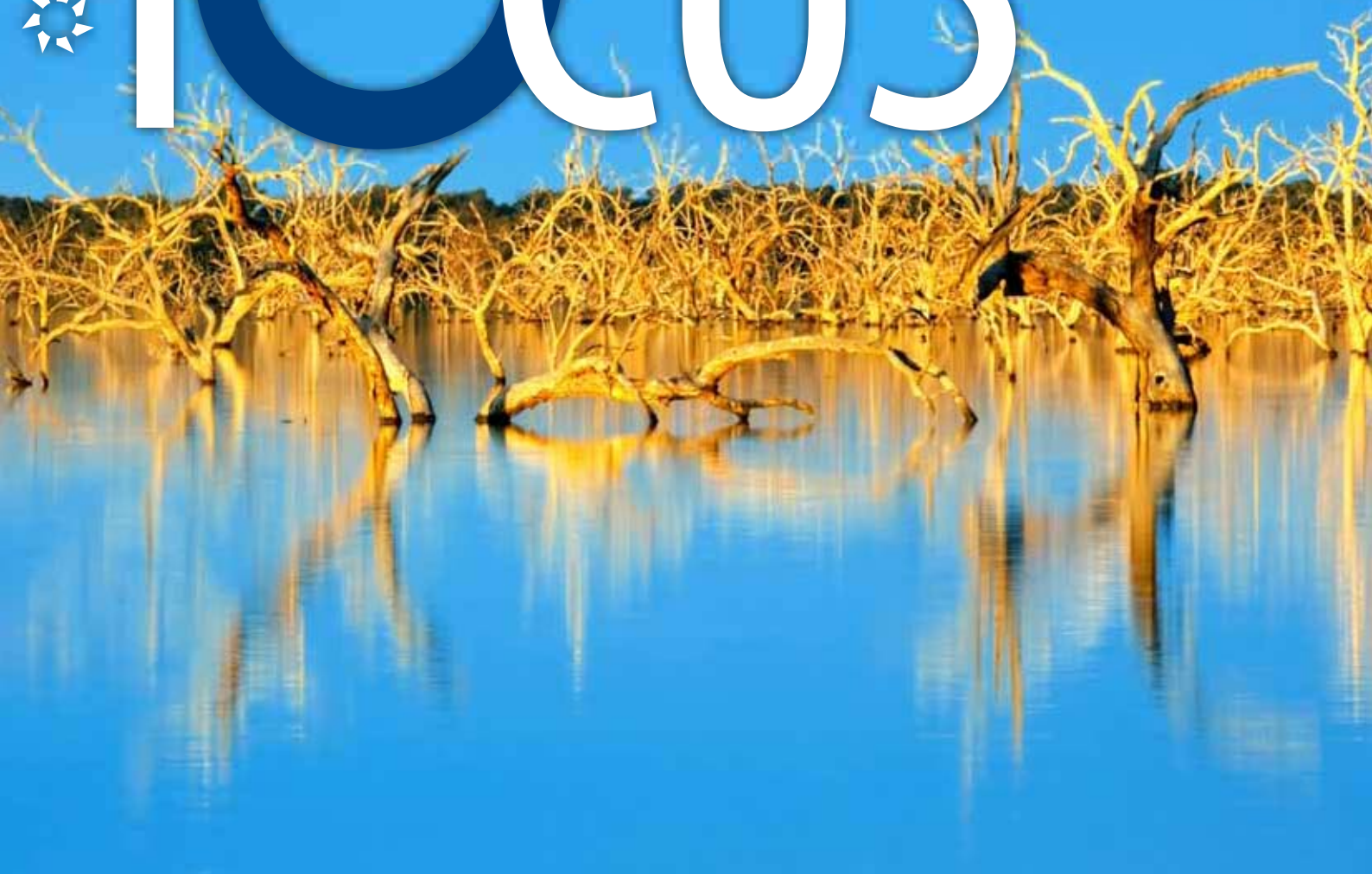




# FOCUS

NUMBER 163  
AUGUST 2010



## WATER AND ITS CORE ROLE IN AUSTRALIA

### LOOKING AT INTERDEPENDENCIES

Water experts examine the key role of water in the Australian economy and society and examine some of the key interdependencies – energy, pricing, optimisation and environmental needs



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Photo: iStockphoto



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## FOCUS

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

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# Putting a price on water

Around Australia – and as agreed in the National Water Initiative – it is time for water prices to reflect the full cost of using every drop of water.



By Mike Young

mike.young@myoung.net.au

In urban Australia, governments have been reluctant to send a direct price signal to water users. As a result, people neither know how much the water they use is worth nor how scarce it is. The reasons for this refusal to use prices to help manage water have a lot to do with politics.

In much of the world, including Australia, there is a deeply held political belief that water should be used to achieve equity objectives. As a result, there is a general belief that the 'right' way to ensure wise use of urban water resources in times of scarcity is to use a mixture of restrictions on outdoor water use, marketing programs designed to encourage people to take shorter showers, for instance, and subsidies to people interested in buying a new washing machine or installing a rain water tank.

Governments have also been turning to building standards with a view to improving water use efficiency. As can be seen in Table 1 (page 6), these approaches have worked in the sense that they have reduced water use. In the past seven years, total water use in Australian households has been reduced by around 17 per cent.

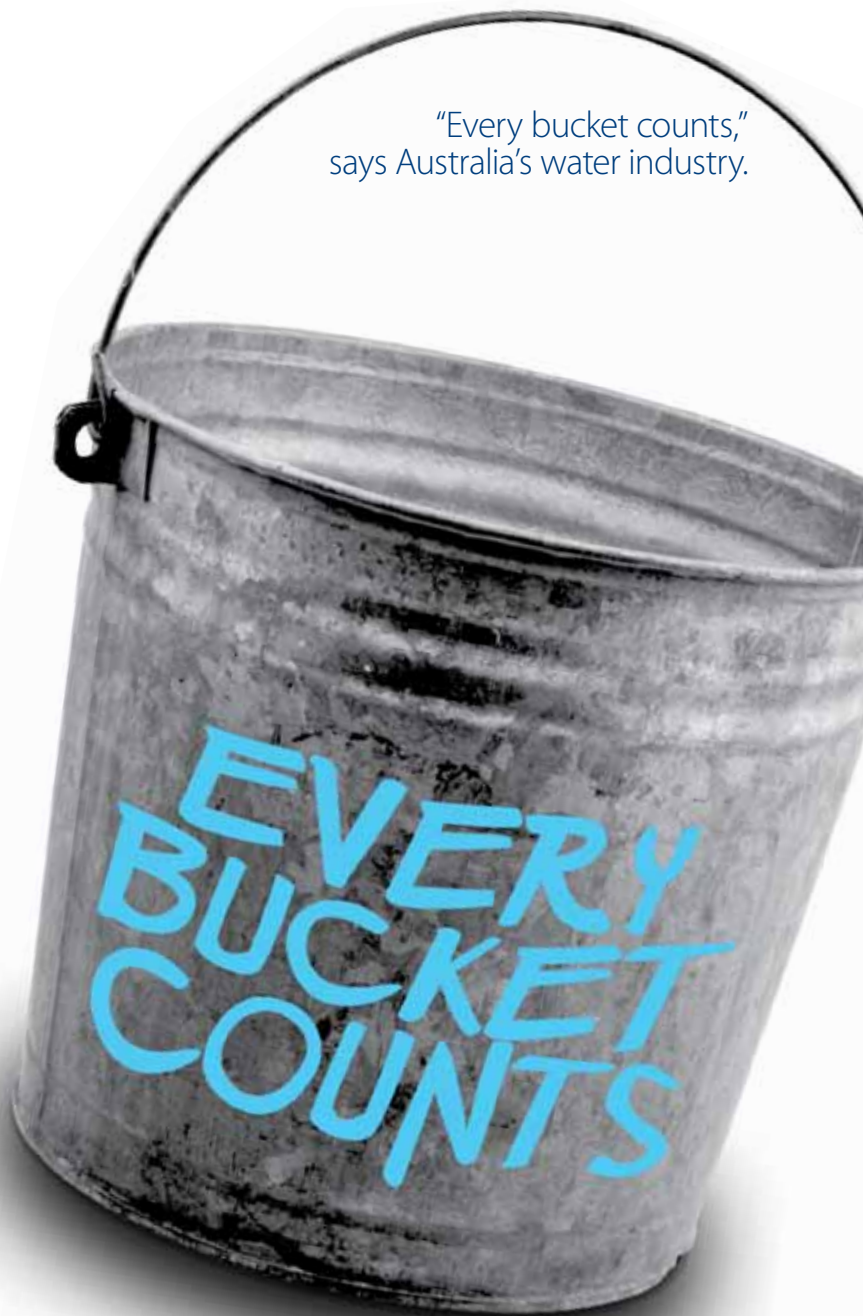
Would a stronger price signal have made a difference to this outcome? Could the same or a better result been achieved at less cost?

Around the world, prices are known to make a difference to consumption and more particularly to the nature of investment decisions that determine how much water people use. As prices rise, people are encouraged to think about the cost of their actions.

It is well known that when prices are low (subsidised) there is under-investment in water-saving technology and over-use.

Why, for example, would a struggling business bother to install a water-recycling system when the cost of doing

"Every bucket counts,"  
says Australia's water industry.



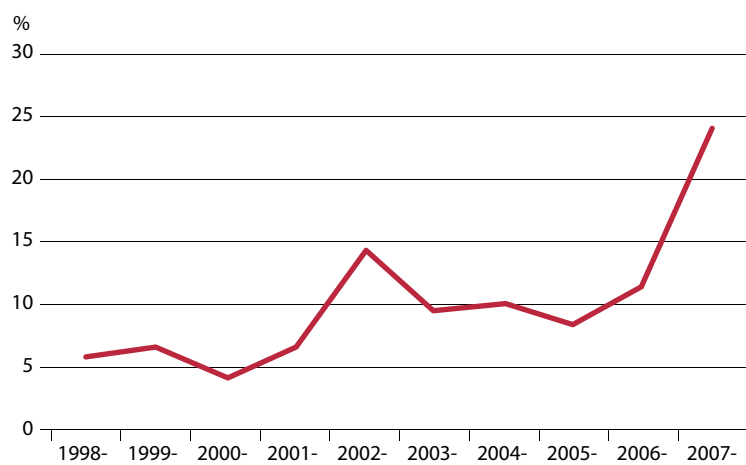
## Contributions are welcome

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**Table 1 Annual volume of water supplied to households by city over last 7 years (GL pa)**

|           | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|-----------|---------|---------|---------|---------|---------|---------|---------|
| Canberra  | 40      | 31      | 31      | 34      | 32      | 26      | 27      |
| Sydney    | 388     | 346     | 330     | 321     | 317     | 293     | 321     |
| Brisbane  | 95      | 97      | 102     | 72      | 61      | 52      | 55      |
| Adelaide  | 124     | 112     | 109     | 110     | 112     | 93      | 93      |
| Melbourne | 242     | 268     | 264     | 273     | 249     | 228     | 223     |
| Perth     | 144     | 161     | 159     | 158     | 169     | 165     | 174     |
| Total     | 1081    | 1016    | 995     | 968     | 939     | 857     | 893     |

Source: Water Services Association of Australia (2010) Implications of population growth in Australia on urban water resources. Occasional Paper 25

**Figure 1 Volume of water allocations traded as a percentage of all allocations made in the Southern Connected River Murray System**

Source: National Water Commission (2010)  
The impacts of water trading in the southern Murray-Darling Basin:  
An economic, social and environmental assessment, Canberra  
Calculations based on MDBA, WAM report data

One of the most noticeable responses to the emergence of water scarcity in urban and industrial Australia has been widespread investment in the development of desalination plants. Each of these plants requires access to large amounts of electricity.

this is greater than the cost of buying subsidized water from a water utility? Similarly, why would an inventor bother to put hard-earned savings into the development of a water-saving device that a business will buy only if it saves them money and in an environment where water prices are subsidised installation of the device would reduce profits.

Restrictions also impose high costs on some water users. If, for example, you want to maintain a garden in Melbourne or Adelaide you have to spend a fortune on rainwater tanks

and/or accessing groundwater. Each of these options is very expensive – much more expensive than the cost of buying access to scarce water through a market mechanism.

Contrast this situation with that found in rural Australia. In that part of the world, irrigators pay the full cost of supplying water to them and are exposed to water market. In places like the Southern Connected River Murray system, where water has become scarce, more than 20 per cent of water allocated to one person is sold to someone else (Figure 1).

In systems like these, every water user is fully aware of the real value of water and acts accordingly. The same cannot be said of the situation in urban and industrial Australia.

Around Australia – and as agreed in the National Water Initiative – it is time for water prices to reflect the full cost of using every drop of water.

For this to occur, all concessions and cross-subsidies that pervade the Australian water scene need to be phased out. At the same time, information about the amount of water used on a day-by-day basis needs to be provided.

Another reason for worrying about price is the cost of carbon pollution.

One of the most noticeable responses to the emergence of water scarcity in urban and industrial Australia has been widespread investment in the development of desalination plants. Each of these plants requires access to large amounts of electricity.

Like water, access to energy around Australia is underpriced – with the result that businesses and households are being sent price signals that discourage them from taking the full cost of energy use into consideration.

Two pricing wrongs don't make a right. If water users were sent a price signal that reflected the full cost of water and energy use, one would expect much more innovation and much more astute investments to be made.

In particular, one would expect to see water-intensive businesses shift towards places where supplies are more abundant, and more population growth to occur in these areas and less population growth in areas where supplies are limited.

In the long run, the result would be a more prosperous nation and more sustainable resource use. ◀

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# Urban wastewater management in a resource-constrained world

The increasing pressure on resources and emissions will have a direct and lasting effect on urban wastewater management.



By Jurg Keller

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**W**ith increasing awareness of the need to achieve 'more from less' in future, a range of new factors is influencing the development of the urban water systems. Many of these are inter-linked with broader global trends, particularly on energy reduction, greenhouse gas emissions and resource recovery concepts. Key factors are already driving the developments in the water industry, with direct implementations likely in the next five to 10 years.

## Wastewater – our new resource

The largest and most valuable resource that can be recovered from wastewater is the water itself.

Given the growing pressures on our water supplies, water recycling will become an integral part of our water supply in future. This can be achieved through a range of recycling solutions such as outdoor water use (irrigation, gardening, car washing), toilet flushing, industrial uses and as part of the drinking water supply.

Drinking water will primarily be achieved through indirect recycling of the highly treated water into a water supply dam or aquifer, although the water quality and reliability achieved with modern technologies, such as membrane filtration or chemical treatment, would even make direct potable reuse feasible and safe.

Although recycled water can never be the sole water source, its contribution to the urban water supply can likely reach 30 to 40 per cent, depending on the external water usage in a particular city or community. While this is a largely 'climate independent' water supply option, it does have significant capital and operating (mainly energy and chemicals) costs, particularly when aiming for high-quality recycled water.

But the major hurdles for such potable re-use implementations are the (perceived) public acceptance issues, inconsistent regulatory requirements and, in many cases, a lack of political will. None of these hurdles are of technological or scientific nature, and they should hopefully

be overcome with increased factual understanding of and experience with such systems.

The recently formed Australian Water Recycling Centre of Excellence should hopefully assist with this process and help to broaden the recovery of this valuable resource in future. At the same time, every effort needs to be made to reduce water consumption, since this is by far the most efficient way to help ensure our water supply security into the future.

The example of Brisbane – where water consumption has remained around 150 litres per person per day, even well after the removal of any water restrictions – highlights what may also be possible in other major cities around the country.

Examining a recharge well at Parafield, north of Adelaide.



# Expending less to deliver more.

Drought and population growth have both contributed to the water shortage in Australia. Due to the existing severe shortage of surface water supplies across several states, many regional areas face significant challenges to find suitable, alternative drinking water supplies for critical human and business needs.

For inland communities, the only reliable water source is groundwater and surface river water, but much of this contains salt. In order to remove salt and produce quality drinking water, capacitive deionisation (CDI) has been evaluated and initial testing for small scale brackish water desalination indicates its cost effectiveness and low energy consumption, compared with membrane desalination technologies, such as reverse osmosis.

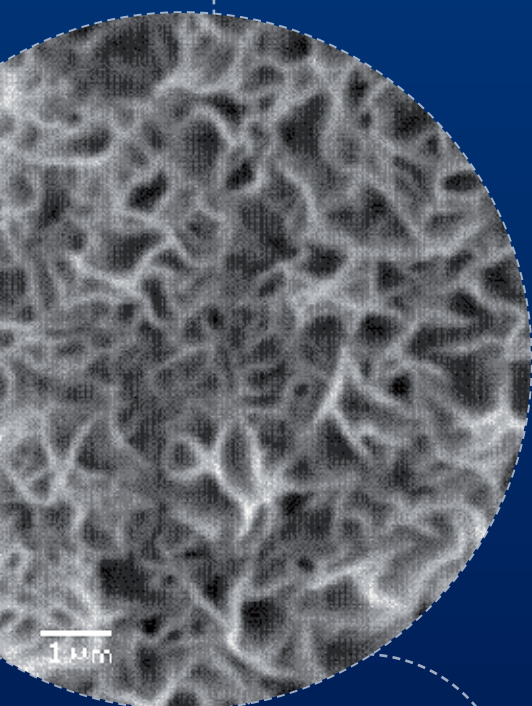
Cross disciplinary research at UniSA led by Associate Professor Linda Zou at the SA Water Centre for Water Management and Reuse, and Professor Robert Short at the Mawson Institute, is expanding research in this promising low-energy alternative desalination method.

The research which also has several industry partners, has led to innovations in using highly structured mesoporous carbons and more recently highly-conductive carbon materials, as electrode materials in the desalination process. These more efficient electrode materials are likely to lead to the overall cost-effective operation of CDI technology.

Close links with industry are ensuring that industry partners are also informed of up-to-date research, and that successful outcomes can be commercialised. Associate Professor Linda Zou has currently received funding from ARC, National Centre of Excellence in Desalination and Water Quality Research Australia to conduct further research in this area.

This research is another example of how UniSA is expanding its reputation for outstanding research achievements, making a real difference to the way we live.

For further information about research at UniSA visit [unisa.edu.au/research](http://unisa.edu.au/research)



*Surface morphology  
of as-prepared carbon  
electrode materials.*



## Energy recovery

Wastewater treatment plants have traditionally been seen as the major energy-consuming process in the urban water systems. However, this has recently changed somewhat in Australia, with the rapid implementation of even more energy-intensive new water supply options such as desalination and water recycling.

Nevertheless, the overall energy requirements of wastewater treatment systems are still considerable since (almost) all of the used water is being treated in these facilities, while typically only a fraction of the water supply comes from these new water supply sources. With the likely ongoing increases in energy costs, energy-efficient wastewater treatment will continue to gain in importance across Australia and worldwide.

The good news is that energy-neutral or even energy-positive treatment plant operation is possible, as already demonstrated in some plants, particularly in Europe.

The Strass plant, near Innsbruck in Austria, has been generating a net power output to the electricity grid since 2005. This plant runs all its treatment processes from the energy recovered from the organic pollutants in the wastewater – and even exports some excess power to the grid. This is achieved through well-optimised integration of existing technologies, with the main element being the energy recovery through an anaerobic process that generates biogas, which is turned into heat and electricity in a combined heat-power plant.

While this is a remarkable and highly desirable achievement, it also needs to be recognised that the recovered energy will primarily offset the energy requirements of the treatment plant, with limited capacity for exporting power to other users.

But by far the largest energy-saving potential in the urban water system is not associated with the actual water supply or wastewater disposal, but is water heating in individual homes.

A recent study by the Water Services Association of Australia (WSAA) has shown that a 15 per cent saving in residential hot water energy consumption could completely offset the total energy use of Australian water utilities. This clearly shows that the benefits of installing solar or heat-pump hot water systems would be far greater than the possible energy recovery available from the wastewater itself.

## Nutrients – the next focus

The third valuable resource that can be recovered from wastewater is nutrients, particularly nitrogen and phosphorus. Although some processes, such as precipitation of struvite (which is magnesium ammonium phosphate, MAP), have been available for many years, the implementation of these is still very limited.

However, with the increasing value of particularly phosphate-based fertilisers, the recovery of these key elements is becoming more attractive. Furthermore, global phosphorus resources in the form of phosphate rock, which is the dominant source of phosphorus used for fertilisers, are diminishing quite rapidly.

Together with the growing needs for food production, a ‘peak phosphorus’ scenario, whereby demand will outstrip supplies of phosphorus on a global scale, is very likely in the next 20 to 40 years. To make matters worse, around 90 per cent of the remaining global phosphate rock reserves are controlled by just five countries – Morocco (which also controls deposits in occupied Western Sahara), China, South Africa, the US and Jordan.

In 2007, China introduced a 135 per cent export tariff, which was a key factor in the major increase in the global phosphate price in 2008. Although demand and prices have been reduced somewhat since then due to the global economic slow-down, the price still remains at around twice the average price of the 2000–05 period.

Therefore, nutrient recovery from wastewater or directly at the source (through urine separation and reuse) will in future gain increasing importance and has the potential to complement or even replace nutrient-removal processes in the longer term.

Phosphorus (and a significant fraction of nitrogen) can be readily re-used from biological phosphorus-removal processes through the land application of the biosolids from the treatment processes. This is already being widely used in various parts of Australia and should be further encouraged as a well-proven and valuable strategy to improve soil consistency and fertility, as well as a true resource recycling.

Also, the recovery of phosphorus from chemical sludges and concentrated liquid streams will be seriously investigated, both due to the value generation, but also as a way to reduce the overall environmental burden from the urban water systems due to the required disposal of these sludges and associated loss of a critical resource.

Furthermore, the use of phosphate in detergents in Australia should also be banned, as there is no reason why such a valuable resource should be wasted in this way. There are suitable replacement chemicals without significant side-effects available as demonstrated in Europe, where phosphate bans have been in existence for well over 20 years.

## Direct greenhouse gas emissions

Although the water industry is not considered a major contributor to greenhouse gas (GHG) emissions in Australia, the impact may still be larger than anticipated. Current Intergovernmental Panel on Climate Change (IPCC) guidelines assume that nitrous oxide (N<sub>2</sub>O) emissions represent one per

cent of the nitrogen input into a wastewater treatment plant, while methane emissions are only considered significant from open anaerobic treatment systems (in ponds).

But recent studies in Australia and overseas have shown that the  $N_2O$  emissions can be considerably higher in some plants and significantly lower in other situations. It is currently unclear what the key factors are for these large discrepancies, but investigations point mainly towards operational issues, so mitigation strategies based on process optimisation should be effective in most cases.

Possibly more challenging are the recent findings that methane emissions from sewer systems are also considerable and might need mitigation. Studies at a number of Australian locations have found methane present in both the liquid and the gas phases of sewer systems, and a related study in the Netherlands has also identified significant methane emissions from the inlet sections at three wastewater treatment plants.

The overall contributions are likely variable depending on site-specific factors, but indications are that the  $CO_2$ -equivalent emissions of methane from sewers are at least comparable to the contributions from  $N_2O$  and may even rival the indirect emissions from power consumption in some cases. Therefore, mitigation of these methane emissions will

likely become an important focus in future when trying to minimise the carbon footprint of wastewater systems.

Overall, it is evident that the increasing pressure on resources and emissions will have a direct and lasting effect on urban wastewater management. The industry is well aware of many of these factors and has taken the lead on a number of fronts.

This will provide some valuable opportunities for innovation and new concepts that go well beyond these key factors and even re-evaluate the way the water system integrates with the broader urban structure and function. ◀

**PROFESSOR JURG KELLER** is Director of the Advanced Water Management Centre (AWMC) at the University of Queensland and Professor in the School of Engineering. He also holds an Australian Professorial Fellowship from the Australian Research Council. He has close to 20 years' experience in water industry research, particularly in biological wastewater treatment, environmental biotechnology, microbial fuel cells and water recycling. He has several collaborative and consulting projects with industry partners, with total research projects underway to a value of around US\$20 million. He was the founding Director of the AWMC in 1996 and has since developed it into one of the leading research centres in this field worldwide.

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CONTENT MATTERS



Hume Dam in wetter times.

# Water for the environment: what have we learned in 25 years?

PHOTO: EWATER CRC, ANDREW TATNELL

By 2004, the case for ‘water for the environment’ was clear and unarguable across virtually all stakeholder groups in water use and management in Australia.



By Gary Jones

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**A**ustralians have come a long way in the past 25 years in our attitudes to water management, especially in realising that the environment needs water. Looking back, the path we followed is clear: recognising environmental degradation arising from excessive water use; responding with policy; and taking action.

Have we achieved environmentally sustainable water use? Can we improve?

The case for restoring river ecosystems was built during the 1980s and 1990s, with ecologists publishing observations of stress in river and floodplain environments. Evidence grew in detail and force as research quantified causal links between biodiversity loss, flow regime change and habitat destruction.

Ultimately, however, it was two seminal events that led bureaucratic and public opinion to recognise that rivers need ‘environmental flows’.

The first was the 1000-kilometre bloom of toxic blue-

green algae in the Darling River in the summer of 1990-91, which subsequent research showed had been due to very low river flows. The second was the closure of the River Murray mouth early in the 2000s, after intermittent closings over the previous 20 years. This prompted the Murray-Darling Basin Ministerial Council to order dredging, which has kept the mouth open now since 2003.

To politicians, the media and the general public these were unequivocal signs that the Murray-Darling Basin rivers were in need of more water.

In 1994, the Council of Australian Governments (COAG) decided to act. It formally initiated water reforms to deal with over-allocation of water and its inefficient and unsustainable use. To start restoring balance between human and environmental water uses, COAG made a clear statement that water should be allocated to the environment, though gave no detail on how that might happen.

Supporting COAG’s initiative, in 1995 the Murray-





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Darling Basin Ministerial Council imposed the cap on water use in the Murray–Darling Basin rivers (although it did not plan for the subsequent growth in groundwater use).

The first national set of policy and management guidelines was provided in 1996, when Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) published *National Principles for the Provision of Water for the Environment*, comprising 12 principles.

This caused the Murray–Darling Basin states to analyse environmental water requirements for their ‘stressed’ rivers. (Victoria had begun this process before 1996 – and was a major influence in the development of the 1996 ‘Principles.’) Research organisations, particularly the CRC for Freshwater Ecology, led by the late Peter Cullen, had already taken a multi-disciplinary approach to environmental flows research and analysis, providing a strong scientific foundation for the planning and management validations being undertaken by the Murray–Darling Basin Commission and state governments.

In the early 2000s, two large, high-profile environmental flow allocation decisions were made. The first, in 2000, was to provide \$375 million to recover a total of 282 gigalitres by 2012 for the Snowy (and Murray) river environments. The second, in 2003, was the \$500 million ‘Living Murray’ ‘first step’ decision to recover 500GL for the River Murray.

By the time the National Water Initiative (NWI) was tabled in 2004, the case for ‘water for the environment’ (as ‘environmental flows’ had become known) was clear and unarguable across virtually all stakeholder groups in water use and management in Australia, and especially in the Murray–Darling Basin. The NWI set us the goal of integrated management of water for environmental and other public benefit outcomes, and reaffirmed and strengthened the commitment of COAG to the provision of water for the environment. The Commonwealth *Water Act 2007* has also taken environmental water needs as its central platform.

PHOTO: EWATER CRC, ANDREW TATNELL

## How have we done?

In the past few years, Australia has implemented much of the 1996 ARMCANZ *National Principles* paper. In my opinion, we have done relatively well in meeting these principles. If I were scoring us on our achievements I would award us a ‘Credit’. Not bad. We could have done much worse.

Picking out some major themes in the *National Principles*, ‘water for the environment’ is mainstream public policy in 2010 – and not mere rhetoric. In my view, Australia’s policy and management of environmental watering at a national level is at or near international best practice, though as a nation we tend to be overly self-critical in this matter. And our engineers, other scientists and policy makers are making progress in learning how to co-operate and integrate science with engineering, and science with policy.

For buying water for the environment, there’s a pile of money on the table, and significant volumes of water are already in the collective (Commonwealth and State) environmental water accounts. Most of this has come through the Federal Government’s approximately \$5 to \$6 billion (depending how you tally it) Water for the Future water recovery program. On top of this, the states’ own programs, along with the Living Murray and Snowy River programs, offer almost another \$1 billion in total.

But for some of the National Principles, I consider Australia still has work to do. We particularly need to improve how we implement environmental water management. One important issue is water managers’ access to ‘best available science’ to underpin decision making – a key requirement of the Water Act 2007.

I strongly believe that decision-support systems – predictive models, online databases and information systems – must be central in bringing current scientific data and knowledge to environmental water management, repeat-



River Murray  
upstream  
of Murray  
Bridge, SA,  
in 2002.

ably and transparently. Expert advisory panels, while valuable, cannot meet these two critical standards.

We are still struggling to achieve a holistic system-wide view of environmental water needs. Water authorities are focusing on the needs of parts of river ecosystems they see as worthy of preservation – such as the six Living Murray ‘icon’ sites and 18 ‘key environmental assets’ in the Murray–Darling Basin Plan. There is significant value in having that knowledge of components. But it is nigh impossible to re-aggregate knowledge to holistically address a whole river’s ecological water needs. Ecological science is lagging behind management here.

It is also my view that environmental watering can benefit from greater public participation. I have written previously on the role private or public environmental water trusts could play, if allowed to, in buying water and donating it to groups authorised to apply it to ecological assets. A recent ruling by the Australian Tax Office, granting deductible gift status for environmental water donations, is a big step towards this.

Overall, water policy and investment are meeting the challenge of providing for environmental needs. Now we need better on-ground implementation of environmental flows, supported by stronger working relationships between management, science, policy and the general community.

### Improving ecological science

I firmly believe Australia needs better integration between science disciplines, across organisations and across large-scale river systems. Most critically, freshwater science in Australia needs a better balance between research based on measurement and description (empiricism), and that based on theory, mechanism and prediction.

Why does this concern me? Because, without a foundation in the theoretical laws of physics, evolution and nature, ecological science is severely challenged when asked to support management decisions at large scale, such as for a whole river basin. It is faced with filling in the inevitable ‘knowledge gaps’ between individual study sites or species.

Detailed studies with a localised focus have a valuable role, but we have a very large country to study and relatively few freshwater ecologists to make the necessary measurements. When scientists in disciplines such as physics, chemistry and astronomy lack data, they turn to theory to help them develop understanding and guide decision making. Ecologists tend not to do that.

We need to get the balance right between empiricism and theory. We are not there yet in freshwater ecology, and we should be aiming to correct the imbalance quickly.

We need to build on the strong data-driven science knowledge we have now, and form theories on the ecologi-

cal workings of landscapes and river systems. This is how the laws of nature and of physics are derived – observations, prototype theories, testing via more observations, and then declaration of a possible new law.

Observation and statistical inference lead to what I call ‘specific truths’, which is all good. But by and large these will not be transferrable. I believe we need to seek ‘generalisable truths’ – broader insights and predictions based on a fundamental understanding of how species, communities and ecosystems function, which are ultimately referable to general ecological theories based on the laws of nature.

To encourage our ecological scientists to think in that way, I suggest their training needs to be adjusted at undergraduate level. We should be teaching students not only to use statistical inference but also to search for possible causal mechanisms and theoretical bases underlying their data. This requires a broad understanding of fundamental science – mathematics, physics and chemistry, thermodynamics, kinetics, mechanics, for instance. Without that fundamental-science background, ecologists can be left struggling for understanding.

In summary, in 25 years we have learned to acknowledge and respect Australia’s environmental water needs. But we can do better.

Our next challenge is to boost ecological understanding and make it accessible to active water managers in a timely, repeatable and transparent manner, so Australia can implement sound environmental water management. ◀

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# Manufactured water: achievements and challenges

A reverse osmosis plant.

PHOTO: G.LESLIE

In years to come the development of infrastructure to secure urban water supplies will be viewed as one of the first major responses to climate change.



By Greg Leslie

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**P**opulation growth, coupled with less predictable yield from dams and reservoirs, has accelerated the need to develop new sources of drinking water for Australian cities. In response, state governments have increased the reliability of potable water supplies through the development of large-scale desalination plants and water recycling schemes.

These projects use a range of membrane processes to manufacture high-quality water by removing contaminants such as dissolved salts, microorganisms and trace organics.

Manufacturing potable water from water sources that are not dependent on rainfall, such as seawater and municipal wastewater, allows water authorities to accommodate population growth and manage the impacts of drought.

The scale and speed of the development of the infrastructure to manufacture water is remarkable. In the seven years from 2005 to 2012, the installed capacity of desalination has grown from 45 to 500 gigalitres per annum (GLA), while over the same period the volume of recycled used as a percentage of total water demand has grown from less than 5 to 15 per cent.

In years to come the development of this infrastructure to secure urban water supplies will be viewed as one of the

first major responses to climate change.

However, the expanded use of manufactured water is attended by a suite of challenges including: maintenance of the new assets to ensure the same plant life as traditional water-supply infrastructure; minimising of the carbon footprint of the desalination and water-recycling operations; and managing the impacts of increasing power prices on the cost of manufactured water.

Manufactured water schemes such as desalination and high-grade water recycling rely on membrane processes and other process mechanical equipment. The mechanical, electrical and instrumentation components account for more than 75 per cent of the capital cost of manufactured water plants. In traditional surface water plants the cost of these components would be less than 30 per cent of the capital cost.

## Extra maintenance

These components are required to operate on feedwaters that are more corrosive than traditional supplies, consequently additional maintenance is required to achieve the same asset life as the traditional plants. In addition, manufactured water plants consume more electricity and carbon-intensive chemicals than conventional water treatment processes. Production of a cubic metre of water by

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seawater desalination requires four kilowatt hours (kWh) of power.

Although water recycling only requires a quarter of the power of desalination, transportation of the recycled water to storage reservoirs can double the total power requirements. The long-term operating cost implications for manufactured water plants is significant.

As the price of electricity increases in a carbon-strained economy, the unit cost of desalinated water will increase more than the cost of alternative water supplies because of the higher sensitivity of the operation and maintenance (O&M) costs of desalination to power costs.

For example, in the next three years, if the average price of power in capital cities increases from of \$0.12/kWh to \$0.2/kWh – as predicted – the production costs of manufactured water will increase by 80 per cent for desalination plants and by 30 per cent for water recycling plants. In addition, if a price of \$15/tonne for carbon is set on the emissions associated with the production of the power, chemicals and membranes used in manufactured water plants the cost of manufactured water will increase by an additional 20 per cent and 5 per cent for desalination and recycling plants respectively.

Consequently, water authorities will need to develop strategies to minimise energy requirements and offset the carbon footprint of desalination and water recycling plants.

### Three options

Essentially, there are three options that can be used to reduce the carbon footprint of desalination and water recycling plants:

- improving the energy efficiency of the treatment process;
- developing or purchasing carbon credits; and
- reducing energy consumption associated with the use of the water in the community and industry.

While there is some scope to optimise the performance of water recycling and desalination plants, there is limited opportunity to further reduce the energy requirements of the reverse osmosis membranes that are used to remove the dissolved salts from seawater and wastewater.

The membranes used in water recycling plants operating in Australia today use only half of the power required in similar plants operating 10 years ago.

Similarly, in desalination plants, technology developments, such as the use of energy recovery devices, have been fully exploited and have reduced power consumption from 5.0kWh/m<sup>3</sup> to 3.3kWh/m<sup>3</sup>. The US National Academy of Sciences and the International Desalination Association have separately released reports indicating that further efforts to improve the energy efficiency of current desalination systems will yield minimal return and that a paradigm

shift is required to achieve significant energy savings.

While there are many active research programs, including the Australian National Centre of Excellence for Desalination recently created by the Commonwealth Government in Perth, it will be several years before new techniques for desalination are available for large-scale applications.

In the short term, the carbon footprints of the large Australian desalination plants have been mostly offset by the purchase carbon credits generated by the production of renewable energy from wind farms. In 2009, the total renewable electricity generating capacity of Australia's wind farms was estimated at 1700MW, of which 280MW will be allocated to offset the power associated with desalination plants that are currently in operation or under construction.

Given that the entire water sector, including the operation of all transfers to urban water systems as well as drinking water and wastewater treatment, accounts for less than four per cent of Australia's total power demand, offsetting the power requirements of a few desalination plants with 16 per cent of the credits from Australia's wind power is a disproportionate allocation of resources.

The one area that has not been fully explored or exploited is the analysis of options to reduce the energy impact of the water sector by achieving efficiencies in the amount of energy associated with domestic use of water and the treatment of wastewater.

For example, it is possible to offset the 280MW associated with Australia's new desalination infrastructure by replacing 1.5 per cent of the standard domestic electric hot water heaters currently operating in Australia's capital cities with solar hot water systems.

More importantly, this approach would not lock up limited sources of renewable energy that would otherwise be available to other sectors of the community and economy.

Managing the power requirements associated with the use of manufactured water would be a better than offsetting the power requirements of production. ◀

**ASSOCIATE PROFESSOR GREG LESLIE** is the deputy director of the UNESCO Centre for Membrane Science and Technology at the University of New South Wales. Prior to joining UNSW, he worked in the public and private sector on water treatment, reuse and desalination projects in Australia, New Zealand, Singapore, Hong Kong and the United States. He currently serves on the National Health and Medical Research Council's Water Advisory Committee, the Independent Advisory Panel for the Orange County Groundwater Replenishment Project and was a past member of the World Health Organisation Technical Committee preparing guidelines for desalination.



# AUSTRALIA NEEDS NEW NATIONAL WATER REFORM AGENDA

The Water and  
Its Interdependencies  
in the Australian Economy  
workshop summary is at  
[www.atse.org.au/atse-in-action/82/159-water-workshop-summary](http://www.atse.org.au/atse-in-action/82/159-water-workshop-summary)



Full focus at the workshop.

A meeting of 50 of Australia's most senior water scientists and policy-makers – organised by the Academy – has called for a refreshed national water reform agenda by 2014.

They noted that Australia's current water research efforts were hugely fragmented, which highlighted the need for a sustainable national water science strategy.

They also agreed that interdependencies between water, energy, climate change, population and agriculture currently “cry out” for intensified research and thinking about dealing with the complexity of otherwise intractable or perverse problems.

The water experts met at a two-day workshop in Sydney and explored the relationships between water and other key drivers of the Australian economy, particularly energy and agriculture, under the challenges of population change, urban growth and climate change.

Individual speakers identified sensitivity to, and projections for, water demand to the year 2050 and the importance of external drivers, interconnections and financial investment to support sustainability of the sector.

Dr John Radcliffe AM FTSE, chair of ATSE's Water Forum, which convened the workshop Water and Its Interdependencies in the Australian Economy, said that discussions had drawn out some significant observations likely to have important policy implications for the future of water in Australia.

One of these was the agreement on the need for a refreshed national water reform agenda by 2014.

Compared to the valuable national Water Reform initiative of 1994 and the 2004 National Water initiative, the new agenda should

be better nested within natural resource management (NRM), energy, population, and food and agriculture policies, he said.

It should provide principles to guide the many institutions and stakeholders involved so that they worked together more effectively.

## “VISIONARY” NATIONAL APPROACH

Dr Radcliffe said those attending the workshop agreed that recent and rapidly emerging technologies for the supply, recycling and manufacture of water emphasised the need for a visionary national approach to providing a reliable water supply with costs, energy and the environment in mind.

Decision-making on major water-energy-sustainability issues required much better science-policy interaction and more serious articulation of Indigenous cultural, spiritual and economic values alongside economic and environmental interests of the broader community in water planning and decisions.

Governments, institutions and communities needed to do all in their power to liberate the knowledge, skills and individual leadership and collaboration of all stakeholders to reflect a more decentralised, disaggregated and localised water world.

Dr Radcliffe said that, in addition to these broad strategies, some specific issues were highlighted:

- the need to understand the potential imminence and impacts of the word reaching ‘peak phosphorus’\*;
- the need for investigation of immediate

priority implementation measures for nutrient recovery from wastewater;

- the need to reduce energy in domestic hot water systems, given that heating water in homes consumes four times as much electricity as that used to supply drinking water and wastewater services;
- the need for approaches to Australian issues on water and energy to embrace ‘systems thinking’;
- improvement in current community participation processes, which left much to be desired; and
- the benefits that would flow from a re-think and new overall direction on water management, noting the vital requirement for community trust.

Dr Radcliffe said the meeting noted that an integrated ‘whole of landscape’ approach should be embraced – rather than planning that separated water management, ecology, coastal processes and planning at local and catchment scales. He said ATSE would be taking forward the workshop actions as it developed its new research project ‘Green Growth in Australia – examining the linkages within – and potential of – sustainable resource management to enable environmentally responsible economic growth’.

*\*Phosphorus, a key component of fertilisers, is crucial for the world's food supplies. But observers note that as reserves of phosphate begin to run out, the impacts are likely to be immense – in terms of rising food prices, growing food insecurity and widening inequalities between rich and poor countries.*

# Water and energy: a complex relationship

There are a number of water supply sources and methods for electricity generators but the location will generally determine the most economical and available source.



By David Tanner

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**W**ater is primarily used for electricity generation in two distinct ways: in hydro-electricity generation – as a source of potential energy to drive water turbines, providing energy for electricity generators – ultimately returned to the environment and not consumed; and in thermal power stations – for generating steam to drive steam turbines, and for cooling the exhaust steam and for other operations, including ash disposal.

Electricity generation accounts for 1.4 per cent, or about 250 gigalitres (GL) a year of fresh water consumption in Australia, excluding hydro-electricity – as the water is available for other users.

Sixty-five per cent of Australia's electricity generation is by fresh-water-cooled thermal plants, where 90 to 95 per cent of water use is for condenser cooling.

In April 2007, Delta Electricity advised "drought conditions continue to restrict the availability of cooling water to Delta's Wallerawang and Mt Piper Power Stations". A number of other electricity generators have suffered operational constraints due to insufficient water in the past few years.

Yet demand for electricity is predicted to grow by 20 per cent by 2030.

## Markets for generators

Electrical generators participate in the following markets:

- energy source – this includes fuel sources especially, and may also include access to energy sources such as wind and solar;
- electricity – generators compete in a wholesale electricity market operated by AEMO (Australian Electricity Market Operators). New generators must compete with existing generators;
- emissions – emissions requirements such as the proposed CPRS (Carbon Pollution Reduction Scheme) are intended to change the mix of generation technologies, but the timing and impact are not clear; and
- water – many existing generators have already had li-

censes granted for water, but smaller generators and new market entrants need to compete in the new water market to secure supply.

Each market has its own drivers, and these are not always consistent across markets. For example, lowering emissions for fossil fuel plants would favour wet-cooled plants, but low water availability may make dry cooling more economical.

## Plant cooling

Thermal plants normally reject more than 50 per cent of the energy derived from the plant heat source. In most cases, this heat is rejected as a temperature increase in the plant cooling water. This applies to a wide variety of energy sources including coal, nuclear, gas, solar thermal, geothermal and biomass. The more efficient the energy conversion process, the less heat is rejected.

In **once-through** cooling systems, seawater (or water from large lake) is usually used directly for cooling. Historically this has been the preferred option for large power plants, but the availability of sites close to the coast is very limited. Enclosed bodies of water are sensitive to the additional heat load. Once-through systems are installed at Eraring, Liddell, Gladstone, Hazelwood, Tallawarra and Pelican Point.

In **evaporative** cooling systems, water is supplied and cooled through evaporation, which produces a saline effluent. About 65 per cent of plants in the AEMO pool are cooled in this way. Efficient coal plants use around 2ML/GW/hour for cooling. Less efficient plants – including nuclear, biomass, solar thermal, geothermal and CCS schemes – use up to 3ML/GW/hour for cooling. Evaporative-cooled coal plants include Bayswater, Stanwell, Loy Yang, Mt. Piper and Callide C. Evaporative systems for biomass plants include Rocky Point, Condong, Broadwater and Racecourse Mills.

**Dry-cooled** thermal plants use air directly for cooling of condensers and normally have high auxiliary power

consumption. Examples are at Millmerran, Kogan Creek and Darling Downs. Dry-cooled plants reduce water use to around 0.1ML/GW/hour and the GHG intensity will typically increase by five per cent over the equivalent wet-cooled system.

**Hybrid** cooling systems combine dry cooling and wet cooling to reduce water use relative to wet systems while improving hot-weather performance relative to dry systems. Hybrid cooling has typically been used for plume abatement in the past.

### Water supply options

There are a number of water supply sources and methods for electricity generators but the location will generally determine the most economical and available source:

- seawater (and saline water) – access to seawater is limited, due to difficulty of achieving permits on coastal sites, and the cost of fuel transport to these sites may be high;
- surface water – surface water flows are not increasing, and are subject to drought risk. In many areas, the water is already highly allocated, and there is increased pressure to increase environmental flows;
- groundwater (including mine water) – many groundwater supplies are overdrawn and some are of poor quality; and
- re-use water schemes – a notable example is a large re-use project in south-east Queensland, which has made water available for some power generators.

Water supply for generators has generally been secured on an individual and incremental basis as a plant is built. Typically, licences have been given by government-owned water authorities to government-owned electricity utilities.

Many of these water supply agreements are not consistent with the National Water Initiative (NWI) guidelines and may include take or pay options and other arrangements that may not encourage efficient water use.

### Present trends

Two large (2000MW) coal-fired base-load generators have been recently approved in NSW, with anticipated lives exceeding 30 years. Due to a lack of water respectively in the Hunter and Cox's River catchments, the plants were approved on the basis of dry cooling and therefore will have low specific water consumption. While new coal plants are typically licensed on the premise that they are CCS-ready (carbon capture and sequestration), it is highly unlikely that CCS will become commercially feasible for these plants within their economic lifetime.

Gas fired combined cycle (GFCC) plants are also likely to be built, and some of these (such as the proposed Dar-

ling Downs 630MW plant) are also based on dry cooling.

Complementing these fossil fuel plants, the installation of more than 10,000MW of wind power is planned within Australia over the next decade. The capacity factor for wind generation is unlikely to exceed 40 per cent.

### Increased renewables

The plan for the introduction of renewable generators is far less clear, due to their costs and/or level of technological maturity. It is generally considered that the base-load generators can provide adequate load back-up and grid stability, but as the number of such generators increases towards or beyond 20 per cent the situation becomes very different.

A very good illustration of this point is within Western Australia where the grid is characterised by:

- small capacity;
- geographically wide area;
- high proportion of wind power;
- no significant hydro plants; and
- largely base-load fossil fuel plants.

As the proportion of wind power increases (it is already approaching an 'installed' capacity of 20 per cent), it is necessary to provide increasingly responsive back-up power systems, as the base-load fossil fuel plants were not designed to be very responsive.

As WA is backed up by a secure gas distribution network, the situation is increasingly being supported by the installation of open-cycle gas turbine plants.

Thus an infrastructure must be developed in WA to support high levels of low capacity factor generators and while this does not impact on water supplies in WA, the situation is different in other states.

### Water for other renewables

While the level of generation from non-wind renewable sources is likely to be small in a national sense, there are areas where the energy-water interaction is important:

- geothermal and solar thermal – these generators are likely to be located inland in areas where, even if water is available, salinity is likely to be an environmental constraint. This would tend to drive air-cooled solutions, at a resulting loss in efficiency;
- bio-energy (from by-product fuels) – there are significant numbers of power plants in Queensland producing electricity from sugar cane and agricultural waste products. In most cases, adequate river water supplies are available for cooling;
- bio-energy for power generation only – where biofuels are grown specifically for power generation the associated farming area will require either access to plentiful



# Mining needs water, but must interact with other users

What is needed is an approach that will permit the integrated accounting of the values from multiple land uses.



By Chris Moran

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**T**he most significant interactions between mining and water are those external to and internal to the mining operation.

Internally, water is used for many tasks – principally, minerals extraction water associated with tailings from comminution (rock crushing and grinding) and flotation, and the heap leaching process. Significant engineering and production concerns include pit dewatering and underground mines where they are below regional water tables and/or when they intercept rainfall.

Externally, the main issues are competition with other potential water users, like irrigators, community perceptions and realities over impacts of water access and use and short and long-term environmental impacts of water extractions and releases.

The most significant uses of energy in minerals extraction are crushing, grinding and, in some cases, fine grinding in preparation for flotation. Comminution uses about 40 per cent of total energy in mining where flotation is the mineral separation method.

Mining operations typically disturb a relatively small proportion (about 10 per cent) of the land held, so miners are also managers of extensive land areas. Across the globe mining exists in all ecosystem types and socio-political domains – and there is potential for conflict over land access because so much land produces forms of carbon that are appropriated for food, fibre, fuel, shelter and biodiversity conservation/protection.

Thus mining and minerals production are intimately linked with strategic energy issues, but the significance of the carbon-water-energy nexus is only just beginning to be realised internationally, while some mines have recognised it for many years.

What many experts see as a global ‘problem’ can be an

opportunity for mining. The first reaction is to see mining as a direct competitor for carbon production. But when the business case for land production is shifted – the carbon production system is not the sole source of income – alternatives for land management and long-term productivity are greater.

Land stewardship in the medium term (for the life of the mining) can permit restoration of land to ensure long-term productivity – possible because we now know far more about sustainable farming than in the past. But many large areas are locked into negative returns and poor investment in land quality because previous practices have degraded land production capability.

A period of stewardship can turn this around. More broadly, what is needed is an approach that will permit the integrated accounting of the values from multiple land uses. Current paradigms focus on comparisons and trade-offs – not a necessary position. Large-scale projects to map the areas of true trade-offs, find areas of synergy and take on the task of designing effective business and production systems are required.

In a more direct and obvious sense, water and energy are intimately linked within the industrial component of mining operations. There is no minerals activity in which water is involved that energy is not, and water is involved in almost all aspects of mining and minerals processing. However, energy is consumed where water is not involved so the situation can be considered somewhat asymmetric.

A formally coupled approach to water and energy accounting could present opportunities for improvements in performance in both.

Overall, it is difficult to see that energy prices will be highly impacted by changes in minerals extraction efficiency – downstream minerals processing, like refining and smelting, are likely to be stronger candidates. But wa-

## Letters to the Editor

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ter prices will be affected.

In areas where water markets are operating and water is scarce, demand for water for mining has already increased prices and will do so in the future. This is in line with government policy to move water to its highest value use. However, social risks arising from perception of industry driving change are not attractive to the minerals industry.

Further, long-term risks arise when irrigation infrastructure, for example, is stranded and cannot be brought back into use productively when mining is finished. In remote locations where water competition is minimal, costs of water are already increasing and are likely to continue.

State governments are increasingly placing water access charges on mines in such locations. It is unlikely that this will change. It is difficult to interpret this in terms of national water policy, which would dictate that charges should be in line with government costs, because the mining industry tends to be a self-supplier – and an arbitrary resource access charge challenges the water reform concepts of linking water price to the value of its use through a market mechanism.

Another form of market may be required to achieve this by setting a shadow price, for example.

Managers will cope because there are no alternatives to managing the system in which they find themselves. The alternative is to shape the system towards corporate management goals or strengths – an unlikely scenario, given

the strength of water reform policy and the value of water in mining and minerals extraction.

In summary, water and energy in mining are closely linked in the industrial processes and in the interaction of the mine with the surrounding environment and communities. Formal techniques are only just beginning to be developed that will provide consistent and comparable metrics for performance assessment.

In regions where water is scarce we can expect markets to move water to mining because of its high returns.

A key challenge is to ensure that the mining activities are carried out in such a way as to ensure the maximum productivity can be extracted from the land around the disturbed areas in the long term. ◀

**PROFESSOR CHRIS MORAN** is the Director of the Sustainable Minerals Institute at the University of Queensland. He has a degree in agriculture and a PhD in soil science and digital image processing and worked in natural resource spatial science in CSIRO for 16 years. He has been involved in minerals industry water and sustainability research for six years and has published around 80 articles. His vision for the Sustainable Minerals Institute is to realise its potential to provide disciplinary excellence and creative ideas to support the global minerals industry achieve sustainable operations which will be indicated and accounted by the positive legacies they produce.

#### ◀ FROM PAGE 20

water for irrigation or be able to use saline water; and

- hydro-electric power – this relies on adequate water being available in the catchment and is sensitive to drought conditions. While the Snowy Scheme has a capacity of 3600MW, its annualised output is typically less than 15 per cent of this value and has been falling since the late 1990s. Only modest increases in hydro-electric generation are being planned.

### Pumped water storage systems

If the grid in the eastern states approaches a high proportion of generation from low capacity renewable sources, major infrastructure changes will be required. This means more responsive back-up generation and increased distribution capacity.

One of the ways that water can help alleviate the situation is with the use of 'pumped water storage'. There is little availability of more surface water, nor much prospect of building new dams for hydro-electric power, other than the modest amount already planned.

This does not discount a very important role for water in supporting the implementation of a high level of renewable generators by the use of pumped storage systems. The existing dams and reservoirs in the Snowy Mountains and Tasmania provide ample storage capacity to contribute to a significant grid back-up capability.

Other alternatives would be seawater storage schemes built in less sensitive areas.

### Recycling and re-use

Power plant internal water re-use schemes are being widely implemented to reduce overall water consumption.

Local water re-use schemes have also provided a secure supply of water to generators. South-east Queensland's Western Corridor Water Recycled Scheme reduces pressure on the region's drinking water supplies by providing an alternative water source of 12GL/year for the Swanbank, Tarong and Tarong North Power Stations. Nonetheless, the scheme is expensive, and the generators pay a premium for this water. ◀

**DAVID TANNER FTSE** is Engineering Manager at AE&E Australia, a Sydney-based power plant EPC Contractor, and has wide experience in power plants and associated water systems. A graduate of the University of Sydney, he has extensive experience in the energy industry and has worked for companies such as Babcock Energy (UK), BHP Engineering and ALSTOM. He has been the lead engineer for many industrial and utility plant projects in Australia and South-East Asia, and has experience in the provision of the associated plant water supply systems including those for salinity trading schemes.

# MORE PASSION NEEDED IN SCIENCE SYLLABUS

ATSE has called for the school curriculum to be infused with a sense of passion about science and a greater education emphasis on the importance of the application of science to the world's economic and cultural advancement.

This was part of a key recommendation by ATSE in its recent review submission to the Australian Curriculum, Assessment and Reporting Authority (ACARA) on the Draft K-10 Australian Curriculum.

ATSE's response noted the current Review and the development of the Australian Curriculum was particularly important.

ATSE also recommended that ACARA work with stakeholders to develop detailed implementation and evaluation plans and guidelines for the Australian Curriculum, with realistic budgetary allocations.

ATSE's specific recommendations included:

- examples from the history and practice of technology be included in the teaching and learning of all subjects in the Australian Curriculum;
- the structure of the Australian Curriculum provide specific guidelines for time spent in the various subject areas, with specific attention to maximising time on science and mathematics;
- the Australian Curriculum addresses specifically the learning of STEM subjects

(Science, Technology, Engineering and Mathematics) in early childhood education;

ATSE recommended that the draft Science curriculum statement be amended to:

- emphasise enjoyment, excitement and passion of STEM education, the critical role of STEM in Australian culture and identity and the critical contribution of STEM to the Australian and global economies and the welfare of our citizens;
- portray science and mathematics as enablers to enhance students' future studies and life choices;
- include curriculum content that demonstrates the value and opportunities created by careers in STEM and focus on the many outstanding contributions of Australian scientists, mathematicians, technologists and engineers; and
- include innovative approaches to students' STEM-related career education.

The submission noted there was consensus in the Academy about two overarching priorities for STEM education.

One was a focus on developing and retaining scientists and engineers in sufficient numbers to alleviate skills shortages in specific key areas of national significance, to meet economic, environmental and social challenges, and to lead relevant

international collaboration. The other was public engagement and universal scientific/mathematical/technological literacy – it remained imperative for the wider community to be sufficiently informed to effectively participate in debate about safety, reliability and sustainability in its future applications of science and technology.

It highlighted ATSE's perspective that education was a key element of infrastructure for the future, endowing the human capital necessary for building the nation's capacity in science and engineering and supporting the exposure of all students to some level of STEM education as an essential requirement for Australia's ability to function in an increasingly technological world.

The submission noted ATSE's education-related activities were cross-sectoral, ranging from early childhood to postgraduate education. The fundamental premise of these activities rested with the criticality of fostering high participation rates and excellent outcomes in STEM education and of nurturing a community mindset that valued both formal and informal STEM education.

It also noted that ATSE addressed education-related priorities specifically through its Education Forum and through strong support (both from the Academy as a whole and from Fellows individually) for many activities across Australia, in all sectors of education.

At the school level, the STELR project was already demonstrating its value to students' STEM education and career development. ATSE also sponsored and conducted career-oriented initiatives, such as the Extreme Science Experience (associated with the Annual Clunies Ross Awards).

Submission at [www.atse.org.au/resource-centre/func-startdown/156/](http://www.atse.org.au/resource-centre/func-startdown/156/)

**Sense of passion – students enjoying the 2010 Extreme Science Experience.**





# Stronger focus needed to optimise technology for aged care

Australia needs an increased national focus on developing and applying smart technology for healthy longevity, says a new ATSE report.

This increased focus is essential to realise the potential of smart technology to ensure a healthy, safe, secure and fulfilling future for the increasing aged population in Australia and the maintenance of a healthy, harmonious and prosperous society.

The report, which also says national coordination and sustained R&D support are essential to make optimum use of the available resources, was launched in Melbourne in July by Professor Margaret Sheil FTSE, Chief Executive Officer of the Australian Research Council.

The 100-page report came from an Australian Research Council-funded study ATSE conducted in 2009, reviewing the state of aged-care technology in Australia and in Europe and using the expertise of Academy Fellows and invited experts to provide an informed view of the future situation of technology for ageing-in-place (continuing to live at home) in Australia.

The study was led by Professor Greg Tegart AM FTSE, together with Professors Terry Turney FTSE and Peter Hudson FTSE, and a Steering Committee chaired by ATSE Vice President Mr Peter Laver AM FTSE.

The report says a suite of emerging innovative technologies offers the prospect of enhanced security, safety, diagnosis, treatment and physical assistance to improve the quality of life for elderly people, to help them remain at home, and to provide financial savings in aged care and medical treatment.

It notes there is already a substantial investment in R&D capacity in this area in Australia but more needs to be done to maintain, strengthen and coordinate this activity and to ensure that public and private aged-care authorities and organisations can effectively utilise the outcomes.

It says the Australian Government has a

critical role to play by promoting a national R&D agenda on technology and ageing to complement the National Strategy on Ageing and the National Enabling Technologies Strategy.

Ageing-in-place supported by smart technologies offers the potential for substantial savings in residential aged care and in reduced admissions to hospitals, by providing early alerts to changing health patterns and by minimising falls and other accidents in the home.

Many of these technologies for elderly-friendly housing depend on information and communication technologies to address social communications, personal health monitoring, telehealth, shopping and education. While



The report, *Smart Technology for Healthy Longevity*, is available at [www.atse.org.au/news/featured-articles/155-smart-tech-for-healthy-longevity](http://www.atse.org.au/news/featured-articles/155-smart-tech-for-healthy-longevity)

Professor Margaret Sheil and Professor Robin Batterham at the launch.

## ACADEMY SHOWS THE WAY AT SHANGHAI EXPO

The Academy was a lead participant in the major bilateral event between Australia and China at the Shanghai World Expo in August, titled 'Partners for Better future – Australia and China: Science and Technology Week'.

All events were at the Australian Pavilion at Expo and a highlight was the launch by Australia's Chief Scientist, Professor Penny Sackett, of the Academy's report *Climate Change and the Urban Environment*, which

flowed from a 2009 ISL-funded workshop in Melbourne.

The Australian Workshop Convenor and report author, Professor Michael Manton FTSE, who chairs ATSE's International Strategy Group, and Academy President Professor Robin Batterham AO FREng FAA FTSE, both addressed the launch event.

Science and Technology Week kicked off with the Australia-China Astronomy

Roundtable on 2 August.

The 'Impacts of Climate Change on Future Urban Societies Workshop' was held on 3 and 4 August, convened for Australia by Professor Manton, linking Australian and Chinese experts in architecture, town planning, water management, human health and climate science. It covered the impacts of climate change and strategies to mitigate and adapt to the impacts.

Two further workshops were held on

## Fellows join Synchrotron Science Colloquium

**Sir Gustav Nossal AC CBE FRS FAA FTSE has been appointed chair of the Australian Synchrotron's new National Science Colloquium (NSC).**

**The NSC has been established to provide strategic advice from leaders in Australia and New Zealand academies, professional bodies, government research organisations and funding agencies – as well as universities, business and government.**

**The new body complements the Synchrotron's Scientific Advisory Committee and User Advisory Committee.**

**Members include**  
**Professor Robin Batterham**  
**AO FEng FAA FTSE, President**  
**of ATSE; Professor Lyn Beazley**  
**AO FTSE, Chief Scientist**  
**Western Australia; Mr Tim**  
**Besley AC FTSE, Former**  
**President of ATSE and Chair of**  
**the CRC for Greenhouse Gas**  
**Technologies; The Hon Barry**  
**Jones AO FAA FAHA FASSA**  
**FTSE, former Science Minister;**  
**Mr Peter Laver AM FTSE, ATSE**  
**Vice President and Director,**  
**Australian Centre for Innovation; and Professor**  
**Margaret Sheil FTSE, Chief Executive Officer,**  
**Australian Research Council.**

**The NSC will provide advice, advocacy, expertise and experience in support of the Synchrotron's research, development and expansion.**



Lyn Beazley

these can be installed in existing homes, future dwellings will need to be custom-designed to incorporate such systems and to cater for the lifelong needs of people.

It says there are opportunities for business and industry to capitalise on projected expanded markets, in Australia and overseas, offered by demographic change, and development of a national broadband system offers opportunities for application of e-health and for greater inclusion of the frail aged into society.

Because the elderly are more frequent users of health services and because medical researchers are developing new drugs and procedures linked to age, the Australian Government's 2010 Intergenerational Report suggests that health spending on those aged over 65 is likely to increase sevenfold.

There will be a need for new models of health care and training to deal with this situation and technology can offer possible solutions to issues of safety and security, diagnosis and treatment, while assistive technologies offer the potential to reduce costs, the report says.

Because of the complexities of the challenges that need to be addressed in applying technology to the aged, it says there is a need to bring together a wide range of technologies to focus on solutions.

The Australian Government has recognised the value of this approach in the recently announced National Enabling Technologies Strategy. The concept of enabling technologies brings into convergence several technologies such as nanotechnologies, information and

communication technologies, biotechnology and cognitive science to focus on areas of social, economic and technical importance.

The report notes that in Europe their application to ageing is termed 'gerontechnology', linking medical aspects of ageing (gerontology) with smart technologies to assist in daily living. This is a well-established concept overseas that needs to be promoted in Australia as a means to coordinate R&D activity in this area.

The report adds that there are important social and ethical issues raised by the application of technologies to aged people, who should be involved more deeply in defining their needs to ensure optimum solutions.

Outcomes should be 'demand-driven' and not a result of 'technology-push'.

With closer linkages via home communication systems there are increased opportunities for loss of privacy, fraud and misuse of personal information, particularly with the frail aged. The issue of privacy is a major one arising from the use of unseen monitoring systems which report to a central base.

The ATSE report says these issues must be addressed in the development and application of enabling technologies for the ageing.

*This report provided the key elements of an Academy submission in July to a Productivity Commission inquiry, Caring for Older Australians. The submission, Ageing-in-Place: Stronger Focus to Optimise Smart Technology Benefits, is at [www.atse.org.au/resource-centre/ATSE-Reports/Health-Technologies/](http://www.atse.org.au/resource-centre/ATSE-Reports/Health-Technologies/)*

5 and 6 August on nanotechnology and biotechnology. Both were convened or chaired by Fellows – among 14 Fellows at the Expo in Science and Technology Week in various roles.

'Nanotechnology Benefiting Society', with Professor Max Lu FTSE and Dr Calum Drummond FTSE as Australian co-convenors, focused on the role of nanotechnology in improving health outcomes, sustainable energy options and information and communication technologies to benefit society and strengthen cooperative bilateral research ties in enabling technologies.

'Biotechnology Improving Food Production and Food Quality and Human Health', chaired by Dr Jim Peacock AC FRS FAA FTSE, examined advances in understanding of the molecular and cellular basis of crop plant performance to meet the food crisis; the links between improved nutrition in major food grains and preventative health strategies; and antibody therapies to meet the increasing challenge of complex health disorders in an ageing population.

Science and Technology Week also marked 30 years of science and research cooperation

between China and Australia, with the two governments hosting a high-level reception to mark three decades of formal collaboration held at the Australian Pavilion.

The week-long program was developed by the Department of Innovation, Industry, Science and Research (DIISR) in collaboration with the Chinese Ministry of Science, ATSE, the Australian Academy of Science (AAS), the Chinese Academy of Sciences, the Science and Technology Commission of Shanghai Municipality and the Shanghai Association of Science and Technology.



(From left) Incoming President of CAETS, Professor Jose Antonio Ceballos, and predecessor presidents – Klaus Bock (Denmark, 2010), John Leggat (Canada, 2009), Achiel van Cauwenberghe (Belgium, 2006), John Zillman (Australia, 2005) and Petr Zuna (Czech Republic, 2002) – on the waterfront in Copenhagen.

## ATSE PROJECT HEADLINES AT DENMARK CAETS MEETING

The 2010 annual meetings of the International Council of Academies of Engineering and Technological Sciences (CAETS) were hosted in Copenhagen by the Danish Academy of Technical Sciences (ATV) in June. ATSE was represented by President Robin Batterham AO FREng FAA FTSE, former president Professor John Zillman AO FAA FTSE and Executive Director – Technical, Dr Vaughan Beck FTSE.

The main events were the formal CAETS Executive and Board meetings, a CAETS-ATV Conference on Sustainable Food Systems (with an associated reception and dinner) and the annual CAETS Council meeting.

The ATSE representatives also participated in a number of bilateral and side meetings including an early morning meeting of the ATSE-led CAETS Working Group on Deployment of Low Emissions Technologies for Electric Power Generation in Response to Climate Change.

'Sustainable Food Systems: Food for All for Ever' drew more than 100 participants and many excellent speakers, including several with connections with ATSE through the Crawford Fund and the 2005 CAETS Convocation in Cairns. Following the conference, the CAETS Council issued a CAETS Symposium Statement on Food Security, incorporating its major conclusions and recommendations. The organisers indicated that the full proceedings will be published within the next few months.

Professor Batterham held discussions with the Indian National Academy of Engineering (INAE) representatives on proposals for joint

ATSE-INAE activities in the INAE Silver Jubilee Year (2012) and bilateral discussions were held with several other academy delegations and with the CAETS Secretary-Treasurer on the future development of CAETS.

Professor Zillman and Dr Beck represented ATSE at the CAETS Council meeting at the Technical University of Denmark, with some 55 participants from 22 of the 26 CAETS member academies along with a small number of invited guests.

The ATSE-led Low Emissions project was the main item of substantive discussion in the Council meeting. Dr Beck provided a comprehensive briefing to the Council and copies of the 100-page draft Working Group report were provided to all delegates.

Following a wide-ranging and very supportive discussion, it was agreed that the report should be finalised, that its essential conclusions should be fed into the forthcoming World Energy Congress and that a summary paper should be prepared for a peer-reviewed journal. There was general support for some form of continuation of the work of the Working Group.

Reports were presented on other CAETS projects including a Japanese-led project on Eco-innovation and a US/Sweden-led project on 'Technology for a quieter world'.

The Council amended the CAETS bylaws to remove the requirement for a large Convocation every second year but ensure at least a one-day symposium in conjunction

with each annual meeting of the Council. Preparations are, however, proceeding for the earlier-planned Nineteenth Convocation in Mexico on 27 June to 2 July 2011 on a theme focused on risk assessment and management. The 2012 meetings will be hosted by the Swiss Academy in Zurich on 29 to 31 August on the theme of 'Public transportation and settlement development'.

The Council meeting reviewed progress on the implementation of the CAETS Strategy for collaboration with the UN System and other international organisations under the guidance of its Committee on International Organisations. This included an extensive briefing and discussion on the scope for input to an ICSU Foresight Study and the potential for CAETS input to UN System governing body sessions over the next few years.

The Council was briefed on the positive impact of the CAETS presentation by the President of the Swiss Academy (Professor Ren Dandliker) to World Climate Conference 3 in August/September 2009 (as reported in the October 2009 issue of *ATSE Focus*).

The incoming President of CAETS for 2011 is Professor Jose Antonio Ceballos of Mexico.

Professor Michael Manton FTSE, chair of the Academy's International Strategy Group, was elected to the CAETS Board for 2011-12 and will continue on the Committee on International Organisations.

*Report by Professor John Zillman.*



# FELLOWS HEAD TWO NEW ARC CENTRES OF EXCELLENCE

Two ATSE Fellows will head ARC Centres of Excellence announced in the 2011 funding round, which totalled \$256 million for 13 centres.

Professor Benjamin Eggleton FTSE, from the University of Sydney, is the Centre Director for the ARC Centre of Excellence for Ultrahigh Bandwidth Devices for Optical Systems, administered by the University of Sydney, which has been funded to \$23.8 million over seven years.

The centre will have a further 21 collaborating and partner organisations, including six Australian universities and NICTA and 13 overseas institutions, to pursue its aim of building a world-leading research centre to create technology that will revolutionise information systems, create and develop Australian industry, and train and mentor young researchers in the science and application of this transformational technology.

The Centre says the outcomes will fuel R&D programs for decades, harnessing links between fundamental research and commercial applications through industry

partners and start-up companies, and developing strong linkages between Australian and overseas universities and companies.

"Our work will lead to a substantial growth in employment in advanced manufacturing and the ICT sector, and will optimise the economic and social value to Australia of the National Broadband Network," it says.

Professor Scott Sloan FAA FTSE, from the University of Newcastle, will head the ARC Centre of Excellence for Geotechnical Science and Engineering, which won funding of \$14.4 million over seven years.

The University of Newcastle's Collaborating and Partner Organisations are the University of Western Australia, the University of Wollongong, Coffey Geotechnics and the Colorado Schools of Mines, USA, and the project will focus on geotechnical issues related to a forecast investment of more than \$250 billion in Australia's energy and transport infrastructure over the next five years.

With this investment, the Centre says,



**Ben Eggleton**



**Scott Sloan**

there is an unprecedented need to design and build this infrastructure as cheaply and safely as possible and in light of the size of the

investment involved, even small percentage savings resulting from scientific research will lead to large returns in absolute dollar terms.

"This project will provide engineers with new science-based tools for predicting the safety of offshore and onshore geostructures such as oil and gas platforms, roads, railways, tunnels, dams, and port facilities."

## RURAL RDCS "CRITICAL" TO INNOVATION SYSTEM

Australia's rural research and development corporations (RDCs) are a critical element of Australia's innovation system, ATSE has told a Productivity Commission inquiry.

The Academy says the engagement they provide between primary producers, government, industry and researchers ensures that the specific R&D needs of our rural sector are met in a way that appropriately shares costs.

At a time when Australia's research workforce is ageing, state governments have cut back their investment and world food shortages are projected, the rural RDCs can enable Australia to largely feed our own growing population, while also contributing the needs of other countries.

In a submission to the Productivity Commission, supported by the Crawford

Fund, ATSE said Australia's RDC model was internationally regarded as best practice in undertaking and delivering rural sector R&D.

There was plenty of evidence to demonstrate good returns on RDC investment and the spillover from this investment benefited all Australians.

ATSE noted, however, a case for extending contribution arrangements to downstream beneficiaries of RDC R&D.

The present cap on government contributions – 0.5 per cent of gross value of production (GVP) unnecessarily limited rural R&D and should be removed. As a step in that direction, ATSE suggested that the government provides one dollar for every two levy dollars between 0.5 and 1 per cent of GVP.

The submission said ATSE saw strength in the diversity of Australia's RDCs. It was also

important that they work together when facing common challenges. There may also be scope for some rationalisation between RDCs. However these matters are for the industry and the RDCs to address.

To the extent that the government believes it needs to influence the behaviour, structure and governance of RDCs it could do so through the provisions of the funding agreements, ATSE said.

ATSE said it believed, overall, the RDC model was effective and efficient. Any changes that risked a reduction in Australia's rural R&D effort or resulted in a move away from the industry-government partnership model would be highly undesirable.

**Submission at [www.atse.org.au/resource-centre/func-startdown/170](http://www.atse.org.au/resource-centre/func-startdown/170)**

# 16 FRESH SCIENTISTS MAKE THEIR MARK

Tasty weeds, bright black holes, Antarctic ice and reversing shoulder joints – these are the research interests of 16 of Australia's top young scientists who were recently named Australia's Fresh Scientists for 2010. Their research was presented for the first time in public through Fresh Science, a national program sponsored by the Australian Government that identifies and publicises new and interesting research being done by early-career scientists around the country. This year's Fresh Scientists are:

- **Dave Ackland**, Department of Mechanical Engineering, University of Melbourne;
- **Peter Domachuk**, School of Physics, University of Sydney;
- **Andrew Dowdy**, Bureau of Meteorology;
- **Jason Du**, CRC for Contamination Assessment and Remediation of the Environment;
- **Nasrin Ghouchi Eskandar**, Ian Wark Research Institute, University of South Australia;

- **Jennifer Firn**, CSIRO Sustainable Ecosystems;
- **David Floyd**, Anglo-Australian Observatory/University of Melbourne;
- **Natalia Galin**, Institute for Marine and Antarctic Science, University of Tasmania;
- **Rylie Green**, Graduate School of Biomedical Engineering, University of New South Wales;
- **Jacek Jasieniak**, CSIRO Molecular and Health Technologies;
- **Naomi McSweeney**, School of Microbiology and Immunology, University of Western Australia;
- **Bridget Murphy**, School of Biological Sciences, University of Sydney;
- **Julien Ridoux**, Department of Electrical and Electronic Engineering, University of Melbourne;
- **Colin Scholes**, CRC for Greenhouse Gas Technologies;
- **Bianca van Lierop**, School of Chemistry, Monash University; and

- **Andrew Ward**, South Australian Research and Development Institute.

The 16 winners were selected from around 80 nominations. They were flown to Melbourne for a day of media training after which they presented their work to the media, school students, the general public, scientists, government and industry over three days in a 'boot camp' in science communication.

Now in its 13th year, Fresh Science is designed to:

- enhance reporting of Australian science;
- highlight and encourage debate on the role of science in Australian society; and
- provide role models for the next generation of Australian scientists.

This edition of *Focus* takes a look at the work of five of the 2010 Fresh Scientists.

**Details of all winners at**  
[http://freshscience.org.au/?page\\_id=2](http://freshscience.org.au/?page_id=2)

## Using silica nanoparticles for drug delivery to the skin

Researchers from the University of South Australia's Ian Wark Research Institute (the Wark) have invented and patented a new technology for delivering cosmetics and drugs to the skin.

They are using nanoparticles of silica (essentially sand) to create longer-lasting cosmetics and creams that control the delivery of drugs through the skin.

They already have a family of international patents on their technology and are now actively looking for commercial partners to get their invention out of the lab and on to your skin.

"We are using specially engineered nanoparticles of silica – so small that about a

PHOTO: DR AUDREY BEAUSSART, THE WARK

thousand of them could fit across a human hair – to create the emulsions on which many cosmetic and therapeutic products are based," says Nasrin Ghouchi-Eskandar from the Wark.

Many liquids we take for granted, such as milk, paint, salad dressings and skin creams, are actually emulsions, tiny droplets of oily compounds dispersed in water. These are typically created using surfactants or detergents, but Nasrin and her colleagues have developed emulsions in which silica nanoparticles – miniscule grains of sand – coat the oil droplets instead.

"Coating the tiny emulsion droplets with silica increases the stability of the mixture and makes it less likely that the active compounds inside will degrade or be released until we want it to happen," says Nasrin.

"These are two significant challenges for formulation scientists.

"Using our method, we found that, from a clinical point of view, drug delivery can be improved by adjusting release through the thickness of the coating. We can prepare both fast-release, and slow or controlled-release

delivery systems."

This could be really beneficial if a drug has to be released at a specific time, or if releasing too much at once can lead to accumulation and toxic effects.

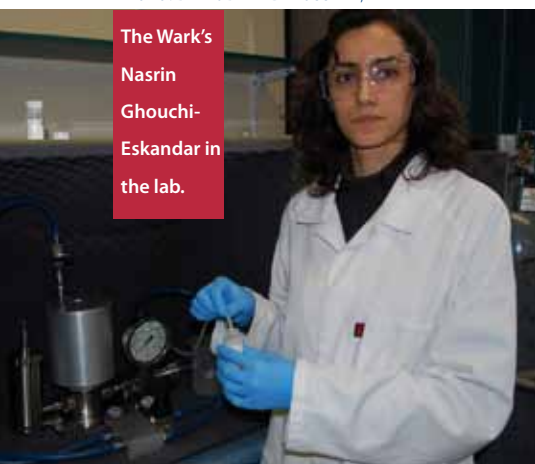
"It turns out that silica nanoparticles interact with skin cells in a way which increases the delivery of drugs to specific skin layers significantly.

"Using the nanoparticles, not only was a higher concentration of the active ingredient delivered, but also leakage into the blood stream was limited. This is a great advantage for skin creams such as sunscreens, for instance. It limits exposure of the rest of the body, and any consequent toxicity.

"And nanoparticle-coated emulsions are cost-effective because they are efficient at delivering drugs. A smaller quantity of active compound can be used in a more stable form.

"And we are working to ensure they are safe. We have shown that nanoparticles did not pass through pig skin and in the near future we will be moving to trials using human skin."

The Wark's  
Nasrin  
Ghouchi-  
Eskandar in  
the lab.



Jacek Jasieniak sprinkling  
quantum dots.



PHOTO: RAFFAELLA SIGNORINI, PADOVA UNIVERSITY

## Print your own lasers, lights and TV screens

Imagine printing your own room lighting, lasers or solar cells from inks you buy at the local newsagent.

Jacek Jasieniak and his colleagues at CSIRO, the University of Melbourne and the University of Padua, in Italy, have moved a step closer to such a future by developing liquid inks based on quantum dots that can be used to print devices.

These quantum dot inks may transform our use of light in the home and office. In the first demonstration of these inks Jacek and his colleagues have made tiny printable lasers.

The first laser, invented 50 years ago in May 1960, was described as a solution looking for a problem. Today dozens of lasers are built into our computers, cars and homes.

Soon, thanks to Jacek's work, we may have millions of tiny lasers working in our homes lighting our rooms and even acting as pixels in printable TV screens. The lasers could also be used as components in optical computers, electronics and sensors, as cheap laser pointers in a range of colours or even fashion accessories.

"Creating cheaper lasers relies heavily on progress in materials science," Jacek says. "At present, lasers are manufactured using expensive materials and production techniques. To make them more cost-effective, we have focused on developing materials that are cheap, function well as lasers, and can be printed. Quantum dots meet all these requirements."

Quantum dots are made of semiconductor material grown as nanometre-sized crystals, about a millionth of a millimetre in diameter. The laser colour they produce can be selectively tuned by varying their size. To build a laser using quantum dots, you need to place them within a structure known as an optical cavity. This structure acts to amplify the light that is produced by the quantum dots to produce the laser.

"Conventional lasers use large optical cavities, which make them impossible to use for printable lasers. To develop true nanometre-sized lasers we have employed a special type of optical cavity that consists of a repeating nano-structured pattern on the surface of the material onto which the quantum dots are printed," he says.

"A major benefit of this nano-structured optical cavity is that it can be produced during the printing process by controlled indentation or scratching of the material's surface.

"The tiny lasers generated using such an approach are highly efficient and can be adapted for numerous applications."

In addition to lasers, this research has significant implications for many other future technologies that use liquid inks to develop printable components. One highly promising example is the production of thin-film solar cells, a research area that Jacek is also currently involved in at CSIRO.

## Ultrasound squeezes water from mining waste

By applying the right amount of ultrasound during processing, Jianhua (Jason) Du and colleagues from the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) have been able to squeeze a considerable amount of fresh water from mining waste.

As well as conserving water, the technique reduces the waste bulk, which could also save mining companies millions of dollars in operational costs and help postpone significant capital expenditure, Jason says.

"When we looked at one of Rio Tinto's mines in the Murray–Darling Basin, we found our method could potentially save 436 megalitres of water a year. That's more than 170 Olympic swimming pools back into the Basin's water reserves – so that's a win for the environment as well as lower costs for the company."

Between 400 and 600 litres of water are needed to process each tonne of ore. As a

Jason Du demonstrates  
the technique.





result, water makes up between 60 and 95 per cent of the more than 10 billion tonnes of tailings that mineral processing produces each year worldwide.

Some of this liquid is recovered by letting the solids settle in tailings ponds, a process that is aided by the addition of thickeners. But these are low in efficiency. What Jason and his colleagues found is that efficiency can be increased by pumping in the right amount of ultrasonic energy at the right time.

Although in their laboratory-scale trial the technique successfully increased the output of solids only by about four per cent by weight, on the scale of a large mine this represents a huge amount of water.

Jason and his colleagues used an electron microscope to examine the structure of the solids which formed after flocculants were introduced in the thickener. They found a network similar to honeycomb in which the water was trapped. The ultrasonic energy

disrupts this network and leads to a denser aggregation.

The less water incorporated during processing also means the smaller the landfill site needed for containment. Together with lesser amounts of equipment and time needed to manage the disposal process, this lowers costs even further.

Jason, whose work is supported by the Australian Research Council, CRC CARE, and Rio Tinto, is based at the University of South Australia.

## A computer as good as an atomic clock

Australian researchers have invented a new clock that will bring atomic accuracy to your desk.

Skype, online games, air traffic control, smart energy grids ... all rely on accurate timing across the internet, but our present computers aren't accurate enough.

They can synchronise with an atomic clock over the internet. But even tiny delays across the network introduce errors – your video conversation gets out of sync, you lose your online game, or the electricity grid wastes power.

The National Broadband Network promises a much faster internet leading to a new digital age. But as the network accelerates, the time kept by computers has to become more and more accurate.

University of Melbourne engineer Julien

Ridoux and his colleague Darryl Veitch see two solutions to the problem: install an atomic clock in your computer for \$50,000, or use their new, free, software clock, which is accurate to within a millionth of a second.

Known as RADclock, their new software has been so successful it is now being tested across Australia with the cooperation of the National Measurement Institute (NMI), the Institute for a Broadband-Enabled Society and the Australian Academic and Research Network (AARNet).

"The techniques used in the past couple of decades are now not accurate enough to ensure the necessary coordination," Julien says, "and the obvious solution of installing an atomic clock in each computer was neither affordable nor practical."

Right now, says Julien, most of us have computers that do not have enough to do. Soon, these computers will all be interconnected by the NBN at very high speed.

"This army of computers can collaborate to create new services and applications but only if they know who is doing what and, particularly, when. With a super-fast network, tasks occur more frequently and that requires computers to track the passing of time much more accurately," he says.

"We have designed the Robust Absolute and Difference clock (RADclock), a novel timing system that is accurate, reliable and inexpensive. Under good conditions this achieves microsecond accuracy, which is as good as an atomic-clock-enhanced computer. And it costs nothing to install."

Their software taps into the counting device already installed in each computer to keep track of how fast the quartz crystal timer is vibrating. But because individual counters are unreliable, the program samples and analyses time information from many computers across the internet, to construct a robust, precise and accurate picture of the passing of time.

"It's time-keeping using a brains trust, if you like – the computers talk to each other and adjust their clocks as a result," Julien says.

An experimental network of RADclock reference clocks is being established in Australia with the cooperation of the NMI and AARNet. This is the first step towards a nationwide high-accuracy infrastructure that will allow any computer access to accurate time.

PHOTO: TIMOTHY BROOMHEAD, UNIVERSITY OF MELBOURNE



**Julien Ridoux making sure computer clocks are in sync.**

## New bugs munch up alumina impurities

Previously unknown species of naturally occurring bacteria have the potential to save the alumina and aluminium industries millions of dollars while helping to reduce their impact on the environment, microbiologist Naomi McSweeney has found in a collaborative project between Alcoa of Australia, CSIRO and the University of Western Australia.

The bacteria can successfully break down and remove sodium oxalate, an organic impurity produced during the refining of low-grade bauxite into alumina. At a typical refinery, sodium oxalate forms by the tonne during the production of alumina. It can affect the colour and the quality of the final product.

"Oxalate can be removed by combustion, but this process releases excess CO<sub>2</sub>," Naomi says.

The bacterial process breaks down the sodium oxalate and produces significantly less CO<sub>2</sub> while avoiding the need to store the impurity. Storing the impurity is a major cost for refineries, so treatment is a preferred option. "Using bacteria to break down and remove oxalate is a better,

more sustainable alternative."

Alcoa of Australia has designed and installed an innovative large-scale bioreactor that has the capability to remove about 40 tonnes a day of sodium oxalate produced at its Kwinana refinery south of Perth.

Naomi has worked with researchers from Alcoa's global Technology Delivery Group and the CSIRO's Light Metals Flagship to identify the main bacteria involved in degrading the oxalate within the bioreactor. They used DNA fingerprinting techniques to pick out the key players.

What they found was a potentially new genus of Proteobacteria and a new species of the known genus *Halomonas*, which are able to use the carbon in the oxalate to grow.

"Oxalates, and bacteria that feed on them, are common in nature – for example in our food, in our guts and in the root systems of plants such as rhubarb," Naomi says. "However, these oxalate-degrading microorganisms were not the ones we found in the bioreactor." The bacteria doing most of the work in the

bioreactor have never been found before.

To enhance the efficiency of the bio-removal process, the researchers are now determining the best conditions for growing these bacteria. Alcoa is seeking to apply the process to other refineries around the world, and hopes it will be able to use it to treat previously stockpiled oxalate.

PHOTO: DAMIEN SMITH

Naomi McSweeney investigating bacteria found at an alumina refinery.



# CONNECTED AND RELEVANT

## Innovation with global outcomes

RMIT's College of Science, Engineering and Health achieves excellence in applied research and technical innovation, with many projects linked to industry needs. Focused on major challenges across diverse areas, RMIT offers research opportunities in areas including:

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- Aerospace and Automotive Design Research
- Biomedical Electronics
- Biotechnology
- Construction Innovation
- Data Search, Analysis and Storage
- Environmental and Molecular Science
- Geospatial Sciences

- Membrane Ion Transport
- Metabolic Diseases
- Microplatforms
- System Modelling and Optimization
- Theory and Simulation of Matter
- Traditional and Complementary Medicine

Multi-disciplinary projects are being carried out in close collaboration with other Australian and international partners.

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[www.rmit.edu.au/seh/research/research-strengths](http://www.rmit.edu.au/seh/research/research-strengths)



**The Flux Station in big seas – photo shows the mooring with only the instrument tower visible above the waves.**

## SOUTHERN OCEAN FLUX STATION

A rugged buoy, purpose-built to withstand the harsh conditions and fatiguing effects of big seas in the 'roaring forties', has been deployed in the wild Southern Ocean to help provide better weather and climate observations.

Called a Flux Station, the buoy is a first for the Southern Ocean. Bureau of Meteorology (BoM) scientist Dr Eric Schulz said the station would relay measurements of wind, temperature, humidity, air pressure, sunlight and rainfall to the BoM every few hours. The information would be relayed to the BoM via satellite transmissions and then made available to forecasters, researchers and the general public via the web.

"In collaboration with our partners we will also measure ocean surface properties such as temperature, salinity, carbon dioxide (CO<sub>2</sub>), oxygen, fluorescence, currents and waves," Dr Schulz said.

The exact nature of how the Southern Ocean interacts with the atmosphere is not fully understood due to its remote and inhospitable nature, but Dr Schulz expects the information the BoM will receive from the Flux Station will greatly improve the scientific understanding of this important interaction.

Dr Schulz said the vast ocean region south of Australia played a critical role in the global climate system – acting as a buffer to smooth out extremes in the atmosphere by soaking up and releasing heat and CO<sub>2</sub>, while transporting changes in the ocean around the southern hemisphere.

The Southern Ocean Flux Station (SOFS) is part of the Australian Integrated Marine Observing System which is funded through the Federal Government's National Collaborative Research Infrastructure Strategy (NCRIS) and the Super Science Initiative to deliver data-streams from the oceans around Australia. Collaborators include CSIRO, the University of Tasmania, the National Oceanic and Atmospheric Administration, the Antarctic Climate and Ecosystems Cooperative Research Centre, and the Marine National Facility.

**Otway Project injection well.**

## CCS RESEARCH FUNDED FOR THE NEXT FIVE YEARS

Australia's world-leading research into carbon capture and storage (CCS) is set to continue with a new five-year program of research now underway at the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC), which has been researching ways to reduce carbon dioxide (CO<sub>2</sub>) emissions since 2003. The success of that work has been recognised with the extension of funding to 2015 under the Federal Government's highly successful CRC Program.

"CO2CRC's 2010–15 program tackles the full chain of CCS – capture, transport and geological storage of CO<sub>2</sub> – while focusing on the major technical obstacles to large-scale deployment," said Dr Peter Cook CBE FTSE, Chief Executive of CO2CRC. "The next five years will be crucial for the global development of CCS, as commercial projects begin to come on-stream, both here, through the Federal Government's CCS Flagship initiative, and overseas.

"CO2CRC research will play an important role in supporting those projects, helping to identify and effectively use storage options, reduce the cost of CO<sub>2</sub> capture and address public concern about the technology."

In recent months the CRC has launched the CCS Atlas of NSW and demonstrated the secure storage of CO<sub>2</sub> deep underground at the CO2CRC Otway Project in Victoria, Australia's first CO<sub>2</sub> storage project.

The new program includes a second stage of applied Otway Project research into CO<sub>2</sub> storage in saline aquifers and monitoring, as well as continuing work at CO<sub>2</sub> capture demonstrations.

*Australian CCS research is part of an international drive to make deep cuts in global greenhouse gas emissions by capturing and geologically storing CO<sub>2</sub> from major sources such as power stations. The CO2CRC brings together CCS researchers from Australian and international universities and research organisations, industry partners and State and Federal Governments.*





## MONASH BUILDS GREEN CHEMISTRY FUTURE



**Edwina Cornish**

Monash University plans to become a world leader in green chemistry and engineering with the development of a \$73 million Green Chemical Futures (GCF) facility at the Clayton campus co-funded by Monash and the Australian Government.

Monash will provide \$44 million and the Government \$29 million for the project that will create an estimated 169 new research jobs by 2016 and 745 construction jobs.

The GCF will partner with a number of national and international institutions including Yale University (USA), Waseda University (Japan) and the Indian Institute of Technology Bombay (Mumbai). GCF scientists and engineers will collaborate on projects along with CSIRO, the Plastics and Chemicals Industries Association and the Victorian Environmental Protection Agency.

It is expected that more than 480 Australian and international research collaborations and a large number of commercial applications will be supported through the new facility.

"The Green Chemical Futures program will bring together cutting edge educational spaces with Monash University's world-leading capacity in green chemistry research and innovation," said Monash Vice-Chancellor Professor Ed Byrne.

Senior Deputy Vice-Chancellor and Deputy Vice-Chancellor (Research) Professor Edwina Cornish FTSE said the facility's research outcomes would be closely aligned with industry to assist in the development and delivery of cleaner, greener solutions for the chemicals and plastics sector. "This facility will place Monash at the forefront of research that will help us all work toward a more sustainable future," she said.

## WORLD-FIRST MINERAL CARBONATION PLANT PLANNED IN NSW

The NSW Government has committed \$3 million in initial funding for a pilot project for the world's first CO<sub>2</sub> mineral carbonation plant, planned as a joint venture between GreenMag Group and the University of Newcastle.

Once mineral carbonation technology is proven at scale, an industrial plant could transform up to 20 million tonnes of carbon dioxide (CO<sub>2</sub>) each year into safe and reusable materials. This equates to taking a third of Australia's cars off our roads each year.

Mineral carbonation or carbon capture and use (CCU) is an

alternative to geosequestration (carbon capture and storage, CCS), which traps CO<sub>2</sub> pumped deep underground. Recent test drilling programs has revealed that the geology of NSW is not as well suited to geosequestration as other states.



**Bogdan Dlugogorski**

The plant will demonstrate locally developed technology processes that transform CO<sub>2</sub> from coal and gas-fired plants and industrial sources. The technology is expected to become economically viable once a carbon price has been established. There are about 30,000 fossil fuel plants in the world.

The University of Newcastle will supply a multi-disciplinary team of chemical engineers and geologists led by the Priority Research Centre for Energy's Professors Bogdan

Dlugogorski FTSE and Eric Kennedy, who will design the plant.

The pilot demonstration plant will be built at a decommissioned BHP experimental site in Newcastle and will provide bulk sample carbonate material to interested product developers by 2012.

## \$10 MILLION PROJECT TO STORE CO<sub>2</sub> IN CHINA COAL

CSIRO is partnering with China United Coalbed Methane Corporation Ltd (CUCBM) on a \$10 million joint demonstration project to store 2000 tonnes of carbon dioxide (CO<sub>2</sub>) underground in the Shanxi Province and extract methane for use as an energy source.

The project will focus on advancing enhanced coal bed methane (ECBM) recovery and providing a pathway to adoption for near-zero emissions technology from coal-fired power.

ECBM involves the injection of CO<sub>2</sub> into coal seams to displace methane that can be used to generate energy, while providing the additional benefit of reducing greenhouse gas emissions by storing the CO<sub>2</sub> underground.

The ECBM demonstration project builds upon CSIRO's existing collaborations with China, which include supporting the launch of a post-combustion capture (PCC) pilot plant in Beijing and the first capture of CO<sub>2</sub> in China using PCC technology.

PHOTO: CSIRO



**Preparing a gas sample for carbon isotopic analysis. Isotopic and chemical tracers are used to verify the secure containment of injected CO<sub>2</sub>.**

# SUSTAINABLE ENERGY – BY THE NUMBERS

By Ian Rae

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Peter Seligman, an electrical engineer at the University of Melbourne, was inspired by David J.C. MacKay's *Sustainable energy – without hot air* to produce an Australian version of this analysis of Britain's energy futures.

Using reasonable and explicit assumptions, in *Australian Sustainable Energy – by the numbers* Seligman examines a range of generation options and describes their prospects in terms of capacity, capital expenditure, unit costs and potential sites for their operation.

Whereas MacKay found that Britain cannot supply all of its needs from renewable energy, having to go offshore or regard nuclear as renewable, Seligman says that in Australia the question is what proportion of the country would we require to supply all our needs. This overview is backed by his conclusion that, apart from minor contributions from waves, wind, biofuels and so on, our future rests on solar and wind technologies and maybe some geothermal sources.

Hydrogen, the darling of energy futurists (and presumably of potential manufacturers) does not feature much in Seligman's new world. Instead, solar cells would cover a 200 by 200 kilometre sun-bathed area (vast, but still only 0.5 per cent of Australia's total area), wind energy would be best harvested near the south coast, and energy from both sources could be stored by pumping seawater up to storages atop the cliffs. This kind of storage has been effected in Japan, and so like the other things that Seligman discusses, the scenario is firmly based in existing practice. No magic megawatts.

To take in the arguments, the reader needs to grapple with the kilowatt (power, or rate of working) and kilowatt hour (quantity of energy), from which it is but a small jump to kWh/day/person although a longer one to petajoules (PJ/year). To help us, there are 60 figures, most of them graphs.

Despite his deluging us with numbers, Seligman is no fanatic. I was relieved to find that he feels we might need to get 10 per cent of our power from non-renewable sources. Gas, obviously, but he makes the point that 'sustainable' is not synonymous with 'renewable', and that our coal reserves could last us for hundreds of years if we can find ways to consume them responsibly.

Electricity generation, of course, is only half the story. Planes will still need liquid fuels but electricity is favoured for cars, thus connecting the transport sector to his main theme, electricity generation. There are as yet no sustainable answers for manufacturing and especially mining, especially where these activities are remote from the grid.

For a bit of whimsy, turn to page 128: opening the refrigerator costs 9.3 watt hours, and if you do it 10 times a day that's 3.9 watts or 9 kWh/year (about two per cent of total power used).



*Australian Sustainable Energy – by the numbers*  
by Dr Peter Seligman,  
Melbourne Energy Institute,  
University of Melbourne,  
2010.

*Innovation in Industrial Research;*  
paperback;  
152 pages;  
\$44.95  
from CSIRO Publishing  
www.publish.csiro.au



Returning to the serious stuff, and acknowledging Seligman's 'in theory' caveat, the answer to the question implied in the book's title about satisfying our energy needs (and most wants, too) without emitting lots of greenhouse gas, is – yes, we can.

Both books are available for free download from the internet, MacKay's at [www.withouthotair.com](http://www.withouthotair.com) and Seligman's at [www.energy.unimelb.edu.au](http://www.energy.unimelb.edu.au).

**PROFESSOR IAN RAE FTSE is a former Technical Director of ATSE and Honorary Professorial Fellow, History and Philosophy of Science, University of Melbourne. He is member of the leadership group of ATSE's Climate Change Forum and former President of the Royal Australian Chemical Institute.**

## GUIDE TO INDUSTRIAL INNOVATION RESEARCH

*Innovation in Industrial Research*, a new book by Dr Paulo de Souza, Research Director of the CSIRO ICT Centre's Tasmanian laboratory, is a 'how to' guide to successful industrial research for scientists, managers and students.

Dr de Souza is a physicist who has worked in industrial research centres in Brazil, the US and Europe, written more than 100 scientific papers and received many international awards for his industrial research.

Explaining the genesis of the book, Dr de Souza said that during his career he had seen many of his scientific colleagues, trained in the atmosphere of academia, taking a trial-and-error approach to learning the skills necessary for doing innovative industrial research.

"Those who fund science, whether from the private or public purse, are increasingly focusing on research for industry, where the emphasis is on prompt outcomes and real-world impact," Dr de Souza said.

"And science is speeding up: a discovery made at the laboratory bench today might take months, not decades, to be realised in a practical application."

*Innovation in Industrial Research* gives researchers insight into how they can improve the quality of their work and, by drawing on input from other disciplines, take a more innovative and ethical approach.

Nobel Laureate Professor Peter Doherty, who wrote the book's foreword, said: "Until this book came along, a comprehensive account of what it takes to build a substantial profile in industrial research had been conspicuously lacking from the long list of books discussing the principles and practices governing a career in academic science."



UQ Vice-Chancellor Paul Greenfield and Julia Gillard at the announcement.

## RESEARCH TO FOCUS ON PERSONALISED MEDICINE

The University of Queensland (UQ) leads an Australian research team that will help usher in the age of personalised medicine, following announcement of \$40.2 million in funding by the Australian Government's Education Investment Fund.

UQ Vice-Chancellor Professor Paul Greenfield AO FTSE said the Government funding secured a \$107 million expansion of the National Imaging Facility, placing Australia at the forefront of medical imaging research and education.

"Advanced medical imaging will be key to improved diagnosis and treatment, leading towards personalised medicine that will give patients individually tailored treatments and prevention strategies," Professor Greenfield said.

Prime Minister Julia Gillard, who announced the funding at UQ, said it would position Australia as a global leader in imaging research, training and technology development.

Flagship equipment obtained through the expansion will include Australia's first scanner combining magnetic resonance imaging (MRI) and positron emission tomography (PET), and the nation's first ultra high-field 7 Tesla human MRI machine – one of only a few in the world.

"This equipment, to be housed in a new Centre for Advanced Imaging complex at UQ's St Lucia campus in Brisbane, will enable discoveries that will translate to better ways of diagnosing and treating diseases like cancer, dementia, arthritis and epilepsy," said Centre for Advanced Imaging Director, Professor David Reutens.

"The new imaging research centre will unlock the scientific potential of a large body of researchers who will, for the first time, have tools to take microscopically detailed pictures of organs in living humans and animals," he said.

The funding will also provide new research instruments to partner organisations in the National Imaging Facility. This network of imaging research facilities and experts, headquartered at the Centre

for Advanced Imaging, includes Queensland Government funding for the UQ component.

The new federal funding adds the Australian Nuclear Science and Technology Organisation (ANSTO), the University of Melbourne, Swinburne University and University of Western Australia to the National Imaging Facility, expanding it to 13 institutions in five states. The government investment is part of Round 3 of the Education Investment Fund

## AIBN tackles Hendra virus

A pioneering product aimed at treating people exposed to the deadly Hendra virus will be produced in Brisbane, after a three-way agreement was announced in Brisbane.

An agreement between Queensland Health, the University of Queensland's Australian Institute for Bioengineering and Nanotechnology (AIBN) and a US foundation will allow the AIBN to produce monoclonal antibodies that target the virus under a grant of \$300,000 from Queensland Health.

The antibodies were developed in Washington, DC, in conjunction with CSIRO's Australian Animal Health Laboratory.

AIBN director Professor Peter Gray FTSE said monoclonal antibodies had shown great promise in treating human diseases including arthritis and tumours associated with breast and colon cancer, as well as viral infections such as HIV and hepatitis.

AIBN was a multidisciplinary research institute focused on health, energy and the environment and was honoured and eager to assist with this important work," he said.

Hendra remains one of the world's rarest but most dangerous human diseases.

## \$30 million for CSL research

The Government will invest \$30 million to increase Australia's research and development capacity through CSL Ltd – as part of a \$235 million campaign to strengthen our ability to protect Australians from disease.

The project will deliver a major expansion in R&D capacity at CSL's facility in Broadmeadows, Victoria. It will help ensure that CSL can conduct medical research that will help save lives, provide lasting benefits to the community, and increase Australia's readiness to tackle future health threats.

"CSL is a strategically important provider of vaccines, anti-venoms, blood products and diagnostic health products for the Australian community," Innovation Minister Senator Kim Carr said.

"This investment will help build the infrastructure and develop the capabilities Australian scientists need to create complex, next-generation drugs and deal with future epidemic diseases."

The CSL CEO is Dr Brian McNamee AO FTSE.

Funding for this investment was provided for in the 2010-11 Budget and in the updated budget projections released in the Treasurer's Economic Statement of 14 July 2010.



Peter Gray



# INQUIRY BACKS BOOST FOR INTERNATIONAL RESEARCH COLLABORATION

A Parliamentary committee has recommended that the Australian Government announce a successor program to the International Science Linkages (ISL) program as soon as practicable to address the concerns of the research community.

The Committee, chaired by Maria Vamvakinou (ALP), Federal Member for Calwell, has also recommended that the successor program to the ISL program should have its budget increased and indexed, and, pending proven success of the new program, that the Department of Innovation, Industry, Science and Research (DIISR) should seek to have funding increased further in future budgets.

These are key recommendations from an inquiry by the House of Representatives Standing Committee on Industry, Science and Innovation into Australia's international research engagement

Key aspects of the inquiry were:

- the nature and extent of existing international research collaborations;
- the benefits to Australia from engaging in international research collaborations;
- the key drivers of international research collaboration at the government, institutional and researcher levels;
- the impediments faced by Australian researchers when initiating and participating in international research collaborations and practical measures for addressing these; and
- principles and strategies for supporting international research engagement.

ATSE made two submissions to the inquiry, in which it warned the Government of the dangers of reduced international research collaboration and called for a significant funding boost.

The Committee said it recognised that international collaboration was driven at the individual researcher level, through one-on-one contact, or engagement between research groups, schools or institutions. It also recognised that Australia was distant from

most of our research partners and that face-to-face collaboration was expensive. It noted that, rather than setting a particular direction or providing prescriptive guidelines on how to collaborate, the Australian Government should continue to provide assistance to encourage and facilitate international collaboration.

The Committee report noted that among the large number of submissions to the inquiry the ISL program was described as being of immense value to international collaboration, yet the program was said to be winding down and was not funded beyond June 2011.

The report said it was unfortunate and regrettable that problems with visa applications had prevented effective international collaboration.

"It is deeply embarrassing to our research institutions to have researchers suffer through immigration bureaucratic processes or, at worst, be refused entry to Australia.

"Australian researchers are highly regarded around the world. The appointment of science counsellor positions in strategic locations around the world should strengthen our reputation as an effective research partner and promote the benefits of engagement with Australian researchers."

The Committee recommended that the Department of Immigration and Citizenship streamline the visa application process for visiting researchers and also maintain closer links with universities and research organisations on visa issues.

Other recommendations included:

- DIISR investigates the viability of a small grants scheme to be established to support the travel expense of Australian early career researchers who win time on foreign instruments and facilities that are unavailable in Australia;
- a quota of 10 per cent of ARC and NHMRC successful grants to be allocated to early-career researchers who are first-time awardees;



**Committee chair Maria Vamvakinou MP.**

- competitive grants, in particular all NHMRC grants, fund the full cost of research in each program to which a grant has been awarded;
- the ARC and NHMRC allocate a fixed percentage of research funding to 'blue sky' research;
- DIISR seeks funding to establish an International Research Collaboration Office to consult with stakeholders in Australian research and to act as a conduit between Australian researchers and overseas research organisations and funding bodies;
- the Minister for Innovation, Industry, Science and Research be given full ministerial responsibility for supporting international research collaboration;
- the science counsellor program be revitalised, with full-time science counsellor positions for the European Union, the US, China and India; and
- the Australia–China Science and Technology Program has its funding increased and indexed, and that DIISR seeks to increase funding to the scheme.

The committee report is at [www.aph.gov.au/house/committee/isi/intresearch/report.htm](http://www.aph.gov.au/house/committee/isi/intresearch/report.htm)

# GETTING A MEASURE ON AUSTRALIA IN SCIENCE WEEK

Whether it's identifying miniscule gold particles that can be used to bust cancer cells, or super-strong tiny carbon tubes to revolutionise micro-electronics, size does matter for Dr Jan Herrmann, project leader of the nanometrology team at the National Measurement Institute (NMI).

The extremely small size of particles in their nano form – measuring as little as one billionth of one metre in diameter – will matter on a disproportionately large scale as the emerging science provides data that can be used for potentially major advances in areas such as medicine and energy technology.

Dr Herrmann discussed the applications of nanometrology, the science of measurement at the nanoscale, during National Science Week in August.

In their nano form, many compounds exhibit properties that are startlingly different from when in their larger guise, Dr Herrmann said.

"We need to understand what happens when things get this small in order to be able to control their properties and to make sure they are used safely and responsibly. Measuring the sizes of nanoparticles accurately is important because their properties often depend very sensitively on their size."

Gold was an example of a material that changed significantly from its macro to its nano state, he said. While gold was readily recognisable as shiny and yellow, it turned blue, then violet and eventually bright red as it approached its nano form. It also changed from being chemically inert to being a very efficient catalyst that promoted chemical reactions.

Dr Herrmann said gold nano-particles of particular sizes could be used in medical diagnostics to enhance contrast for magnetic resonance imaging and in potential treatments to selectively destroy cancerous cells.

Carbon in its nano form also possessed different qualities to macro carbon such as

graphite or diamonds. In its very small state, carbon could appear as nanotubes – tubes as minute as one nanometer in diameter – that were 1000 times stronger than steel and extremely good conductors of heat and electricity.

Being able to measure carbon nanotubes and manipulate them safely had the potential for substantial applications, in areas such as molecular electronics, Dr Herrmann said.

Dr Herrmann's NMI team is now designing and building an ultra-precision atomic-force microscope which will be able to image objects at the nanoscale and measure their dimensions accurately.

Since being awarded a Doctorate in Physics from the University of Leipzig, Germany, Dr Herrmann has worked in R&D at the University of California, San Diego, as well as at CSIRO and NMI in Australia. His interest in the nano world and his enthusiasm for uncovering its secrets has seen him publish more than 65 peer-reviewed journal papers and address audiences around the world.

Dr Herrmann was a key member of the 2010 Science Week National Tour, which took in every State and Territory. He was joined by radio personality Dr Chris Smith; the Naked Scientist, Arctic explorer and environmental scientist, Tim Jarvis AM; and microbiologist and cave researcher Dr Hazel Barton.

These prominent science personalities visited a host of major and regional centres, making presentations, duelling in debates and engaging in interviews – in museums, universities, schools, libraries and major public venues – to share their expertise, inspire up-and-coming talent and promote science across Australia.

National Science Week, now in its 13th year, is Australia's largest festival celebrating science, innovation, mathematics, engineering and technology.

Held annually in August, National Science Week welcomes an audience of more than

a million and hosts more than 1000 events across the nation, in every state and territory, with the majority free and open to the public.

A grassroots program, National Science Week is delivered by universities, schools, museums and science centres across Australia. It is an initiative of the Australian Government through the Department of Innovation, Industry, Science and Research (DIISR) and is supported by CSIRO, the Australian Science Teachers Association (ASTA) and the ABC.

The National Tour is pivotal to the annual National Science Week celebrations. Running concurrently with National Science Week, the National Tour invites world scientists to tour the nation, sharing their expertise and spreading their enthusiasm for science.

Another key activity during National Science Week is the National Project, an online activity designed to inspire as many people as possible to be interested in science. This year the project connected Australians and scientists with the Big Sleep Survey, in which Australians were asked to contribute to scientific knowledge by documenting their sleep habits.



# PUT SOME SUGAR IN YOUR TANK



**Premier Bligh, Professor Dale and Senator Carr at the launch.**

The previously discarded waste from Queensland's sugarcane crop may replace up to a third of the state's unleaded petrol needs, depending on results from Queensland University of Technology (QUT) research at the new Mackay Renewable Biocommodities Pilot Plant.

The purpose-built pilot plant, hosted by Mackay Sugar, is a nucleus for a potential biorefinery precinct, where Queensland's emerging biofuels and bio-products industries will be researched and developed, QUT Professor James Dale said.

The new plant was opened by Premier Anna Bligh, Federal Minister for Innovation, Industry, Science and Research Senator Kim Carr, and QUT Vice-Chancellor Professor Peter Coaldrake.

Professor Dale, who heads QUT's Centre for Tropical Crops and Biocommodities, said the pilot plant was a unique research facility that would produce biofuel for vehicles and other products such as building materials, paints, waxes and resins out of the waste from sugarcane (bagasse) and other cane by-products as well as waste and other crops.

"These new low greenhouse gas industries have the potential to future-proof Australia from what is becoming a carbon-constrained world by using the plant-based waste that does not take from food production," he said.

"Bio-based products require less energy to manufacture and produce less greenhouse gas emissions and other pollutants than do fuels and chemicals made from petroleum products.

"We believe the Mackay Pilot Plant will bridge the gap between laboratory research and commercial reality. It could potentially reduce commercialisation costs for new technologies by over \$10 million and reduce the commercial timeframe by five years."

QUT's research involves turning bagasse into ethanol and other biofuels and using the waste products left over from that process to make further bio-products. QUT is also developing enhanced sugarcane for biofuel production because it is regarded as the best biomass feedstock (the raw plant-based materials for industry) in the world.

"Queensland's largest agricultural crop is sugarcane and it has the potential to replace up to 35 per cent of Queensland's unleaded petrol requirements, which reduces our need to import oil, reduces greenhouse gases and revitalises North Queensland's sugar industry," Professor Dale said.

"Australia has a significant opportunity to be a world leader in this rapidly growing industry given our large biomass resource, high-quality science and technologically advanced agricultural industry."

The Mackay Pilot Plant has been funded by the Australian Government through the National Collaborative Research Infrastructure Strategy, the Queensland Government's Smart State Research Facilities Fund and the Australian Government's Education Investment Fund and QUT.

## NEW SOLAR FACILITY IN MELBOURNE

A \$12 million project aimed at delivering next-generation solar cell technology has been launched in Melbourne.

The Victoria-Suntech Advanced Solar Facility (VSASF) is a collaborative venture between Melbourne's Swinburne University of Technology and Suntech Power Holdings in China, one of the world's leading producers of solar panels. It will be headed by Dr Zhengrong Shi FTSE, Suntech's Chairman and Chief Executive.

The facility, expected to be staffed by about 10 researchers, has been partially funded by a \$3 million grant under the Victorian Science Agenda Investment Fund.

VSASF Director, Professor Min Gu FTSE, said current solar cell efficiency was far below what was expected of it in the future. The aim of industry is to try to double the solar cell efficiency and reduce costs.

The collaboration would provide a platform for the partners to commercialise Nanoplas, a revolutionary nanoplasmonic solar cell technology being developed at Swinburne.

The Nanoplas technology would allow for the efficient collection of solar energy from a wider colour spectrum than cells currently being developed. This could make them twice as efficient as the current generation of cells, making them significantly less costly to produce and use.

"As soon as we prove the concept, Suntech will work with the Victorian Government to invest money to produce a plant in Victoria," said Professor Gu, who is also director of the Swinburne Centre for Micro-Photonics.

He said the technology was expected to be commercialised in about three to five years. It would also complement Suntech's industry-leading Pluto solar cell technology.

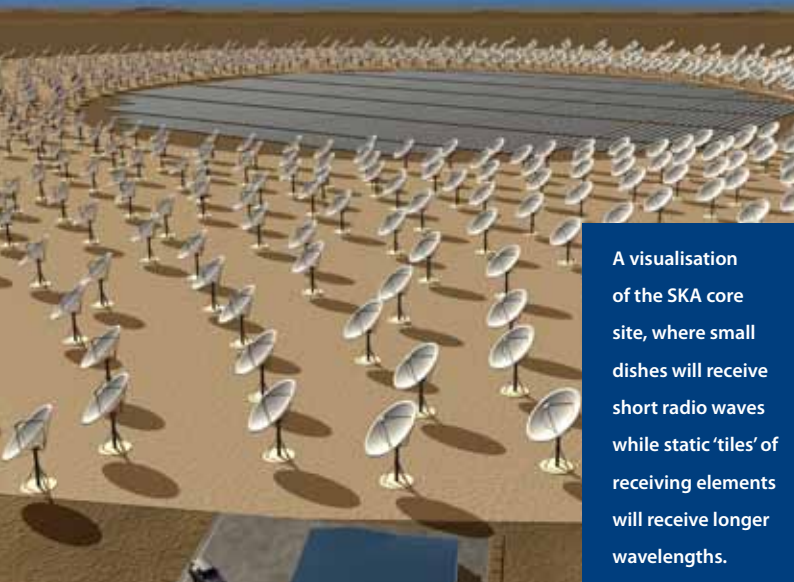
"We are pretty confident that we should be able to apply this Nanoplas technology into their current product," Professor Gu said. "On the other hand, our concept can also produce a totally independent solar cell, but that will probably take longer."

Professor Gu said the project would compete with a similar project that had recently been announced in Europe. The VSASF team was in a unique position to research, develop and commercialise the innovative solar cell technology.



**Min Gu**





A visualisation of the SKA core site, where small dishes will receive short radio waves while static 'tiles' of receiving elements will receive longer wavelengths.

IMAGE: XILISTUDIOS AND ISPO

## NATURAL ENERGY TO HELP POWER SKA

CSIRO will receive \$47.3 million for the development of solar and geothermal energy technologies to power a radio-astronomy observatory and its supporting computer centre.

The Sustainable Energy for SKA facility will be funded through the Sustainability Round of the Government's Education Investment Fund (EIF) and the funding will support renewable energy infrastructure projects for the Murchison Radio Astronomy Observatory and the Pawsey High-Performance Computing Centre for SKA Science in Perth.

The Square Kilometre Array (SKA) is a global \$2.5 billion program to build the world's largest radio telescope. Two sites have been shortlisted to host the telescope, one in Australia and New Zealand, and one in southern Africa.

CSIRO Chief Executive Dr Megan Clark FTSE said the new project would accelerate the development of renewable energy technologies in Australia. "The Sustainable Energy for SKA project will fund solar and photovoltaic technology to help power the Murchison site and the nation's largest direct heat geothermal demonstrator to cool the Pawsey Centre supercomputer," Dr Clark said.

"This project will also allow the practical application of research by scientists and students from all over Australia in renewable energy as well as in astronomy, computer science, engineering, geology and environmental management.

"It is a unique opportunity for many different areas of science to come together and work on something that will benefit all Australians, the development and application of renewable energy technologies."

The Pawsey Centre in Perth, co-located with CSIRO's Australian Resources Research Centre, will become one of Australia's largest direct heat geothermal demonstration sites. Researchers plan to address the heating and cooling requirements of not only the SKA data centre but the entire geosciences facility. They will also conduct research on the performance and longevity of geothermal wells.

A full-scale hybrid solar storage and generation plant, coupled with sophisticated energy management systems, will also be built to service the CSIRO-managed remote Murchison Radio Astronomy Observatory about 700 kilometres north of Perth.

The Murchison Radio Astronomy Observatory and the CSIRO Australian SKA Pathfinder at the Observatory are important parts of

the infrastructure for Australia and New Zealand's bid to host the SKA radio telescope.

Both of these facilities have high electricity demands, so the ability to feed that demand using on-site geothermal and solar renewable energy technologies will provide multiple benefits.

## TOTAL RENEWABLE ENERGY PLAN LAUNCHED

Zero Carbon Australia has launched a report that claims it is technically feasible that a 100 per cent renewable electricity supply system could be implemented in Australia in 10 years.

The 200-page report, put together by researchers from Beyond Zero Emissions and the University of Melbourne Energy Institute, said an outlay of \$370 billion over a decade would create an energy-secure infrastructure and generate fuel savings of \$1.6 trillion by 2040, through a reduction in oil imports.

The plan would rely on existing technologies, including wind farms and concentrated solar thermal plants with energy storage capacity to dispense power at night.

ATSE President Professor Robin Batterham AO FEng FAA FTSE said there was nothing startling about the technology proposed.

"Australia can and should be positioning itself as a global renewable superpower for future prosperity," he said.

## RENEWABLE ENERGY ON NETWORKS

The Energy Networks Association (ENA) and CSIRO will embark on a joint project focused on exploring the impacts and benefits of embedded generation for Australian electricity networks. The five-month project expands on earlier work commissioned by CSIRO in 2008 to study the value and impacts of embedded generation from an electricity network perspective.

"This important joint project between ENA and CSIRO will provide valuable information for electricity network businesses to increase their understanding of the potential benefits and impacts of embedded generation, as well as preparing network businesses for higher penetration of renewable energy sources, such as photovoltaic cells," said ENA Chief Executive Andrew Blyth. "Importantly, the main outcome of the project will be a comprehensive and practical report for ENA members to use in developing strategies, operational plans and staff training material that will assist in the future development of the network.

"Specifically, the study will allow network businesses to better plan and design their grids to cope with the uptake of renewable generation technology. This will be done by modelling a range of different embedded generation scenarios."

In addition to considering different scenarios and case studies, the project will look at the ability of renewable energy technologies to integrate effectively into a network and possible barriers that may impact on the benefits of utilising the uptake of renewable energy.



PHOTO: ROGER LOVELL

Families will have more control over their energy use with the new web-based energy management system.

## REMOTE-ACCESS METERS CAN CUT ENERGY COSTS

A new web-based smart metering system has been developed by CSIRO to enable householders, small businesses and electricity retailers to remotely control energy use over a broadband internet connection – to help cut energy use, costs and carbon emissions.

CSIRO project leader Dr Martin de Groot, said the system would give householders the flexibility to cut back their electricity use at times when it is needed elsewhere on the grid.

CSIRO has worked with the energy service company Energy Response and hardware designer Saturn South to develop a system able to aggregate a large number of smaller users – previously logistically impossible and cost-prohibitive.

“By taking advantage of common broadband internet connections we are now able to build and deploy a very cheap, real-time platform to deliver energy services to individual dwellings,” Dr de Groot said.

The system involves installing a mini smart-meter in a household or business electrical switchboard, which can then be managed remotely from a centralised control platform.

“Once regulatory approval has been given, energy service companies will be able offer householders more favourable electricity supply agreements and enable them to be more adaptable in their consumption patterns.”

CSIRO has estimated projected cost savings for Tasmania, where

the new demand side technology was developed, \$10.9 million in annual electricity expenditure – even if less than 10 per cent of Tasmanian customers used the system.

The infrastructure is cheap, can be retrofitted to existing buildings and complements other technologies such as local generators and intelligent home automation systems.

## \$30M FOR NEWCASTLE INSTITUTE FOR ENERGY AND RESOURCES

The Australian Government will contribute \$30 million to develop the Newcastle Institute for Energy and Resources at the University of Newcastle through the Sustainability Round of the Education Investment Fund.

“Working in national and international collaborations, researchers at this world-class facility will conduct innovative research in next-generation energy production,” said Innovation Minister Senator Kim Carr. “Minimising energy usage in the resources sector will be at the heart of the institute’s work, supporting our resources industry to become cleaner and greener.”

The institute will help transform Australian industries by researching:

- the reduction of energy (and water) consumption in coal and minerals processing and transport;
- the reduction of carbon emissions through next-generation carbon capture and storage (CCS) technologies;
- alternative energy sources, including geothermal and polymer solar cells;
- improved efficiency in power generation; and
- smarter, more efficient grids for distributed electricity generation.

The university will develop the institute by purchasing and extending the former BHP Billiton Newcastle Technology Centre. Once completed, the institute will support up to 300 researchers.

## INVESTING TO HARNESS THE SUN

Dyesol Australia, a company developing superior solar cells has received an injection of funds from CSIRO’s Australian Growth Partnership (AGP).

Dyesol, a leader in the area of dye-sensitised solar cells, has invested heavily in its strategy of partnering with global corporations to commercialise its technology in the building integrated photovoltaic market – a strategy that allows common building surfaces, such as roofing and windows, to produce electricity.

The agreement with Queanbeyan-based Dyesol will help fund collaboration with CSIRO’s Energy Transformed Flagship to examine higher-performing dye-solar-cell technologies.

CSIRO’s AGP program, funded by the Australian Government, was created to help SMEs make a difference in an area of national priority.

# SCRAMJET PROJECT TAKES OFF

A \$14 million project to help develop scramjet-based access-to-space systems is scheduling a free-flying scramjet flight experiment – SCRAMSPACE I – at the entry point to the scramjet access-to-space speed range, Mach 8 (8600km/hour) at Woomera, SA, in late 2012.

In parallel, scramjet concepts will be tested at even greater speeds – up to Mach 14 – in the University of Queensland's (UQ) world-class hypersonic ground-test facilities.

The project, which attracted \$5 million funding in the new Australian Space Research Program this year, is also supported by \$9 million from an international partnership consortium, led by UQ. The consortium includes four other universities, three international aerospace organisations (including Australia's DSTO) and three industry partners.

"No complete scramjet designs have been flight tested at these extreme speeds before now," said the program director and DSTO Chair for Hypersonics at UQ Professor Russell Boyce.

Professor Boyce said partner agreements had been signed and appointments had been made to the project. Progress had been made on design, layout and flowpath analysis of preliminary concepts, and planning for the flight campaign had begun.

*Scramjets are air-breathing engines capable of travelling at hypersonic speeds, greater than Mach 5. Scramjet-based launch systems promise safe, reliable and economical access to space for launches of communications satellites. Although scramjet technology has been known since the 1950s, it has proved a hard nut for international scientists to crack. Australia's first professor of space engineering, UQ's Emeritus Professor Ray Stalker AO FAA FTSE, began studying scramjets in 1982. His research led to UQ's Centre for Hypersonics, one of the world's largest space engineering university groups. Professor Stalker won an ATSE Clunies Ross Lifetime Contribution Award in 2008 for his work.*



PHOTO: STUART GOULD

**Parliamentary Secretary for Innovation and Industry Richard Marles (second from right) being briefed on the scramjet project during his recent visit to the UQ facilities.**

## RESEARCH HUB TO SECURE SA'S WATER FUTURE

A new \$50 million water research institute – the Goyder Institute for Water Research – will be established in South Australia to help secure and manage the state's water supply and position SA as a world leader in water innovation and science.

The SA Government will provide \$25 million over five years for the institute, which will be matched in kind by CSIRO, the University of SA, the University of Adelaide and Flinders University.

The institute will provide independent scientific advice on SA's water system, improving the government's ability to forecast threats to water security and develop an integrated approach to water management.

"The Goyder Institute will produce cutting-edge science to develop innovative water management strategies for the ongoing water security of all South Australians," said SA Premier Mike Rann.

SA's Chief Scientist Dr Ian Chessell FTSE said the Goyder Institute would be nationally recognised as a hub for water research.

"This institute is a partnership between the SA Government and CSIRO, as well as the University of SA, the University of Adelaide, Flinders University, the SA Research and Development Institute, and the Australian Water Quality Centre of SA Water," Dr Chessell said. "Other key research organisations will also be invited to collaborate with the institute, which will improve connections between industry and research organisations."

## CSIRO INVESTS TO UNLOCK NICKEL RESERVES

Nickel mining company Direct Nickel has received an injection of capital from CSIRO's Australian Growth Partnership (AGP) program to work with CSIRO on unlocking vast nickel reserves at a new purpose-built facility.

Direct Nickel has developed a process that allows otherwise uneconomic laterites to be commercially extracted. The process operates at low pressures and temperatures, and recycles about 95 per cent of the process reagents.

CSIRO will invest \$1.5 million to fund the construction of a mineral processing prototype facility at its Waterford site in Western Australia, and provide funds to allow Direct Nickel to carry out a scientific collaboration with CSIRO's Minerals Down Under Flagship.

The collaboration will use the facility to test and develop the Direct Nickel process at a scale that will allow it to be assessed for real-world applications.

About 70 per cent of the world's land-based nickel resources are in a form known as laterites. Australia has about 16 per cent of the world's laterite resources, but the poor economics of laterite processing have meant that only about 40 per cent of total global nickel production comes from this form of nickel.

CSIRO's AGP program – funded by the Australian Government – extends finance to small and medium-sized enterprises that can make a difference in an area of national priority.





IMAGE: CSIRO

**CSIRO scientists are already using the GPU cluster in a range of scientific disciplines. Computational modellers simulating human swimming have found their code runs six times faster when using the GPU cluster.**

NVIDIA, one of the world's leading developers of graphics processing units (GPUs), has selected CSIRO as a member of its international network of high-performance computing research centres.

GPUs are the computer hardware that lies at the heart of game consoles and, increasingly, supercomputers.

CSIRO's Group Executive, Information Sciences, Dr Alex Zelinsky FTSE, said the announcement – at the International Supercomputing Conference in Hamburg, Germany – furthered CSIRO's goal of being a world leader in the application of GPU technology to a broad range of scientific and industrial problems.

"To be involved in NVIDIA's CUDA Research Center Program, which is designed for institutions that embrace GPU computing across multiple research fields, is a great honour for CSIRO," Dr Zelinsky said. "We're excited to be in such good company. CUDA Research Centers include Johns Hopkins University and Singapore's Nanyang Technological University."

CSIRO is currently the only CUDA Research Center in the southern hemisphere. Its CSIRO's GPU cluster, with 256 GPUs, was the first of its kind in Australia and is one of the world's fastest computers. The GPU cluster in Canberra is in everyday use with more than 100 CSIRO scientists trained to use it. It runs Linux and Windows applications.

## UNRAVELLING THE NORTH WEST SHELF SEABED

Pioneering researchers from the University of WA's Centre for Offshore Foundation Systems (COFS) are developing new benchmarks for deep water engineering and exploration to unravel the complexities and unique characteristics of the North West Shelf ocean floor. One of the most significant oil and gas production fields in the world, the North West Shelf also offers some of the most intriguing seabed challenges.

"The North West Shelf is a particularly carbonate substance – carbonate silt and carbonate sand – this is different to other deep-sea exploration sites in the world," according to Professor Christophe

Gaudin, Deputy Director of COFS.

With much of the scientific understanding of deep-sea exploration benchmarked in the Gulf of Mexico within a soft clay seabed, little knowledge could be transferred and adapted to the unique North West Shelf environment, creating a vast opportunity for revolutionary research and the pioneering of new standards for the oil and gas industry in Australia.

Founded by ARC Federation Fellows Professor Mark Randolph FAA FTSE in 1997, COFS was set up to better understand the particularity of Australian soils and to develop adequate foundation solutions. In the past decade research understanding of the North West Shelf seabed has deepened greatly through the work of COFS, largely with the use of the innovative centrifuge facility, the only such facility in Australia.

"The centrifuge facility is not just a testing facility, it is a modelling facility, providing a deep understanding of how the soil behaves and how any geotechnical structure will perform," Professor Gaudin said.



COFS centrifuge in action.

He said COFS was the most active centrifuge facility in the world for both industry sponsored research and academic research. The COFS team had worked on all the major pipeline developments of the North West Shelf, collaborating with all the major resource companies.

## BREAKTHROUGH ON FIRE FOAM CANCER RISK

Australian scientists have developed a groundbreaking treatment to clean up the highly toxic and persistent foam chemicals used worldwide to fight thousands of fires. Their achievement comes in response to growing global concern over the cancer and environmental risks from long-lasting chemicals in the foams used internationally to control petrol and other fires at tens of thousands of sites worldwide during the past half century.

Large industrial fires, traffic, truck and railway accidents, and even building fires may involve the use of fire-fighting foam, which can then escape into the surrounding environment and contaminate water supplies.

The importance of the work by researchers at the CRC for Contamination Assessment and Remediation of the Environment (CRC CARE) was hailed recently in the presentation of one of Australia's top science prizes, a 2010 CRC STAR Award from the Department of Industry Innovation Science and Research.

# Scientists and society in an ethical world

**H**ow do scientists and society interact in an ethical world – one in which ethics is openly discussed and forms an important part of decision making? That was the question posed by Professor Penny Sackett, Chief Scientist for Australia, in her 2010 Vincent Fairfax Oration, ‘Scientists and Society in an Ethical World’.

Leaders must make decisions, she said. “Those decisions, if well-advised, will depend in large part on evidence. Increasingly, that evidence is likely to come from science, broadly defined to include both natural and social sciences.

“Leaders are those, by definition, that others follow. If a leader is self-aware and accepts the leadership role, then he or she will know that these decisions affect others. This in turn means that leaders have a social responsibility, or at the very least will be perceived to have a social responsibility, to act ethically, to make ethical decisions.”

She defined the word science in three ways:

- science as knowledge;
- science as an activity; and
- science as it is applied

Professor Sackett said that pure knowledge was value-free – that knowledge or inanimate objects obtain meaning and moral value only through interaction with humans, and that they do so through human action or intent – and that **science as pure knowledge** was outside the realm of ethics.

“If we are speaking of **science as a human activity**, then ethics definitely comes in to play.”

She instanced the many codes of ethical practice for scientists that had been formulated by a variety of groups in relation to animal or human subjects of research; the natural or cultural environment; the health and safety of those performing the research; how data are recorded, stored and shared; and the manner in which research is recognised.

“It is not known precisely how often major breaches of ethics in the professional practice of research occurs, but the recorded cases are few, despite (or perhaps due to) the rigorous examination and re-examination of scientific evidence before, during and after the peer review process,” she said.

**Science as it has been applied** by society had given us packaged food, forensics and nuclear bombs; mobile phones, eye glasses and patented genes; antibiotics, plastic grocery bags and subliminal marketing techniques, she said.

“There is no doubt that modern life is inconceivable without science. And for all its faults, few ... would wish to return to the world of tens of thousands of years ago.”

Science – in identifying the application of scientific knowl-

edge in ways that affect us as humans or our environment – is often closer to what most scientists would probably call technology, innovation or, sometimes, engineering, she said.

Professor Sackett laid a series of questions before the Fairfax Oration audience.

- Who is responsible for the application of science, and thus for its ethics? The scientist who discovered the first idea? Scientists or innovators who translate the science into application? The patent office? The entity that funded the original basic research or the subsequent applied research and development? The corporation or public body that dispenses the application or technology? The consumer who buys, uses or benefits from the particular application of science?
- Should ethical codes be enforced on the ends to which science is applied? If so, by what means and by whom?
- How or should ethical codes on scientific applications change, and under what circumstances?
- Should the non-scientists in society trust scientists with the responsibility for scientific ethics?
- Should scientists trust that responsibility to non-scientists in society?
- In an ethical world, what is the responsibility of the scientist to the rest of society? What is the responsibility of society to those who practice science?
- What are the ethical relationships between science and policy? Science and law? Science and commerce? Science and journalism?

There could be no doubt we were living in a world in which scientific ethics continued to be important, Professor Sackett said, but this raised some real questions:

- What is the ethical response to future generations, or to the non-human inhabitants of this planet, particularly as it is clear that we are living beyond the finite resources of this planet?
- What is the conversation that scientists and the rest of society need to begin around the ethics of the application of science in the food, energy and water arenas?
- How can we achieve all this with appropriate levels of discourse in a population that is largely scientific illiterate or in a society in which scientists do not engage with their fellow citizens?

She called for a “more vigorous, profound and influential definition and demonstration” of ethics among leaders in contributing to a more ethical world for all society, including the “actions of and reactions to” scientists.

## Three Fellows honoured

Three Fellows were honoured in the Queen's Birthday Honours, announced in June.

Professor Vicki Sara AO FAA FTSE was recognised for distinguished service to science through contributions to research and policy development, and to higher education as Chancellor of the University of Technology, Sydney.

As well as being Chancellor at UTS, Professor Sara is Chair of the Australian Stem Cell Centre, Director of the Australian Centre for Plant Functional Genomics and is a professor at the Institute of Molecular Biosciences at the University of Queensland. Professor Sara joined the Academy in 1998.

Professor Yiu-Wing Mai AM FRS FAA FTSE, School of Aerospace, Mechanical and Mechatronic Engineering, University of Sydney, was honoured for service to engineering, particularly in the fields of advanced composite materials, and fracture research.

Professor Mai holds a personal chair at the university and was a 2002 Federation Fellow. He joined the Academy in 1992.

Dr Paul Donaghue OAM FTSE, former Chief Scientist at Orica, was recognised for service to science, particularly through technological research and development roles, and to professional organisations.

Dr Donaghue is a former ATSE Councillor (2000-08) and Victorian Division Chair (2008-09), who joined the Academy in 1998.

Vicki Sara



Dongke Zhang

## Dongke Zhang scores three Linkage Project grants

The Director of the University of Western Australia's Centre for Energy, Winthrop Professor Dongke Zhang FTSE, has been awarded three grants in the latest round of the Australian Research Council's Linkage Projects scheme.

He received \$2.5 million over five years to develop a secure source of sustainable energy for Australian regional communities which embrace environmentally sustainable and cost-effective approaches to global climate change.

The project will investigate synthetic natural gas and biochar from biomass to provide energy in remote communities, as well as soil carbon sequestration.

Two other projects led by Professor Zhang attracted \$730,000 over several years to investigate the conversion of methanol gas into sulphur-free, clean combustion diesel and to develop a biogas from green waste and animal droppings.

UWA received more than \$8.4 million to support 13 research projects – the second-highest level of funding to any Australian university.

A total of \$66.7 million in Linkage Project grants was awarded to 32 institutions for 218 projects, announced by the Minister for Innovation, Industry, Science and Research, Senator Kim Carr.

The 218 projects had forged partnerships with 458 national and international organizations – government, private and non-profit.

"These partners are contributing a total of \$128.2 million in cash and in-kind support, on top of the Australian Government's \$66.7 million."

The Linkage Projects scheme is part of

the Australian Research Council's National Competitive Grants Program, which nurtures the creative abilities and skills of Australia's most promising researchers.

The University of NSW received the highest funding – \$9.3 million for 27 projects – followed by UWA (\$8.4 million), University of Melbourne (\$7.5 million), University of Queensland (\$5.7 million), Monash University (\$4.8 million), University of Sydney (\$4.0 million), QUT (\$2.9 million), University of Adelaide (\$2.5 million) and RMIT (\$2 million).

■ A summary of the 218 successful projects is at [www.arc.gov.au/ncgp/lp/lp\\_outcomes.htm](http://www.arc.gov.au/ncgp/lp/lp_outcomes.htm)

## Chennupati Jagadish gets double honours

Professor Chennupati Jagadish FAA FTSE has been awarded that the Quantum Device Award for 2010 by award committee of 37th International Symposium on Compound Semiconductors (ISCS2010) for his "pioneering and sustained contributions to compound semiconductor quantum structures and optoelectronic devices."

Professor Jagadish heads the Optoelectronics and Nanotechnology Group at the ANU's Research School of Physical Sciences and Engineering.

Professor Jagadish has also been selected as the recipient of the IEEE Photonics Society 2010 Distinguished Service Award, "for dedicated service to the Photonics Society in diverse areas, including exceptional contributions to membership activities in Asia, and significant contributions to conferences and publications."

The presentation will be made in Denver, Colorado, in November



Chennupati Jagadish



# Fellows prominent in 2010 Top 100 Engineers listing



Hugh Durrant-Whyte

Nearly 40 per cent of Australia's "most influential" engineers are Fellows of ATSE, according to Engineers Australia's 2010 Top 100 Engineers listing.

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

ATSE Fellows made up 38 of the names in the 2010 Top 100 Engineers list, the seventh year it has been organised by Engineers Australia. Fellows also comprised three of the six selection advisory panel members – ATSE Vice President Dr John Nutt AM FTSE, Mr Peter North AM FTSE and Dr Mike Sargent AM FTSE.

ATSE Fellows contributed 15 names to the list of 46 comprising the biggest category (Industry).

These were: Mr Leigh Clifford AO FTSE (Chairman, Qantas), Dr Bob Every FTSE (Chairman, Wesfarmers), Dr Peter Farrell AM FTSE (Chairman and CEO, Resmed), Mr James Graham FTSE (MD, Gresham Partners), Mr John Grill FTSE (CEO, Worley Parsons), Mr Gordon Jardine FTSE (CEO, Powerlink Queensland), Dr Wal King AO FTSE (CEO, Leighton Holdings), Dr Andrew Liveris FTSE (Chair, President and CEO, Dow Chemical), Ms Susan Murphy FTSE (CEO, WA Water Corporation), Mr Doug Rathbone AM FTSE (CEO, Nufarm), Dr Chris Roberts FTSE (CEO, Cochlear), Mr Julian Segal FTSE (CEO, Caltex), Dr Zhengrong Shi FTSE (CEO and Chairman, Suntech Power Holdings), Mr Don Voelte FTSE (MD, Woodside), Mr Bill Wild FTSE (COO, Leighton Holdings).

ATSE dominated the Academia/Research listing, providing 10 names in a category of 11 – Professor John Carter FTSE (Pro Vice Chancellor, University of Newcastle), Professor

Peter Dowd FTSE (President, Australian Council of Engineering Deans), Professor Mike Dureau FTSE (Chairman and ED, Warren Centre for Advanced Engineering), Professor Paul Greenfield AO FTSE (VC, University of Queensland), Professor Peter Lee FTSE (VC, University of Southern Cross), Dr Adi Paterson FTSE (CEO, ANSTO), Professor Beverley Ronalds FTSE (Group Executive, Energy, and Chief, CSIRO Petroleum), Professor Geoff Stevens FTSE (Pro Vice Chancellor, University of Melbourne), Professor Ian Young FTSE (Vice Chancellor and President, Swinburne University) and Professor Alex Zelinsky FTSE (Group Executive, Information and Communication Sciences and Technologies, CSIRO).

ATSE Fellows also dominated the Innovation/Expertise category, notching seven of the 10 rankings.

These were Mr Peter Cockbain FTSE (Technical Director, AMPControl), Professor Hugh Durrant-Whyte FAA FTSE (Research Director, Australian Centre for Field Robotics and Professor of Mechatronics, University of Sydney), Professor Peter Gray FTSE (Director, Australian Institute for Bioengineering and Nanotechnology, University of Queensland), Professor Max Lu FTSE (Deputy Vice Chancellor, University of Queensland), Dr David Skellern FTSE (CEO, NICTA), Professor Rod Tucker FAA FTSE (Director of Photonics, Melbourne University), Mr Chris Vonwiller FTSE (CEO, Appen).

In the Consulting listing, ATSE again contributed two names – Mr Paul Douglas FTSE (CEO, Sinclair Knight Merz) and Dr Robert Care FTSE (CEO, Arup Australia).

ATSE President Professor Robin Batterham AO FREng FAA FTSE was listed in the Associations category; Dr Stephen Gumley FTSE (CEO, Defence Materiel Organisation) and Dr Mary O'Kane FTSE (NSW Chief Scientist and Scientific Engineer) were named in the Public Service category; and WA Governor Dr Ken Michael AC FTSE was listed in the Politics/Other category.

## CORRECTION

In *Focus* 163 we recorded the election of Dr Ezio Rizzardo FRS FAA FTSE and Professor Hugh Durrant-Whyte FRS FAA FTSE to the Royal Society and noted their elections brought to 15 the number of ATSE Fellows who are also Fellows of the Royal Society.

Our apologies to Professor Yu Wing Mai AM FRS FAA FTSE, who was elected FRS in 2008. Sixteen Fellows have been elected FRS.

## City to Cape – 2100 sea level rise

Some 150 people attended the seminar titled City to Cape – 2100 sea-level rise in July in Perth, hosted by the WA Division, in conjunction with Engineers Australia and the Australian Sustainable Development Institute at Curtin University.

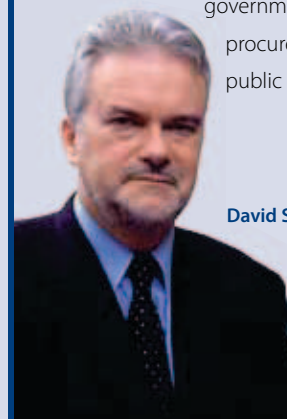
The seminar theme was how to cope with the likely impacts of projected sea-level rise on Australia's Southwest Coast – from Perth to Cape Naturaliste – by 2100.

The organisers are preparing a seminar report.

## David Singleton back in Melbourne

Mr David Singleton FTSE, head of global infrastructure for the international design, planning and engineering consultancy Arup, has relocated to Melbourne. He has been leading the infrastructure practice from London for five years. Mr Tristram Carfrae FTSE leads Arup's global building practice from Sydney.

Arup Australasian Chief Executive Dr Robert Care FTSE said Arup intended to focus on the provision of value-added, high-level consulting services to Australian governments on the procurement of critical public infrastructure.



David Singleton

# Clunies Ross Alumni launched

The ATSE Clunies Ross Alumni was announced at the 2010 Awards Dinner at the Melbourne Town Hall – aimed at creating a community of Australian achievers in the commercialisation of science and technology.

The Melbourne announcement was followed by breakfast launches in Sydney and Brisbane during June to create awareness of the Alumni with past award winners, Fellows, sponsors and potential supporters.

The Academy is committed to encouraging and promoting excellence and achievement in the application of engineering and the technological sciences for the benefit of Australia. The Awards are recognised nationally as pre-eminent in this category, celebrating Australian science and technology innovation and achievement.

To further strengthen this recognition of the Awards the ATSE Board has resolved to establish the ATSE Clunies Ross Alumni and to invite all Awardees to become members. There are now 105 Medallists and nine Lifetime Awardees across Australia.

ATSE Clunies Ross Chair of Governors, Mr Bruce Kean AM FTSE, told the Awards dinner that the objective of the Alumni was to create and promote a community of Australian achievers, provide depth and enhancement to the value of the ATSE Clunies Ross Awards and to ensure a permanent relationship between the Academy and Medallists.

The alumni would offer members the following benefits:

- recognition by ATSE;
- invitation to all ATSE public events with registrations at Fellow's rates;
- free subscription to ATSE *Focus* bi-monthly magazine and other publications;
- free subscription to ATSE Monthly Newsletter;



- access to interact and engage on key ATSE policy research and activities; and
- invitation to participate in Divisional meetings and presentations.

## Broadband changes signal a revolution – Cutler

Fast broadband should herald a revolution in health, education and environmental care for the whole of Australia, according to Dr



Terry Cutler FTSE, Principal of Cutler & Company, and chair of the 2008 Review of the National Innovation System.

But the national focus

needed to shift from building the network to delivering the huge public good benefits it should deliver, he told a July national roundtable 'Australia's Broadband Future' in Brisbane, hosted by the ARC Centre of Excellence for Creative Industries and Innovation (CCI), which he chairs.

The roundtable was the highlight of CCI 2.0 Symposium, the nation's leading forum on creativity and innovation, and debated "How will Australian society be changed by fast broadband?"

"We've been talking about broadband for years. There's no doubt it is the future," Dr Cutler said. "It's a bare fact of life if we want to be a part of the modern world."

"But the current focus is mostly on rolling it out – there has not been nearly enough emphasis on what we are actually going to do with it. There is no national strategy."

Dr Cutler, Deputy Chair of the CSIRO, said the entire cost of the National Broadband Network could be justified by applying it to just one of three major public interest applications – e-health, online education and learning and improving our environmental management.

"A nationwide e-health platform would be a huge benefit and give us one of the most advanced healthcare systems in the world. But we need to start serious planning how to deliver it."

"A second opportunity lies in rethinking how we deliver knowledge to Australians, not just in school but throughout the whole of our lives. Again, fast broadband can play a mighty role in reshaping education and learning."

A third potential use for the network lay in the fast-radiating network of sensors which were reporting all our impacts on the environment, he said.

"As these link up via broadband, we can manage far better how humans interface with the environment, and control our adverse impacts on it."

"We also need to be keenly aware that we can stuff it up, if we only focus on the supply side – just building the network. We need far more emphasis on the demand side – on what we can do with broadband that will generate the value to the nation."

## Going South

An Antarctic science seminar titled 'Going South' to commemorate the career and contribution of the late Dr Phillip Law AC CBE FAA FTSE will be held in Melbourne on 15 September.

The initiative links the ATSE Victorian and Tasmanian Divisions, along with the Academy of Science and the Royal Society of Victoria, with support from the Australian Antarctic Division, CSIRO and the Bureau of Meteorology.

Speakers are being engaged now for topics including the Evolution of Antarctic Science, Ice and Oceans, Terrestrial Biology and Risk, Life in the Oceans, and the Changing Climate.

■ Registrations [www.atse.org.au](http://www.atse.org.au)

# Skin cancer Frazer's next target



**Ian Frazer working with Extreme Science Experience students**

Developing a cervical cancer vaccine and watching it start protecting millions of young women worldwide is more than most researchers would hope for in a lifetime.

But Professor Ian Frazer FAA FTSE and his team at the University of Queensland's Diamantina Institute for Cancer, Immunology and Metabolic Medicine are expected in the next few years to follow their first huge achievement with another – a vaccine against skin cancer.

That research was built on two synergies, said Professor Frazer: the institute's location in Brisbane ("the skin cancer capital of the world") and, that like cervical cancer, some skin cancers are virus-related.

"That virus is very similar to the one that causes cervical cancer," said Professor Frazer, who developed the cervical cancer vaccine in partnership with the late Dr Jian Zhou. It is distributed worldwide under the brand names Gardasil and Cervarix.

Professor Frazer said he could not predict the outcome of the skin cancer research or a likely release date for a future vaccine.

"The best possible outcome is we might end up preventing skin cancer – or at least reducing its severity and incidence – with a vaccine that is very similar in the way it works to the one we use to prevent cervical cancer," he said.

A string of awards followed Professor

Frazer's first big discovery, including the CSIRO Eureka Prize for Leadership in Science (2005), Australian of the Year and Queenslander of the Year (2006), the Howard Florey Medal for Medical Research (2007), an ATSE Clunies Ross Award (2007), the Balzan Prize for Preventive Medicine (2008) and the Australian Medical Association Gold Medal (2009).

Pharmaceutical company Merck has distributed 40 million doses of Gardasil, worth \$4.6 billion, since its release in 2006. The UK, Canada, Europe and the United States have widely adopted the vaccine, and more than 80 per cent of Australian secondary school girls have received it. The vaccine also is making its way into the developing world.

Professor Frazer's UQ tenure dates from 1985, when the university's medical school lured him away from the world-renowned Walter and Eliza Hall Institute in Melbourne. The drawcard for Professor Frazer was the UQ medical school's vision for translating scientific research into clinical practice.

A quarter of a century on, that vision is culminating in the development of the \$354 million Translational Research Institute (TRI) in Brisbane.

The TRI – due for completion in 2012 and currently one of Brisbane's biggest building projects – is a joint venture between UQ, Princess Alexandra Hospital (PAH), Queensland University of Technology (QUT), the Mater Medical Research Institute (MMRI) and the Queensland Government. Funding has come from the Federal and state governments, American philanthropist Charles Feeney, UQ and QUT.

UQ says it will be among the world's biggest research institutes, rivalling in scope bodies such as the National Institute of Medical Research in London's Mill Hill and the USA's Institute of Allergy and Infectious Diseases at Bethesda in Maryland.

Eventually 700 researchers will work at the TRI, which will house the Diamantina Institute and researchers from PAH, QUT, MMRI and Biopharmaceuticals Australia (a Queensland Government production facility).

*Since its official inception in 1910, UQ has grown into a world-class university with more than 40,000 students across three main campuses and more than 45 research and teaching sites.*

## NSW Governor sees potential for medical miracles

Careers in science and engineering offer the potential to create medical miracles according to the New South Wales Governor, Professor Marie Bashir AC CVO FTSE.

Addressing 50 Year 11 science students at ANSTO, Professor Bashir said that Australia urgently needed 60,000 science and engineering graduates.

"Young people thinking about careers in science should not be put off by the 'nerd' image that scientists have developed," said Professor Bashir, elected an Honorary Fellow of ATSE in 2006.

"You can still do science and enjoy rock and roll, and sport as well.

"In my lifetime, I have seen medical miracles, and many of these are discoveries that have come from physics. You are on the pathway to saving millions of lives...you can all be Leonardos. It's not grandiose, it's real. The possibilities are endless."

The students, on a National Youth Science Forum tour, saw the reactor facility, and the neutron Guide Hall where neutron scattering techniques are among some of the cutting edge research at ANSTO through its Bragg Institute.

ANSTO CEO, Dr Adi Paterson FTSE, escorted Professor Bashir and other special guests around the facility.

**The NSW Governor,  
Professor Maria Bashir**





# 'More for less' imperative in manufacturing



**Calum Drummond**

Finite resources and space and a rapidly increasing global population are fuelling the 'more from less' imperative in how we make and use products, according to the Chief of CSIRO Materials Science and Engineering, Dr Calum Drummond FTSE.

At the same time product lifecycles had expanded from 'cradle to grave' to include the need for recycling and waste minimisation, he told a recent Materials Science Technologies lunch in Sydney.

Dr Drummond was among a list of leading materials science experts that agreed Australia's manufacturing future lay in developing niche products in the health, defence, mining and energy sectors.

Dr Drummond, who has a strong interest in the commercialisation of research, was outlining the key global megatrends.

"We are trying to extract as much value as possible from inputs and then re-use them; it's all about sustainability and the need to accommodate an increasingly urbanised world," he said.

"Another important trend is the consumer demand for 'personalisation'. This century we have seen a strong move from mass production to mass customisation – it's all about me, I want an ipod with my own personal applications' – and that's driving a lot of things in materials development and manufacturing."

Dr Drummond said Australia was in the box seat to develop and export mining technology and similarly, by solving some of our national challenges such as limited water and energy resources, we could benefit economically by exporting the resulting technology.

Australia's competitive advantage lay in developing niche, innovative 'value-add' products, particularly in preventative health, mining, defence and the 'green economy'.

Australia needed more companies like Cochlear and ResMed, he said.

"One of the big opportunities is in developing technology to accommodate a less centralised health system where GPs will be doing more in their local practices and will need more technologically-advanced devices and diagnostics in their surgeries."

Dr Drummond continues in the role of Chief of the CSIRO Division of Materials Science and Engineering (CMSE), following the merging of the Division of Molecular and Health Technologies into CMSE.

Dr Drummond joined CSIRO as a Postdoctoral Fellow in 1987 and over his career has directly worked on projects with more than 30 companies or industry support agencies to either develop products or improve processes.

Prior to being appointed Chief of CMSE in 2007, Dr Drummond was seconded from CSIRO to be Vice President Research at CAP-XX Pty Ltd, a Sydney-based company that designs and manufactures advanced supercapacitors and was listed on the London Stock Exchange in 2006.

Dr Drummond's research has been recognised through an ARC Federation Fellowship, an ARC Queen Elizabeth II Fellowship, the Australian Academy of Science's RJW Le Fevre

Memorial Prize and the Royal Australian Chemical Institute (RACI) Rennie Memorial Medal.

## Ian Johnston takes a road safety message to students

"Road crash death and injury – the preventable disease of the young" was the topic addressed by Professor Ian Johnston AM FTSE as the Eminent Speaker for 2010 for the WA Division.

His lecture was presented at Curtin University in June to 100 high school students from schools south of Perth and at Edith Cowan University to 80 students from schools to the north of the city. He also gave a public lecture at Presbyterian Ladies College.

Professor Johnston's talk focussed on the magnitude of the problem despite recent improvements that have reduced the road toll in countries such as Australia.

He then covered exciting new technological developments for vehicle and road design and explained the diverse range of disciplines that are involved in road safety research.

He challenged the audiences with his ideas for changes that would result in safer vehicles and better drivers and stimulated interesting discussions after each presentation.

The WA Division acknowledges the collaboration and financial support to run these events received from Scitech, Department of Main Roads, Curtin University, Edith Cowan University and Presbyterian Ladies College.

(From left) Ms Beth Blackwood, principal of Presbyterian Ladies College, Mr Malcolm Moore from Scitech, Professor Ian Johnston and Dr Ian Duncan, WA Division Chair.



# Two Fellows win Australian Laureate Fellowships

Professor Mark Bradford FTSE from the University of New South Wales and Professor Min Gu FAA FTSE from Swinburne University have been named among 15 world-class researchers awarded Australian Laureate Fellowships to tackle some of the most urgent and complex research issues facing Australia and the world.

The Australian Laureate Fellowships scheme gives outstanding research leaders the opportunity to solve big problems and pass on their skills to the next generation, Innovation Minister Senator Kim Carr said.

"These 15 top-flight researchers and their teams will receive a total of \$35.5 million," Senator Carr said.

"Consistent with their high international standing, the 15 Australian Laureate Fellows will collaborate with research partners from 28 countries. This will not only make for better research outcomes; it will extend Australia's international research connections, which are vital for our performance in the increasingly integrated global research system."

Professor Bradford is a previous Australian Research Council Federation Fellow and is currently the Director for the Centre for Infrastructure Engineering and Safety at UNSW. His research interests include researching structures subjected to extreme actions; numerical methods; structural retrofit; design codes and dynamics and elasto-dynamic buckling.

The aim of Professor Bradford's project will be to develop a "green" sustainable composite steel-concrete building frame system that reduces greenhouse gas emissions throughout the life-cycle of building construction, usage and deconstruction. The project will provide a solution to a major contemporary engineering challenge facing Australia.

Professor Gu is University Distinguished Professor and Director of the Centre



Min Gu

for Micro-Photonics at the Swinburne University. He is regarded as a pioneer and an international leading authority on three-dimensional (3D) optical imaging science. Professor Gu has played a central role in the development of 3D optical imaging theory for advanced modern optical microscopy.

Professor Gu's project will establish a cutting-edge nanophotonic platform that will allow for the revolutionary scientific discoveries in 3D super-resolution optics as well as technological breakthroughs in ultrafast compact nonlinear optical microscopy. This paradigm-shift research will accelerate the realisation of the new age of Petabyte optical memory technology and enable innovative discoveries to be translated into practical nanophotonic devices with substantial commercial potential for Australia.

## Pond joins ANSTO Board and Greenfield reappointed

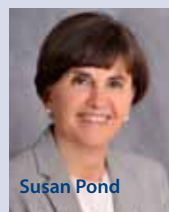
Dr Susan Pond FTSE has been appointed to the Board of the Australian Nuclear Science and Technology Organisation (ANSTO) and Professor Paul Greenfield AO FTSE has been reappointed.

Both are part-time board members for four-year terms.

Chairman of ANSTO's Board, Dr Ziggy Switkowski FTSE, said Dr Pond's scientific and business experience would be a great asset to ANSTO.

"Dr Pond has a very distinguished career in scientific, medical, educational and commercial fields," Dr Switkowski said. "Her combination of clinical and scientific expertise combined with her strategic planning and commercial leadership make her a valuable addition to our Board."

Until recently Dr Pond was a senior executive with Johnson & Johnson serving as both Director of Pharmaceutical Research and Managing Director of its Australian biotechnology company, where she was a strong driver of



Susan Pond

research collaboration programs. Dr Pond also served as Chair of AusBiotech.

Dr Pond has held senior professorial positions at the University of California, San Francisco and the University of Queensland. She currently serves on the Board of Commercialisation Australia, the Board of ATSE and the Board of Governors of the Centenary Institute of Cancer Medicine and Cell Biology,

Dr Switkowski said Professor Greenfield, Vice-Chancellor and President of the University of Queensland, had been a valuable ANSTO Board member for the past three years and has made important contributions in areas of strategy, project funding and management, research assessment and corporate governance.

## ALTC teaching citations for Simmons and Tobar

Outstanding contributions to student learning have been recognised across the nation with the Australian Learning and Teaching Council (ALTC) announcing awards for 193 citations valued at more than \$2 million.

The ALTC's Citations for Outstanding Contributions to Student Learning, valued at \$10,000 each, were awarded to 170 individuals and 23 teams who have demonstrated sustained dedication to improving the quality of the student learning experience.

Professor John Simmons FTSE, Emeritus Professor of Engineering at the University of Queensland and an ATSE Director, was recognised "For excellence in teaching that has inspired, challenged and encouraged engineering students in six decades, and for national leadership of culture change in engineering education".

University of WA Winthrop Professor Michael Tobar was recognised "For inspiring Physics students to reach their full potential and transform to successful research scientists through participation in ground breaking research".

Dr Carol Nicoll, ALTC Chief Executive Officer, said that the breadth of the achievements demonstrated the significant commitment in the higher education sector to enriching the student experience.

# Keith Neill made major research contributions



Keith Neill

The Academy is saddened to note the recent death in Melbourne of Dr Keith Neill AM FTSE, a former General Manager Research at ICIANZ and secretary of AIRG, who had been a Fellow of ATSE since 1993.

Dr Neill (85) was a Fellow of the Royal Australian Chemical Institute, a Member of the Royal Society of Chemistry, London, and a Member of the Society of Chemical Industry.

He was Honorary Editor of *ATSE Focus* from 2001 to 2005.

He made major contributions in R&D and application to the chemical, mining and agricultural industries through development of diverse products and processes leading to the retention and growth of the chemical industry in Australia.

These included personal innovation in the development of novel processes for the production of pigments, high-performance brake fluids, a unique system for the gelling of slurry explosives in underground mining and improved methods for the safer production of PVC. His research resulted in a number of inventions for which about 40 patents were granted.

Following his education at Sydney University and Nottingham University, where he gained his PhD in 1952, he worked as a researcher at the London School of Hygiene and Tropical Medicine until he returned to Australia in 1955 before joining ICI in 1956.

During the following 32 years he held a number of positions culminating in his appointment as General Manager Research in 1985, including a period with the ICI Dyestuffs Division in England (1961–63).

He won a Sydney University hockey 'blue' and was a keen sailor – a member of the Somers Yacht Club in Victoria for several decades, including two stints as Commodore, former Chairman of the

Westernport Association of Yacht Clubs and member of various committees of the Victorian Yachting Council.

## Australia 2030 Seminar

The Academy will conduct a national seminar titled 'Australia 2030' in Sydney on 11 November, the Thursday prior to Assembly 5 on 12 November and the AGM events on 13 November – also in Sydney.

'Australia 2030' is being organised by the NSW Division and will be held at the Offices of the State Department of Industry and Investment 47th floor MLC Centre, Martin Place. The keynote speaker is Professor Ross Garnaut.

The Seminar will draw together speakers from both the private and public sectors to identify the key issues they see in their enterprises as they plan for the future – covering issues such as population decentralisation, transport, energy, food security, water and health and aged care services.

## Rolf Prince marks 60 years in education



**Emeritus Professor**  
**Rolf Prince**

In 1950 Emeritus Professor Rolf Prince AO FEng FTSE gave his first lecture, 'The Second Law of Thermodynamics'. Sixty years on Professor Prince continues to make a strong contribution to the University of Sydney's engineering education

thrust. His six decades of work were celebrated in July when Professor Prince delivered a Celebratory Lecture, 'Celebrating 60 Years of Teaching', at the university to a distinguished audience, including the graduates of the Class of 1950 and those who followed – in the formative years of the University's Department of Chemical and Biological Engineering.

Two graduates from the School of

Chemical and Biomolecular Engineering gave their impressions of their educational experience with Professor Prince as their lecturer.

Professor Prince shared the lectern with Professor David Glasser, Professor of Chemical Engineering and co-founder and Director of the Centre of Material and Process Syntheses (COMPS) at the University of Witwatersrand, Johannesburg – who presented remotely a short account of modern day practical applications of the second law of thermodynamics.

## Focus on our fellows

### Rob Lewis

Affiliate Professor Rob Lewis, who has led the South Australian Research and Development Institute SARDI as Executive Director for the past 17 years, will be succeeded by Affiliate Professor Pauline Mooney. Professor Mooney joined SARDI five years ago as Research Director and has been Deputy Executive Director for the past year. Professor Lewis will continue to serve on various private and public sector boards, including as independent Chair of the Fisheries and Aquaculture National Priorities Forum.

### Peter Newman

Professor Peter Newman FTSE, Professor of Sustainability at Curtin University of Technology, has accepted an invitation to be a Lead Author (Working Group III) to the 5th Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). Professor Newman joined ATSE in 2009.

### David Skellern

Dr David Skellern FTSE, who won a 2010 ATSE Clunies Ross Award, has been awarded the MA Sargent Medal by the Electrical College and the ITEE College of Engineers Australia for "the breadth and depth of his contribution to technical innovation, his eminence in the practice of electrical engineering and his exceptional management and leadership" in ICT.





# GOING SOUTH

Photo: Todor Iolovski/Australian Antarctic Division

## Phillip Law Commemorative Antarctic Science Symposium

**Theme:** The Academy of Technological Sciences and Engineering (ATSE) will host a one-day Antarctic Science Symposium titled **Going South in Melbourne** on **Wednesday 15 September 2010**. The seminar will commemorate the career and contribution of the late **Dr Phillip Law AC CBE FAA FTSE**, Director of the Australian Antarctic Division from 1949 to 1966. It will overview Antarctic Science and its relevance and importance to Australia.

Top-line speakers from the AAD, ANU, CSIRO, ANARE, University of Tasmania and University of Melbourne will address the Evolution of Antarctic Science and a range of topics within the theme of Ice, Oceans and Land.

This well-priced Symposium covers most aspects of Antarctic science and technology and should interest everyone interested in Antarctic issues. It links the ATSE Victorian and Tasmanian Divisions, the Academy of Science, the Royal Society of Victoria and the Australian Antarctic Division.

**Date:** Wednesday 15 September 2010

**Venue:** Meeting Room 219 – Melbourne Exhibition and Convention Centre

**Cost:** \$100 – \$75 for students (includes catering)

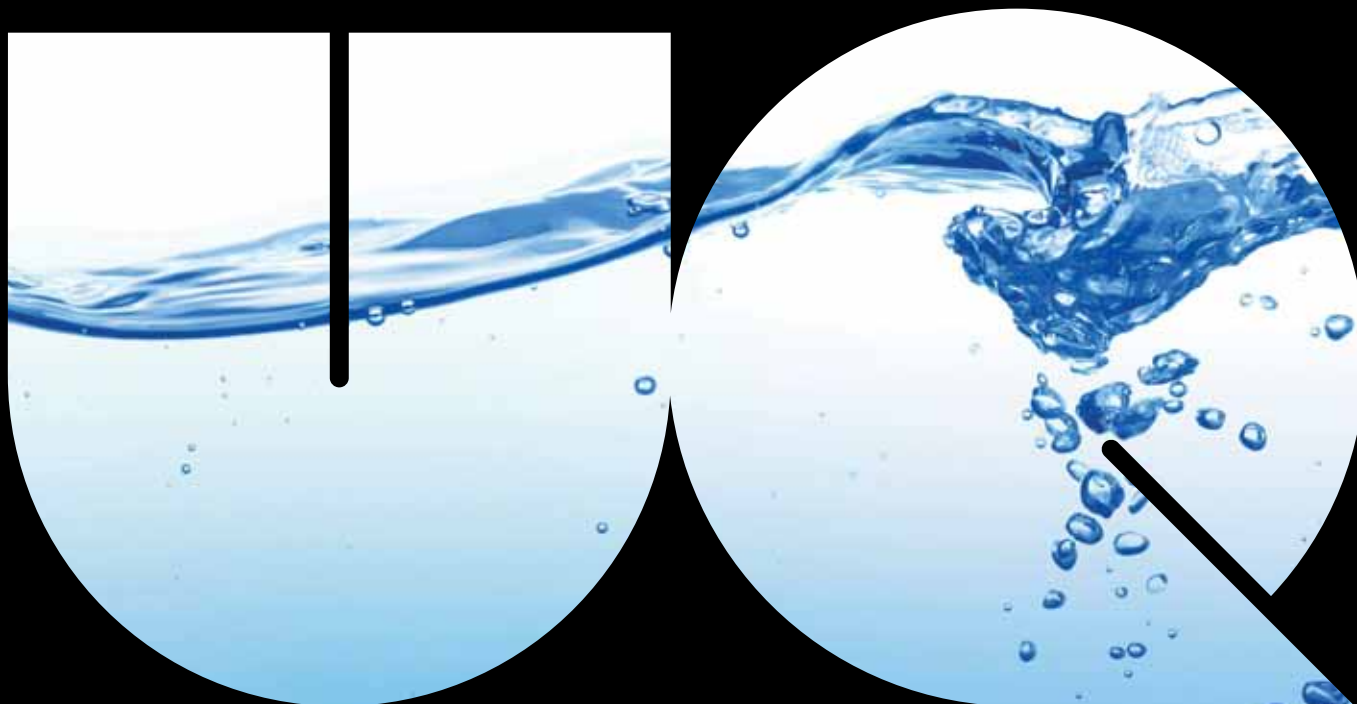
**Register:** Contact ATSE on 03 9864 0900 or [events@atse.org.au](mailto:events@atse.org.au) for information.  
On-line registration at [www.atse.org.au](http://www.atse.org.au)



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Australian Academy of Science



# GEOHERMAL ENERGY TO EASE OUTBACK WATER SHORTAGES

**An underground source of hot-rock energy may have the potential to produce low-cost fresh water.**

Research at The University of Queensland's Queensland Geothermal Energy Centre of Excellence (QGECE) has found that Queensland possesses ample geothermal energy resources to power thermal desalination plants and provide clean water for small towns suffering from water shortages.

According to Centre Director, Professor Hal Gurgenci, "geothermal heat can be used to heat and humidify a greenhouse and produce fresh water at the same time. It is a clever combination where desalination is coupled with an agricultural function which is both cost-efficient and environmentally-friendly."

The Centre's researchers have estimated that a geothermal desalination plant can easily provide the fresh water needs for an outback town at the cost of around 80 cents to \$1.60 per kilolitre. These costs significantly undercut the 2010/2011 bulk water prices of \$1.00 to \$2.00 per kilolitre as outlined by the Queensland Water Commission.

Currently, the QGECE is aiming to develop a new exploration method for hot rock geothermal resources. An outcome of this project will be more precise knowledge on where these resources are likely to be found in Queensland without having to drill expensive exploration wells.

This knowledge will also substantially increase the chance of a geothermal desalination plant being engineered in Queensland.

UQ consistently ranks among the world's top universities\* and attracts over 4000 people annually from around the world to pursue research higher degrees (RHD).

Through Australia's most convenient RHD entry scheme, you may apply for admission and scholarship with just one form, any day of the year. To apply, visit [uq.edu.au/grad-school](http://uq.edu.au/grad-school) and discover Australia's world-class research for yourself.

\*UQ has been named in the top 50 universities in the world for the fifth year running in the UK's 2009 Times Higher Education-QS World University Rankings.