professor Rose Amal FTSE, Scientia Professor, School of Chemical Engineering, The University of New South Wales and an internationally recognised chemical engineering researcher, is a member of the NSW Division Committee.

Dr Deborah Rathjen FTSE and Dr Leanna Read FTSE are members of the SA Division Committee. Dr Rathjen is Chair and Managing Director of Bionomics and has more than 20 years' experience in the biotech industry.

Dr Read FTSE is an ATSE Director and a founder of Adelaide biotechnology company, TGR BioSciences. She has been a member of the Prime Minister's Science, Engineering and Innovation Council and the Federal Government's Industry Research and Development Board and serves on SA's Economic Development Board and the SA Premier's Science and Research Council.

BRONWYN EVANS

Dr Bronwyn Evans has been appointed CEO of Standards Australia. An engineer by profession, Dr Evans comes to the role following an extensive global career in healthcare and engineering, having most recently held the position of Senior Vice President, Quality, Clinical and Regulatory at Cochlear Ltd. Prior to that Dr

Evans held senior positions at GE Healthcare and Ultrasound. Standards Australia Directors include Mr Peter Cockbain FTSE and Mr David Singleton FTSE.

Standards Australia is the nation's peak non-government Standards organisation. It is charged by the Commonwealth Government to meet Australia's need for contemporary, internationally aligned Standards and related services.



Kaye Basford



PHOTO: SHUTTERSTOCK

STILE is a finalist

Many schools are not using computers effectively, so Academy President Dr Alan Finkel AM FTSE and a small team have developed a cloud-based education platform called STILE to address the problem.

"Teachers have struggled to integrate computers into their teaching for better learning results," says Dr Finkel, Chancellor of Monash University and CEO of STILE.

"Where they have, their use has often been confined to conventional file types such as email and Word documents."

Dr Finkel and his team are vying for an Education Category Prize as a category finalist in the 2013 *The Australian Innovation Challenge* with the STILE Digital Workbook.

He says the STILE platform lets teachers create interactive multimedia lessons and the assessment of student performance.

ATSE's latest STELR programs are being developed using the STILE platform. STELR was a finalist in the same category in the 2012 Innovation Challenge.

JOHN ALLEN A SUGAR INDUSTRY LEGEND

Dr John Allen AM FTSE, who died in Mackay on in August, aged 88, was an engineer who became a national figure in the sugar industry and spent 24 years at the Sugar Research Institute in Mackay, Queensland.

After naval service at Garden Island, Sydney, during WW II, he studied electrical and mechanical engineering at the University of Sydney, graduating in 1950.

He was a lecturer in mechanical engineering from 1951–59 at the University of NSW, where he completed his PhD in 1960

before spending a couple of years as Manager, Technical Services with Carrier Air Conditioning.

He was to spend the rest of his working life in the sugar industry, joining the Institute as Director of Research in 1962 and then serving as Director of the Institute from 1979–86.

He was elected to the Academy in 1982 and was appointed a Member of the Order of Australia in 1986 for his "service to the sugar industry, particularly the Sugar Research Institute".

His Fellowship citation noted that he played a major role in the SRI, achieving positions of "national leadership and international standing in international sugar cane technology".

He served as an ATSE Councillor (1984–86) and as Chair of the Queensland Division in 1986.

Dr Allen was President of the Queensland Society of Sugar Cane Technologists (1974–75) and was active for many years in the International Society of Sugar Cane Technologists, serving as Australia's Regional Vice President 1968–80.

He recalled in 1981 that when he joined the SRI in 1962 it had a staff of 13 and an annual budget of £40,000 (then about \$80,000). By 1981 the annual expenditure topped \$2.7 million, and the organisation had 65 staff.

He served on various Queensland Government committees and was a member (1978–81) of the Commonwealth Council for



John Allen

Interactive multimedia lessons.

Rural Research and Development. He served as a member of the Council of James Cook University.

ANTON MIDDELBERG WINS UQ PROMOTION

Professor Anton Middelberg FTSE has been appointed Pro Vice Chancellor, Research and International, at the University of Queensland from February 2014.

He is currently a professor of chemical engineering at the university and, according to Professor Peter Høj FTSE, UQ's President and Vice Chancellor, he is an internationally recognised chemical engineer working at the interface of chemistry and the life sciences.

Professor Middelberg obtained his PhD from The University of Adelaide in 1993 and his Master of Arts from the Cambridge in 2001. Before joining UQ he held positions at The University of Adelaide and Cambridge, as well as at UC Berkeley in the US. He returned to Australia and joined UQ in 2003.



Anton Middelberg

UQ says that over the past decade he has led more than \$12 million in research projects, and has supervised 41 PhD students to completion. He is a co-inventor of Pepfactants – a novel class of reversible surfactants – which won UQ's \$100,000 business plan competition and is being commercialised through a spin-out company.

He has received numerous awards including the Brodie and Shedden-Uhde medals of Engineers Australia, and has editorial roles on journals including *Chemical Engineering Science*, *Vaccine*, *Trends in Biotechnology*, and *Biochemical Engineering Journal*.

MARK TONER

Dr Mark Toner received the Fluor Award for "exceptional management and leadership talent that has directly resulted in a sustained corporate success over a significant period" at the national Chemical Engineering Conference (Chemeca) in Brisbane in October. The award was sponsored by Engineers Australia, the Institution of Chemical Engineers, the Royal Australian Chemical Institute and the Society of Chemical Engineers New Zealand.

Graduate Research Training.



www.unimelb.edu.au/research/

Join Australia's Best Minds

The University of Melbourne is seeking high calibre PhD students to contribute to projects at the forefront of international research.

At the University of Melbourne, one of Australia's leading research universities, you will become part of a dynamic research community, working alongside the best and brightest researchers in the country.

Our generous scholarship programs provide students with financial support and opportunities for international fieldwork and travel.

To find out more about undertaking a graduate research degree at Melbourne, visit: www.unimelb.edu.au/research/

dream large





CREATING A SUSTAINABLE FUTURE

ADVANCED WATER MANAGEMENT CENTRE

The University of Queensland's (UQ) Advanced Water Management Centre (AWMC) is working towards a sustainable future for the water industry, recognising the importance of protecting our water resources and critical infrastructure.

Internationally recognised as a centre of excellence in innovative water technology and management, for nearly 20 years the AWMC has developed leading expertise in education, research and consulting, working in close partnership with government and industry users.

In 2008, the **Water Recycling Research Program** was launched and has investigated several innovative topics ranging from water quality to by-product management. In close collaboration with Seqwater and Veolia Water Australia, the aim has been to improve and optimise the operation of Advanced Water Treatment Plants as well as understand fundamental aspects on the usage of membranes for recycled water production.

Since 2010 the scope of the research program has been extended to include other urban water sources such as drinking water and stormwater. Major research initiatives include water quality characterisation of stormwater and optimising management of drinking water quality through treatment.

Led by Director Jurg Keller, the 2013 Australian Water Association's Water Professional of the Year, the AWMC has over 50 academic and research staff and more than 50 research students. The AWMC has an outstanding track record of successful research, development and application projects, many with industry and research collaborators. More information is available at awmc.uq.edu.au

The Federal Government's 2012 Excellence in Research for Australia exercise confirmed The University of Queensland as one of the nation's top two universities, measured by the quality of its comprehensive range of specialised research fields. ERA reported that research at UQ is well above world standard in more specialised fields than at any other Australian university; this reflects UQ's leading global role in many areas of discovery. UQ's outstanding critical mass offers researchers significant interdisciplinary capability.

Join more than 4,500 students currently pursuing a research higher degree at UQ. Visit uq.edu.au/grad-school

YOUR UQ. YOUR ADVANTAGE.



GROUP OF EIGHT
MEMBER



uq.edu.au



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA