



FOCUS

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ENGINEERING EXCELLENCE

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Photo: One Shelley Street – Winner, Building and Structures category, Engineering Excellence Awards 2009 | ©Arup

ARUP

5

Modelling – engineering moves into the virtual world

By Anthony Barry

9

Irrigation modernisation – sustainability in action

By Paul Douglas

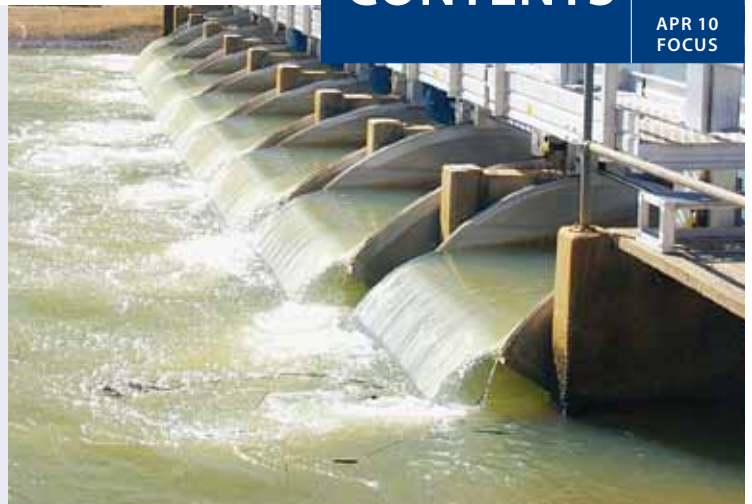
13

Engineering big bridges in South-East Asia

By Richard Kell



Front cover: The dramatic diagrid faces of One Shelley Street, Sydney.
Photo: Arup



Irrigation for the 21st century – FutureFlow style (see page 9).

- 17 Form, function and sustainability
- 21 Necessity drives sustainable water solutions
- 23 ATSE focuses on electricity for the next 40 years
- 25 ATSE hosts national energy briefing
- 27 Front and centre at ThinkFuture 2010
- 31 German team visits for photovoltaic talks
- 34 Teachers go back to school for science and technology
- 35 Government praises STELR and boosts science teachers
- 41 Science must be exposed
- 46 ATSE in *Focus*

FOCUS

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

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**THE UNIVERSITY OF
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Modelling – engineering moves into the virtual world

Modelling and simulation helps decision makers to envision the future they seek to create and gives them confidence in making successful investment and commitment decisions.



By Tony Barry

barrya@ap.aurecongroup.com

Technology is changing the face of engineering, management and the delivery of specialist technical services. Advances in computing have made it possible to vastly extend the range and depth of modelling and simulation applications within engineering consultancies.

Increasingly, global consultancy businesses are turning to advanced simulation and modelling to deliver reduced risk across a project lifecycle and to create optimum design solutions for clients.

Whether developing infrastructure or industrial, commercial, environmental or community-based projects, the capability to model multiple facets of complex projects is saving time, money and reducing project risk.

By incorporating various future scenarios and detailed projections, estimates and statistics into simulations early in the project-planning phase, clients benefit from significantly reduced project risk.

Modelling and simulation assists decision makers to envision the future they seek to create and gives them confidence in making successful investment and commitment decisions.

Testing infrastructure scenarios

Engineering consultancies are increasingly being called upon to provide clients with ultimate confidence in their project investments.

One method for delivering this is by creating virtual environments where it is possible to test the viability of building materials, resources, proposed project sites and consumption forecasts, as well as environmental and community impacts to design best practice project solutions.

Many of these technologies previously existed as individual systems, but at Aurecon we are pioneering 3D modelling capabilities by integrating them into our entire business to create a holistic, virtual project scenario to present to clients.

Today's engineering consultancies now contain teams



that are skilled in such areas as finite element modelling, blast and impact simulation, computational fluid dynamics for fire safety engineering, wind flow and façade modelling. By combining these technologically based outputs, clients derive direct benefits from having more accurate pricing information, a smoother construction program and improved facility management and maintenance.

The integration of design, analysis and documentation of projects, using 3D modelling software packages, is proving particularly useful to clients. This technology is being applied in the property sector, where a single 3D representation for thermal modelling, energy modelling, lighting models, structural modelling and many other areas of advanced analysis is developed and presented to clients.

On major property projects, clash detection is being used to check structural designs for interference prior to construction between different design elements. By identifying potential structural clashes during the design phase, costs and delays associated with discovering problems during the construction process are reduced.

Modelling improves freight forecasts and planning.

Increasingly, information is embedded in the various models, which allows equipment and materials schedules to be created automatically. This improves the service that is provided to the clients and contractors, both during and after construction, once the building is occupied.

Transport infrastructure

Urban personal transport systems are very complex, with a large number of factors influencing travellers' choices for a particular trip. An increasingly important issue for transport agencies is the design and implementation of multi-modal transport systems that ultimately provide improved options for travellers and enable mode choices that reduce congestion and emissions in urban areas.

From light rail urban commuter lines to economically vital freight and mixed-use networks, diverse modelling capabilities support any rail project scenario.

Through railway network simulation software packages, such as OpenTrack and TRAIN, engineers at Aurecon can replicate complex rail systems to design critical infrastructure and power supply solutions.

This sophisticated technology incorporates track profiles, speed limits, signalling configurations and timetable information to quickly and easily identify the impacts of different design options. The effects of adding or moving infrastructure design components can be instantly evaluated, considerably reducing timelines on design programs and associated project risks.

Aurecon's unique in-house freight vehicle modelling framework estimates heavy commercial vehicles and their distribution patterns across a supply-chain network. Clients, both public and private, can use this information to better understand these movements, ultimately leading to better policy and infrastructure planning.

Designing for future requirements

Advanced modelling systems allow public and private sector clients to estimate the economic benefits of upgrading key import/export transport facilities through accurate forecasts up to 25 years into the future. The framework created by such modelling allows testing for road infrastructure plans or policy changes to determine the effect on road use, congestion, and road wear and tear.

The resultant model draws upon many multidisciplinary techniques, including statistical analysis and modelling, econometric modelling, supply-chain modelling and mapping and survey design.

More importantly, strategic transport modelling and demand forecasts assist governments to plan transport infrastructure so it is efficient, sustainable, cost-effective and flexible for future expansions. Aurecon undertook freight movement modelling in Melbourne for the Victorian Department of Transport that reflected freight movement along various sections of the supply chain. The data was then used to strategically plan future systems to cater for Melbourne's freight growth.

Traffic-flow modelling capabilities allow engineers, planners, owners/operators and governments to consolidate complex data into a clear and comprehensive model that considers project impacts on environment, local communities, retail hubs and industry developments.

Intricate microsimulation models provide clients with a valuable intellectual asset that can be used for a plethora of purposes, offering considerable cost savings across multiple projects. In New Zealand, Aurecon delivered a dynamic simulation model to forecast traffic flow and demand generated by one of the country's largest retail developments. This provided the client with significant cost savings, as variations to designs and environmental impact were assessed prior to construction.

For the future, emerging developments in computing, networking and data storage promise to further revolutionise how simulation will be applied by engineers and technical consultants in the future.

Wind modelling

As the world embraces green energy solutions, consultants are turning to sophisticated modelling technology to help clients site strategically located and cost-effective wind farms.

Essential for reducing project risks and assessing feasibility, meteorological models analyse the physics of a particular site's atmosphere to predict wind speeds based on reliable simulations of actual weather events. This data allows in-house meteorologists and wind experts to identify the best locations for siting wind farms. This technology delivers financiers considerable cost savings in the pre-feasibility phase and drives investment confidence in the emerging energy-generation market.

Aurecon used a 'world first', in-house modelling system on the Castle Hill Wind Farm project in New Zealand to demonstrate that initial uncertainty in wind farm development can be significantly reduced using advanced analytical modelling techniques.

Advanced mesoscale modelling capabilities saved the

Letters to the Editor

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

client substantial costs and development time and added significant value to the project by verifying performance projections and determining the optimal turbine location sites. With proven accuracy and reliability, this technology is becoming a vital tool in developing future wind farms around the world.

Drawing upon experience in every stage of wind farm design and development, our meteorologists and wind experts turned to modelling technology for Castle Hill Wind Farm's initial wind resource assessment, rather than the traditional approach of erecting short monitoring masts. Measured data from masts, which have since been erected, confirm Aurecon's original predictions and demonstrate that the confidence clients have in innovative approaches to wind farm design is well placed. This wind-modelling technology has already been used on projects in Australia, New Zealand, South Africa, Afghanistan, Morocco, Malta, Poland, France, Belgium and the UK.

Looking to the future

As the role of engineering management and specialist technical services consultancies expands, new technologies will play an ever-increasing part in project assessment, design and delivery.

While engineers will always be called upon to design, manage and deliver complex projects, they will increasingly turn to modelling as a powerful tool that improves project quality and lifecycle performance.

As engineers respond to the challenges of creating a better and more sustainable world for future generations, powerful modelling tools enable businesses like Aurecon to deliver innovative solutions that are supported by even deeper technical analysis. ◀

ANTHONY BARRY FTSE is Chief Executive, Asia Pacific of Aurecon and has 34 years of experience in engineering, 27 of which have been in consulting. As a civil engineer, he worked on many road and highway projects, with later experience in land development, mining and airport and other transportation projects. He subsequently diversified into major land and urban redevelopment projects. He holds a Masters of Engineering Science and has served as National President of the Association of Consulting Engineers of Australia from late 2004 to 2006, and remained a director until November 2008.

Modelling delivers better project outcomes

FREIGHT MODELLING

Aurecon has designed and developed Australia's first freight-movement model to improve urban freight forecasts and aid with transport planning. Initially developed for the Victorian Department of Transport, the model reflects freight movements along various sections of the supply chain and can be used to strategically plan future freight systems in Melbourne. Since its implementation, Aurecon has been engaged by transport agencies in Sydney, Brisbane, Perth and Adelaide to transform the model so that it is applicable to these respective cities' freight transport networks.

EDEN PARK STADIUM

Aurecon is providing structural engineering for the redevelopment of the Eden Park Stadium in Auckland, New Zealand. The upgrade will allow the stadium to have a permanent seating capacity of 50,000, with an increase to 60,000 for the 2011 Rugby World Cup. By undertaking extensive wind tunnel testing and computational fluid dynamics (CFD) modelling, Aurecon ensured natural ventilation within the covered concourse spaces. The modelling enabled the firm to define structural loads on the cantilever roof and stadium envelope, minimise the height of fume exhaust stacks, assess smoke spill and ensure pedestrian comfort.

Eden Park Stadium for the future.



Helping the world see clearly.

The cornea, the eye's window on the world, plays a vital role in ocular function by allowing the passage of light through a transparent surface. When the corneal surface is damaged, through injury or disease, this can lead to a loss of visual acuity and ultimately blindness.

At UniSA's Mawson Institute, Senior Research Fellow Dr David Steele and his team are using plasma polymer coatings, films produced from organic compounds, to coat contact lenses. These polymer coatings can be tailored to provide the optimum surfaces for specific types of cells. With this new science, there is the potential to restore vision by a cell therapy technique – transplanting a new corneal surface grown in the laboratory from the patient's own cells.

This research is part of an international collaboration between the Mawson Institute, the Centre for Eye Research Australia, the Bernard O'Brien Institute for Microsurgery and the L V Prasad.

In an allied project to develop a complete bioengineered cornea, the Mawson Institute's expertise in biomaterials preparation and surface engineering is again being harnessed. This bioengineered cornea, to be constructed from a polymeric scaffold incorporating cells, will play an important role in the discovery, development and selection of new ophthalmic drugs and novel ocular drug delivery systems.

This research is another example of how UniSA continues to expand its reputation for outstanding collaborative achievements and ground breaking research, making a real difference to the way we live.

For more information about research at UniSA visit unisa.edu.au/research

"The international collaborative development of a cell therapy to resurface the cornea will help address a major cause of blindness worldwide."

Dr David Steele, Senior Research Fellow.



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Irrigation modernisation – sustainability in action

The FutureFlow project is delivering economic, social and environmental benefits well beyond the project boundary, and will do so for the design life of the capital works.



By Paul Douglas, with Ross Titchmarsh and David Mathlin

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Technology, science and innovation are central to finding solutions to the many economic, social and environmental challenges we face today.

Our clients and communities need help to address sustainability issues. With appropriate skills and an ability to foster innovation, engineers, scientists and project managers are in a powerful position to respond.

There is an opportunity to embed sustainability in everything we do – deliberately and by design.

Embedding sustainability is easy to say and harder to do, as it requires us to completely rethink how we approach the scoping and delivery of projects. But we are now seeing the delivery of significant and far-reaching benefits through major projects, with the FutureFlow Irrigation Modernisation Project being a recent example.

The FutureFlow project in the Goulburn–Murray Water region in northern Victoria is now the world's largest automated irrigation water management system. It is delivering economic, social and environmental benefits well beyond the project boundary, and will do so for the design life of the capital works.

The project was a collaboration between Goulburn–Murray Water's FutureFlow alliance – which included Sinclair Knight Merz (SKM), Transfield Services Australia and Comdain – and several suppliers, including Rubicon Systems Australia. It built on previous research and pilot works undertaken by Goulburn–Murray Water and funding was provided by several Federal Government programs.

Innovative thinking

Following 12 years of drought, farmers' reliance on an out-of-date irrigation system was threatening the productivity of this key food-production region.

From the outset, the project had several important and clear sustainability objectives requiring innovative thinking:

- to secure efficient water supplies to one of Australia's most important agricultural regions;
- to stem the massive 30 per cent water loss along the

100-year-old irrigation system by updating water channels and delivery infrastructure, thereby making more water available to the environment in the Murray–Darling basin; and

- to engage all stakeholders along the entire irrigation channel without disrupting water supply during the project.

Irrigation for the 21st century – FutureFlow style.



Over 15 months, the \$290 million project replaced outdated irrigation infrastructure with a new integrated water-management system in record time, using innovative approaches to project delivery.

More than 2000 kilometres of channels and thousands of irrigation infrastructure assets were integrated into an automated water-distribution network.

The FutureFlow consortium worked within a tight timeline to deliver significant works. It employed a staged and systemic approach to ensure the project was delivered efficiently, including:

- negotiating with customers to decommission unsustainable infrastructure and 50km of under-utilised channels;
- upgrading the communication network to enable the thousands of new electronic assets to communicate via radio;
- replacing manual drop bar regulators with more than 1700 automated regulating structures – FlumeGates – to automate flows and provide information on channel performance;
- upgrading high-loss pools through plastic lining or replacing channels with pipelines; and

- replacing or rationalising 3500 Dethridge wheels – a 100-year-old technology – with accurate electronic meters.

Many of the new electronic meters are fully automated, meaning they supply water to customers' farms at the flow rate and times requested by the irrigators. These meters interact with the FlumeGates to provide a fully integrated and efficient system and also interact with on-farm automation.

Radio waves

The new system includes solar-powered channel-control gates and water meters, which are integrated into a radio network controlled by Goulburn–Murray Water's Operations Support Centre. The water authority expects to have more than 15,000 radio sites over its five water districts by 2012.

The new system can automatically process customer orders and deliver the exact amount of water when and where it is required. Previously it could take four days for a request to be delivered.

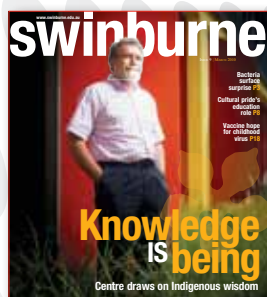
Because the system measures inflows and outflows in real time, the performance of each channel can be evaluated and areas with high water loss identified.

The project will save more than 94 billion litres of water each year – equivalent to approximately 17 per cent of

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the volume of Sydney Harbour, or 37,600 Olympic swimming pools. Most of this saved water will be returned to northern Victoria's stressed rivers and wetlands via environmental flows.

The automated channel system will better control pass flows into receiving rivers and wetlands to mirror natural flow patterns. A proportion of the savings will be returned to local irrigators to increase their water entitlements, further enhancing the viability of their individual enterprises.

Energy smarts

The gravity irrigation system is an extremely low-energy system. The exclusive use of solar power on the irrigation infrastructure maintains this low energy profile. It is estimated that 215 kilowatts of renewable power is generated from the solar-powered system.

The next stage is providing on-farm efficiencies, such as using soil moisture probes, drip irrigation and high surface irrigation, which have the potential to raise application efficiency from 70 to 90 per cent.

A key challenge for the project was to build an excellent relationship with the irrigation community. This was largely due to the size of the project, its complex logistics and tight timeframe.

Twenty full-time customer consultation officers were employed to meet irrigators, explain the project and help with the commissioning and operation of their new irrigation assets. More than 2500 individual irrigators and land-owners were consulted, and the project's final design was influenced by the individual requirements of each customer.

Independent farm designers were also employed to provide irrigators with advice about meter size and flow rate. The design was continually evolving and required strong cooperation within the alliance as the construction team implemented work in stages.

This effective consultation meant all customers agreed to works on their property and legal powers were not required to access land.

The local area benefited from employment and, where possible, supplies were procured in the region. Rubicon upgraded its manufacturing plant in Shepparton to produce the automated irrigation gates required for the project, which also provided significant local employment.

A model for the future?

A project like FutureFlow is special because it tests the boundaries of what has been done before. And it is special because it examines the broader community context of which it is part.

It showcases the best of Australian engineering and recently won the Australian Water Association's prestigious

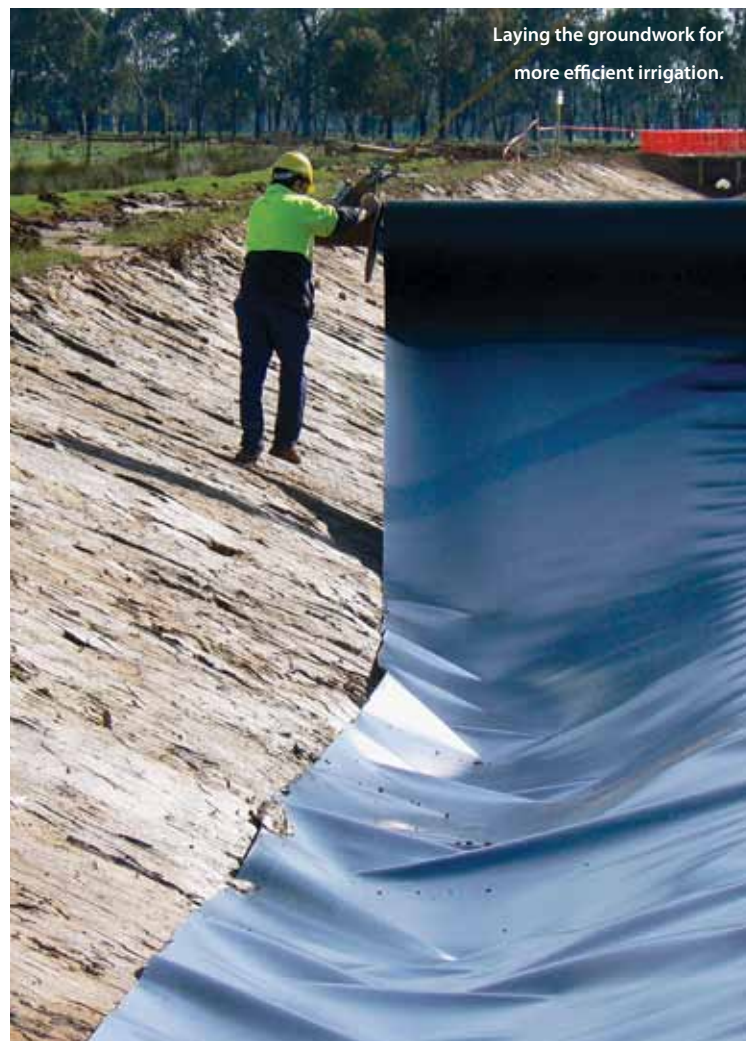
Water Innovation Award.

The Murray–Darling is now under enormous stress as a result of past water-allocation decisions, prolonged drought, natural climate variability and emerging climate change. Exemplifying sustainability in action, this project serves as a great role model for other applications, potentially elsewhere in the Murray–Darling Basin.

SKM has already played a role in helping determine the ongoing effects that reduced rainfall and runoff will have on available water and the resulting impact on water users in the Basin. We have completed hydrologic and groundwater modelling for the Murray–Darling Basin Commission and investigated the impact on the various water demands for all catchments in Victoria and the majority in NSW.

Irrigation modernisation almost certainly has a further role to play in the economic, social and environmental sustainability of the Murray–Darling Basin. ◀

PAUL DOUGAS FTSE is Chief Executive Officer and Managing Director of Sinclair Knight Merz. **Ross Titchmarsh** was SKM's Project Manager on the FutureFlow Irrigation Modernisation Project and **David Mathlin** acted as SKM's senior representative on the FutureFlow Alliance leadership team.





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Engineering big bridges in South-East Asia

The Batam-Tonton Bridge.

The iconic Anzac Bridge demonstrated the capacity of Australian engineers, which has paid dividends in overseas work and export income.



By Richard Kell

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Big bridges are complex structures that pose many challenges for their designers and builders, who must integrate their skills to achieve safe and efficient structures. They are landmarks and form vital links within cities or regions. They must withstand traffic loads and the impacts of high winds and seismic, thermal, dynamic, material and geotechnical effects.

Australian engineers and builders have been responsible for many notable big bridges in South-East Asia in recent years. Much of this success derived from the reputations of major Australian bridges – Melbourne's Bolte Bridge and Brisbane's Gateway Bridge and, in particular, the cable-stayed Anzac Bridge at Glebe Island in Sydney.

The iconic Anzac Bridge demonstrated the capacity of Australian engineers, which has paid dividends in overseas work and export income. The vision and courage that was required to design and construct Anzac Bridge contributed significantly to Australia's reputation amongst our Asian neighbours for technologically advanced bridge engineering.

Without the reference of a project as successful as the

Anzac Bridge it would not have been possible for Australian engineers to win overseas commissions for similar designs for overseas clients.

The bridge provided the impetus for the builders, Baulderstone Hornibrook, and engineers, Cardno, to become involved in similar bridges in SE Asia and illustrates the lesson for the future that development by public authorities of major infrastructure involving innovation and advanced technology has the capacity to impact favourably on export opportunities. This is not normally considered at the time of evaluating projects.

Australian engineering has delivered the Friendship Bridge across the Mekong River border between Nong Khai (in Thailand) and Vientiane (in Laos), the My Thuan Bridge over the Mekong near Vinh Long, and the Phu My Bridge over the Saigon River in Ho Chi Minh City, Vietnam. Others have included the Batam–Tonton Bridge between Batam Island and Tonton Island, Indonesia; the Steel Bridges Program (some 3500 bridges) in Indonesia; the Sarawak Bridges Program in Malaysia including three

major balanced cantilever bridges; and the Padma Bridge over the River Padma in Bangladesh, which will connect the south-west of the country with its capital, Dhaka.

All of these bridges are landmark contributions to the highway systems and the wellbeing of the people in each country.

Three major bridges are highlighted – all of which involved Cardno, the Australian-based global infrastructure services consultancy.

Batam–Tonton Bridge, Indonesia

The Indonesian Government's Batam Industrial Development Authority (BIDA) administers the development of Batam and adjoining islands south of Singapore, including a new road and bridges connecting the islands to establish a major manufacturing region.

BIDA invited tenders for the construction of the bridge – the first cable-stayed road bridge in Indonesia – on a concept design prepared by the Institute of Technology, Bandung (LAPI-ITP). Cardno was initially engaged by BIDA to carry out the proof check of the LAPI-ITP concept design including dynamic performance modelling, and was subsequently commissioned by the contractor PT Pembangunan Perumahan (PT PP) to redesign the pylons, the superstructure and abutments to better suit the contractor's construction approach.

The cable-stayed bridge was designed to comply with the Indonesian Bridge Design Code 1992 (based on the 1992 Austroads Bridge Design Code) and comprises three spans (145.9 metres/350.0m/145.9m) with an overall length of 641.8m. The bridge deck is on a vertical curve to provide shipping clearance of 35m over the central 200m-wide shipping channel.

The width of the bridge is 21.5m, providing two two-lane carriageways with footways. The A-shaped pylons are 120m above the top of the pile cap level. Each pylon leg is supported by a 16m-diameter pile cap on 30 cast-in-situ piles of 1.5m diameter founded at 40m depth into hard siltstone.

The deck consists of a reinforced concrete slab monolithic with 2m-deep prestressed concrete cross-girders and edge beams. Two planes of post-tensioning stay cables support the deck from the pylons. The design allowed for replacement of a cable due to damage by corrosion or unplanned failure of the cable caused by freak traffic accident or terrorist action.

Given the high seismic risk in the region, dynamic analysis was critical to determine the adequacy of the pylon foundations and abutments in terms of the dynamic behaviour of the bridge, prompting additional restraints in the final design.

The Australian involvement in the Batam–Tonton Bridge did not end with the proof check and detailed design by Cardno.

Design of false-work and forms was carried out in Australia and the Resident Engineers were also Australian. Professor Harry Poulos AM FTSE, of Coffey Geotechnical, provided advice of the foundations and the Bridge Branch of the NSW Roads and Traffic Authority carried out the proof check of the Cardno design.

ASEAN Bridge, Sarawak, Malaysia

The ASEAN Bridge over the Baram River forms part of the North–South Trunk Road in the East Malaysian state of Sarawak, linking Sarawak with Brunei.

The Baram River is Sarawak's second-largest river and flows into the South China Sea, providing access to the undeveloped hinterland. It carries substantial river traffic including timber barges up to 3000 tonnes, small coastal traders and many commercial passenger vessels.

The ASEAN Bridge is 11 kilometres upstream of the river's mouth and replaced a vehicular ferry. The bridge includes the longest main span in Sarawak, at 180m, and is also the longest bridge in Sarawak, with a total length of 1040m.

It is a private toll project, financed and operated by the Sarawak company Shin Yang Group, which has a 30-year operating concession. The construction was by Shin Yang's subsidiary, Woodville Development.

Cardno designed the bridge with KTA (Sarawak), leading Sarawak consulting engineers. Cardno was responsible for:

- overall concept design;
- design of the 400m-long balanced cantilever river spans structure; and
- inspections and assistance during construction as Chief Resident Engineer.

The bridge comprises three balanced-cantilever spans of 110m, 180m and 110m over the river and T-girder approach spans. The bridge has a summit vertical curve to achieve river clearance. The 20.5m deck comprises two carriageways with two lanes and footways each side.

The balanced cantilever section comprises a variable depth, single-cell, post-tensioned concrete box girder, integral with the main piers, segmentally constructed using two 150-tonne OHT form travellers, with maximum cantilevers of 91m.

The approach span precast post-tensioned T-girders are tied through deck link slabs across each pier to provide a continuous deck with joints only at the main span.

With the bridge's close proximity to the South China Sea, durability was recognised as an important design

criterion. Concrete strengths were nominated as high as practically achievable and concrete covers increased above minimum requirements, consistent with Australian bridge design practice.

The pilecaps protrude above high-water level, visible to traffic, and are shaped so that, if accidentally hit by a barge, they prevent the barge 'riding up' the pilecap and hitting the pier column. The main river pier pilecaps are supported on 33 concrete-filled steel tube piles approximately 100m long and 1.5m in diameter, founded in a very dense sand layer.

The ASEAN Bridge is typical of the modern balanced cantilever bridge, with a slender parabolic profile for the box girder superstructure. The choice of this structurally efficient form of bridge has maximised the utilisation of local material and labour.

Phu My Bridge, Vietnam

The Phu My Bridge, completed in October 2009, spans the Saigon River in Ho Chi Minh City and will form part of a new ring road currently under construction – an important transport link from the southern Mekong delta region to central and northern Vietnam.

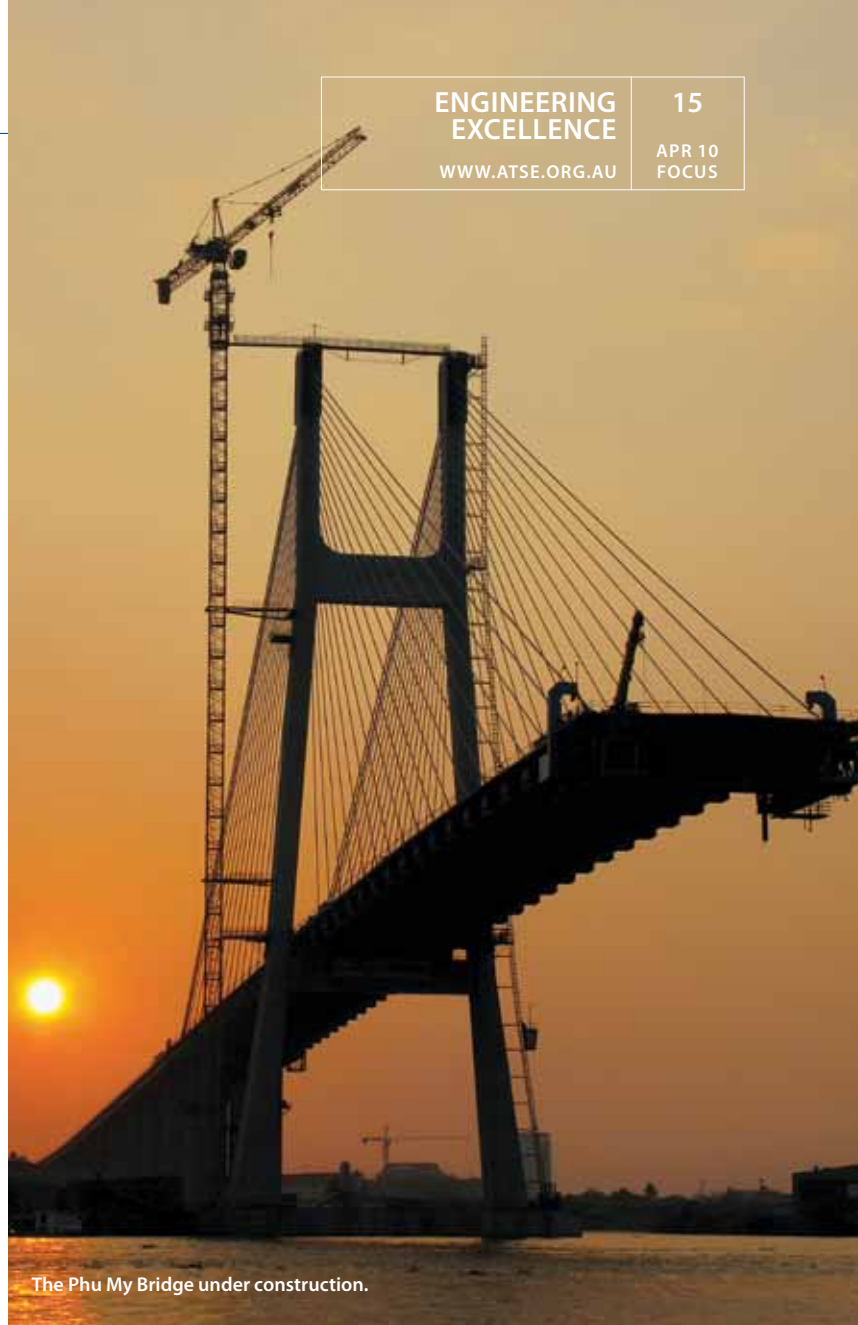
The Phu My Bridge contract comprised the design and construction of a 705m-long cable-stayed main bridge with a clear span of 380m, and approach structures on either side of 758m and 638m. The main span deck is 27m wide and comprises six traffic lanes and foot/cycleways. Clearance to river traffic is provided with 45m vertical clearance in a 250m-wide zone.

The bridge was constructed by BBBH Consortium, a joint venture between Bilfinger Berger of Germany and Baulderstone Hornibrook of Australia, the contractors for the Anzac Bridge in Sydney. The client, Phu My Bridge Corporation (PMC), is a private consortium of Vietnamese companies, which has a licence to operate the bridge as part of a toll road.

The main bridge design was produced in France by the consultant Arcadis and the approach structures were designed in Australia by Cardno, which also designed the main bridge temporary works and construction engineering, together with Leonhardt, Andrä und Partner (LAP) from Germany.

Each pylon is founded on two groups of 14 piles, up to 80m depth, with grouted bases, and connected by a two-cell pilecap. The elegant 140m-high pylon towers are H-shaped with two cross beams. Each tapering leg is a box section. The stay anchorages are located inside the tower box.

The concrete deck slab is suspended from the pylons by stay cables and is prestressed in both the longitudinal and transverse directions. The deck has longitudinal edge



The Phu My Bridge under construction.

girders linked by cross girders. Two vertical planes of stay cables are connected to the edge girders via precast anchor pods at 10m spacing. The deck was constructed segmentally by balanced cantilever from each tower.

The project required significant planning to optimise the construction, with close collaboration between the contractor and construction engineers (both Australian German consortia), resulting in few problems during the construction process and achievement of a five-day construction cycle and completion in only 32 months. ◀

Civil engineer **RICHARD KELL AM FTSE** was a director (1999–05) and chairman (until mid-2004) of Cardno Pty Ltd, a leading consulting engineering company listed on the ASX, with approximately 3000 staff and offices throughout Australia and overseas. He is now a consultant to Cardno and a director of subsidiary company Cardno International Pty Ltd. He was President of the International Federation of Consulting Engineers (2003–05). He has almost 50 years' experience working on infrastructure projects throughout Australia and overseas. He continues as Project Director on Cardno development assistance projects in Papua New Guinea, Indonesia and Solomon Islands.

Fostering, nurturing and exciting the inner scientist

Teachers meet STELR across Australia

HELPING THE TEACHERS HELP THEIR STUDENTS THROUGH STELR

- During March 370 teachers from 185 schools in all states and territories attended STELR professional development workshops in Melbourne, Brisbane, Sydney and Perth. Teacher comments were warm and the STELR concept was praised by Hon Richard Marles, Parliamentary Secretary for Innovation and Industry, who opened the Melbourne workshop.
- "We need children studying science...we need them to grow up and want to be scientists. Their work as scientists will help us deal with the challenges of the future – the challenges of feeding the world, managing our resources, the growth and development of our nation," he said. "As teachers, you can sow the seed of that enthusiasm for problem solving - show your students that science is exciting, it is fun and it is worthwhile."



THE STELR PROGRAM

- STELR is an exciting new curriculum program that aims to reverse the low level of interest among students in science courses and careers.
- STELR targets students in Years 9 or 10 – and their science teachers – and will be provided free of charge to 150 secondary schools from across Australia in 2010.
- STELR is a 6-to-10 week package involving inquiry-based activities. It engages students through investigations into global warming, climate change and renewable energy resources.
- STELR operates within the curriculum. It is intended for delivery to all students in the year level.

2010 PARTICIPATING SCHOOLS RECEIVE:

- a comprehensive set of curriculum materials, including teacher and student resources;
- a class set of solar and wind laboratory equipment (yours to keep);
- on-going support throughout the year.

Learn more about STELR at www.stelr.org.au
or contact STELR Project Manager Peter Pentland
(03) 9864 0906 or peter.pentland@atse.org.au

*"As science teachers,
your job is so important ...
there is no more important job
than yours in our nation today."*
– Richard Marles, Parliamentary
Secretary for Innovation
and Industry

The STELR Stage One Project 2009-2010 is supported
by the Australian Government.

 **ATSE**
STELR

STELR is a key initiative of the Australian Academy of Technological Sciences and Engineering (ATSE) www.atse.org.au

Form, function and sustainability

Sustainable materials, alternative transport options, recycling facilities and the ability to monitor and track environmental performance of the building construction and operation were also fundamental.

Natural light floods the
One Shelley Street building.



By Tristram Carfrae
and John Hewitt

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One Shelley Street at Sydney's King Street Wharf is a striking combination of beauty and function. Featuring a magnificent external diagrid structure and internal atrium, the building establishes new benchmarks in environmental sustainability and workplace functionality, achieving a 6 Star Green Star rating – the highest possible 'green' rating in Australia – from the Green Buildings Council of Australia.

Brookfield Multiplex's brief for One Shelley Street was to create a premium commercial office building with a strong architectural presence. Integral to the competition-winning architectural design is its diagonal grid, or diagrid, structure – a steel frame running through and on the outside of the building.

Conceived by architect James Fitzpatrick, the diagrid creates a distinctive visual characteristic and gives the building its unique identity. Its 10-storey central atrium is filled with natural light and acts as the building's hub, interconnecting the floors with 26 cantilevered meeting pods and bridges.

Paramount to the building's success is its level of sustainability and the feasibility of its design in terms of cost. Brookfield Multiplex wished to obtain the highest possible Green Star office design rating with emphasis on reduced water use and minimised carbon emissions.

Sustainable materials, alternative transport options, recycling facilities and the ability to monitor and track environ-

mental performance of the building construction and operation were also fundamental to the environmental goals of the building. This level of sustainability is increasingly sought.

Comprising one level of retail and 10 levels of A-grade commercial office space, One Shelley Street required expansive interlinked internal spaces to ensure connectivity between all work areas and to promote easy communication among the 3000 eventual occupants. Additionally, an indoor environment with superior air quality, occupant comfort and abundant natural light was also a high priority.

WSP Lincolne Scott and Advanced Environmental were involved from the early concept stages to ensure the client's goal of a world-leading ecologically sustainable development was realised. A comprehensive and site-specific environmental management plan was implemented and a full-time environmental representative was employed to ensure compliance with set goals.

In regard to energy, One Shelley Street was designed to exceed the 5 star NABERS (National Australian Built Environment Rating System) benchmark by 40 per cent. This allows the potential for the development to emit a very low level of greenhouse gas when compared to other buildings of comparable size and location.

The passive chilled beams with harbour heat rejection save more than six million litres of water and 2013 tonnes of carbon dioxide each year – equivalent to 2.4 Olympic

swimming pools of water and 50 average cars being taken off the road every year.

To increase natural light into the building, detailed consideration was given to the glazing selection in combination with lighting controls. An individually addressable DALI lighting system with automated perimeter dimming to adjust for daylight penetration was included in the design.

Indoor air pollutants were minimised by material specification, 100 per cent fresh air with no recirculated component, increased fresh air rates and optimised ventilation design. A comprehensive water and energy metering strategy with regular monitoring and reporting was also a significant factor of the success of the design.

Arup worked with the client and the project consultants to determine how best to negotiate the issues associated with the construction of a commercial office building above an existing basement. Originally home to a bus garage, the basement featured a complex column arrangement, with entry and exit ramps not appropriate for the new design. By placing the vertical diagrid structure outside the facade, internal floor spaces are unencumbered by perimeter columns, maximising the flexibility of the internal floor space and helping to transfer forces to the perimeter of the existing basement.

The diamond pattern created by the diagrid is fully triangulated using the slab edge beam on the inside face of the

facade. Stub connections cantilever inwards from the diagrid in order to transfer forces back to the edge beams. A regular diagrid pattern was chosen for ease of fabrication and erection, while the simple internal steelwork comprises standard universal beams with regular penetrations for services.

This repetitive design allowed for a speedy construction with all steel framing elements being assembled quickly. The 11-storey main frame was erected in around five months.

The diagrid enables the redistribution of vertical loads towards strong points in the existing basement, readily spanning across the bus ramps and minimising the basement strengthening works.

In one area within the atrium, the location of the bus parking in the basement prevents the placement of columns along the line of the atrium above. The diagrid therefore spans over three grid bays (approximately 29 metres), to suspend this area from above. This is achieved with no apparent additional structure.

Arup worked closely with the Robert Bird Group, which designed the substructure for the building at ground level and below, to develop the overall analysis of the building and the design of the new transfer structures that link the superstructure and the substructure. (The Robert Bird Group also provided peer review and certification for the structural design of the building as a whole.)

The connection between the diagrid and concrete

Keen to be green

Recent investigations by the Green Building Council of Australia indicate that large organisations are now demanding Green Star-rated office buildings, which not only enhance productivity but also strengthen brand association and credibility. According to a cost study by Davis Langdon, no significant cost differences are identified when green buildings are compared with conventional buildings. Provided the buildings with green credentials operate the way they are intended, this will generate added value for various stakeholders.

**Innovative bridges,
stairs and pods.**



ground floor structures was designed to transfer substantial vertical and lateral loads while minimising damage to the existing structure. This was done using welded dowel pins on the underside of base plates. These were laid out to align where grout-filled core holes could be positioned in the ground floor slabs around existing post-tensioning ducts. Beneath this level, existing and new structures pick up the loads and transfer them through the basement levels.

Arup incorporated complex 3D modelling, structural optimisation and documentation into the design of the diagrid (such as that used on the Beijing Water Cube) to allow rapid development and checking of design options for optimum performance and economy. The resulting building offers large flexible floor plates, natural light, great amenities and an opportunity to create a unique and safe working environment for the tenants.

Arup also designed the steel framing for the bridges, stairs and pods within the atrium, which reach out several metres across the atrium space to create meeting rooms and give open access between levels. Structurally, these needed to be light enough to avoid compromising the strength of the floors to which they attach, while also stiff and strong enough to act as an extension to the floors without undue deflection and vibration.

Intense collaboration

The structural system that was developed uses a steel frame of square hollow sections attached to the edges of the floors at two levels. This was augmented by diagonal braces for added stiffness. Particular care was taken to check the design for vibrations caused by occupant foot-falls.

In addition to the unique use of the external diagrid frame, another clever part of the construction is located inside the building and hidden above the ceilings. Intense collaboration by all parties resulted in the use of relatively deep 610 Universal Beam sections complete with standardised, large, un-stiffened penetrations to accommodate all building services passing through them.

These composite steel floor beams required no welding or painting and could therefore be delivered directly to site from the steel supplier, once again saving significant time and cost. The steel frame erection was carefully analysed beforehand so that all erection movements were fully understood and compensated for in the steelwork.

A complete fire strategy relating to egress, smoke control, structural fire resistance and emergency services was also incorporated into the building's design. The open atrium set a challenge to Arup's fire engineering team as the Building Code of Australia (BCA) is based on fire separation between floors to minimise fire and smoke spread throughout a building.

The fire engineering design uses a combination of atrium smoke exhaust and drop down smoke curtains to the upper levels along the atrium edge to keep smoke off non-fire floors, while allowing smoke from a fire floor to spill into the atrium. The exhaust and make-up air louvres in the atrium end walls maintain tenable conditions to allow for safe evacuation of the building. With smoke relief from the fire floor, smoke damage is also limited.

The use of the atrium for smoke exhaust also removed the need for additional smoke shafts on the office floors, which once again increased the net lettable area. Arup then rationalised the egress design, as increasing the net lettable area meant extended travel distances on the floor and an increased number of people exiting.

Sprinklers to the atrium roof were omitted and an aspirating system was used for smoke detection at the roof for Occupational Health and Safety and maintenance reasons. Glazed lifts run through the atrium, providing transparent connectivity to the building, which again were only permitted through the performance-based design.

Arup's fire engineering team sought input from the firm's computational fluid dynamics (CFD) experts globally and locally to incorporate best practice CFD modelling to prove the robustness of their design. This was approved by the NSW Fire Brigade and the Building Certifier.

Arup investigated a range of fire scenarios to check the robustness of the design, including different system failure scenarios. All were successful, with the fire engineering design subject of a peer review as well as review from the NSW Fire Brigades and the Building Certifier. All these parties approved it, attesting to the robustness of both the strategy and the analysis of the design. ◀

Arup, WSP Lincolne Scott and Brookfield Multiplex won one of five national excellence awards at the 2009 Australian Engineering Excellence Awards for their work on One Shelley Street.

TRISTRAM CARFRAE FTSE is a Principal at Arup, based in Sydney. He believes that good buildings should consume fewer materials and less energy, time and money, while providing greater amenity. He has a reputation for challenging the established way of doing things and this unique approach has produced some of the world's most exciting structures, where structural form is itself an aesthetic statement. His awards include the 2009 MacRobert Award, The Royal Academy of Engineering; 2008 Hero of Innovation, the Warren Centre; 2006 Royal Designer for Industry, The Royal Society for the encouragement of Arts, Manufactures and Commerce; 2006 Milne Medal, the International Association for Bridge and Structural Engineering; and 2001 Professional Engineer of the Year, Engineers Australia.

JOHN HEWITT is a Senior Associate of Arup, based in Sydney. He is an experienced structural engineer and fire safety engineer and has worked at Arup since 1983 on many high-profile projects in Europe, Asia, North America and Australia.



Dr David Nisbet, Materials Engineering

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MONASH University

Australia has had to become water-wise
before many other nations.

Necessity drives sustainable water solutions

Australia is riding a wave of proactive thinking that can be exported to the world and provide more opportunities for Australian engineers and scientists.



By Nicholas Apostolidis

nicholas.apostolidis@ghd.com

Ten years ago there were no major operational desalination plants in Australia, but climate change was making its way into the mindset of government and businesses alike. In 2010, following the worst drought on record, there are myriad water solutions being rolled out in this country's major cities.

Globally, we are now transitioning through a decade of heightened climate change awareness. Our politicians, the media, industry and institutions remind us daily of the threats and challenges associated with a warming planet. The call to action has never been louder.

Melting polar caps, rising ocean levels, floods, droughts and raging weather patterns capture our attention more frequently than ever. In Australia, the water industry has been in the front line of the war against climate change. More specifically, our water industry is facing a surge of adversity in the quest to provide water security to our rising population.

Our geographic location and the relative extremes of our climate have elevated the urgency for sustainable water resources. In essence, we have been forced to take the lead globally to develop a quick response.

Since the turn of the century, Australia has spent more than \$20 billion in the development of water solutions. Over the next 10 years it is likely that this trend will be replicated. Today, almost every capital city on Australia's coastline has built – or is in the process of building – a desalination plant.

Fast-tracked by urgency

Most of these projects have been fast-tracked due to the urgent nature of the problem. We simply had no option but to take action. A heightened awareness at community level and vigilant government action has meant Australian engineers and scientists have been pushed to formulate a range of responses to provide sustainable water solutions that have minimum effect on the environment.

The solutions now being adopted by most major urban areas across the country involve a combination of demand and supply-side measures that take advantage of the community's heightened awareness and improvements in technology, particularly membranes.

By adopting this more holistic approach, Australian cities are being configured to be more resilient to the impacts of climate change and much better-placed to accommodate future population growth.

Western Australia was perhaps one of the first states to experience the impacts of climate change, with a significant reduction in the stream flows reaching major water reservoirs over a protracted period starting in the late 1970s. The response to this predicament was the launch of the 'Security Through Diversity' plan by the WA Water Corporation. The plan embraced a combination of demand management and supply side solutions that included the construction of Australia's first major desalination plant in Perth.

Aside from improving water supply security, this plant

demonstrated Australia's commitment to sustainability by being one of the first major plants in the world to be powered by wind. The energy requirements for this plant are provided by the Emu Downs wind-generation facility at Badgingarra, 200 kilometres north of Perth.

The WA Water Corporation is purchasing about 70 per cent of the energy output to provide for all of the power needs at the plant, with the remainder being fed into the state's electricity grid. Acknowledging the success of this solution, similar strategies are or will be considered for most of the major desalination facilities in Australia, to deliver lower greenhouse emissions compared to alternative water supply schemes.

We can be smarter

Australian engineers and scientists have also recognised that as a growing country we can be smarter in the way we plan our future cities and communities.

The linear water system configurations that we inherited from the last century may not be as robust in a climate change world. By adopting a more integrated approach in the way we provide water supply, wastewater and storm-water services we can deliver more sustainable outcomes.

For example, the Pimpama Coomera development area, ultimately serving 150,000 people on the Gold Coast, incor-

porates the use of recycled water for landscape and outdoor use and rainwater tanks for toilet flushing and laundry use.

By adopting this configuration it reduces the amount of water that needs to be imported to the development by up to 80 per cent and reduces discharges to the environment by more than 70 per cent at similar costs to a linear scheme.

The fact that Australia has had to become water-wise before many other nations has led government, engineers, planners and facilitators to understand that the path to sustainable water resources is multi-faceted.

To further evolve, engineers must now illustrate that 'smart' solutions initiated at concept phase cost no more than traditional forms of water management. An integrated approach incorporating community planning, retrofitting of existing buildings and infrastructure and the development of more robust systems will equate to provision of fit-for-purpose water that is both environmentally conscious and cost effective.

As we enter uncharted waters from a technical, environmental and fiscal standpoint, we should take comfort in the fact that the cards Mother Nature has dealt Australia have led to dynamic change in the way we as engineers and scientists design responses to water security.

We have been pushed to the front line and forced to combine innovative engineering with environmental empathy. We are lucky that this 'rite of passage' has arrived on our shores so soon, as we are now seen as a pioneer in the adoption of advanced technology.

In comparison to other nations of greater population and higher water demand, Australia is riding a wave of proactive thinking that can be exported to the world and provide more opportunities for Australian engineers and scientists. ◀

NICK APOSTOLIDIS is General Manager, Client Development at GHD. He was appointed to the Board in 2002. He has more than 30 years' international experience in consulting, in particular the water sector which he led for the past 10 years. He is a director of Water Australia and was recently appointed to the Board of the Australian Green Infrastructure Council. In his current role, Mr Apostolidis is responsible for the Global Market Sector Leaders, Marketing and Innovation.

'MAKE IT SO', SAY ENGINEERS

New multi-million dollar public awareness initiative has been launched by the engineering profession to assist in curbing the skills tide.

Engineers Australia is investing more than \$2.5 million in a new public awareness initiative – 'Make it so', which aims to shift Australians' perceptions and increase understanding of the engineering profession, while inspiring more Australians to consider careers in engineering.

A core component of the new initiative is a world-first competition calling on everyday Australians to submit ideas via a dedicated website, with one person having their idea 'made so' by an engineering team. People are encouraged to visit www.makeitso.org.au to submit, share and champion their ideas.

Peter Taylor, CEO of Engineers Australia said a benchmark study had revealed that while engineering had a high level of advocacy among Australians, there was a very low level of understanding about what the profession actually involved.

"These results combined with a declining number of young people choosing to study engineering at university and a long-standing shortage

of engineers in the workforce prompted us to take action," he said.

"The study also revealed that Australians highly associate engineering with turning ideas into reality. We decided to pursue this insight and appeal to Australians' love of innovation and imagination by encouraging them to share their own ideas and showcase how an engineering team can help make it so.

"We want to lift the curtain on what it is engineers actually do. We want to help Australians understand that from bridges to Blackberrys, drinking water to the Water Cube – engineers and engineering teams help 'make it so' in the community," Mr Taylor said.

In the lead up to the initiative, social researcher Mark McCrindle queried Australians on what they would like engineers to assist them with in the coming decade. Overwhelmingly Australians nominated water sustainability, followed by medical innovation, housing and infrastructure development to deal with a growing national population and climate change.

More information at www.makeitso.org.au



Hard at work (from left) John Sligar, Ron Hardwick, George Grozev and Tommy Mølbak.

ATSE FOCUSES ON ELECTRICITY FOR THE NEXT 40 YEARS

The policy and technology challenges behind secure electricity systems in Australia for the next 40 years was the focus of a two-day international workshop conducted by the Academy in Sydney.

More than 40 energy experts attended to hear a raft of speakers, including Mr Peter Greenwood, Group Executive Director (Strategy), China Light and Power Holdings (Hong Kong) and Mr Tommy Mølbak, Manager, Modelling and Optimisation, Dong Energy Kraftsverkje (Denmark).

The workshop was funded through the International Science Linkages – Special Academies Program (ISL-SAP) of the Australian Department of Innovation, Industry, Science and Research and supported by the NSW Government. It was a key initiative of the Academy's Energy Forum, which has been active in pursuing energy options for Australia through a number of workshops and studies in recent years.

Dr John Burgess FTSE and Mr Ron Hardwick FTSE were ATSE speakers. Other speakers included:

- Mr Phil Southwell, General Manager Strategy and Corporate Affairs, Western Power, and Chair of the International Committee C1 of the International Council of Large Electric Systems (CIGRE);
- Dr Brian Spalding, Executive General Manager Operations, Australian Energy Market Operator (AEMO);
- Dr George Grozev, Research Scientist, CSIRO Sustainable Ecosystems;

- Professor David Hill, Professor and Federation Fellow, ANU;
- Mr Adrian Clark, Manager Intelligent Networks, EnergyAustralia;
- Mr Steve Edwell, Chair, Australian Energy Regulator; and
- Mr Drew Clarke, Secretary, Department of Resources, Energy and Tourism.

A raft of Fellows participated, led by ATSE President, Professor Robin Batterham AO

FREng FAA FTSE, and the NSW Chief Scientist and Scientific Engineer, Professor Mary O'Kane FTSE. Participating Fellows included Vice President Mr Peter Laver AM FTSE, Energy Forum Chair Mr Martin Thomas AM FTSE, Dr John Sligar FTSE, Dr Mike Sargent AM FTSE, Dr Alan Finkel AM FTSE, Mr Ken Dredge FTSE, Dr Ian Duncan FTSE and ATSE Executive Director – Technical, Dr Vaughan Beck FTSE.

In his welcome address recorded for the workshop, Resources and Energy Minister Martin Ferguson noted the major investment challenge ahead.

"Australia needs to invest about \$100 billion in our electricity infrastructure, including generation and network assets, between now and 2020 just to meet growing demand and replace ageing infrastructure," he said. "This is an investment comparable to Australia's current asset base of \$120 billion in power generation, transmission and distribution.

"Australia has the capacity to make the necessary investment to meet the challenge ahead. The Government is engaging with industry and experts to ensure our market and regulatory settings encourage the investment we need."

Academies meet with Nobel Laureate

ATSE CEO Dr Margaret Hartley was among the guests in February when Senator Kim Carr, the Minister for Innovation, Industry, Science and Research, named the 'Blackburn Room' at Questacon – Australia's national science and technology centre in Canberra – in honour of the Nobel Laureate, Professor Elizabeth Blackburn AC FRS.



(From left) Dr Sue Meek, Chief Executive, Australian Academy of Science; Dr John Byron, Executive Director, Australian Academy of the Humanities; Dr Margaret Hartley CEO, ATSE; Professor Elizabeth Blackburn; guest; and Dr John Beaton, Executive Director, Australian Academy of Social Sciences.

Professor Blackburn is an Australian-born biological researcher at the University of California, San Francisco, who studies the telomere (a structure at the end of chromosomes that protects the chromosome). She co-discovered telomerase, the enzyme that replenishes the telomere. For this work, she was awarded the 2009 Nobel Prize in Physiology or Medicine, sharing it with two others.

During her visit to Australia in February the Chief Scientist of Australia, Professor Penny Sackett, also hosted a Q&A session between Professor Blackburn and herself and Year 12 students from Canberra.



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ATSE HOSTS NATIONAL ENERGY BRIEFING

ATSE linked with IChemE in Australia (the Institution of Chemical Engineers) to hold a national energy briefing dinner in Melbourne recently – with keynote presentations from two Academy Fellows.

The dinner, sponsored by Dow Chemical (Australia), featured:

- Mr Andrew Liveris FTSE, the Michigan-based Chair and CEO of Dow Chemical Company, the diversified global chemical company with annual sales in 160 countries exceeding \$50 billion and some 46,000 employees ([see page 26](#));



(From left) John White, Drew Clark and Andrew Liveris.

- Mr John White FTSE, one of Australia's most experienced industry executives and currently Chair, Global Renewables and MD of Ignite Energy Resources, with major brown coal deposits in Gippsland and plans to integrate leading-edge,

low-emissions technologies to create high-value energy and biological fertiliser products ([see page 29](#)); and

- The Secretary of the Federal Department of Resources, Energy and Tourism, Mr Drew Clark PSM, who has extensive

experience in the development and delivery of policy and programs in the fields of science, business and energy.

Some 150 ATSE Fellows, IChemE members and Dow senior executives attended the briefing dinner at Melbourne's Docklands.

ATSE hands-on at CAETS Japan meeting

An eight-country push to reduce electricity generation emissions in response to greenhouse gas reduction targets – an initiative originated by ATSE – was progressed at a recent CAETS Working Group meeting in Tokyo.

ATSE Executive Director – Technical, Dr Vaughan Beck FTSE, and ATSE expert contributor Dr John Burgess FTSE joined delegates from academies in the UK, Korea, India, South Africa, Germany, Canada and Japan to discuss the project titled 'Evaluation of Strategies to Deploy Low Emissions Technologies for Electric Power Generation in Response to Climate Change'.

They developed an outline of a presentation that will be delivered to the June meeting in Copenhagen of the Council of CAETS (the International Council of Academies of Engineering and Technological Sciences).

The Working Group identified seven issues and associated actions that will form the basis of the presentation to the CAETS Council meeting.

1. Implementing low-carbon technologies is

expensive and has high uncertainty and risk. In some cases this deters deployment. Users will pay a substantially higher price for the same service.

2. Renewable energy will make an increasing contribution, but globally (with national variations) we will continue to rely on fossil fuels, with some nuclear, in at least the medium term (to 2030).
3. The decision to address climate change has created the need for a long-term strategic development of new low-carbon technologies that only governments can drive.
4. Each country will have a unique portfolio of technologies derived from a wider global set.
5. Demand management will be essential, and the introduction of the new technologies will raise a suite of new social issues.
6. Electricity will increasingly become the energy carrier of choice, including potentially for road transport – movement towards the Electricity Economy. To enable the use of low-carbon technologies, the

architecture of many existing grids will have to change.

7. Global deployment of existing best practice in energy efficiency would deliver enormous reductions in carbon emissions without large development expenditure or risk.

Dr Beck said after the Tokyo meeting that the issue of climate change was receiving considerable attention internationally.

"While governments are setting targets and providing funding support for low-emissions technology research and demonstration, it is clear that further and larger investments will be required to deploy these technologies at large scale.

"There is a need to accelerate the deployment of these technologies if target levels of greenhouse gases are to be met.

"Current public policy reflects to varying degrees this need to accelerate technology deployment but it is not yet well informed on the practicalities of the implementation pathways," he said.

Contributions are welcome

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



Andrew Liveris
makes a point.

A DIFFERENT TAKE ON THE ENERGY ISSUE

If individual countries want to expand their economies and provide a sustainable business environment that attracts investments, they must embrace “new ways of doing business”.

That was the message from Andrew Liveris, who said the days of believing that the growing the economy and environmental protection were two separate ideas was outdated.

“The economy and the environment are part of the same big picture,” Mr Liveris said. “If our cities are under water in 50 years, the global economy will be too. Since there isn’t an option, we need to get positive and find ways to achieve win-win solutions.”

Mr Liveris acknowledged that all countries, including Australia, must make tough decisions and equally tough tradeoffs. But he used Dow as an example of one company that had transformed the way it approached growth by incorporating environmental and other issues into its strategy.

“We’ve transformed our company around the idea that some of the world’s biggest challenges – megatrends like the need for cleaner, more abundant, more affordable energy – can be major business opportunities,” he said.

He encouraged the audience to use the same drivers Dow was using – conservation and innovation – as a launching pad to transform government policies that would accelerate growth while also protecting the environment. He said conservation was the “quickest, cheapest and easiest” answer to the world’s growing energy crisis, pointing out that Dow had invested approximately

US\$1 billion in energy conservation over the past several years, making major changes in chemical processes, large scale investments in cogeneration facilities, and also fundamentals such as ensuring that steam traps do not leak.

Since 1990, that investment had allowed the company to reduce its energy intensity by 38 per cent, saving 1600 trillion BTU of energy. During the same period, the company also prevented 86 million metric tons of CO₂ from being released into the atmosphere – a 20 per cent reduction in absolute greenhouse gas emissions, well beyond the voluntary targets set at Kyoto.

The best bonus, he said, was that the US\$1 billion investment converted into a savings of US\$8.6 billion. “I’ll be honest, if that \$1 billion investment was a \$1 billion loss, we wouldn’t have done it. Dow is a business, not a philanthropy. We made these changes not just because they’re good for the environment, but because they’re good for our bottom line.”

Higher sustainability goals

Convinced that environmental consciousness is good business, the company had set higher sustainability goals and climate change targets for the future. By 2015, the company aimed to reduce energy intensity by another 25 per cent and cut greenhouse gas intensity by 2.5 per cent a year.

“I am confident that what Australia is doing – pledging to reduce emissions by 25 per cent below 2000 levels by 2020 and its ‘Water for the Future’ framework – will also yield future bonuses that justify the tough

decisions that you are making today,” he said.

“Doubling efficiency improvements would hold CO₂ concentrations below 550ppm, the apparent threshold for dangerous climate change; save \$3 trillion in electricity generation costs; and reduce demand by the output of 2000 coal-fired power plants.”

Mr Liveris said that conversation by itself, however, would not be enough to solve the world’s problems. The other necessary initiative must be innovation, both within industry laboratories and within the halls of government.

Over the past century, groundbreaking ideas and technologies had made the impossible possible time and again. Aeroplanes cut distances between countries and antibiotics and vaccines eliminated some of the planet’s most deadly diseases. New crop strains ended hunger for millions of people in developing countries while the microprocessor ushered in an age of instant communication.

The need to balance development and environmental protection was driving innovation at Dow, Mr Liveris said. But it was also driving new developments throughout Australia and the rest of the world, he said, that “are nothing short of breathtaking”, such as the following.

CARBON CAPTURE AND STORAGE.

Only a few years ago, the idea that carbon dioxide would be harvested from a smokestack was unthinkable, but it is already happening today although not scalable as yet. If carbon capture and storage becomes feasible, it would mean that coal could continue to be a big part of the energy mix and would remove the single biggest hurdle to Australia’s transition to clean energy. “That’s why it was encouraging to see Australia start the Global Carbon Capture and Storage Institute and take real international leadership on this issue. Dow is proud to be one of the Institute’s founding members.”

BIOFUEL

Algae eat through carbon emissions with machine-like efficiency and their waste product is ethanol, a fuel.

NEXT-GENERATION NUCLEAR PLANTS

Small nuclear power sources that are so safe, they can be used at an industrial site not just

from which to draw nuclear energy, but also heat energy.

"None of these technologies is a sure thing, but innovation never is," he said. "If any one of them works, it would be a game-changer for Australia and the world."

Innovation in public policy

Mr Liveris thinks innovation should not just happen in science laboratories – it should also happen in legislatures. "We need creativity and entrepreneurship in public policy just as much as in the private sector. We need governments and multilateral organisations to bring business leaders, NGOs, academics, and other stakeholders to the table and craft balanced, comprehensive energy policies. We need innovative public-private partnerships now more than ever"

He outlined four broad policy innovations that could help bridge the gap between economic development and environmental protection. "If we don't meet these challenges," he said, "we could be facing the worst catastrophe human beings have ever faced."

1 Policies that encourage efficiency

Paralleling Dow's own experience, energy efficiency is also the low-hanging fruit for public policy makers. Public and private sectors should work together on meaningful efficiency standards for things like buildings, automobiles and appliances – standards that would be implemented by business.

2 Policies that speed the development of alternative and renewable energy supplies

"There's a saying in our business: 'It's easy to find the first investor ... for my second plant.'"

Government needs to seed the ground for alternative energy and pioneers of innovations must be supported.

3 Policies that address climate change

Carbon pricing, for example, is a way to reduce carbon footprint and at the same time, introduce some degree of predictability for businesses to make investment decisions. The other half of the equation is that money generated must be channelled towards developing new technologies.

4 Appropriate energy policy ... the best use of our energy resources

While viable alternatives are being invented and scaled up, current resources need to be embraced and used efficiently to ensure that economies continue to grow. This is best helped by a comprehensive, balanced energy policy that encourages the availability, sustainability and stable supply of traditional energy.

"That which baffles me is that every year, three million tons of liquefied natural gas come on shore to Darwin but not a single drop is available domestically to Australians," said Mr Liveris, a Darwin native.

"Because prices are high right now for oil and gas, the market dictates that all this LNG should be sold and shipped to other countries."

Positive government action

He said that market forces were not the solution and called for positive government action as a remedy.

Balancing gas available for domestic

consumption versus LNG export would not just meet local energy needs, he said, but it would also open the opportunities for the development of advanced downstream manufacturing industries that takes commodities and turn them into high-value, high-margin products.

There should be an incentive to use gas, rather than coal, for local consumption that recognised the preferred environmental impact. Australia was in a unique position to capitalise on the gas resource position to stimulate downstream value-adding.

Such value-added manufacturing would stimulate local investment, create high-paying jobs, attract top scientists and engineers, put money back into the system, and strengthen the industrial and economic base of the nations like Australia.

"The US chemical industry used US\$85 billion worth of energy/feedstocks last year," he said. "We had a direct output, however, equal to US\$689 billion, an eight-fold value-add. For every job created in the chemical industry, more than five additional jobs were generated elsewhere in the economy."

Every day, Dow used the energy equivalent of 850,000 barrels of oil – nearly equal to the daily oil consumption of Australia. He pointed out, however, that Dow wasn't simply burning fossil fuels – it was breaking hydrocarbon molecules down and using the pieces as building blocks for its manufacturing process. About 85 per cent of Dow's energy demand was used on feedstocks – raw materials to make its products.

"Without energy, chemistry doesn't work. That means we at Dow have a real interest in being at the forefront of this fight."

Front and centre at ThinkFuture 2010

The Academy played a leading role at the ThinkFuture 2010 Smart Infrastructure Conference in Canberra in March.

ATSE President Professor Robin Batterham AO FEng FAA FTSE joined Australia's Privacy Commissioner, Karen Curtis, as the keynote speaker at the event, hosted by the House of Representatives Standing Committee on Infrastructure, Transport, Regional Development and Local Government.

Three ATSE Fellows participated as workshop convenors:

Water Sector – Dr Tom Connor FTSE, Director Engineering and Technology, Kellogg Brown and Root, and a member of ATSE's Water Forum leadership group;

Transport Sector – Dr Max Lay AM FTSE, Director, Connect East; and

Energy Sector – Mr Martin Thomas AM FTSE, Chair Dulhunty Power and Chair of ATSE's Energy Forum.

The Conference focused on ways to maximise the potential benefits to Australian communities of embedding smart technology into Australia's infrastructure and was held as part of the Committee's inquiry into smart infrastructure.



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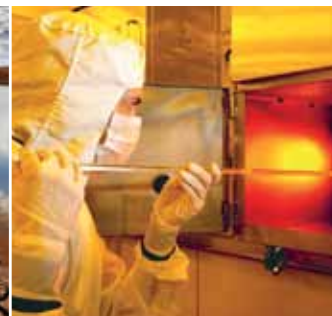
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NUCLEAR AND BIO-CCS HOLD ENERGY AND ENVIRONMENT ANSWERS

Australia's degraded soils could hold the key to solving Australia's carbon dioxide (CO₂) emissions problems, according to John White.

Increasing soil carbon is one of the few proven, large-scale possibilities – and arguably the best and most sustainable way – to remove existing atmospheric CO₂ in the short-term and, at the same time, make soils more fertile and drought and salinity-resistant, providing enhanced food security and quality.

This bio-sequestration of CO₂ (Bio-CCS) would provide a low-risk, low-cost system that government should recognise and encourage, with support equivalent to that being provided for geological carbon capture and storage (Geo-CCS) – a technology which may not be available at-scale for many decades, he told the ATSE/ICHEM energy briefing dinner.

Australia's landscape and farms are so degraded and vast that they could suck up fossil fuel emissions through Bio-CCS at positive value and at low cost for hundreds of years, providing a multiple win-win solution for farmers, the community, big emitters and the environment.

He noted that Australia did not have an energy security issue, with extensive coal and gas reserves, abundant low-cost uranium and vast renewable energy potential.

But Australia did have a shortage of transport fuels and a greenhouse gas emissions problem and, therefore, energy policy challenges.

He argued that nuclear energy and, in particular, nuclear fuel leasing could be significant part of the low-emissions climate change solution for Australia, but noted government policy was not yet favourable.

He said Bio-CCS provided an immediate opportunity to help resolve Australia's CO₂ issue – which would allow us to continue to utilise Australia's abundant coal and other fossil fuels, until alternative low-emissions and renewable energy infrastructure could be established over the next 30 to 50 years.

Great opportunity for Australia

"A predominant cause of climate change is worldwide vegetation clearing and degradation of soil carbon – perhaps it is a more significant cause than fossil fuel burning, historically speaking," Mr White said.

"This presents great opportunity for Australia. We have some of the most degraded agricultural lands in the world, so our opportunity to sequester CO₂ as terrestrial carbon, using modified farming techniques, is vast – potentially sufficient to offset all our fossil fuel emissions for many decades, even centuries, with appropriate policy settings.

"Australia has some of the world's largest brown coal or lignite reserves. These are, geologically, very young – just past being peat.

"Victoria's lignite is some of the 'cleanest' coal in the world – low in sulfur, ash and heavy metals – but it is up to two-thirds water and unacceptable to burn for electricity, as it is low in thermal efficiency and emits two to three times the CO₂ of black coal or gas.

"Victoria has 430 billion tonnes of lignite, with about 40 billion

tonnes mineable at \$5 to \$10 a tonne, which is several times the energy reserve of the North West Shelf and equivalent to Saudi Arabia's oil fields. This could power south-eastern Australia for several centuries.

"Victoria's lignite will always be much cleaner and cheaper than Australian east coast black coal, but I do not believe that electricity is the highest value use for this rich clean lignite material," Mr White said.

New Australian technologies showed real prospect to convert lignite at low cost and with low emissions into clean, low-sulfur thermal/coking coal equivalent, transport fuels and fertilisers.

The management of CO₂ emissions from lignite use remained an issue, but one answer might be biological carbon capture and storage, or Bio-CCS, using the same peat-like lignite to make a biological, carbon-based, humic and fulvic-rich fertiliser, to catalyse Australia's vast cropping and grazing lands to photosynthesise CO₂ from the atmosphere and store it productively, through the plant roots, as soil carbon.

He noted a 2009 European Environment Commission report which underlined the crucial role soils could play in mitigating climate change and that "Soils contain around twice the amount of carbon in the atmosphere and three times the amount to be found in vegetation."

► [MORE ON PAGE 30](#)

Nuclear has the answers

Australia could resolve its emissions reduction obligations by planning to build 20 nuclear power stations by 2050, according to John White.

"We have the oldest, most stable geology, bar-none, in the world, from which we mine uranium near the Woomera/Maralinga exclusion zone," he said.

"Australia can establish an High Isolation Repository in this internationally superior location for storing spent nuclear fuel, near the Adelaide–Darwin railway line, and we can add value to Australian-mined uranium (and, in the future, thorium), to manufacture nuclear fuel assemblies.

"With 24/7 satellite tracking devices embedded, Australia could then lease nuclear fuel to the world, bringing it back for safe storage – as we should – given we have around half the world's low-cost export uranium (and prolific thorium) for new-generation, low-risk reactors.

"Australian nuclear fuel leasing could therefore earn billions of dollars to help fund a low-emissions nuclear power (and renewable energy) fleet, and it would solve the emerging nuclear proliferation issues of selling yellow-cake, that cannot be tracked with certainty, to countries that are not members of the Non-Proliferation Treaty.

"But Australia will have to be encouraged in this direction by the international need and leadership, which I predict will be the case."

◀ FROM PAGE 29

The report also emphasised the need to sequester carbon in soils – “the technique is cost competitive and immediately available, requires no new or unproven technologies, and has a mitigation potential comparable to that of any other sector of the economy.”

“A major cause of climate change has been the clearing of vegetation and forest, and the degradation of agricultural lands of vegetation coverage and soil carbon,” Mr White said.

“My firm view is that humans are causing climate change – and it will have extreme consequences for human life on Earth. Planet Earth will survive this climate change event, as it has previous ones in the geological record, but humans may not fare so well.

“So we should quickly do everything that is useful and efficient to reduce the various possible causes of climate change and to suck-down CO₂ from the atmosphere, as a precautionary measure.

“An estimate of the total carbon lost from soils worldwide, by human activity over the past 10,000 years, is about 6000 billion tonnes – which could be 15 to 20 times the total fossil fuel emissions since the Industrial Revolution – around 360 billion tonnes.

“In addition, the altered surface albedo effect of vegetation and forest clearance has a major impact on surface/atmospheric temperatures and local precipitation and evaporation – which sounds like climate change!

“So I suggest the focus on fossil fuel emissions as the predominant cause of climate change – and the source of the main cure – is misplaced.

“The Earth’s biomass has been photosynthesising CO₂ from the atmosphere and converting it to organic/carbon matter in the soils and oceans for around a billion years – to form the peat/coal/oil/gas, which humans have dug up and burned a significant percentage, mainly over the past few generations.

“It should not surprise us that destroying a major means of bio-sequestration, namely vegetation coverage, and burning a significant portion of a billion years of sequestered carbon, in the form of fossil fuels in just a few decades, could have a significant effect on the dynamics in the atmosphere.

“It then seems obvious to me that if we wish to reverse this impact, we should seek to harness the Earth’s natural CO₂ pumps – the plants and biology – to re-establish and accelerate the photosynthesis of CO₂ back into the soils via the plants’ root structures.

Mr White said scientists had estimated that soil carbon lost since European settlement from the 500 million hectares of Australian rangelands and farmlands, by traditional grazing and cropping, could be as much as 150 to 200 billion tonnes of CO₂ sequestered in the soils. The average soil carbon content of these farmlands had dropped from three to four per cent down to around one per cent in this period. This was

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CSIRO – managing Australian treasures

Did you know that CSIRO manages three major national research facilities: The Australian Animal Health Laboratory, the Australia Telescope, and the research vessel *Southern Surveyor*?

The **Southern Surveyor** is available to marine scientists to explore and study our oceans and is Australia’s only dedicated blue-water research vessel.

The **Australia Telescope National Facility** is the largest astronomical institution in Australia. 80% of the telescopes’ users come from outside CSIRO.

The **Australian Animal Health Laboratory** has produced new diagnostic tests, vaccines and treatments for both exotic and endemic animal diseases.

CSIRO also manages over 30 other research facilities. These irreplaceable collections include the Australian National Fish Collection, Australian National Insect Collection, Australian National Herbarium, Australian National Wildlife Collection, and the National Tree Seed Collection.



equivalent to around 300 years of Australia's current annual greenhouse gas emissions.

"So if Australia could remediate its vast agricultural soils just part way back to pre-European soil carbon levels (without using excessive synthetic chemical fertilisers and fungicides that destroy soil carbon and biology and emit nitrous oxide), soils scientists such as Dr Christine Jones suggest that we would be sequestering approximately 50 billion tonnes of CO₂ for each one per cent increase in soil carbon (down to 30 centimetres depth).

Biological fertilisers

"Against this, note that global greenhouse gas emissions are approximately 45 billion tonnes per annum.

"Putting it another way, a 0.2 per cent increase in soil carbon on just five per cent of Australia's cropping and grazing lands, each year, would offset all of Australia's current annual greenhouse gas emissions.

"This process converts CO₂ from waste and pollutant into a useful feedstock.

"Australian companies over the past 15 years have developed biological fertilisers blended from carbon-based materials, lignite particularly, and other nutrients, minerals and micro-biology, which reduce the need for synthetic chemical fertilisers and pesticides, at lower

Technology can now convert climate change from being a threat into a massive opportunity for Australia.

cost and using the same on-farm distribution rates and machinery.

"As part of a biological cropping and grazing system, which avoids deep-tillage, stubble-burning and over-grazing, biological fertiliser is now used on hundreds of farms across Australia.

"It sustainably increases soil carbon year-on-year, by rebuilding the biology and humic substances in the soils, so that plants can grow deeper roots and exude carbon photosynthesised from atmospheric CO₂ into the soils.

Technology can now convert climate change from being a threat into a massive opportunity for Australia.

"Biological farming and other Bio-CCS technologies, such as algal sequestration of flue-gas CO₂, can form a 'carbon bridge' – to a low emissions nuclear and renewable energy future, sustainably – delivering energy security and food security and protecting our economy from high costs of CO₂ mitigation.

"Rebuilding terrestrial carbon levels is arguably the only immediately available, large-scale system for reducing the legacy CO₂ levels in the atmosphere," he concluded.

German team visits for photovoltaic talks

ATSE hosted the week-long visit of a 12-man German advanced photovoltaics delegation to Australia in February.

The German delegation visited Melbourne, Sydney and Newcastle and engaged with Australian counterparts at a one-day research roundtable meeting in Canberra.

The visit was sponsored by the German and Australian Governments, with support from the Department of Innovation, Industry, Science and Research's International Science Linkages (ISL) program.

ATSE CEO Dr Margaret Hartley noted that Australia and Germany had many energy-related issues. "Both countries are especially strong in the field of photovoltaics and are seeking to augment the use of this technology. Those Australian researchers participating in this event represent the cream of Australian researchers in the field of photovoltaics."

The visit began with a dinner in Melbourne hosted by ATSE Vice President Mr Peter Laver AM FTSE.

The delegation met with senior researchers from the University of Melbourne, CSIRO

(Melbourne and Newcastle), RMIT, Swinburne University, the University of NSW, the University of Newcastle and ANU, and attended policy meetings in Melbourne, Sydney and Canberra.

ATSE was strongly represented, with Fellows acting as site visit hosts and as discussion participants in each location. These included ATSE Executive Director – Technical, Dr Vaughan

Beck, Professor Erol Harvey, Dr Calum Drummond, Professor Chris Fell, Professor Edwina Cornish, Professor Yi-bing Cheng, Professor Min Gu, Professor Frank Larkins, Dr Geoff Garrett, Dr Mike Sargent, Professor Martin Green, Professor Stuart Wenham, Professor Andrew Holmes, Professor Andrew Blakers and Professor Chennupati Jagadish.

The German delegation leader, Dr Klaus Lips, Vice Director Institute Silicon-Photovoltaics, Helmholtz-Zentrum Berlin für Materialien und Energie (centre), visits Bio 21 in Melbourne.



Science meets Parliament “most valuable” – delegates

In March ATSE sponsored Science meets Parliament (SmP) 2010, a major event in Canberra organised by the Federation of Australian Scientific and Technological Societies (FASTS).

ATSE's gold sponsorship entitled it to nominate five mid-career scientists as delegates to attend – Mike Shackleton, ARRB; Ben Muir and Sharon Sagnella, CSIRO; Tanya Monro FTSE, Adelaide University; and Craig Priest, University of South Australia. Each delegate was proposed by an ATSE Fellow.

ATSE Fellow Dr Cathy Foley, President of FASTS, welcomed guests to the SmP dinner at Parliament House, addressed by Senator Kim Carr, Minister for Innovation, Industry, Science and Research. The keynote speaker – on the debate surrounding climate change – was Chair of the Australian Science Media Centre, also sponsored by ATSE, Mr Peter Yates.

Professor Tanya Monro's work in photonics and advanced sensing was among the topics selected for a Meet the Scientists media conference during the two-day event, which also included a National Press Club lunch, briefing sessions on presenting science to Parliamentarians and meetings between participants and Federal parliamentarians to discuss issues of mutual interest.

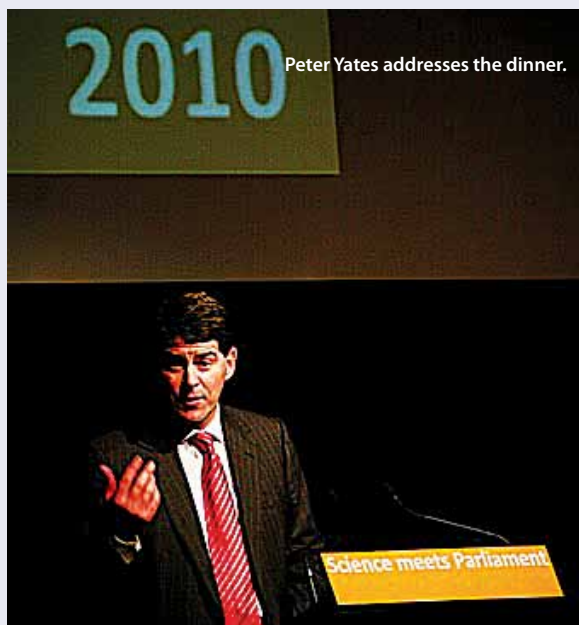
CEO Dr Margaret Hartley, Dr John Bell and Mr Tom Fisher represented ATSE at the dinner and lunch.

The five ATSE delegates all said the event was of value to them and enhanced their understanding of politics and the media.



Mike Shackleton is General Manager: Academy and Development at ARRB Group (formerly the Australia Road Research Board). Mike's research interests are road asset productivity and research performance management and he is reading for a PhD on the latter topic at Monash University.

At ARRB, he is responsible for programs aimed at making Australia's road research capability sustainable. Other activities



involve working with ARRB's Chief Scientists to instill scientific rigour as a core value in ARRB's researchers, and fostering collaboration between ARRB and local and international research partners.

Mike saw the SmP program as one of the most valuable professional development events he has attended.

"This is because it identifies the 'story' of the research as the key to communicating with those who do not have the time to build a picture for themselves from all the facts and data," he said.

"The networking opportunities SmP offers cannot be overestimated. It is comforting to find that the concerns in one discipline are common to others as well. This comfort stems from not just 'common suffering' but also from the opportunity to learn from the experiences of others."



Professor Tanya Monro FTSE is an ARC Federation Fellow and the Director of the Institute for Photonics and Advanced Sensing (IPAS) at the University of Adelaide. IPAS works at the boundaries of physics, chemistry and biology to create technologies for health, the environment, defence, food

and wine. She is also the Director of the Centre of Expertise in Photonics, which, in partnership with DSTO, develops new optical fibres for defence.

In 2009 she was named *The Weekend Australian Magazine's* Next 100 Emerging Leader, Science, and in 2008 was awarded

the Australian Prime Minister's Malcolm McIntosh Prize for Physical Scientist of the Year. In 1998 Tanya was awarded the Bragg Gold Medal for the best Physics PhD in Australia. She then moved to the UK where she won a Royal Society University Research Fellowship, and in 2005 came to Adelaide as inaugural Chair of Photonics. Professor Monro has published over 320 papers and raised more than \$59 million for research.

"SmP gave me amazing tips on how to get a pithy message across to politicians – all in the time it took for a sparkler to burn! For me it was also a fantastic way to get to know a great diversity of talented scientists from across Australia," she said.



Dr Ben Muir is a research scientist and project/team leader at CSIRO Molecular and Health Technologies. He gained a PhD in Materials Engineering from Monash University in 2003. Before joining CSIRO he discovered and helped commercialise an antibody-binding technology in an

Australian biotechnology company.

He currently works on the development of medical imaging contrast agents that are made from nanoparticles. These nanoparticles will be able to save lives by diagnosing diseases in people before they even display symptoms.

"I am very grateful to have been lucky enough to be invited by ATSE to attend Science Meets Parliament. It was fantastic to see the inner workings of Parliament House and realise that politicians have an incredibly busy and difficult job in implementing and developing policy in our country," he said.

"They spend an incredible amount of their time meeting with various stakeholders and organisations in order to determine what issues they need to take action on.

"One of the main take-home messages for me was the fact that we can all implement change in a positive way and affect the direction our government takes, not only in science issues but in any aspect of life that we feel passionately about," he added.



Dr Sharon Sagnella is currently a postdoctoral fellow at CSIRO Molecular and Health Technologies. She was awarded her PhD in Biomedical Engineering from Case Western Reserve University in 2003. Before joining CSIRO, she worked in the field of biomaterials, with a focus

on cardiovascular biomaterials.

Since joining CSIRO in 2005, she has worked in the field of nanotechnology, with a focus on the development of multifaceted drug delivery systems made from nanoparticles. These nanoparticles combine early detection and diagnosis of

diseases with the ability to deliver treatments more effectively with limited side-effects.

"I am very appreciative to ATSE for providing me with the opportunity to attend Science meets Parliament," she said.

"The entire two-day program presented a fantastic opportunity to meet with both politicians and other scientist and to see how vital effective communication between scientists and politicians is for effecting positive changes within the government.

"It was also interesting to be given the opportunity see how busy an average day at Parliament House can be for a politician, and thus how important it is to get your message across to them in an efficient and effective manner."



Dr Craig Priest is a research fellow at the Ian Wark Research Institute, University of SA. He completed his PhD in 2005 on the interaction of liquids with chemically microstructured surfaces, followed by postdoctoral work at the Max Planck Institute for Dynamics and Self-Organization, Germany, on

emulsion structure and behavior in microfluidic systems.

He is currently investigating the behavior of liquids in microfluidic devices for applications in solvent extraction, dispersions, and capillarity. His work is focused on the development of next-generation microfluidic devices for industrial process intensification.

"Science meets Parliament provided an excellent platform to engage with our parliamentarians and gain a greater understanding of what drives our political leaders," he said.

"The emphasis on the scientist's role in guiding political decision-making and therefore new policies was interesting, especially in the context of the drivers of media and community consensus. Understanding the 'agenda' of the Parliament and mastering effective communication can be challenging for many scientists, but SmP was a great opportunity to develop these necessary skills and put them into practice.

"I especially enjoyed interacting with scientists from different disciplines and locations in Australia, both industry and academia," he added.

Cathy Foley welcomes guests at
Parliament House dinner.

Science
meets
Parliament
2010





(From left) Graeme Offer and Diana Tomazos, from South Fremantle Senior High School, and Stephanie Hibbert and Namita Patel, from Newman Senior High School, get familiar with the equipment at the Perth workshop.



Teachers go back to school for science

Nearly 400 teachers from across Australia met in March as part of a campaign to re-energise science teaching in Australian high schools.

They attended two-day professional development workshops in Melbourne, Brisbane, Sydney and Perth as part of ATSE's STELR campaign to bring more relevance to science teaching in secondary schools.

The Melbourne workshop was officially opened by Mr Richard Marles, the Parliamentary Secretary for Industry and Innovation, and the Perth workshop by Dr Elizabeth Constance, WA Minister for Education.

The teachers came from the 185 metropolitan and regional schools in the six states and two territories that are participating in the STELR Phase 1 Project in 2010 and bringing the relevance concept to some 24,500 high school students in 973 classes.



Rod Dunstan, STELR Project Officer, at the Melbourne workshop.

The STELR (Science and Technology Education Leveraging Relevance) program emphasises enhanced student engagement and interest in science and technology by highlighting the relevance of science in everyday issues.

The workshops were run by ATSE's STELR team, led by STELR Project Manager Peter Pentland, with support from the Chair of the STELR Steering Committee, Professor Russell Tytler.

Each workshop included a cocktail event where ATSE Fellows joined teachers to discuss science and technology education issues.

STELR provides schools with a carefully planned and resourced curriculum unit, incorporating 'hands-on' learning opportunities, which are closely aligned with technologies that have a high degree of relevance to the lives of students and teachers. STELR is in its second year in Australian schools, following a successful 'proof-of-concept' program in four Victorian high schools in 2008.

The workshops sought to:

- cover the philosophy of the STELR project;
- improve the teaching skills of the participating teachers;
- feature some of the country's top education academics delivering lectures and workshops on the latest theory and science education practice;
- feature hands-on workshops run by teachers experienced in running the STELR project in classrooms; and



Teachers discuss the STELR concepts at the Sydney workshop.



Teachers go "hands-on" at the Melbourne workshop.

and technology

- provide a forum for exchanging ideas and networking opportunities for teachers.

The STELR program is based on renewable energy technologies which ATSE believes will:

- help students and teachers see science and technology as extremely relevant to their living circumstances today and in the future;
- demonstrate to students its potential in their job prospects; and
- provide an inquiry-based platform upon which formal studies in enabling scientific disciplines and science-based professions can be based.

The STELR program is being funded by ATSE, Australian and state education departments and private donors.



WA Education Minister Elizabeth Constable at the Perth workshop with teachers (left) Kathryn Pope and Sonia Huepauff from Australind Senior High School.

Government praises STELR and boosts science teachers

The Minister for Education, Julia Gillard, and the Parliamentary Secretary for Industry and Innovation, Richard Marles, have welcomed progress on the \$2 million STELR project to encourage students to study the sciences in senior secondary years.

They issued a joint media release backing the STELR project after Mr Marles launched the first 2010 STELR professional learning seminar for secondary teachers in Melbourne.

"The aim of this project is to get more students interested in learning about science," Mr Marles said. "It will see teachers extend and develop skills in inquiry-based teaching, with particular focus on renewable energy."

"I believe there is science in every person, in every child," Mr Marles told the Melbourne workshop. "To me the key to encouraging kids to take up

► MORE ON PAGE 36



Former ATSE President Tim Besley (centre) and ATSE Vice President John Nutt (right) meet teachers at the Sydney workshop.



Gavin Jennings and Jennifer Huppert with Year 10 science students

at Mount Scopus Memorial College.

PHOTO: PETER HASKIN, AJN

STELR CLASSROOM SHOW FOR VICTORIAN MINISTER

Mount Scopus Memorial College recently put ATSE's Science and Technology Education Leveraging Relevance (STELR) program on show for the Victorian Minister for the Environment, Climate Change and Innovation, Mr Gavin Jennings, and Southern Metropolitan Region MLC Ms Jennifer Huppert. STELR has been developed to promote student belief that physics, chemistry, biology and mathematics are highly relevant to their future lives. STELR aims to increase the number of students choosing a career in science and engineering by improving the quality of science teaching and scientific literacy. Mr Jennings explained the program to a Year 10 science class before the students demonstrated the uses of solar energy.



Mount Scopus students work with ATSE's Jenny Sharwood.

◀ FROM PAGE 35



Richard Marles

science lies in fostering, nurturing and exciting the inner scientist that already exists – and not to scare it off by making science appear overly complex and difficult.

"That's why as science teachers, your job is so important ... there is no more important job than yours in our nation today.

"We need children studying science ... we need them to grow up and want to be scientists. Their work as scientists will help us deal with the challenges of the future – the challenges of feeding the world, managing our resources, the growth and development of our nation.

"As teachers, you can sow the seed of that enthusiasm for problem solving – show your students that science is exciting, it is fun and it is worthwhile," Mr Marles said.

STELR is being piloted nationally in 185 schools that were selected in consultation with state and territory education authorities. Students will participate in a six to 10-week module using a hands-on learning approach.

"Classroom activities will cover concepts such as global warming, climate change, greenhouse effects, renewable energy resources, energy forms, transformations and conservation," Mr Marles said.

"Teaching science through the context of renewable energy will encourage students to consider further study and careers in science and engineering. This will help to address skill

shortages in technological careers and trades."

The statement noted that the Australian Government had invested more than \$570 million over the four years from 2008-09 in specific science and maths education initiatives. This included reduced student contributions for those studying maths, science and statistics units at university and HECS-HELP remissions for graduates who go on to work in related fields.

In addition, the Government was advancing science and maths education in schools through other substantial investment and initiatives including:

- Australia's first National Curriculum;
- the Smarter School National Partnerships;
- Digital Education Revolution;
- Digital Architecture Initiatives; and
- Science and Language Centres for high schools as part of the Government's Building the Education Revolution.

Corporate sponsorship has also been provided for the STELR project, with Rio Tinto providing \$150,000 (plus travel sponsorship of up to \$40,000) and Orica providing \$150,000.

More information about the Australian Government's education initiatives and a list of the 185 schools participating in STELR are at
www.deewr.gov.au/Schooling/Programs/Pages/ScienceTechnologyMathematics.aspx

The real export earnings from overseas students

The assumptions behind the ABS estimates for the value of overseas students to the education industry are poorly understood and have never been questioned.



By Bob Birrell
and Fred Smith

bob.birrell@arts.monash.edu.au

fred.smith@aanet.com.au

Export income from overseas students studying in Australia is widely stated in the media as the country's third highest, behind coal and iron ore, and currently worth \$17 billion.

This figure is based upon estimates – published by the Australian Bureau of Statistics (ABS) – of trade in services, which include educational services, as part of its overall estimates of the contribution of international trade to Australia's balance of payments.

It is a figure widely welcomed by the higher education sector, in particular the Australian Education International (AEI), which is responsible for overseeing and promoting the overseas student industry in Australia.

The ABS estimate for the credit items in relation to education for goods and services (living expenses) and fees for the year 2007-08 was \$13.7 billion and the latest comparable ABS estimate for the year 2008-09 is \$16.6 billion. This increase follows the growth in enrolments of overseas students.

The assumptions behind the ABS estimates for the value of overseas students to the education industry are poorly understood and have never been questioned. We have two major concerns about these estimates.

The first is that the ABS estimates are *gross* income. They do not take account of income earned by students in Australia or recruitment expenses paid overseas. These amounts should be deducted from the gross fee and expenses revenue in order estimate the actual contribution of the industry to Australia's export performance.

The second is that the ABS estimates of student expenditure on living expenses are too high. The reason is that these estimates are based on survey information dating to 2004 when the overseas student profile was quite different from that of today.

On the first concern, it is true that the ABS makes an estimate of the 'compensation for employees' to account for the earnings of overseas students in Australia. For 2007-08 this amount was about \$1.2 billion. This amount should be subtracted from the gross export earnings es-

timate for the education industry, but it is not. Also, our analysis indicates that the ABS estimate for these earnings is too low, as it is based on outdated survey information.

On the second issue, concerning the estimates of student expenditures on goods and services while in Australia, the ABS estimates that on average, each overseas student spent \$29,997 on goods and services in 2007-08 and \$19,657 on fees for a total of \$49,654.

This figure is very high and should have immediately sounded warning bells. It is a figure that is way beyond the financial capacity of most domestic students, let alone overseas students, many of whom come from low-income societies. Like the estimates of student earnings, the reason for this excessive estimate is that it is based on outdated survey information.

A further warning comes from the estimates for 2007-08 by the Association of International Educators in the US for average expenditure by overseas students of US\$18,260 on living expenses and US\$16,189 on fees, for a total of US\$35,315 per student (about A\$38,800).

The ABS estimates of overseas student expenditure on living expenses and the amount of time spent working are based on a survey conducted by the University of Queensland Social Research Centre in 2004. This survey was aimed at a national sample of all overseas students in Australia at the time. The majority of the 3186 students who responded were higher education students (62 per cent), with the next largest group being VET students (18 per cent). The largest country of origin group was students from mainland China, followed by Malaysia, Singapore and Hong Kong. The Indian proportion was just 5 per cent, almost all of whom were enrolled in the higher education sector.

Massive changes to the countries of origin, motivation for studying in Australia and fields of study have occurred since the arrival of the students surveyed in 2004. Prior to 2004, most overseas students were attracted to full-fee university courses. Most of these students appear to have come

from relatively affluent families as only 32 per cent of them indicated that they were employed in Australia. Of those that were employed, most (72 per cent) reported incomes of less than \$200 per week. Yet, the survey found that students spent, on average, \$539 per week or \$28,028 per year on living expenses. This indicates that the students received considerable financial assistance from their families.

By 2008 the higher education sector had experienced a significant decline in the share of enrolments from the more affluent countries of Hong Kong, Malaysia and Singapore and a surge in enrolments from poorer countries, notably China and India. Another major change was the number of students enrolled in VET courses, particularly students coming from India whose primary objective was to achieve permanent residency. This change in the demographic background and area of study of overseas students in 2008 compared to 2004 means the survey data of 2004 is of little or no value for estimates of overseas student expenditure or earnings in Australia.

In the absence of a better estimate of what overseas students spend on living expenses, we have drawn on the advice provided by Australian universities on the minimum costs they would face in Australia. These range from \$13,000 to \$25,000 per year depending upon location and type of rental accommodation.

Overseas students can live more cheaply than these figures if they accept shared accommodation in a house rented exclusively to students. There is plenty of anecdotal evidence that many students take up this option.

Another insight into student living expenses is the amount that Australian students spend. There is relatively recent data that is derived from the 2006 Universities Australia study, *Australian University Student Finances 2006*. This survey reveals that the median annual expenditure for full-time

domestic undergraduate students in 2006 was \$11,320.

Overseas students will generally need much more than \$11,320, primarily because they do not have access to subsidised family assistance for board and lodging.

Assuming a rent of \$150 a week or \$8000 a year (on top of the \$11,320 figure), the annual expenditure would amount to around \$20,000 annually for living expenses – a figure in line with the university advice quoted. This is the figure we have used in our estimates of student expenditures.

Overseas students are permitted to work 20 hours a week (and full-time during holidays). A student earning the low rate of \$10 an hour for 20 hours work a week (cash in hand) for 50 weeks would earn about \$10,000 a year. Many would work longer hours in order to pay back loans taken out to finance their fees and to pay for their living expenses in Australia.

It is difficult for educational institutes to enforce the 20 hours a week restriction. Employers and VET colleges have little incentive to report excess work hours. The universities have only limited obligations to track the work record and class attendance of their overseas students.

The earnings of domestic full-time students provide an indication of the potential overseas student earnings. The median income of these students in 2006 was estimated to be \$11,000. Of this, \$8270 came from earnings in the labour market.

Based on these figure we have adopted the conservative estimate that overseas students earned around \$9000 per annum in 2007-08.

The ABS estimate of fee income of \$19,657 per student does not depend upon the 2004 survey, but is based on data provided by AEI. This should be a reasonable estimate of fee income, but course providers usually use the services of overseas agents to recruit students. The fee for

International
students
at Monash
University.



this service is paid to the agents in the home country and amounts to some 25 to 30 per cent for the VET sector and 10 to 15 per cent for the higher education sector. Thus, it should be subtracted from the export earnings from fees. We have adopted a figure of 10 per cent.

The bottom line of our analysis involves three adjustments to the ABS estimates of the contribution of educational services in Australia to Australia's export revenue:

- the adjustment for expenditure by overseas students in Australia 2007-08 – our estimate is that this expenditure was about \$5.47 billion rather than the \$8.2 billion estimated by ABS;
- the ABS fee income estimate should be \$4.84 billion rather than \$5.4 billion – this adjustment takes account of the payments to overseas recruiters. This gives a total export income of \$10.3 billion compared with the ABS figure of \$13.7 billion; and
- finally there should be a deduction for 'compensation for employees' – our estimate is the adjustment should be \$2.5 million rather than the ABS estimates of \$1.2 billion.

The final outcome from these adjustments for the net export revenue from educational services to overseas students in 2007-08 is \$7.8 billion, or just over half (56 per cent) of the \$13.7 billion claimed by the overseas education industry. ◀

Based on the paper Export Earnings from the overseas student industry: how much? Australian Universities Review, vol. 52, no. 1, 2010, page 4

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DR BOB BIRRELL has a degree in economics from the University of Melbourne, in history from the University of London, and a PhD in Sociology from Princeton University. Most of his academic work has been at Monash University and since 1991 he has run the university's Centre for Population and Urban Research. He has acted as an adviser on immigration issues to Labor and Coalition governments and was a member of the National Population Council from 1987-93. He was a member of the independent Review of the General Skilled Migration Program, which reported in May 2006.

Australians back S&T, says nanotech survey

Most Australians (84 per cent) feel positive that science and technology are improving society and these positive perceptions have been strongly held over the past five years.

That should be a big relief for scientists worried about recent attacks on the science of climate change and on immunisation, as it is a key result from a national survey into community attitudes to science and nanotechnology, conducted for the Federal Government and presented at ICONN 2010 in February – Australia's International Conference on Nanoscience and Nanotechnology.

The report also revealed that Australians were excited about the potential of nanotechnology in medicine, solar energy and environmental protection, but cautious about the use of nanotechnology in food and cosmetics.

"This report is a huge boost for researchers in nanotechnology," said Dr Cathy Foley FTSE, conference co-director with Dr Calum Drummond FTSE, also from CSIRO.

NSW Chief Scientist and Scientific Engineer, Professor Mary O'Kane FTSE said Australia had been quick to grasp the potential of nanotechnology "but we must take a balanced approach by investing in research and technology while also addressing concerns about environmental health and workplace safety".

The poll of 1100 Australians, conducted in October last year, pointed to medical advances including the recent development of swine flu and cervical cancer vaccines, along with internet technologies, as key reasons for recipients' positive views of science.

"The survey shows that people's attitudes to nanotechnology are complex," said Dr Craig Cormick, manager of public affairs and community engagement at the Australian Government Department of Innovation, Industry, Science and Research. "At the big picture scale, people are very positive, but that view fragments when you look at different applications. These different attitudes really align with people's values. You could almost say that the technology itself is irrelevant."

The positive view most people have about nanotechnology is also balanced by concern about unknowns, the survey showed. "It's not worries about nano-stuff in their computers," Dr Cormick said. "It's worries about what people are putting in their mouths or on their skin. They want to know that it works, and that someone is making it safe."

The poll also showed that the general public really wants to hear both sides of the story when it comes to new technology. "They want to hear the benefits and the risks, and be in a position to make their own mind up," Dr Cormick said.

"The public does want a lot more information on nanotechnology and they want it from sources they put trust in."

Exactly who those sources might be vary widely, he said. For some people it is NGOs, others want to hear from the government, and other groups rely on the advice of friends.

The message for scientists, governments and universities is to involve the public at a much earlier stage, Dr Cormick said. "The scientific community needs to have a better understanding of what the public is concerned about and make sure that they take the public along with them."

Survey results www.innovation.gov.au/Industry/Nanotechnology/Pages/PublicAwarenessandEngagement.aspx

Student maths down to a “dangerous level”

The state of mathematical sciences in Australia has deteriorated to a dangerous level and will require universities to provide additional maths-enabling courses and to improve cooperation between education and maths faculties in future, according to the Group of Eight's (Go8) new report, *Review of Education in Mathematics, Data Science and Quantitative Disciplines*.

The Review, chaired by former University of Sydney Vice-Chancellor, Professor Gavin Brown, was commissioned by the Go8 Vice-Chancellors in 2009 because of serious concerns about the number and quality of students entering university courses requiring strong quantitative skills.

The Review highlights some startling statistics:

- from 2001 to 2007 the number of students enrolled in a mathematics major in Australian universities declined by about 15 per cent;
- the number of students taking advanced maths at high school also dropped by 27 per cent between 1995 and 2007; and
- demand for mathematics and statistics graduates is predicted to grow by 3.5 per cent per year until 2013.

The Review concluded that “universities cannot ignore the downward change in mathematics preparedness affecting entering



Alan Robson

students. In the short term there appear to be only two conceivable responses: the provision of enabling (that is, remedial) programs and the lowering of standards.”

Go8 Chair, Professor Alan Robson AM FTSE, welcomed the review's six recommendations, which focus on equipping primary school teachers with mathematical skills and the need for remedial maths courses at the tertiary level.

“The Go8 requested a broad review because of the national

significance of the issues and because tackling this problem will require action from other universities and state and federal governments,” Professor Robson said.

“The Go8 Vice-Chancellors will carefully consider the Review's recommendations and will work with other stakeholders to attempt to arrest the decline.”

The Review is at www.go8.edu.au/storage/go8statements/2010/Go8MathsReview.pdf



Louise Ryan

PHOTO: CSIRO

CSIRO TACKLING THE MATHS CRISIS

Dr Louise Ryan, Chief of CSIRO Mathematics, Informatics and Statistics – a contributor to the Go8's review – says the findings are sobering.

“Quality maths graduates are crucial to CSIRO research. Our mathematicians and statisticians are the foundation for our science, delivering results for mining and manufacturing, health, human services and the environment,” Dr Ryan said.

“For Australia to be at the forefront of science and business, we need to do more to increase the nation's output of talented young people in the mathematical sciences.”

She said CSIRO has for a long time experienced a lack of talented maths graduates to fill positions left open by retiring staff, let alone a predicted 3.5 per cent annual growth in demand. “Few maths and statistics graduates pursue a research career, leaving employers like CSIRO, the Australian Bureau of Statistics (ABS) and the Go8 universities with a smaller pool of local talent to draw upon.

“We're cooperating with other major employers such as the ABS to find ways to address these shortages,” Dr Ryan said.

A promising initiative is a new Graduate Fellows program, which was developed by CSIRO Mathematics, Informatics and Statistics. This program will give Honours graduates in maths and statistics a chance to test-drive a research career in CSIRO before deciding whether to go into the workforce or study for a PhD. The first of the new Fellows was scheduled to start in March.

New programs from CSIRO Education are also addressing several of the report's recommendations in maths education at primary and secondary schools, and maths teaching.

One of these is Maths by Email – a partnership with the Australian Mathematical Science Institute (AMSI), to produce a free, fortnightly email newsletter aimed at school students, parents and teachers with hands-on activities and articles showing the intriguing ways maths can solve problems. There are already more than 800 subscribers and the first issue is planned to go out soon.

Another program is the Mathematicians in Schools program, of which Dr Ryan is patron. This program matches working mathematicians with schools which they visit to talk about the work they do or help teachers develop practical lesson plans. There are currently 72 partnerships and that number is growing.

Science must be exposed

We need the broader community to understand our culture and scientific methods and we must not shy away from sceptics and questioners



By Cathy Foley

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"... the fragile nature of trust between science and society, demonstrating that the perceived misbehaviour of even a few scientists can diminish the credibility of science as a whole. What needs to be done? Two aspects need urgent attention: the general practice of science and the personal behaviours of scientists."

– Ralph Cicerone, President of the National Academy of Science, *Science*, 5 February 2010

Has science gone off the rails? Has the backlash of the climate change debate revealed a sinister science culture that needs reform? Or is it that multiple issues that impact science culture and processes have intersected?

Has this collision created consequences and impacts as a result of the growing entwining of science and society? Is this what has caused confusion, doubt and loss of trust highlighted by Ralph Cicerone?

What has contributed to this perceived "misbehaviour" could be listed as:

- perceived scientific process manipulation – is it real?
- cronyism?
- arrogance – "trust me, I'm a scientist";
- science is expected to solve all the big issues of society and so is more deeply immersed in public policy development;
- expectation of the communication of science so the general public who fund most research can understand what it means and have open access to data;
- unintentional consequences of new technologies, which have led to the concerns about nanotechnology and GM foods;
- increased competitiveness – as funding is tighter and more specifically directed, and the emergence of science metrics as a major contributor to decision making;
- the stagnation of increasing the numbers of women in science;
- private communication and personal in-house discussions being exposed, where private conversations be-

come public ('Climategate' email);

- scientific results that impact public policy, causing greater public scrutiny; and
- the rise of a version of 'scientific debate' outside the scientific publication/conference process.

It is tempting to nod and say that the scientific process has had its day – that the volunteerism that is the basis of so much of the scientific process (refereeing papers, editing journals, organising conferences, reviewing grant applications) is no longer sustainable as the volume of research papers increases, the number of conference and symposia explodes, and the number of submissions for grant applications increases.

There is talk that the scientific process has cronyism and 'mateship' limiting the scientific debate and that those with opposing ideas are not taken seriously.

But hang on a minute – the scientific process has pretty much worked over the past 345 years, since Henry Oldenburg established the scientific review process in scientific publishing of *Philosophical Transactions of the Royal Society*.

There are many checks and balances to enable errors to be corrected and biases to be overturned. However, scientific publishing and open access expectations has created a new complex problem. The scientific process of peer review is still robust and needs to be the basis of science.

In the past, the hard copy journal and the manual processing (including sending manuscripts and reviews 'snail mail') meant long lead times to publication. All this has changed as we now have electronic journals and e-publishing processes with web-based submission.

We also have the introduction of science metrics with journal impact factors, citations counts and H factors driving new behaviours to boost one's own metrics. In some countries and institutions there are also personal rewards to scientists with significant bonuses for each scientific paper published, which has led to the 'salami slicing' of journal paper content adding to the exposition of scientific journal paper submissions.

The timing of these complications of scientific publishing, and hence peer review, has intersected with the growth of science informing public policy development that can have sweeping changes on the broad economy.

Now there is a need by all society to see the scientific debate and increase the communication of the issues that have the greatest impact. This is where we scientists have not been effective.

The media has been a willing venue for this open debate. The public are greedy for it. The businesses that will be affected are willing to fund it but we scientists have been caught short.

We have been saying that our scientific process is where the discussion should be. This makes sense to us. However, the general public does not understand what peer review is. They are not aware of the difference between something that is first published in a book compared to something that is first published in a peer-reviewed article.

Our response has been to complain, retract and be horrified that we are not being taken seriously. We have been devastated that our integrity has been questioned and the gift of trust has been taken away.

We scientists were in this situation 26 years ago when the science budget was massively slashed and the then Minister for Science, Barry Jones, called scientists "wimps". A year later we formed the Federation of Australian Science and Technological Societies (FASTS) to coordinate ourselves and make science a major influence on public policy.

Now we are riding on success with the highest-ever increase in funding in the 2009 Budget, increases in most science degree enrolments (due to the implementation of

new policies such as there reduction of fees for these courses) and the Government's evidence-based policy development making science visible and centre stage.

So this latest questioning of science and scientists needs us to step up to the new expectations that our past successes have created. We need to make sure that we all always act with the highest integrity and make sure that it is the science discovery and innovation that leads us.

We need the broader community to understand our culture and scientific methods and we must not shy away from sceptics and questioners.

Rather, we must embrace their concerns to make sure that we do the best science, develop safe technologies and are not arrogant about our contributions.

Science has a lot of be proud of. It has influenced public policy in Australia in many areas of endeavour that make this country great. We need to build on that to make sure that we regain any loss of trust and move the fragile relationship with society to be robust and strong.

Science must be exposed! ◀

DR CATHY FOLEY PSM FTSE is the President of the Federation of Australian Science and Technology Societies (FASTS) and immediate past President of the Australian Institute of Physics. She is a Chief Research Scientist with CSIRO Materials Science and Engineering. She is the Research Program Leader for Devices Systems and Engineering and a project leader of a Superconducting Devices and Applications Project, which is developing superconducting systems for applications as diverse as mineral exploration, detection of metal for quality assurance in manufacturing, electrode-less heart monitors and remote detection of contraband at airports.

Preparing a learning society for the future

The Prime Minister's Science, Engineering and Innovation Council (PMSEIC) has been advised by an Expert Working Group that breakthroughs in the science of learning, including brain function, motivation and the practice of teaching, have the potential to transform how individual Australians acquire and retain knowledge throughout their lives.

The *Transforming Learning and the Transmission of Knowledge: Preparing a learning society for the future* report focuses on fundamental questions that influence our ability to learn and highlights the potential of bringing together researchers and practitioners to address the science of learning within a structured and sustained program.

The Executive Officer of PMSEIC, Professor Penny Sackett, Chief Scientist for Australia, said that the report highlighted the opportunity for Australia to transform its practices related to learning, with the aim of enhancing life-long learning outcomes for all Australians.

"The report contains as its central recommendation the establishment of a 'Science of Learning Program', to be delivered through a number of interdisciplinary and inter-professional 'Science of Learning Centres'," she said.

"The Centres would have a transformational impact on learning by advancing the scientific understanding of effective learning techniques; generating knowledge to inform education policy and practice; and by testing innovative

approaches in real world environments to maximise learning outcomes."

The research findings from these Centres could lead to improvements in equity, educational practice and practitioner development – all of which should narrow the achievement gap and maximise Australia's economic productivity, Professor Sackett said.

The Centres, if established, would cover Australia geographically and socio-economically and would build on the work already being conducted across Australia by departments of education, researchers and educational groups.

Full report at www.innovation.gov.au/section/pmseic/pages/21.aspx

UWA puts new focus on engineering education

The University of Western Australia is responding to the global demands on engineering education with initiatives to improve teaching and learning, including the launch of a new academy, dedicated to understanding and improving the ways students learn, in the Faculty of Engineering, Computing and Mathematics.

The new Faculty Academy for the Scholarship of Education (FASE) is being pioneered by Winthrop Professor Caroline Baillie, who previously held the DuPont Chair of Engineering Education Research and Development at Queens University, Kingston, Ontario, where she was also cross appointed into Chemical Engineering, Sociology and Women's studies. Formerly she was lecturer at Imperial College London and the University of Sydney, as well as Deputy Director of the Materials Subject centre, part of the Learning and Teaching support network in the UK.

"Engineers have always served society, by providing basic services such as water and sanitation, as well as roads and railways," Professor Baillie said. "Engineers create everything from aeroplanes to artificial limbs so it's hard to imagine life without their input."

"Engineering ... is critically connected to the local economy as well as the more intangible yet critical global issues such as poverty reduction and sustainability of our resources. Increasingly, engineering graduates need to address a wide range of problems with the skills to take on the challenge and contribute in a meaningful and appropriate way."

UWA Vice Chancellor, Professor Alan Robson AM FTSE, said: "Winthrop Professor Baillie's appointment clearly demonstrates UWA's commitment to the development of creative and exciting learning experiences."



(From left) UWA Acting Dean of Engineering, Computing and Mathematics, Professor John Dell, Winthrop Professor Caroline Baillie and Mr Bill Marmion MLA, Member for Nedlands, representing the Minister for Education, at the FASE launch.

Engineers identify impacts of skills shortage

A survey of nearly 2400 engineers by the Australian National Engineering Taskforce – backed by ATSE – has revealed critical gaps in engineering skills and capacity at workplaces across Australia, highlighting the potentially catastrophic impacts of Australia's engineering skills crisis.

"These results show that the chronic shortfall in Australia's engineering services capacity, which is well-recognised by Government and business, is already hitting key engineering services and impacting on infrastructure quality, productivity and cost," said APESMA CEO and ANET spokesperson Chris Walton.

ANET is a coalition of APESMA, Engineers Australia, the Association of Consulting Engineers Australia, the Deans of Engineering and ATSE.

It has been formed to investigate the national shortfall in engineering capacity and to work with the Federal Government and industry to formulate actions and policy recommendations to solve the problem with industry support. Its current project is mapping the engineering skills shortfall across industries.

"There is a very real risk that the investment of billions of dollars in national infrastructure projects and in the resources sector will be compromised by this capacity shortfall," said Engineers Australia CEO Peter Taylor.

The survey showed 60 per cent of engineers had identified a skills shortage in their work area, 54 per cent of respondents said there was a loss of capability in their workplace and 40 per cent felt their organisations didn't have the right mix of engineering skills to meet current or future needs.

Mr Walton said engineers working in all sectors of the economy had identified impacts on their workplaces and the community that cannot be ignored.

"Over 54 per cent of respondents identified a loss of workplace capability, with a range of effects on the delivery of projects, productivity and international competitiveness," he said.

The internet-based survey of 2392 engineers was conducted over a two-week period in December 2009. Respondents answered a range of questions related to skills, capability and training.

Nearly two-thirds of respondents came from the private sector and more than half came key industries – construction, transport, storage, water, gas, electricity, government administration and defence.

In a related survey of 14 of the largest consulting firms, respondents confirmed the shortfall in the domestic labour market and commented on the high cost involved in recruiting overseas.

Skills Australia has recently identified engineering skills development as an area requiring intervention from Government and industry to ensure that future community need is met.

John Kerin – 40 years of ABARE

In the identifiable phases of Australian agricultural production and the agricultural economics profession, the work of the Australian Bureau of Agricultural and Resource Economics (ABARE) has been necessarily ahead of national policy responses, according to former Australian Treasurer and Minister for Primary Industries John Kerin AM FTSE.

“The Outlook conferences, and their seven regional outlook counterparts each year, have become a crucial communications forum to put Bureau projections and analyses before the widest audience and engage with and listen to their client base at a high level,” he told the 40th ABARE Outlook Conference in Canberra recently.

We were now in a phase of agricultural production that, as ever, needed both research and policy responses, he said, recalling that he attended the first Outlook conference.



John Kerin

“The only constant with any organisation is change: adapting to change and anticipating change. The quality of the government of any society depends in large part on the resilience and adaptability of its institutions,” Mr Kerin said. “Reform of policy is always hard, really hard.

“It has been the crucial attribute of the Bureau, as a research agency, to inform policy and to have the capacity to freely publish as long as not actively advocating

policy change or overt criticism of the government of the day. The task of the policy maker is to synthesise all the strands of evidence and analysis before him or her, not just adopt one-off pieces of work.

“Agricultural policy and the profession of agricultural economics has always adapted to changes occurring in Australia, which is often instigated by seasonal conditions and domestic policy settings, but more often by international economic and trading conditions, which bounce back on Australia,” he said.

Productivity revolution needed for global food security

Dr Nick Austin of the Australian Centre for International Agricultural Research (ACIAR) says we need a revolution in productivity to deal with global food security.

“Population growth and constraints on food production, including from the anticipated affects of climate change and shifting supply and demand patterns, must be balanced by improved agricultural yields,” Dr Austin told the ABARE Outlook conference in Canberra (March). “What is

necessary is not one revolution in agricultural productivity, but a series of country-specific responses to spark a range of mini-revolutions in productivity that leverage off intellectual capital and an understanding of the environment.

“ACIAR seeks to promote Australia’s leadership in research to enhance global agricultural productivity.”

Dr Kym Anderson, Professor of Economics at the University of Adelaide, told delegates that climate change and an anti-trade bias in some governments’ agricultural policies raised concerns for food security in developing countries.

“Government assistance to the farm sector insulates producers from price signals, while protectionist trade policies have resulted in slower growth in trade and thinner world food markets, together with increased price volatility,” Dr Anderson said. “This global problem requires a global solution, namely more World Trade Organization discipline against policies such as import tariffs and quotas, and export restrictions that limit growth in agricultural trade.

“This is especially important in the context of long-term threats to global food security, such as climate change and the biofuel policies pursued by developed nations.”

Dr Brian Fisher, Principal of ABARE, noted that farmers’ terms of trade have been in a long-term decline.

“However, with an increasing world population driving a substantial increase in food consumption, farmers’ terms of trade may start to rise in the decades ahead,” Dr Fisher said. “The reduction of trade barriers and increased agricultural research and development are the central issues that need to be addressed in order to promote global food security going out.”

Water key to northern Australia food potential

Access to water resources is the key to realising the potential of northern Australia to sustainably increase its current area of crop and significantly increase beef production, delegates at the ABARE Outlook conference in Canberra were told.

CSIRO Deputy Chief of Sustainable Ecosystems Dr Peter Stone presented his analysis of sustainable agricultural development in northern Australia.

“Northern Australia is already a significant food producer on a global scale, yet it can produce more. Currently, it produces more than \$1 billion worth of cattle and about \$200 million worth of crops each year,” Dr Stone said. “Water, despite its large volume in the area, is limiting some agricultural development. However, water planning will be required to ensure that new water consumption is sustainable.”

Northern Australia Land and Water Taskforce Chair Joe Ross said the development of groundwater resources provided the best prospect to support new consumptive uses of water.

Mr Ross said that smaller scale and more widely distributed irrigation systems offered significant potential and the taskforce supported these as an achievable and sustainable development option for northern agriculture.



PHOTO: AUCIA NANIAD

Deploying an Argo ocean profiler in the Southern Ocean.

Southern Ocean winds open window to the deep sea

Australian and US scientists have discovered how changes in winds blowing on the Southern Ocean drive variations in the depth of the surface layer of sea water responsible for regulating exchanges of heat and carbon dioxide between the ocean and the atmosphere.

The researchers' findings provide new insights into natural processes which have a major influence on the rate of change in climate.

The surface-mixed layer is a crucial pathway between the atmosphere and the deeper layers of the ocean. Changes in the depth of the mixed layer can affect air-sea exchange, carbon and heat storage in the ocean, and the rate at which water sinks from the surface ocean into the deep ocean.

Changes in the mixed layer also affect biological productivity, by altering how much light and nutrients are available to support growth of plankton at the base of the food chain.

CSIRO Wealth from Oceans Flagship oceanographer, Dr Jean-Baptiste Sallée, said the winds over the Southern Ocean had increased in strength and shifted closer to Antarctica in recent decades – one of the strongest trends in Southern Hemisphere climate over the past 30 years.

"Our knowledge of how the Southern Ocean changes in time is poor because of the lack of ship-based observations in this remote region. But we now have seven years of year-round observations from a fleet of profiling floats known as Argo, which allow us to see for the first time how the Southern Ocean changes with the seasons and from year-to-year."

New climate index answers WA rainfall puzzle

CSIRO and Chinese scientists have developed a new climatic index that provides an answer to a riddle that has puzzled researchers for decades: 'Why has south-west Western Australia experienced dramatic declines in rainfall since the 1970s?'

The Southwest Australian Circulation Index (SWACI) shows how much of the 'blame' can be attributed to the weakening of a major atmospheric circulation over the Indian Ocean.

In a paper published in *Journal of Climate*, CSIRO statistician Dr Yun Li and climate physicists Professor Jianping Li and Juan Feng from the Chinese Academy of Sciences, say the SWACI also provides researchers with a new tool for predicting annual patterns of wet season rainfall.

"Using this new index we have found that the Southwest Australian Circulation is becoming weaker early in the winter wet season (May to July) causing the drier conditions observed in south-west WA," Dr Li said.

Since the mid-1970s south-west WA has experienced a 15 to 20 per cent decrease in average winter rainfall, from 323mm in 1925–76 to 276mm from 1976–03.

Dr Li says the SWACI is similar to the more commonly known Southern Oscillation Index (SOI) used to indicate the strength of the El Niño–Southern Oscillation (ENSO) in the Pacific Ocean, which influences rainfall patterns in eastern Australia. It is a number determined from the intensity and direction of seasonal winds over southern WA that helps researchers get an at-a-glance picture of the local climate.

South-west WA receives most of its annual rainfall during winter from passing cold fronts and storms. However, since the mid-1970s the number of storms in the region has decreased, leading to less rainfall, with the drier conditions being exacerbated by more high-pressure systems entering the area.

"The atmospheric circulation over south-west WA is a monsoon-like system," Dr Li said. "It has wet and dry seasons like northern Australian monsoons but they happen at different times. The wet season rains fall in winter rather than in summer."

"We've found a strong correlation between the Southwest Australian Circulation and the winter wet season. In years when the circulation is weaker, the SWACI has a value of less than -1, and there are more high-pressure systems over the southern Indian Ocean, delivering weaker westerly and northerly winds and dry conditions. When the index is stronger (above 1), low pressure systems are more common in winter and rain falls more often."

He said further investigation using global climate models would be required to confirm whether warming oceans or natural fluctuations are responsible for the weakening circulation.

"The SWACI will help identify rainfall patterns throughout the year as well as long-term drying trends for south-west WA. It will also help increase the accuracy of global circulation models in predicting future climate scenarios," Dr Li said.

Steve Powles wins 2010 Seed of Light award

Steve Powles and his GRDC award.



Mr Young said the Seed of Light award was presented each year to someone who made a significant contribution to communicating the outcomes of research.

"Over the years, Steve has made sure knowledge is available and can be applied in a practical manner so farmers are able to live with herbicide-resistant weeds," he said.

"It's due to the work done at WAHRI, led by Steve, that WA farming systems have been led back from the brink of the disaster they were facing due to widespread herbicide-resistant weeds overwhelming WA farming systems."

Mr Young said Professor Powles was an international authority on all aspects of herbicide resistance, from

An internationally recognised plant scientist who helped rescue many Australian farms from the brink of disaster has been awarded the 2010 Grains Research and Development Corporation (GRDC) Western Region 'Seed of Light' award for his contribution to herbicide resistance research.

The University of Western Australia's Winthrop Professor Stephen Powles FTSE, Director of the WA Herbicide Resistance Initiative (WAHRI) in the UWA School of Plant Biology, received the award at the 2010 WA Agribusiness Crop Updates, an annual event organised by the Department of Agriculture and Food WA for researchers and agribusiness.

GRDC Western Panel Chairman and Kojonup grower Neil Young noted Professor Powles' significant contribution to herbicide resistance in agriculture, not only in Australia, but on a world scale.

a basic biochemical understanding of how plants evolve resistance through to practical on-farm management.

"He is now widely regarded as the world expert on herbicide resistance in plants, on which he has published 150 research papers. He is one of the world's most highly cited plant scientists."

Professor Powles' leadership talent is evident in the success of his large research team, which is focused on herbicide resistance in weeds and crops. After nine years of GRDC funding, WAHRI continues to pioneer research into resistance in Australian cropping and is recognised globally as leading the way in predicting the long-term impact of herbicide resistance.

Professor Powles also has extensive knowledge of genetically modified crops, has widely published on glyphosate sustainability and is a frequent visitor to both North and South America to speak on GM crop issues.

He was awarded the Centenary Medal in 2003 and elected an ATSE Fellow in 1999.

Professor Powles was inaugural Chair of the Gene Technology Regulator expert committee from 2002 to 2008 and remains an expert adviser to the committee. He is a Science Fellow at the national pesticide regulator, the Australian Pesticides and Veterinary Medicines Authority, and a former Director of CRC Weed Management Systems.

ATSE hosts Japan researchers

ATSE hosted a group of eight mid-career researchers from Japan who visited Australia in February to progress S&T linkages.

This visit was funded by the Department of Innovation, Industry, Science and Research (DIISR) and the Japan Society for the Promotion of Science, and administered by ATSE and the Engineering Academy of Japan (EAJ). Dr Toshiyuki Yamada, Executive Director, EAJ, accompanied the researchers.

The Japanese party was hosted by scientists at various Australian universities, CRCs, CSIRO elements, research institutions.

Welcome dinner for the Japan delegation – (from left) Dr Vaughan Beck, ATSE Executive Director – Technical, Dr Toshiyuki Yamada, EAJ, and Dr Margaret Hartley, ATSE CEO.



Ben Eggleton wins Scopus Award

ATSE Fellow Professor Ben Eggleton was one of five Australian researchers who recently (3 March) received Scopus 2010 Young Researcher of the Year awards at Parliament House, Canberra.

Professor Eggleton, a Federation Fellow and Research Director of CUDOS (the ARC Centre of Excellence for Ultrahigh-bandwidth Devices for Optical Systems), University of Sydney, won the Physical Sciences category.

Professor Eggleton was elected to the Academy in November 2009, honoured for his internationally recognised contributions to photonics both in university and industrial settings.

Universities Australia joined Elsevier Australia to recognise and encourage the best of Australia's young researchers through the establishment of the Scopus Young Researcher of the Year Awards. The awards for 2010 were presented in the following categories: Humanities and Social Sciences; Physical Sciences; Engineering and Technology; Life Sciences and Biological Sciences; and Medicine and Medical Sciences.

Elsevier operates a worldwide network of scientific publishing activities and services and describes itself as the world's leading publisher of science and health information, serving more than 30 million scientists, students and health and information professionals worldwide. Scopus, Elsevier's flagship product and the world's largest abstract and citation database, was chosen by the Australian Research Council (ARC) for its Excellence in Research for Australia (ERA) initiative.

Keeva Vozoff honoured by geologists

Dr Keeva Vozoff, a Fellow since 1982, received the Reginald Fessen Award from the Society of Exploration Geologists (SEG), the US-based international society of applied



Ben Eggleton

geophysics, at the SEG annual meeting in Houston in October 2009.

Reporting on the award, SEG said Dr Vozoff is the father of 3D electro-magnetic (EM) modelling (1955), 3D EM inversion (1960) and joint inversion (1970s), along with many more specific enhancements, which carried EM well beyond mining applications to its recognition today as a prime direct hydrocarbon indicator.

Dr Vozoff predicted almost all technical aspects of the marine EM method decades before they were used to find oil and is one of the few geophysicists who has invented and innovated for more than 55 years. He started his career of innovation with computer modeling in 1952 when he calculated, on the Massachusetts Institute of Technology Whirlwind 2 computer, the first multilayer dispersion curves for surface waves.

Dr Vozoff received his PhD from MIT in

1956 and had a distinguished academic and industrial career. He was an Assistant Professor at the University of Alberta (1958–64), Professor of Geophysics at Macquarie University

(1972–94), and visiting professor at the University of Cologne (1989–96) and the University of California, Berkeley (1978–80).

He has received the Alexander von Humboldt Award, one of the highest German awards for scientists. He worked for several exploration companies before he became Senior Vice-President at Geoscience Inc, a company that pioneered digital geophysics in the late 1960s.

After retiring, Dr Vozoff was Adjunct Professor at Curtin University in Perth until 2002 and a director of several business ventures that focus on rolling out novel geophysical technologies.

WA new Fellows show variety

Forty WA Fellows and partners welcomed three newly elected fellows in March.

Ms Sue Murphy, CEO of the Water Corporation, spoke on the 'Water Forever' program that aims to reduce water consumption by 15 per cent and utilise 30 per cent of recycled water by 2010 through achieved by demand management, ground water replenishment, new technologies and catchment management.

Professor Peter Newman from Curtin University of Technology explained his journey from chemist to environmental scientist with a special interest in sustainable cities and reduction of automobile dependence. He

emphasised the need to give people a realistic but hopeful view of the future.

Professor Lyn Beazley, WA Chief Scientist, spoke on her research areas of neurophysiology and reproductive physiology, as well as the exciting science projects that are underway in WA.



Keeva Vozoff (right) receives his award.

Sun sets on Philip Law, Antarctic pioneer

Foundation Fellow and Antarctic legend Dr Philip Law AC CBE FAA FTSE died in Melbourne on 28 February, aged 97.

Dr Law led the first thorough exploration of Australia's Antarctic Territory coast and fostered a global reputation for Australian science on the ice.

He was Director of the Australian National Antarctic Research Expeditions (ANARE) from 1949 to 1966 – the same period that Robert Menzies was Prime Minister. He chaired the Australian National Committee on Antarctic Research from 1966 to 1980.

The Australian Antarctic Division says of him: *While Mawson's work led directly to the establishment of Australian Antarctic Territory, it was left to Philip Garth Law to consolidate Australia's reputation in Antarctica after the establishment of ANARE. As a tireless promoter of Australia's Antarctic interests, he secured substantial and ongoing national commitment to Antarctica.*

In January 1949 Phillip Law was appointed Director of the Antarctic Division and leader of ANARE – a position which he was to hold for the next 17 years.

Law capitalised on the experiences of the pioneers and, with the benefit of better ships and modern technology, under his leadership ANARE achieved in a short time what would have been inconceivable to the early explorers. It was Law whose leadership led to the establishment of Mawson, the first permanent station on the continent.

By the time of Law's retirement from the Antarctic Division in 1966 he had established an indelible record of achievement in Antarctic exploration.

■ *As an Antarctic explorer, in less than 20 years, Law made 28 voyages to Antarctic and subantarctic regions – most of them as expedition leader.*

PHOTO: JOHN STANWIX © COMMONWEALTH OF AUSTRALIA



Philip Law knee-deep in powder snow on Arthurson Bluff, Oates Land.

- *He made 28 landings at previously unvisited sites.*
- *Under his direction over 5000 kilometres of AAT coastline was accurately charted for the first time.*
- *He established two stations on the continent, Mawson and Davis, and took over control of Wilkes from the US. Under his leadership, Australia administered four stations.*
- *Winter parties working inland from the stations during this time extended the total area mapped to more than one million square kilometres.*

The Australian Antarctic program owes a substantial debt to Phillip Law.

Our areas of operations in Antarctica and our ways of working there follow the clear lead set by him. Australia still maintains three stations occupied year-round in the Antarctic and one on subantarctic Macquarie Island. Mawson and Davis occupy the sites originally selected by Law, while the first Casey station was opened in 1969 to replace Wilkes, which became uninhabitable following inundation by snow and ice.

In 1987 Law Base, named in honour of Phillip Law, was established in the Larsemann Hills near the site where Law first landed in February 1958.

For his pioneering work Dr Law received numerous awards including the Founder's Gold Medal of the Royal Geographical Society and the Gold Medal of the Australian Geographic Society.

The Minister for Environment Protection, Heritage and the Arts, Peter Garrett, paid tribute to Dr Law, saying his foresight and drive forged the beginnings of Australia's very successful Antarctic program and consolidated Australia's Antarctic interests.

"While the work of Sir Douglas Mawson led directly to the establishment of the Australian Antarctic Territory, it was Dr Law who forged

Australia's National Antarctic Research Expeditions (ANARE) as the forerunner to today's very successful Australian Antarctic program," Mr Garrett said.

"Often referred to affectionately as 'Mr Antarctica', Dr Law is among the true Antarctic pioneers and explorers."

A recent look into Philip Law's life was the book *Dr Phillip Garth Law: His Extraordinary Life & Times*, by Ian Toohill, (The Royal Societies of Australia, Melbourne, 2009, printed in Australia by On-Demand at Southbank, in Melbourne).

ATSE'S

former Technical Director, Professor Ian Rae FTSE, reviewed the book in ATSE Focus 156 (page 38, June/July

2009) – see <http://www.atse.org.au/index.php?sectionid=1265> (full edition).

"Law describes himself in an earlier book as a man gifted with luck, which he defines as the 'tiny margin between success and disaster'," wrote Ian Rae.

"There's more to it than that, as we all know: intelligence, prescience, planning and physical endurance have made big contributions to 'Law Luck'.

"If you have never read of Law's struggles with the bureaucracy and heard his stirring tales of Antarctic exploration and Antarctic science, then here is a chance to acquaint yourself with a great Australian," he added.

Philip Law at Long Beach, Heard Island, 1963.

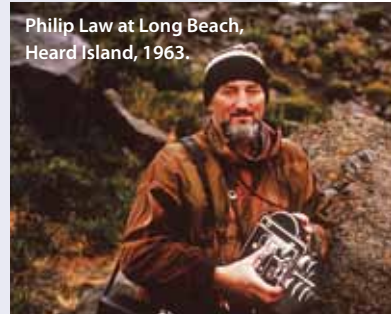


PHOTO: GRAHAME BUDD © COMMONWEALTH OF AUSTRALIA

Open Science and Dry Times – two new books

Professor Julian Cribb FTSE has co-authored two new books – on science communication and on what Australians can learn from the deserts and the desert people.

Open Science: Sharing Knowledge in the Global Century, written with Tjempaka Sari, explores ways to communicate science in a highly networked world where billions of people still have little or no access to advanced knowledge or technologies.

The authors describe low-cost, effective means to transfer knowledge to target audiences in industry, government, the community and to the public at large.

They say science and human knowledge urgently need to be opened up to the global public if we are to head off the six major crises that overshadow the human destiny in the coming 40 years – resource scarcity, the food crisis, climate change, pollution, pandemic disease and poverty – through science communication.

They call for the sharing of scientific knowledge among billions of humans on a scale never before attempted and explore practical ways that researchers, scientific organisations, governments and innovators can do this.

The book argues that the knowledge to solve many of the challenges confronting humanity already exists or is being developed, but it is poorly disseminated, leaving large parts of humanity without the know-how or technology to tackle problems such as water scarcity, energy shortages, hunger, pollution, disease and environmental degradation.

Production of human knowledge now doubles every five years, yet much is kept secret, withheld as intellectual property or is simply never communicated outside science.

"A vast gap has opened between the creation and the sharing of knowledge," the book argues. "Because of this, a significant part of the world scientific effort is effectively stillborn, or fails to achieve its potential. The intellectual effort, time, money and



Two new books from Julian Cribb.

human genius that is invested in research is lost because of a failure to effectively transmit the fruits of science to the people and places where it is most needed."

The book features sections on good science writing, practical advice on how to develop communication and media plans, ways to measure communication performance, how to manage institutional 'crises', how to deal with politicians, the media and public on complex issues and much more.

It outlines a new technique for assessing the likely public reaction to major new technologies with the power to affect millions of lives, to avoid the growing phenomenon of "technology rejection".

Open Science: Sharing Knowledge in the Global Century (220pp), published by CSIRO Publishing, is available for \$39.95 online (www.publish.csiro.au/nid/21/pid/6195.htm) or by calling 1300 788 000.

DESERT WISDOM

Dry Times: Blueprint for a Red Land argues that desert plants, animals and people have been surviving and thriving for thousands of years on scarce resources and in uncertain climates – and they have the systems to cope with uncertainty.

Written by former Desert Knowledge CRC (DKCRC) CEO and CSIRO principal research scientist Dr Mark Stafford Smith and Julian Cribb, the book distils three decades of "desert wisdom" – the rules of survival as practised by the people and wildlife.

A key message of the book is that desert people know, from long and harsh experience, what is the best way to organise themselves and develop their industries and communities. External approaches, though well-intentioned, often fail because they do not appreciate the full picture or conflict with one of the basic rules for desert survival.

It describes what drives deserts and their inhabitants: unpredictability, variability, sparse populations and resources, remoteness, local knowledge, cultural differences and social uncertainty. It explains how these have led to various strategies that enable both people and wildlife to prosper amid otherwise harsh surrounds.

"Besides seeming hot, dry and empty, deserts are also enormously rich – but the richness is concentrated in certain places and at certain times, like when the rains come," Dr Stafford Smith says. "All living creatures, including us, obey certain rules to take advantage of this fact."

The bottom line, say the authors, is that in the resource-scarce, increasingly uncertain 21st century, Australians and people the world over need to pay much closer attention to the deserts – and what they can teach us all about the rules of survival.

Dry Times: Blueprint for a Red Land (184 pages), published by CSIRO Publishing, is available online (www.publish.csiro.au/pid/6070.htm) and in bookshops for \$49.95.

CEO speaks at RMIT awards

ATSE CEO Dr Margaret Hartley was the guest speaker at the RMIT 2009 Medical Sciences Awards Ceremony in March, which recognised the outstanding achievements in 2009 of students and staff in biomedical science, human movement, laboratory medicine, medical radiations, pharmaceutical sciences and physical education.

Green light for Australian/French nuclear science partnership

ANSTO CEO Dr Adi Paterson was in Paris in March to sign an agreement with his counterpart, Professor Bernard Bigot, head of the French Atomic Energy Commission (CEA), under which ANSTO and CEA will partner more widely in research areas such as nuclear medicine, life sciences, radiation therapy, safety and radiological protection.

The signing took place at the International Conference on access to Civil Nuclear Energy, which was attended by 1400 delegates from across the globe.

"CEA, with more than 15,000 staff, is a leader in research, development and innovation in Europe," Dr Paterson said. "ANSTO has key research programs that have become possible because of our state-of-the-art OPAL research reactor and our unique accelerator

capabilities, which make it mutually attractive to collaborate more intensively."

ANSTO and the CEA first joined forces in 1992, signing a cooperation agreement on the peaceful uses of advanced nuclear technology. It enabled important collaborative projects in areas such as medical imaging, radioactive waste forms and environmental research. ANSTO researchers have also been involved in climate and atmospheric pollution monitoring in Europe as well as specialised medical imaging in collaboration with CEA.

"It is crucial that Australia continues to have a seat at the European table," Dr Paterson said.



Adi Paterson

SMO – Cleantech Science & Solutions

The Sir Mark Oliphant Conference 'Cleantech Science and Solutions – mainstream and at the edge' will be held from 5 to 7 May in Melbourne and focus on 'cleantech' – technologies and services that have both environmental and economic benefits. Speakers include Professor Robin Batterham AO FREng FAA FTSE and Dr Erol Harvey FTSE.

Details: www.smoclean.org

Australian Uranium Summit

The Australian Uranium Summit 2010 will be held in Perth on 10 and 11 May and follows the Western Australian Liberal government's decision to overturn a ban on uranium mining, paving the way for the development of new uranium mines in the state. Martin Thomas AM FTSE, chair of ATSE Energy Forum, will be a speaker.

Details: www.acevents.com.au/uranium2010/fees.html

GreenTech 2010

Jeremy Rifkin, the US economist and climate change policy adviser to the EU Government and some of the biggest companies in the world, will be the International Keynote Guest Speaker at GreenTech 2010, to be held from 8 to 10 June at Luna Park, Sydney. Speakers will also include Evan Thornley, CEO of A Better Place, and Jonathon Jutsen FTSE, Director, Energetics.

Details: www.acevents.com.au/greentech2010

IUGG Assembly

'Earth on the Edge: Science for a Sustainable Planet' will be held from the 28 June to 8 July 2011 at the Melbourne Convention and Exhibition Centre. This will be only the second time that the International Union of Geodesy and Geophysics (IUGG) General Assembly has been held in the Southern Hemisphere. Dr Peter Manins PSM FTSE chairs the scientific program committee for the event.

Details www.iugg2011.com

Fellows in the news

Helen Garnett

Professor Helen Garnett, former Vice Chancellor of Charles Darwin University, is the chairman of the Australian Biosecurity Intelligence Network (ABIN), officially launched in March.

ABIN aims to dramatically improve the ability of Australia's biosecurity community of researchers, industry and governments to work together to address common problems or emerging biosecurity issues through a nationally networked IT framework.

Professor Garnett was Pro Vice Chancellor at the University of Technology, Sydney, and

CEO at ANSTO before taking up her role at Charles Darwin University.

Chennupati Jagadish

Professor Chennupati Jagadish, who heads the Optoelectronics and Nanotechnology Group at ANU, has been made a Fellow of the American Materials Research Society – an award that honours MRS members who are notable for their distinguished research accomplishments and their outstanding contributions to the advancement of materials research, world-wide.

John Oakeshott

ATSE Fellow Dr John Oakeshott, Chief Scientist, CSIRO Entomology, based in Canberra, was one of 17 new Fellows elected to the Australian Academy of Science in March. The AAS noted his recognition for insect molecular genetics and the role of natural genetic variation in evolution, including the molecular basis of insecticide resistance. ATSE congratulates Dr Oakeshott.



Chennupati Jagadish

2010

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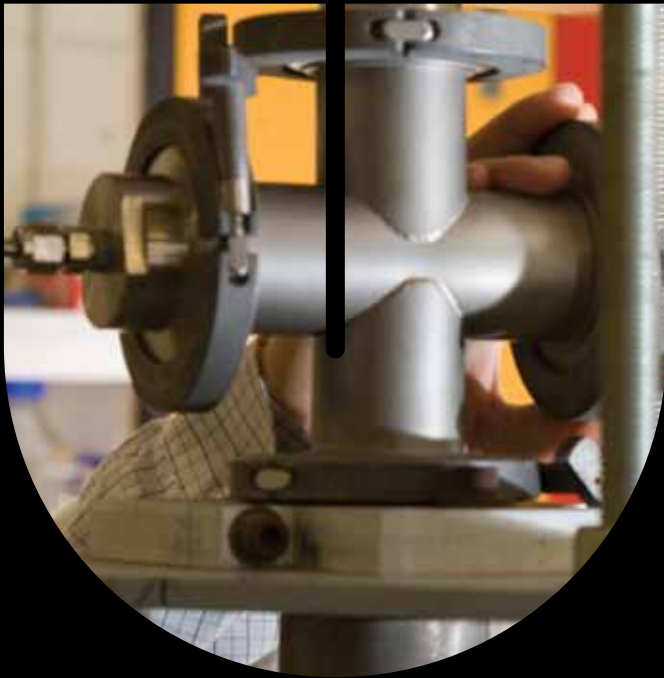
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