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INTERNATIONAL COLLABORATION

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FOR AUSTRALIA



Clunies Ross Awards

2018 CALL FOR NOMINATIONS

The Clunies Ross Awards have a proud 25-year tradition of recognising contributions by dedicated individuals who have shared their vision and knowledge with others to apply technology for the benefit of Australia.

Do you know a science and technology entrepreneur? Someone who has commercialised technology? Or someone who had led the adoption of technology?

NOMINATE THEM FOR A 2018 CLUNIES ROSS AWARD

Nominations are now open and must be submitted by 2.00pm AEDT on Friday 27 October 2017.

In 2018 the Clunies Ross Awards will be awarded in three categories with a single winner in each category.

CLUNIES ROSS ENTREPRENEUR OF THE YEAR AWARD

For those who have played a leadership role in the translation of a technology-based product or service that has led to financial success and demonstrated impact for Australia, and in which they have personally had a significant input in the inventorship or development of the technology. Such a person would typically have business responsibility as a CEO or a senior manager and may be working in either an early stage SME or a mature company environment.

Typically this would be an entrepreneurial person leading an activity that is disrupting well established vendors or commercialising new opportunities through innovative use of new technologies.

CLUNIES ROSS KNOWLEDGE COMMERCIALISATION AWARD

For those who have been responsible for the development and adoption of a technology and for sharing their knowledge leading to commercialisation, for example by licensing with a financially successful outcome.

Typically this could be a researcher or developer in a Public Funded Research Organisation, university or private company who has successfully passed his or her product/invention/service to a third party to commercialise and has generated significant revenue to the person and/or organisation they are associated with.

CLUNIES ROSS INNOVATION AWARD

For those who have been responsible for the development and adoption of a technology that has significantly improved societal and/or industry capabilities. In this case the primary outcome is not a financial benefit but has measurable broad community or industry impact.

Typically this could be a researcher or developer in a Public Funded Research Organisation, university or private company, where the outcome is in the form of industry development, or measureable improvement in community well-being or sustainability measures. Examples could include technologies that improve remote monitoring of agriculture/ecosystems, or improved access to remote learning and health care.

For further information visit www.atse.org.au/cluniesrossawards

Submit your completed nomination form by 2.00pm AEDT Friday 27 October 2017.

The Australian Academy of Technology and Engineering (ATSE) administers the Clunies Ross Awards program.

For more information contact the Clunies Ross Awards coordinator via email clunies.ross@atse.org.au

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Front cover photo: Exploring the potential of glass (see page 15).

FOCUS

ATSE Focus is produced to stimulate discussion and public policy initiatives on key topics of interest to the Academy and the nation. Many articles are contributed by ATSE Fellows with expertise in these areas. Opinion articles will be considered for publication. Items between 800 and 1400 words are preferred. Please address comments, suggested topics and article for publication to editor@atse.org.au.

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Australian Academy of Technology and Engineering
Address:

Level 1, 1 Bowen Crescent, Melbourne

Postal Address:

GPO Box 4055, Melbourne, Victoria 3001

Telephone: 03 9864 0900

Facsimile: 03 9864 0930

Email: editor@atse.org.au

CEO: Dr Margaret Hartley FTSE

Editor: Bill Mackey

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The logo for The Australian Power Institute (API) is a blue circle containing the letters 'API' in white. Below the letters, the text 'The Australian Power Institute' is written in a smaller white font.

API

The Australian
Power Institute

A collage of four images related to power engineering: 1) Three people in safety gear looking at a laptop on a solar panel array. 2) A large industrial building with a glass facade. 3) A large industrial structure, possibly a cooling tower or chimney, near a body of water. 4) Two people in safety gear looking at a tablet in front of a wind turbine.

*Our vision is to create sustainability and
excellence in Australia's power engineering.*

What is the API?

The Australian Power Institute (API) is a not for profit national organisation established by the Australian power industry to boost the quality and numbers of power engineering graduates with the skills and motivation for a career in the energy industry which encompasses:

- Generation, transmission and distribution utilities
- Manufacturers and suppliers to the industry
- Consultants to the industry
- End users of electricity in their operations.

Value Proposition

To deliver a sustainable supply of highly skilled power engineering professionals working effectively to meet the challenges of creating Australia's new energy future, and underpin the technical and commercial success of member companies in the energy sector.

The key objectives of API are to achieve the following:

- Provide a sustainable supply of quality power engineering graduates to industry
- University power engineering teaching and learning provides relevant industry skills
- Value added continuing professional development programs
- A respected organisation leading the national development of power engineering skills.

Further Information

Contact - Mike Griffin (Chief Executive)

0419 643 795

 mike.griffin@api.edu.au

 www.api.edu.au and www.powerengineering.org.au



BY KAYE BASFORD
k.e.basford@uq.edu.au



International collaboration is a key to our future.

Taking a strategic approach to international collaboration

INTERNATIONAL COLLABORATION Australia's economic, social and environmental well-being depends on having a world-class science community and business sector that is globally engaged.



Science, technology and innovation have always been globally connected endeavours. For a country like Australia – a medium-sized

immigrant nation, heavily reliant on exports – it has been imperative that we engage with the rest of the world.

As waves of digital disruption fundamentally change many of our industry sectors, Australia needs to maintain a constant focus on how we interact and partner with other countries to maintain our prosperity and high standard of living.

On the technology front, Australia can only expect to develop a small fraction of

This edition of *ATSE Focus* contains a selection of profiles of recipients of the first round of GCF Priming Grants (starting page 9), which demonstrate the diversity of projects and partnerships being supported by the program. The profiles of 40 of the 73 first-round grant recipients are already being collated into a Priming Grants booklet that ATSE will publish shortly and post to its website.

new technologies, so we must constantly be looking to adopt and adapt what is generated elsewhere.

The Australian Department of Industry, Innovation and Science says (on its web page) that Australia's economic, social and environmental well-being depends on having a world-class science community and

business sector that is globally engaged.

It notes the importance of:

- sharing international knowledge and expertise;
- initiating and developing international collaborations;
- accessing world-class infrastructure;
- entering overseas markets;

- ensuring that Australia's science achievements are globally recognised; and
- leading efforts to address global challenges.

In its 2015 report *Measuring the Value of International Collaboration*, the Academy of the Humanities said international research collaboration was a key feature of the Australian research landscape and was integral to Australia's future.

Like ATSE, a member of the Australian Council of Learned Academies (ACOLA), that Academy noted "increasing the international

as part of the strategic planning process showed that, while these countries remain key partners, ATSE should not limit itself to interacting with these nations.

Under its new Strategy Plan, the Academy will prioritise its engagement – globally, regionally and bilaterally – to ensure it aligns effectively with government priorities, Australia's innovation needs, and ATSE's National Technology Challenges. Part of this approach involves a stronger emphasis on multilateral forums.

AS WAVES OF DIGITAL DISRUPTION FUNDAMENTALLY CHANGE MANY OF OUR INDUSTRY SECTORS, AUSTRALIA NEEDS TO MAINTAIN A CONSTANT FOCUS ON HOW WE INTERACT AND PARTNER WITH OTHER COUNTRIES TO MAINTAIN OUR PROSPERITY AND HIGH STANDARD OF LIVING.

connectedness and depth of international engagement of research is fundamental to the long-term competitiveness of domestic research, and to ensure that research drives economic and social advancement."

In a 2014 report, Universities Australia noted that collaborating with other countries was an important contributor to a nation's research performance and that Australia's rate of international collaboration was above that of the UK and the US, but below many other international competitors.

With all this in mind, it is easy to see why international engagement is a critical factor in the work ATSE does. The development of the Academy's new Strategy Plan has provided an opportunity to reassess our international engagement, relationships and programs. Led by the Board and the Academy's International Strategy Group, ATSE has taken a considered look at what it does and with whom it does it.

'Connecting globally for the benefit of Australia' is one of its eight key priorities, with a focus on encouraging researcher–SME collaboration, enhancing links with its sister academies around the world, and engaging both with economies whose technologists and engineers are going to provide world best practice examples and opportunities, and those who would benefit from Australian technology expertise.

ATSE's previous strategy plan prioritised engagement with five key countries in our region – China, India, Japan, Korea and Indonesia. Our consultation with Fellows

In addition to ongoing participation in the International Council of Academies of Engineering and Technological Sciences (CAETS), ATSE has recently been invited by the Australian Government to participate in the Asia Pacific Economic Cooperation (APEC) Policy Partnership on Science, Technology and Innovation. Through involvement in this group, the Academy is able to interact simultaneously with governments and like-minded organisations in our region, and identify itself as a leader in promoting Australian innovation. ATSE has also been invited as an observer at this year's East Asia Roundtable Meeting of Engineering Academies (with Korea, Japan and China), and attendance will further cement the relationships with these entities and their countries.

The Academy's flagship international program continues to be the Global Connections Fund (GCF), which it administers on behalf of the Australian Government. This program is funded as part of the Global Innovation Strategy of the National Innovation and Science Agenda (NISA), and seeks to foster partnerships between Australian researchers and SMEs and their counterparts in 17 priority economies.

The article on Priming Grants (page 5) outlines the history and rationale behind the GCF, illustrating the trusted relationship ATSE maintains with the Government to design and operate these types of programs. ATSE has now run two rounds of Priming Grants and two rounds of Bridging Grants, and

initial feedback and analyses show that this program is generating positive outcomes.

ATSE has traditionally administered a number of exchange programs for early career and emerging researcher leaders on behalf of the Government. The long running Australia–Japan and Australian–Korea Emerging Research Leaders Exchange Programs have now wound up, reflecting a shift in government policy from bilateral to broader relationships, as demonstrated by the GCF.

However, the successful Young Scientists Exchange Program with China continues to operate, with 16 Australian researchers visiting China this year and a reciprocal group visiting Australian research institutions.

In keeping with the new ATSE Strategy Plan, this mix of researcher and SME travel and exchange programs seeks to foster greater innovation collaboration for our scientists and entrepreneurs.

In addition to our multilateral academy relationships via CAETS, ATSE continues to hold individual workshops and roundtables with our sister academies. In March, ATSE partnered with the Indian National Academy of Engineering to organise a joint workshop on urban water management. In November, ATSE will host a delegation from the Chinese Academy of Engineering to discuss technology in food safety, as a follow up to a successful joint workshop on the same topic in Beijing in 2016.

Individually and through ACOLA, ATSE is strengthening its relationship with the Royal Society Te Aparangi (Royal Society of New Zealand), leading to a number of trans-Tasman collaborations.

These diverse activities and relationships demonstrate the importance the Academy places on its international partnerships and engagement. It leverages these relationships to better achieve its vision of Australia as an innovative, globally competitive nation that embraces technology. ☺

Professor Kaye Basford FTSE is Professor in Biometry and Head of the School of Biomedical Sciences at the University of Queensland, former President of the International Biometric Society and the Statistical Society of Australia, and previously Head of the School of Land, Crop and Food Sciences. She is a member of the Board of Trustees of the International Rice Research Institute and a Director of the Crawford Fund. As a Director of ATSE, she chairs its Audit and Risk Committee and is Vice President with responsibility for its International Strategy Group.



BY MARK BRADLEY
mark.bradley@atse.org.au

Priming Grants concept drives international engagement

INTERNATIONAL COLLABORATION Priming Grants demonstrate that relatively small grants provided in a timely manner can have real impacts for awardees and the innovation ecosystem in Australia.

Cooperation in science, technology and innovation at the international level is a key element in national science and innovation systems and is vital in supporting economic growth in Australia.

Collaborative relationships leverage one another's strengths in a cooperative way, producing benefits for both Australia and partner economies, and assist both in their development as technology leaders.

A recognised and significant barrier to the translation of research intellectual property into commercial products or services has been the ability of researchers and small-to-medium enterprises (SMEs) to form productive dialogues and collaborative partnerships.

If these potential collaborations are across international jurisdictions then often the difficulties in establishing and maintaining them make it just too hard to bother.

Recognising this difficulty, the Australian Government – under a bilateral partnership with the European Union (EU) – trialled a new program in 2013: Connecting Australian–European Science and Innovation Excellence (CAESIE).

An innovative feature of this program was the concept of very early stage commercialisation engagement grants, called Priming Grants – developed and administered by the Australian Academy of Technology and Engineering (ATSE) to support contacts between businesses and researchers that had identified a collaborative partnership opportunity between Australia and EU countries.

These grants, over a two-year period, delivered 58 new SME–researcher partnerships, yielded four patents and sought more than \$16 million in funding from an initial \$1.9 million of European and Australian Government funding (an eight-fold multiplier).

Building on the success of these activities, the Australian Government's National Innovation and Science Agenda has invested \$36 million over four years in a Global Innovation Strategy to improve Australia's international science, research and innovation collaboration.

Within this program, a \$4.9 million Global Connections Fund (GCF) provides grant support for global SME-to-researcher collaborations to enable viable projects to grow and test commercialisation in industries of strategic growth in Australia.

The GCF Program consists of two forms of funding: Priming Grants and Bridging Grants.

Both grant schemes, administered by ATSE with a particular emphasis on translational activities and commercialisation outcomes seek to:

- increase collaborations with 17 key global economies;
- promote researcher–industry engagement and knowledge transfer; and
- encourage translational activities and end-use development and commercialisation outcomes.

PRIMING GRANTS

The Priming Grants take a unique 'hands on' approach, providing bespoke expert advice and direction during the application process and a 'light touch' online application system that reduces red tape and is quick and easy for applicants to use.

Successful SME or research applicants are awarded a Priming Grant to fund a face-to-face engagement with prospective partners to establish if a long-term working collaboration can be formed. The application process has been designed to be fast and simple with a minimum of fuss, which is widely appreciated by applicants.

The first round of Priming Grants was conducted during April–May 2016 and

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LETTERS TO THE EDITOR

ATSE *Focus* welcomes letters from readers in response to published article or on technology related topics. Please keep letters brief. Longer letters may be run as contributed articles.

Please address to editor@atse.org.au

THE NEM AFTER THE FINKEL REVIEW

1 November 2017 / Sydney

**REGISTER
TODAY**

Be part of the Australian Academy of Technology and Engineering's Symposium in Sydney on the impact of the Finkel Review on energy security and the future of the National Electricity Market. It will address the key issues facing the industry, investors, policy makers and regulators.

The recommendations of the Review Panel and the COAG response will have profound implications for the Australian economy for many years and will pose unprecedented challenges for policy makers, regulators and the energy industry.

This ATSE Symposium, organised by its NSW Division, will bring together a range of distinguished speakers with unmatched expertise, including experts both from Australia and two jurisdictions facing similar challenges – New York and the UK.

The Symposium provides a unique opportunity to appreciate the ramifications involved and contribute to an important national debate.

**Be part of the debate – register today at
www.atse.org.au/nsw-energy-symposium**

SPEAKERS INCLUDE

- **Dr Alan Finkel AO FAA FTSE**
Chief Scientist of Australia
- **Professor John Loughhead**
OBE FREng FTSE
Chief Scientific Adviser, Department for Business, Energy and Industrial Strategy, UK Government
- **Mr James T. Gallagher**
Executive Director, New York State Smart Grid Consortium
- **Ms Audrey Zibelman**
CEO, Australian Electricity Market Operator (AEMO)

EVENT DETAILS

DATE

Wednesday 1 November 2017

TIME

8:00am - 6:30pm

VENUE

Commonwealth Bank of Australia
Colonial Theatre
Level 20, Darling Park Tower 1
201 Sussex St, Sydney NSW 2000

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results were announced in June 2016, with 73 grants proceeding to final reporting status. All grantees provide a report on outcomes of their project and complete an online survey run by ATSE.

The results of the survey and reports have seen a high level of successful outcomes: 87 per cent classified their collaborative projects as 'very successful', 11 per cent of grantees regarded their projects as 'partially successful' and a work in progress, and one project was not successful in establishing a collaboration (Figure 1).

The outcomes far exceeded the original expectations of the program with most grantees taking the opportunity (Table 1) to:

- identify ongoing funding sources to develop their projects further (49 per cent);
- identify new additional collaborative partners (65 per cent); and
- develop additional business or research opportunities (62 per cent) in addition to those proposed originally.

CATALYTIC ENABLERS

The Priming Grants were shown to be catalytic enablers, with 74 per cent responding that the grants accelerated the pace at which these collaborative arrangements occurred.

Importantly, 21 per cent of those surveyed said that without the Priming Grant funds these interactions 'would not or may not' have taken place.

Priming Grants lay the groundwork for the eventual realisation of translational activities from basic research into the commercial arena if a solid collaboration is formed.

Apart from developing the proposed partnerships, a number of other benefits accrued to those participating, including:

- bringing participants into contact with other organisations;
- an increased likelihood of working with additional partners; and
- (modest) enlightenment of the grantees from an international science commercialisation perspective.

Grantees were able to raise working capital exceeding \$2.3 million – meaning that every Government dollar was immediately leveraged 4.4-fold. Further, 37 per cent of grantees reported that, on the basis of the engagement activities under the grant, they

FIGURE 1 Priming Grants 2016 survey results: 'Overall, was the collaboration you originally proposed successful?'

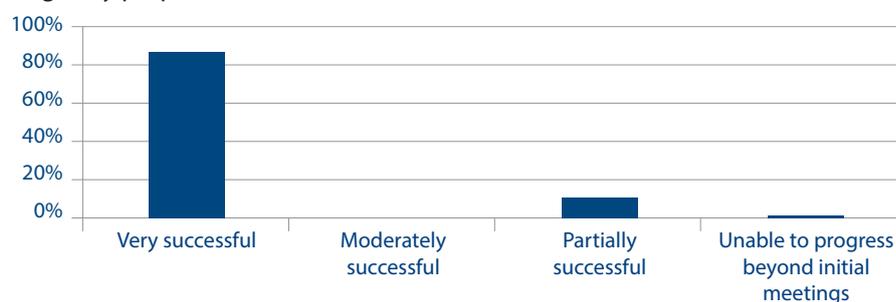


TABLE 1 Priming Grants 2016 survey results: opportunities realised.

Opportunity	Outcome (%)
Implemented our ideas as a research–industry collaboration	84.1
Applied for additional funding (AU or EU sources)	49.2
Commercial investment from another party	9.5
Identified additional collaborative partners or individuals	65.0
Progressed our products or services to prototype status	25.4
Developed additional business or research opportunities	62.0
None of the above	1.6

Priming Grants take a unique 'hands on' approach, providing bespoke expert advice and direction during the application process and a 'light touch' online application system that reduces red tape and is quick and easy for applicants to use.

were applying for additional grant funds totalling \$16,608,223 – potentially a 32-fold multiplier of the original grant investment of \$518,000 for this round.

OTHER BENEFITS

Ten per cent of respondents reported that they had applied for a provisional patent with their collaboration partner; 82 per cent indicated that the generation of new IP was a possible future event; others considered that their works could generate copyright and trade secrets. Respondents were clearly cognisant of the IP considerations around their projects, looking to future developments and the need to secure the IP benefits that may accrue from international collaborations for Australia.

Respondents reported that 396 people were involved in the grant activities – 149 in Australia and 247 internationally and 61 per cent of the grants generated new employment opportunities, including student positions.

Grantees considered the program excellent and rated GCF highly in terms of delivery of the program and meeting their requirements during the process.

Virtually all respondents indicated that they were very satisfied with the Priming Grants as a support initiative and liked the 'light touch' administration, including short application times and brevity of applications and of reporting requirements.

When asked to rank the various type of international connector services, the most recommended programs/services under the current GCF were Priming Grants and Bridging Grants – with less interest in undertaking trade missions, online partnering or matching services.

Priming Grants were seen as a very cost-effective service, which demonstrated that relatively small grants provided in a timely manner could have real impacts and outcomes for awardees and the innovation ecosystem in Australia.

The Priming Grants continue to be a successful early stage engagement instrument. The first round under the GCF demonstrated that the program has global applicability in supporting engagement between SMEs and Researchers." 

Dr Mark Bradley is ATSE's Manager International Innovation Programs.

ONLY AT SEASIM

The National Sea Simulator (SeaSim) is a world-leading research aquarium facility at the Australian Institute of Marine Science headquarters in Townsville, north Queensland, adjacent to the Great Barrier Reef.

SEASIM CAN REPLICATE CURRENT AND FUTURE OCEAN CONDITIONS.

Here researchers are provided with precise control of complex combinations of environmental variables, supporting novel, high-precision and long-term experiments.

Researchers can replicate naturally occurring environments or human-induced conditions, including simulation of diurnal, monthly and seasonal cycles, with control over a range of environmental parameters including light, temperature, acidity, salinity, sedimentation and contaminants.

SeaSim is a cutting-edge facility that helps researchers understand the cumulative effects of climate change, ocean acidification, water quality, marine pests, pollution and coastal and industrial development impacts.

Global collaboration

The University of Miami's Rosenstiel School of Marine and Atmospheric Science is looking at how changes in the brain chemistry of small reef fish can change their behaviour.



Professor Martin Grosell, University of Miami Rosenstiel School of Marine and Atmospheric Science.

The University's Department of Marine Biology and Ecology Professor Martin Grosell said the SeaSim was the only place in the world where this type of detailed research could be undertaken.

He said, "I am really impressed with the facilities here, it is mind blowing, there really isn't anywhere else we can do this scope of study with this accuracy."

"Using the SeaSim, we can fluctuate CO2 levels which occur naturally to get a more accurate picture of what it could look like in 80 years."

For more information

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aims.gov.au/seasim



Australian Government



AUSTRALIAN INSTITUTE
OF MARINE SCIENCE



Dr Mohit Chhaya**CUSTOMISING BONES WITH 3D PRINTING**

Since it was first developed, 3D printing has struck a dent in many scientific fields, particularly in the healthcare sector.

The tool is predominantly used for prototypes – surgeons, for instance, can 3D-print a body part model to help explore anatomy and better plan their surgical work.

Co-founder of Biofabrication Design Solutions (BDS) Dr Mohit Chhaya calls this the “low hanging fruit” for 3D printing’s potential uses. He says his company is devoted to taking 3D printing a step further and customising bone models to be implanted into the body of a patient.

“This is where there’s a lot of movement and growth in the industry. You can use MRI or CT scans and make a custom implant,” Dr Chhaya says.

Titanium and steel bone implants are made this way, but Dr Chhaya says they’re too stiff and carry the bulk of the load, causing bone density to deteriorate in a similar way to astronauts’ bones after a stint in space. Instead, the Brisbane-based scientist and businessman makes intricate, porous and durable plastic implants that can be

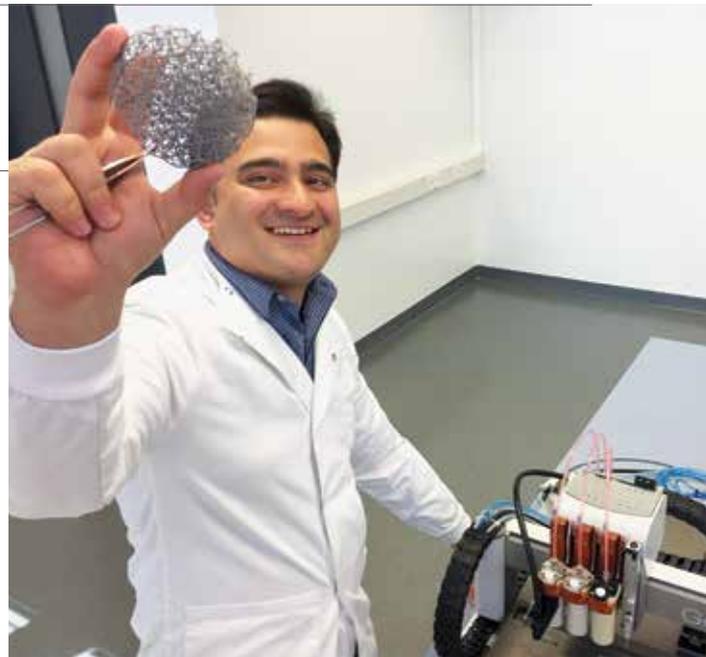
integrated into the body.

Their aim is to give bioengineers in hospitals the ability to design these structures using a software BDS is developing. “We make not just a customised shape, but a customised architecture. We discovered this is something that the surgeons really need,” Dr Chhaya says.

BDS was spawned from the laboratories of Dr Chhaya’s PhD supervisor at Queensland University of Technology, Professor Dietmar Hutmacher – a bioengineer who helped pioneer these 3D plastic structures.

Dr Chhaya started making his business a reality during and after his PhD, which was focused on breast cancer implants. Now at only 29 years old, Dr Chhaya is recognising where 3D printing is lacking and used the Priming Grant to patch the holes in the technology.

He says because 3D printing is still a relatively new technology when it comes



Dr Chhaya holds up a spongy scaffold for breast reconstruction.

to biomedical research, it’s hard to be exact when looking at what you can hold, compared with what was designed on the computer. “If it’s for a patient’s implant, then you really want to be sure. The tolerances are really tight.”

BDS cooperated with a research group at the Technical University of Munich, who used X-rays to analyse the printed part, comparing it to the model.

“We have a process that we can now very soon bring it to Australia, and this would be one of the first ways we can control the quality of the print,” Dr Chhaya says. ☺

Dr Anita Parbhakar-Fox**BUILDING A BETTER MINING INDUSTRY**

Australia has a long mining history, but the stringent safety measures in place now weren’t always there.

The University of Tasmania’s Dr Anita Parbhakar-Fox is a geo-environmental scientist making sure mining operations today don’t make the same mistakes historic mine sites made. She says her research is focused on transforming the mining value chain and her role is working in geo-environmental characterisation.

“We’re looking at ways we can forecast the geo-environmental risks of mining operations way before they’re commissioned,” Dr Parbhakar-Fox says. “We’re trying to be predictive about what the impacts on the environment are going to be so the mining companies have a better idea of the environmental liabilities and how to plan for them.”

There are about 50,000 abandoned mine sites in Australia,

and most are producing acidic water, polluting the surrounding environment. In some cases, the acid can threaten our drinking water, Dr Parbhakar-Fox says.

The main culprits that cause acidic drainage are sulfide minerals. If miners don’t manage their waste and sulfide minerals lie on the surface of the waste mound, they will oxidise and transform into sulfuric acid. If the acid gets into the environment, it can enter creek systems, impact aquatic life and then propagate down the food chain, she says.

“If we understand the characteristics of the waste materials, we know how to better design waste landforms.”

The 34-year-old geoscientist moved to Australia from the UK 11 years ago.

She was a successful recipient of the Priming Grant and, together with collaborator Dr Christopher Brough, from Petrolab UK, she set her sights on improving one of the tests for acid-mine drainage – kinetic tests



Dr Parbhakar-Fox’s research aims to make sure historic mines aren’t leaking acid into the environment.

CONTINUED ON PAGE 12



CLEVER RESOURCEFUL SOLUTIONS

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Dr Mark Blaskovich

CREATING NEW ANTIBIOTICS TO STAY AHEAD OF DISEASE



Dr Blaskovich (centre) at work with colleagues, Dr Alysha Elliott and Dr Johannes Zuegg.

The risk of bacteria resistant to antibiotics is fast becoming a global crisis and Dr Mark Blaskovich from the University of Queensland is on the front line, fighting to find a way to keep a potential pandemic at bay.

The medicinal chemist, who has more than 15 years' experience in drug development, creates new antibiotics specifically designed to treat drug-resistant pathogens.

"What we're trying to do is raise public awareness that this is an issue that people should be concerned about because the potential danger down the road is real," Dr Blaskovich says.

Already, about 700,000 people die each year from drug-resistant infections, but this

number is expected to rise to 10 million by 2050 if nothing changes.

Drug-resistant bacteria, however, are nothing new, Dr Blaskovich says. For decades, new antibiotics would be developed faster than the bacteria could adjust. But scientists are no longer able to keep up with the rate bacteria acquire resistance, and Dr Blaskovich says this is predominantly from a lack of funding.

"Most major pharmaceutical companies are no longer investing in basic antibiotic research, and that's largely due to the lack of financial return."

Dr Blaskovich was a recipient of the Priming Grant, which he used to collaborate with Visterra Inc in Boston, US. They explored the possibility of creating a 'guided missile' – an antibody drug conjugate that works by targeting and then killing drug-resistant bacteria without harming human cells.

"You can compare it to carpet bombing in World War II, where to destroy a factory you had to bomb a whole city because the bombs weren't selective enough," he says. "Now with

a guided missile you can selectively just hit that factory and avoid killing all the innocent people surrounding it."

The Canadian-born scientist worked in Seattle for about a decade in multiple molecular science companies before moving to Australia in 2005, where he has taken on both academic and commercial positions.

But not all his roles have been in science. When his sons began to play baseball, he says having a North American accent threw him into a coaching position, despite not having much baseball experience. "The baseball community in Australia is small, but there are some really high-calibre people you rub shoulders with."

Dr Blaskovich is also known for being the sole author of the comprehensive book, *The Handbook on Syntheses of Amino Acids*.

"That was an over 10-year labour of love that took up a lot of my spare time. It was a larger-than-anticipated task," he says, explaining that he might have been too thorough in covering "literally all the literature on amino acid synthesis".

But he adds that seeing his book on a bookshelf in Oxford was a highpoint. ☺

Dr Christoph Rüdiger

A BIRD'S-EYE VIEW OF OUR LAND

Dr Christoph Rüdiger has a perspective of the Earth not many of us get to see. The Monash University scientist has a bird's-eye view of our planet and keeps watch over its face to monitor surface dynamics using satellite data.

With this data, he can observe the effects of weather events or surface changes – for instance on soil moisture and crop health. But Dr Rüdiger says he hopes people understand that 'predictions' don't have absolute certainty attached.

"There're always a range of possible outcomes and people can be disappointed because, for example, the fire didn't start exactly there, on that date, on that hour, but two days later and not exactly in the predicted location," Dr Rüdiger says.

The uncertainty involved in his work, however, isn't necessarily a blight on the industry.

"It's a challenge and that's what science is about," he says. "If we didn't have the uncertainty, we wouldn't have science and for me it wouldn't be interesting. That's basically why I became a scientist."

Currently, Dr Rüdiger is using satellite data made available from European satellites to eye Australian farms, thanks in part to the Priming Grant. He says the data from this new fleet of satellites, called



Dr Rudiger's three-day-old footprints in Lake Eyre.

Copernicus, can potentially change the face of agribusiness.

For the new of satellites, the temporal resolution is unprecedented, passing over the same spot on Earth every five days. The current satellites providing that type of data have a temporal resolution of four

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FROM PAGE 9

BUILDING A BETTER MINING INDUSTRY

designed to check whether the sulfide minerals in mining waste will potentially oxidise.

One of the problems with the test, Dr Parbhakar-Fox explains, is that there's a minimum cut-off point for when the waste can be declared safe – usually in around six months' time – and the two researchers believe this isn't long enough.

"We're trying to help the industry better understand what's happening by introducing forecasting tests that we know work.

"We know the tests need to be formally in the protocol. If it's not stated in the protocol or global standards, people could potentially cut corners."

Dr Parbhakar-Fox adds the global standards organisations are currently looking to improve kinetic testing standards.

"This is a really opportunistic time to have won this grant and to be able to do this work, so we're very happy and excited about changing it. We just want to set the standards high." ☺

FROM PAGE 11

A BIRD'S-EYE VIEW OF OUR LAND

to eight weeks, so when it's cloudy scientists could be forced to wait months to see the surface.

Now, scientists can monitor vegetation on a weekly basis.

"In Australia, farmers can have tens of thousands of hectares of land, so it's crucial they don't have to drive so far through the field and still not see what's in the centre."

Part of Dr Rüdiger's job is to translate data into useable visuals for farmers.

Born in Germany, the 42-year-old scientist has lived in five different countries – Germany, France, Australia, the US and the UK – and worked at organisations such as NASA and the French meteorological service. Through this international experience and network of professional relationships, he orchestrated the data's availability in Australia, and its processing overseas.

"All the raw satellite data being free is a massive leap forward."

Working at NASA was a dream come true, he says. "When I was standing in front of the gates in the morning and getting a badge, professionally, that was my dream."

But his greatest achievement, he says, isn't strictly related to his scientific career; Dr Rüdiger trekked to Mount Everest lower base camp after a conference in the capital of Tibet.

"It was the most amazing thing to come over the last pass and suddenly seeing the mountain range," he says. ☺

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Dr Matthew Harris COPPER-67 THE KEY TO CANCER TREATMENT

We are in a war on cancer and some treatments, such as chemotherapy, are like setting a bomb off in the body – the tumour may be destroyed, but the rest of the body becomes debilitated. But what if there was a way to target cancer and kill a tumour without any collateral damage?

Sydney-based SME Clarity Pharmaceuticals is developing a way to do just that with nuclear medicine. By labelling a drug with a radioactive tag, doctors can watch the drug through imaging as it travels through the body and seeks its target.

Managing director of Clarity Pharmaceuticals Dr Matthew Harris says being able to see the drug infiltrate the body allows doctors to treat the patient more accurately.

Clarity uses a specific form of copper, called copper-64, together with positron-emission tomography (PET) imaging, to enable this targeted treatment.

“Once we have confirmation that, yes, the drug actually goes to the tumour and is safe, we use another form of copper, copper-67, which kills cancer in a localised manner, making the treatment safer and more efficient,” Dr Harris says. “It gives you a lot of confidence to treat the patient. This is opposed to getting a diagnosis, taking chemotherapy and then hoping the drug goes to the tumours. We

actually visualise it.”

Clarity Pharmaceuticals is a development company – it doesn't presently have any products on the market but is currently engaged in clinical trials, testing radio-tagged drugs on humans. Soon, the drug will be trialled on children suffering from cancer.



Dr Harris (right) with Head of Clinical and Contract Research Mr Amos Hedt.

“That's something that also drives us, we're all focused and passionate about hopefully helping a child with cancer,” Dr Harris says.

Using funds from the Priming Grant, Clarity Pharmaceuticals set up a working relationship with Idaho State University's Idaho Accelerator Centre in the US. There, a research team pioneered a production method for copper-67, a rare form of copper that isn't available in Australia.

“It's very important to work out whether we could actually use that in Australia in our trials, as well as the potential to make copper-67 in Australia in the future,” Dr Harris says.

Copper-67 is at the “cutting-edge”, Dr Harris says, and adds that up until now the production of it didn't result in high enough yields.

“The benefits of using copper for targeted therapy are nothing new in science, but it's only now coming of age, thanks to Clarity's team and technology, and the efforts of our colleagues in Idaho who ensure regular and commercially viable supply of copper-67.”

Dr Gang (Kevin) Li SUSTAINING SOCIETY AND REDUCING POLLUTION

Whether we like it or not, society still functions on fossil fuels. It's University of Melbourne chemical engineer Dr Gang (Kevin) Li's job to make sure these practices are as clean and environmentally friendly as possible.

He says while conventional production from the chemical industry – for instance, gas, oil and plastics – is highly polluting, it's essential to modern life.

“As chemical engineers, we have to sustain the prosperity of society, but in the meantime, reduce pollution and make the process more environmentally friendly, sustainable and efficient,” Dr Li says.

His research primarily focuses on developing new technologies to tackle this concept and separate natural gases, particularly methane gas capture technology. Methane is more than 20 times more potent than carbon dioxide as a greenhouse gas.

“We want to make the natural gas clean and pure so it can be upgraded to pipeline quality or LNG quality so then we can sell the gas on the domestic or international market.”

The Chinese-born engineer and his colleagues at the University of Western Australia, including Professor Eric May, developed a new family of adsorbent materials that he says has the highest methane selectivity in the world – it outperforms all other industrial adsorbents separating methane from nitrogen.

He says funds from the Priming Grant meant he could present this new material to global industrial partners, such as China's DKT Energy Technologies, linking him to the largest coal seam gas market in the world.

“This ATSE grant is very helpful because it's a grant that led to an even larger opportunity,” Dr Li says.

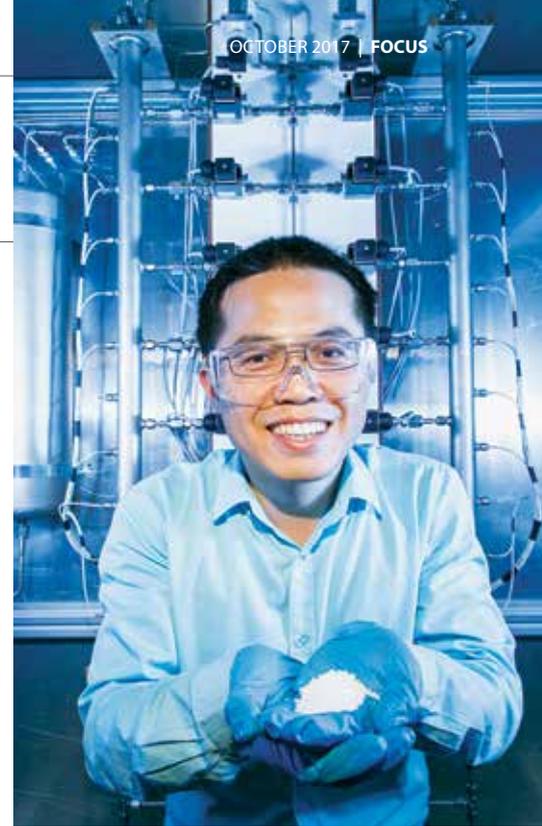
The opportunity Dr Li mentions is successfully acquiring \$1 million from the Global Innovations Linkages grant to continue this venture – one of the highlights of his career.

“When the gas industry comes to us, and says ‘We have a problem recovering the dilute gas, can you develop a better technology to help us improve profit and capture methane from the vents?’, his work is exciting, Dr Li says.

“It's so exciting when you can solve a real-life problem.”

In collaboration with WA company Oilfield Technologies his research on gas separation will be commercialised in the next three years.

For the innovative nature of his research, in 2015 Dr Li was awarded the Woodside Oil and Gas Encouragement Award and Perth Convention Bureau Travel award at the WA Innovator of the Year Awards.



Kevin Li with ionic liquid zeolite adsorbents in front of the pilot adsorption rig.

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Professor Ebendorff-Heidepriem makes a paperweight with Glass Studio Program Manager Ms Kristel Britcher.

Professor Heike Ebendorff-Heidepriem GLASS CAN BE BOTH SCIENCE AND ART

For some scientists, a failed experiment can be a crushing disappointment. Perhaps the solution was slightly contaminated, or perhaps they just forgot to 'carry the one'.

For University of Adelaide glass scientist Professor Heike Ebendorff-Heidepriem, however, failures in the laboratory translate to unique works of art. Her research focuses on developing optical glasses and fibres, which means she experiments with the way light travels through glass. When something goes wrong, the light still creates vivid patterns in the glass.

"Everything about glass is exciting to me," Professor Ebendorff-Heidepriem says. "And particularly optical fibres. It's about creating new structures, manipulating the light that's travelling along these fibres and then interacting with the environment."

For fun, the German scientist has been involved in the marriage of science and art – six years ago she was involved in an exhibition, coordinated by her previous supervisor. The exhibition, called 'A Fine Line', put failed glass science experiments on display.

"They couldn't really be used for light to

travel along the glass, but they looked beautiful."

She is currently working on another project, this time involving glass peppered with gold nanoparticles.

Optical fibres are usually associated with telecommunications, but Professor Ebendorff-Heidepriem's research focuses on developing new light sources, such as novel lasers and new sensing tools, that use light for measurements.

For instance, she's currently working with Defence Science and Technology Group to make glasses and fibres that transmit light outside of the visible spectrum, such as infrared radiation. "Defence is interested in developing glasses with new transmission windows," she says.

For the project around her Priming Grant, Professor Ebendorff-Heidepriem worked with the cutting-edge technology provided by IRflex, which specialises in unique mid-infrared glass technology and production.

She brought her expertise in micro-structured fibre design and together they collaborated to create a new mid-infrared

transmitting fibre for high-power light.

"I'm very happy with the collaboration," she says. "It was one of those chance encounters." Professor Ebendorff-Heidepriem had met the CEO at a conference in the Bahamas.

After completing her PhD in Germany, Professor Ebendorff-Heidepriem moved to the UK for four years before coming to Australia.

Throughout her scientific career she has received a cache of awards, such as a Women's Research Excellence Mid-Career Award (2015) and the International Zwick Science Award (2009) for the most innovative use of a Zwick machine, turning it from a metal testing machine to a glass extrusion machine. (The Zwick Roell Group, based in Germany, is a manufacturer of static testing machines and systems for materials and components testing.)

Professor Els Meeusen DEVELOPING DIAGNOSTIC TREATMENTS FOR CANCER

The path from science to business isn't one often trodden by scientists. For Professor Els Meeusen, who left academia four years ago to concentrate on a biotechnology company called CancerProbe that she set up with two colleagues, it was a transition that came with a few learning curves.

"I've done what I wanted to do in the academic field, and I wanted to try this out. I thought it would be very important and worthwhile," Professor Meeusen says.

"I'm learning new skills about other companies and presenting work to them, rather than writing papers. It's a very different mindset, but I've always been on the more translational side of things anyway."

Professor Meeusen's expertise wasn't initially in cancer, but in immunology. While she was researching at Monash University, she discovered that worm parasites and cancer both escape and manipulate the immune system in the same way when they grow larger. She developed CancerProbe to explore this idea further with the goal of developing diagnostic treatments for cancer.

"I suppose I have come up with it separately but I think people are coming up with it independent from my own idea as well," she says of using parasites as the scaffold for cancer research.



Professor Meeusen analyses cancer patients' immune profiles.

"Cancer and immunology together isn't a new research field, it has been around for a long time but it hasn't been really popular in the cancer or biology fields, which is more about chemotherapy and surgery."

CancerProbe specifically researches ovarian and breast cancers. The approach is unique: the company uses a tissue in the body, called the lymph node, to detect tumour antigens.

But getting access to lymph nodes of ovarian cancer patients in Australia isn't easy, Professor Meeusen says. In Australia, when a tumour is removed in surgical procedures, the lymph node isn't also taken out.

The Priming Grant awarded to Professor Meeusen addresses this issue and funded her trip to Japan where lymph nodes are removed and can therefore be studied.

"The trip was very successful. I told them how to continue collecting the tissue while I'm away, but it depends on how many patients they get so it's a slow process," she says. "There's still a lot of work to be done before we get a final product, we're continuously working to find new funding."

Professor Meeusen currently lives in Melbourne, having moved to Australia from Belgium in 1983.

Nuclear science and technology benefiting all Australians

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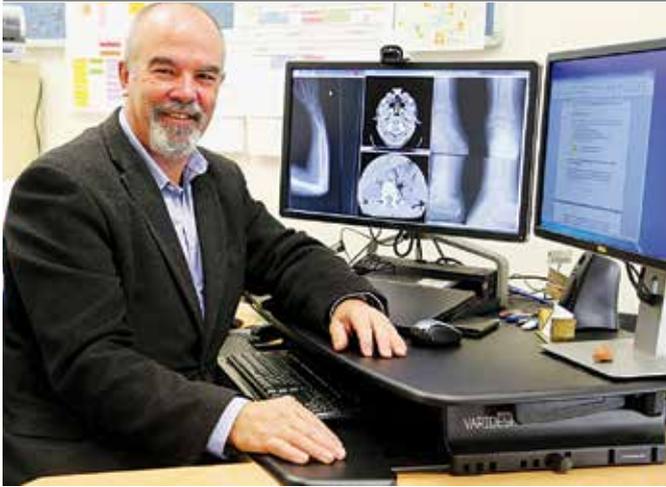


produce nuclear medicine to aid diagnosis of diseases such as cancer and heart disease,

Solutions for industry



and support Australian industries, including exploring new battery technologies.



Professor Davidson aims to reduce radiation dosages.

Professor Rob Davidson WORKING FOR SAFER MEDICAL IMAGING

Professor Rob Davidson found his calling as a researcher. With more than 20 years as an academic in medical imaging, Professor Davidson says he's still passionate about his work.

"I have held previous jobs where I've woken up and thought, 'Why am I going to work?' Ever since I've become an academic there isn't one day that's not exciting," he says.

"There are new things to think about, new ideas popping into your head and you're being challenged on those ideas. It is extremely mentally stimulating."

The radiographer from the University of Canberra started his science career as a clinician and then broke away for a stint in sales and marketing selling X-rays, CT scans and MRIs.

But research is where Professor Davidson most flourishes. He was recently named in the top 10 researchers in medical imaging in the world and, as the second person to be appointed at a professorial level in medical imaging in Australia, he says he takes pride in being one of the leaders of the profession.

"My biggest achievement has been able to progress the profession academically," he says.

Most of his academic career has been devoted to researching the safety of radiation to patients during medical imaging procedures.

Professor Davidson says there is a risk for potential cancer induction to every patient that receives a dosage of radiation. And more widespread use of computer topography (CT) scans – which has almost 100 times the radiation dosage of an X-ray scan – can be attributed to more cancer-related deaths in Australia, Dr Davidson says.

So why not just minimise the radiation?

Professor Davidson, who has been on radiation safety committees in the past, says toning down the dosage translates to poorer quality images. This means the effectiveness of medical imaging to diagnose health problems would be substantially impacted.

The Priming Grant will help him create a novel tool to assess image quality, which may ultimately lead to minimising radiation dosages without tarnishing sharpness.

"CT is a really good diagnostic tool, clinicians are relying on it more and more. But we're increasing the overall dosage of radiation to the population," Professor Davidson says. ☺

Robert Southerton USING GENOMICS TO BREED BETTER EUCALYPTS

Breeding eucalyptus trees is a job that requires patience – they can take up to 20 years to grow, depending on where they're located.

While this is a relatively short period compared with other types of dominating trees, paper is often derived from eucalypts and many companies can't afford to wait until a tree reaches a suitable height before they're turned into fresh paper.

This is where Gondwana Genomics comes in. The company develops DNA tests for certain markers, to boost the rate of selectively breeding eucalypt trees.

Gondwana Genomics managing director Robert Southerton says that unlike crops such as wheat, which have been selectively bred for thousands of years to the high-yielding breeds we're familiar with, humans have only just begun to try to streamline eucalypts.

"They're still pretty close to wild. There's a lot of improvement that can be made from breeding them," Mr Southerton says. "If we're going to reduce the stress of deforestation, then we need to make the land we've got as efficient as possible."

By taking a sliver of a eucalypt, from the bark or a leaf stem, Gondwana Genomics tests the DNA of the whole tree in a laboratory in Canberra, and peers into the seedling's future performance.

"Rather than planting trees out many, many times and replicating trials, and wait years before making selections, you can do a simple DNA test and work out a tree's performance. You can fast-track the breeding and get to the next generation."

So, what makes a tree "genetically superior"? Mr Southerton says Gondwana Genomics primarily aims for high growth, stabilised tree density and a high pulp output. "That's in general terms, but we tailor it for the companies we're working with."

Gondwana Genomics used their Priming Grant funding to build a relationship with China Eucalypt Research Centre (CERC) and prove the effectiveness of the technology. CERC, in turn, has a network of commercial pulp and paper companies in southern China.

The technology, Mr Southerton explains, involves a DNA marker panel, which was sourced from CSIRO and developed in Gondwana Genomics. This cost-effective panel lets the scientists predict the performance of future tree generations for selecting superior trees while they are still seedlings, not just within a generation.

This predictive power from the DNA marker panels is cutting-edge.

"You get off on being the first in the world, and this technology will have a really significant impact," Mr Southerton says. ☺



Robert Southerton accelerates the process of breeding eucalypts to obtain genetically superior trees.

THE WORLD NEEDS NEW



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The study of schizophrenia presents countless barriers. But Associate Professor Juanita Todd is pushing our understanding of schizophrenia forward in ways previously thought impossible. Juanita is working on the discovery that brains affected by schizophrenia react differently when a sound pattern suddenly changes, a difference that is helping detect the earliest signs of the illness. It's a promising new approach - giving those who live with schizophrenia new hope.

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ATSE IN ACTION

ATSE sends its views to Canberra

ATSE has recently made a number of submissions to Government inquiries, which included those below.

AUTOMATED VEHICLES

ATSE's submission to the National Transport Commission's discussion paper *Regulatory options to assure automated vehicle safety in Australia* outlined its support of the introduction of regulatory frameworks for autonomous vehicles that promote innovation and rapid time to market of new technologies, while still ensuring safety.

ATSE recommended manufacturers carry out the testing of new autonomous vehicle technologies, provided certification is mandatory and Government specifies the test procedures and continues to monitor safety events.

The submission also outlined a range of definitions that should be incorporated in new methodologies for certifying vehicle safety.

OUR CITIES

ATSE's submission to the House of Representatives Standing Committee on Infrastructure, Transport and Cities' *Inquiry into the Australian Government's role in the development of cities* recommended a collaborative systems thinking approach to urban development that addressed the needs of the community.

ATSE supported investment in technologies that enabled environmentally friendly and efficient transport, including a shift to a fully autonomous, integrated multimodal electric transport system.

ATSE envisaged future cities that linked water resource management, flooding issues, water resource capture, stormwater management and environmental conservation issues to urban planning and increased urban green spaces. It said buildings standards should require energy efficiency and demand-side management of

energy and maximise the use of rooftop solar power. City development must be informed by collaborative research and innovation to achieve global best practice, it said.

SPACE INDUSTRY

In a submission to the *Australian Government Review of Australia's Space Industry Capability*, ATSE said national coordination was needed to meet Australia's critical need for secure, long-term satellite capability. This should involve access to international systems and operation of our own satellites.

ATSE recommended a national space agency be established to ensure Australia's position as a respected contributor to the global space industry. Lead times in the Australian space industry were long and viable national space programs required sustained public policy support and investment, ATSE said.

STELR NOW IN 600 SCHOOLS

Wadalba Community School, on the NSW Central Coast, officially signed on in August as the 600th school in the national STELR program.

Wadalba students will now be able to engage fully with STELR – Science and Technology Education Leveraging Relevance – as part of ATSE's national campaign to get Australian secondary students interested in science and technology courses and careers.

Wadalba Community School Principal Jason McGrath received a kit of STELR equipment from the Governor of New South Wales, General David Hurley AC DSC (Ret'd) FTSE, who attended the event with Mrs Linda Hurley.

Mr Richard Sheldrake AM FTSE, NSW Division Chairman, represented ATSE and Ms Belinda Grealy represented long-term anchor sponsor Orica.

Guests were able to watch the students using the STELR equipment at the event. This equipment is now in more than 20 per cent of Australian high schools – with an estimated 75,000 secondary students and more than 2000 teachers involved each year.

Orica was proud to be a foundation sponsor, Ms Grealy said.

"Orica aims to make lasting and positive contributions in its programs and STELR certainly makes that happen.

"STELR equipment is going to spark learning and inspire students into thinking about having a career in STEM."

Mr Peter Pentland, Executive Manager ATSE School Programs, said the 600th school was a great achievement for the program.

"When we started this journey in 2007 we were aiming for wide adoption of the STELR principles, designed to respond to the declining



Wadalba students accept the STELR equipment presented by General Hurley (right) with Belinda Grealy from Orica.

participation in STEM subjects in schools and tertiary institutions.

"We are delighted that, with support of our partners, we have been able to achieve such a dramatic expansion of the program."

Conceived by Australia Chief Scientist Dr Finkel AO FAA FTSE, ATSE's immediate past president, STELR has evolved to reflect the new Australian Curriculum: Science and the various modules are designed to be taught within the curriculum, making them available to all students in the appropriate year levels (6 to 10) of each participating school.

STELR has had long-term anchor support from Orica and the Australian Power Institute and substantial support from Cochlear, CSR, Cigre, Charles Darwin University, Deakin University, Southern Cross University, the University of Wollongong, *Cosmos Magazine*, Stile Education and an array of ATSE Fellows and charitable trusts.

ATSE IN ACTION

IMNIS takes mentoring program national

The IMNIS program has expanded significantly, with a range of programs launching in NSW, WA, SA and Queensland, following the Victorian launch in June.

In its first six months the Industry Mentoring Network in STEM (IMNIS) project has connected 204 PhD students around Australia with high-profile industry leaders in medical technologies, minerals resources and energy resources.

An award-winning initiative of the Australian Academy of Technology and Engineering (ATSE), IMNIS is now working with three of the government's industry growth centres.

It has MedTech-Pharma programs in Victoria, NSW, Queensland and SA. In partnership with MTPConnect (the Medical Technology and Pharmaceutical Industry Growth Centre) and AusBiotech, these programs have paired 141 PhD students from 11 universities with industry leaders in a one-year mentoring program.

In collaboration with two more of the Government's industry growth centres, METS Ignited (Mining Equipment, Technology and Services sector) and National Energy Resources Australia (NERA), IMNIS has also launched programs in energy resources and minerals resources in WA, Queensland and SA. Together these programs have 63 PhD students from seven participating universities.

In Perth, WA's Minister for Water, Fisheries, Forest, Innovation and ICT, and Science, Mr Dave Kelly, officially opened the Energy-Minerals Resources program.

Professor Mary O'Kane AC FTSE, NSW Chief Scientist and Engineer, launched the NSW MedTech-Pharma program in Sydney.

SA Chief Scientist, Dr Leanna Read FTSE formally opened the MedTech-Pharma and Energy Resources programs in Adelaide and the Queensland Acting Chief Scientist, Dr Christine Williams, launched that state's MedTech-Pharma and Minerals Resources programs.

IMNIS coordinates one-year mentoring



Mary O'Kane launches the program in Sydney.

programs complemented by state-level events to provide guidance, strengthen skills, share expertise and extend networks.

The national roll-out of the IMNIS MedTech-Pharma program is possible thanks to funding from our major partner MTPConnect with strong support from our consortium partner AusBiotech, Australia's peak biotechnology industry association. IMNIS is grateful to sponsors CSL and KPMG, and supporters FB Rice and Engineers Australia for their support.

OUR FUTURE DEPENDS ON DIGITAL READINESS

Australia's productivity and competitiveness in the Digital Age will rely on an innovative industry sector that embraces research, technological innovation, and local and international collaboration, according to ATSE.

It says priority must be given to preparing Australian industry and society to be leaders and fast followers in the emergence and development of digital futures.

These are key points in ATSE's Position Statement on Digital Futures, which is available online (see Featured items on Home Page – 'Embracing Australia's digital futures').

It says today's digital technologies are having a significant societal and economic impact on Australia, and are the basis of a newly emerging set of foundational technologies which will disrupt every aspect of the economy.

The uptake and effective utilisation of ICT services has facilitated innovation in advanced environmental management solutions, new diagnostic and preventative health techniques and methods to detect, respond to and recover from natural disasters and emergency situations.

It predicts Australia's manufacturing, production and services sectors will increasingly be enabled by access to broadband, both fixed and mobile, as well as low power network technologies for the Internet of Things (IoT). This can facilitate the widespread adoption of digitally enabled technologies such as 3D printing, nanoscale

fabrication, machine learning and automation.

"National capabilities in information technologies and digital engineering will underpin growth in all Australian industry sectors, including health, agriculture, finance, mining, education and other services sectors," it says.

"Strong collaboration between researchers and industry is key to achieving the agility to successfully seize this opportunity, particularly given the challenges of digital disruption to industries that have significantly invested in traditional methods."

It notes ICT has also strongly impacted societal culture and behaviour. "People are increasingly moving towards living part of their lives in the digital world, including socialising, learning, conducting financial transactions, and storing and sharing personal data.

"Emerging technologies will see this evolution continue with a deepening of human-machine partnerships and relinquishing of tasks to autonomous systems."

The Position Statement says ATSE will address the three pillars of digital transformation – ICT development, ICT application and ICT societal impact.

ATSE will analyse these priority focus areas to identify key actions that will assist industry and government to prepare for digital transformation opportunities in the future and to address current societal needs.

ATSE IN ACTION

ATSE's WISE Project goes into filming

Filming has begun on ATSE's 'Profiles of Women in STEM Careers and Entrepreneurship', a project that aims to engage students in schools and foster positive attitudes towards their own study and career possibilities for the future.

The 'WISE' project features 20 video profiles, championing women pursuing STEM careers and enterprises, highlighting their individual journeys, achievements and ambitions.

This project was made possible by a grant under Round 1 funding from the \$8 million Women in STEM and Entrepreneurship grant program under the National Innovation and Science Agenda.

Building on the influence of existing STELR career profiles, the videos will demonstrate the positive impact valuable transferable skills could gain students, while also dispelling stereotypes about STEM professionals and their work.

Women from all states and territories are involved in the two to three minute videos that will support STELR curriculum packages.

Nearly 20 STEM fields will be represented in the videos. ATSE will develop supporting curriculum content for the STELR WISE videos, being produced by video production company Visual Domain.

Inoka Amarasekara is the WISE Project Officer. She researched more than 300 potential candidates for the videos before the list was culled to 20 by an advisory committee. She has been responsible for finalising the list, processing invitations, liaising with the 'talent' and Visual Domain to finalise the shooting schedule and ensuring the quality and value of the videos.

The videos will be self-narrated and follow the theme 'reflecting on my career'. This will allow for diversity between the videos but enable them to suit each profile by having a common theme. The videos will reveal the personalities, capture candid moments, lifestyle, hobbies, work places and environments.

Focus groups post-production will enable format and style to be fine-tuned.

When completed, the 20 videos will be hosted on the RIAus Australia's Science

Channel to guide students interested in STEM careers. They will also be embedded into the STELR web-based curriculum packages and linked to a re-vamped STELR website careers page.



James Lawler, Creative Director (left), and Jaci Brown, CSIRO Tasmania, during filming. Jaci is working on an app for farmers that will help them prepare and plan ahead according to predicted climate conditions.

MINING: DINOSAUR OR DELIVERER?

Tasmania's mining industry – long a major employer and revenue source – came under the spotlight in August when the Tasmanian Division and the ATSE Mineral Resources Forum held a public meeting in Hobart as part of National Science Week.

The aim of 'Mining in Tasmania: Dinosaur or Deliverer?' was to raise community awareness and understanding of current issues around the future of mining in Tasmania.

Mining's importance has been declining due to its economics and commodity prices, environmental and community concerns, mining and exploration company perceptions, and government policy.

The forum attracted about 60 participants, who enjoyed a performance by both a 'dinosaur' and a 'deliverer' – characters chosen to epitomise the two contrasting futures open to mining in Tasmania.

Key speakers included economist and company director Saul Eslake, consultant geologist Ken Morrison, environmental geometallurgist Anita Parbhakar-Fox and West Coast Council Mayor Phil Vickers.

The audience also heard from parliamentarians from the three political

parties active in the state – Labor Member of the Legislative Council, Sarah Lovell; Minister for State Growth in the Tasmanian Government, Guy Barnett; and Greens Senator in the Australian Parliament, Peter Whish-Wilson – noting that all three parties supported mining in Tasmania, and recognised the risks of its decline ending in extinction.

Ms Denise Goldsworthy, Chair of ATSE's Mineral Resources Forum, argued that some of Tasmania's inherent characteristics were simultaneously assets and liabilities. She noted the small size and population of the state ought to result in flexible operations

capable of rapidly taking advantage of new technology and innovation but, economies of scale and successful competition with much larger mainland neighbours were both difficult to achieve.

The open discussion explored a variety of issues: the balance of pressures to conserve wilderness areas versus mineral exploration; the crucial role of government in the recovery of the mining industry to a stronger and sustainable position; the high-productivity nature of mining; the need for long-term planning; and widening community awareness of the importance of responsible mining.



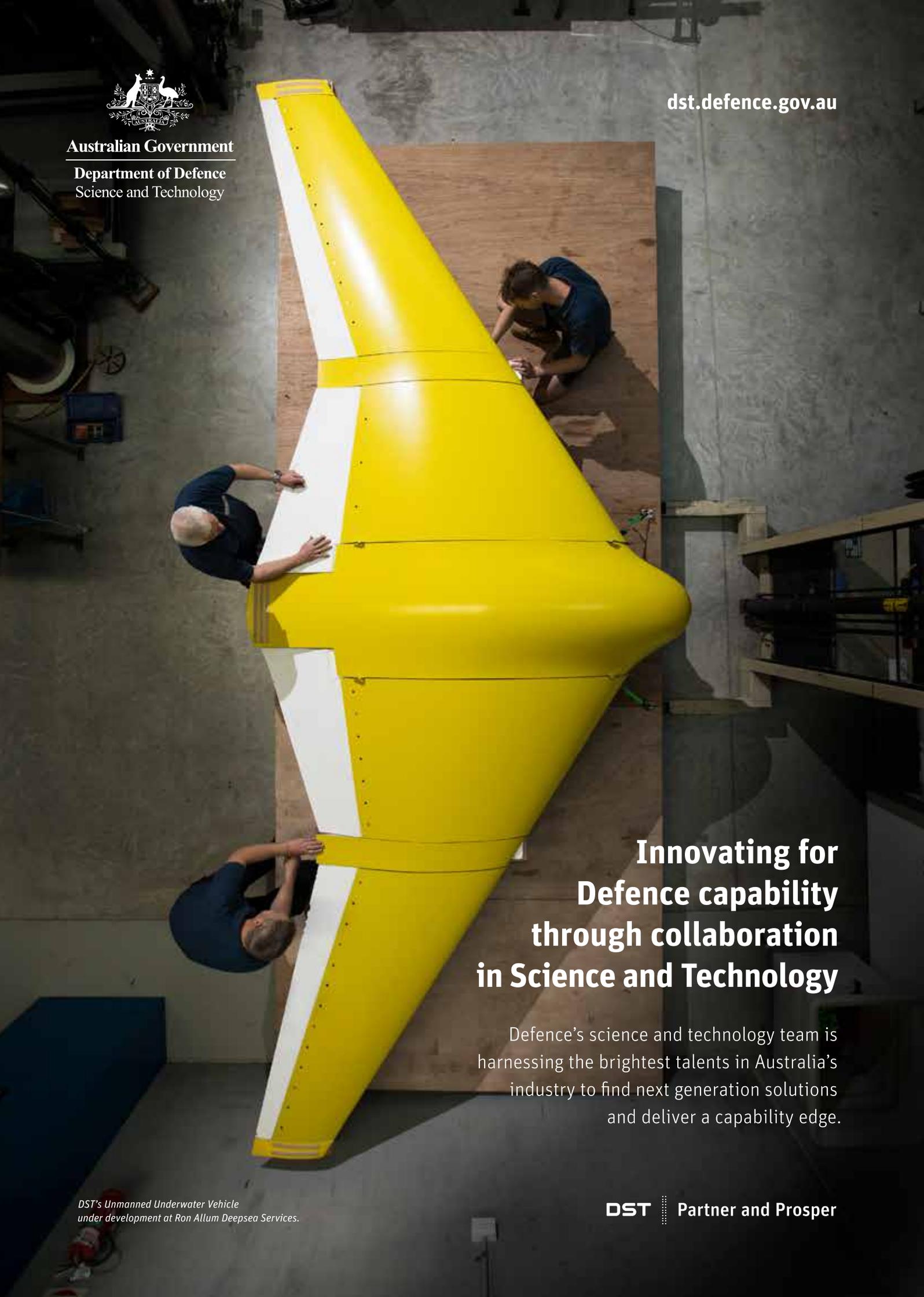
The Dinosaur (Chris Large) and The Deliverer (Nathan Chapman) voice views of mining in Tasmania.



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ATSE IN ACTION



Adi Paterson at the welcome ceremony.

Australia joins Gen IV nuclear partnership

Australia has joined the Generation IV International Forum (GIF) Framework Agreement, a partnership through which it will contribute to international work on the development of future nuclear energy technologies.

This will enable Australia to become actively engaged in research and development projects related to Generation IV systems, particularly in relation to advanced materials.

GIF is a cooperative international endeavor to develop and design

the next generation of nuclear energy systems. Its research is focused on six reactor designs, which aim to deliver safe, secure, sustainable, competitive and versatile nuclear technology in the future.

As the 14th member of the GIF, Australian researchers will work with counterparts (from countries including Canada, France, Japan, China, South Korea, South Africa, Russia, Switzerland and the US) to develop Generation IV designs of nuclear energy systems, which seek to:

- use fuel more efficiently;
- produce less waste;
- be more economically competitive; and
- meet stringent standards in relation to safety and non-proliferation.

The CEO of the Australian Nuclear Science and Technology Organisation (ANSTO), Dr Adi Paterson FTSE, attended a ceremony in France to officially welcome Australia.

"Australia has no nuclear power program, but we do have significant local expertise through which we can lend assistance in next-generation research, which is what this partnership is about," Dr Paterson said.

"This Agreement will enable Australia to contribute to an international group focused on peaceful use of nuclear technology, and the international energy systems of the future.

"Our participation in GIF is an affirmation of Australia's exemplary research capabilities and STEM industry, strengthened by ANSTO's expertise and highly developed nuclear science infrastructure."

CCS: A MITIGATION OPTION WE CANNOT IGNORE

BY BRUCE GODFREY

Energy systems will move towards more renewables, more storage, smarter grids, lower carbon fuels and greater efficiency.

But as the recent ATSE Action Statement makes clear, we need to recognise that coal-fired power stations continue to be built, especially in Asia, and gas-fired generators are currently still a necessary component for energy reliability.

If we want to keep global warming below 2°C we need to consider the cost of the CO₂ disposal and carbon capture and storage (CCS) is an option that we cannot ignore in this regard.

There is also no viable alternative to coal use for a range of industrial processes such as steel-making – and therefore currently no alternative to CCS if we are to limit emissions from such industrial processes.

As one of the world's largest fossil fuel exporters, Australia has a significant role to play in the application of CCS as a carbon-reduction technology, working in partnership with energy-importing countries to accelerate its uptake, including for industrial processes

The ATSE Action Statement saw no major technical obstacle to the uptake of CCS, pointing to the fact that many components of CCS have been used for decades. Successful retrofits of CCS to coal-fired power stations have been applied at Boundary Dam and Petra Nova in North America.

However, critics of CCS say that the cost of CCS makes it unaffordable – but until we test the costs in the Australian context with a commercial-scale CCS demonstration system, focused on retrofit, we are not in a position to make this judgement.

The ATSE statement proposes performing such a commercial test in Australia in the next five years. If nothing else, such a commercial test will establish the true cost in Australia of disposing of CO₂ waste from fossil fuel-burning energy sources.

Why is CCS not already being deployed in Australia and elsewhere? ATSE believes the problem lies with "the lack of supportive policy initiatives" and the absence of "bipartisan Government support including stable and lasting policies for all emission reduction technologies".

The experience gained through deployment is key to establishing the cost and the operational effectiveness of CCS under Australian conditions, and to bringing down costs.

Given the prominence of fossil fuels in the economy, CCS is a very important mitigation option for Australia. But its importance is global.

For example, most climate change models now build in a significant component of 'negative emissions' achievable through CCS, such as via bioenergy and CCS (BECCS). As pointed out by various studies and echoed in the ATSE Action Statement, in the absence of CCS, not only is it likely the world will overshoot the Paris emissions target but the cost of mitigation will be far higher.

The ATSE Action Statement proposes that as long as fossil fuels are used, if we are to make deep cuts in emissions, the time for action on CCS, in Australia and globally, is now!

■ Dr Bruce Godfrey FTSE is an ATSE Director and chairs its Energy Forum

ATSE IN ACTION

SA Division stages Whyalla technology showcase

ATSE hosted a one-day technology showcase in regional South Australia recently as part of an industry conference focused on the Upper Spencer Gulf region – drawing together the centres of Whyalla, Port Pirie and Port Augusta.

Transforming Industry Through Technology was a technology showcase conducted with SA universities to promote business–academic research cooperation and bring to the attention of regional industries the state’s research capability.

The showcase featured technologies developed by SA’s universities – each offering collaboration to help SMEs engage in multidisciplinary research programs and

partnerships with a strong commercial focus.

Promoting the showcase, SA Division Chair Mr Mike Heard FTSE emphasised to conference attendees the value of collaboration between industry and research institutions.

“Time and again we’re told that to survive and thrive in business we must embrace innovation,” he said.

“My core message today is that we can’t afford to wait for new technology to find us. We must proactively seek it out.

“Technology shocks come hard and fast. Every business – small, medium and large – needs to be alert to the challenges and the opportunities they present.

“Many studies show that businesses that collaborate with research do better. Yet

there is a mutual wariness, verging on fear, between Australian businesses and research institutions about collaboration.”

Mr Heard urged business to better understand the commercial focus of universities.

“Increasingly, research grants are conditional upon collaboration with industry, where the future technology needs of the business drives the research. I strongly encourage you to visit their stands, meet the researchers, and start building your relationships with the universities through them.

“Having great technology partners is every bit as essential as great loyal customers; in fact without technology leadership you end up without customers.”

FELLOWS STRONG IN FOCSA

The Federation of Chinese Scholars in Australia (FOCSA), a consortium of 12 Chinese professional associations in Australia, will hold the 7th Australian–China Symposium in Education, Science and Technology in Sydney from 28 to 30 November.

It aims to attract about 200 participants, including university executive officers, leading experts and scholars from both Australia and China – including ATSE and the Academy of Science, the Chinese Academy of Engineering and the Chinese Academy of Science.

The ATSE President, Professor Hugh Bradlow FTSE, will deliver a keynote address.

ATSE Fellows have taken a leading role in FOCSA, which includes in its objectives promotion and furthering bilateral links and cooperation between Australia and China in science, technology, engineering services and education.



Lin Ye

The current President and Symposium organiser is Professor Lin Ye FTSE from the School of Aerospace, Mechanical and Mechatronic Engineering at The University of Sydney.

The inaugural president of FOCSA was Professor Max Lu FTSE AO FAA FTSE (Vice Chancellor of the University of Surrey), followed by Professor Aibing Yu FAA FTSE (Pro Vice Chancellor of Monash University), Professor Min Gu FAA FTSE (Associate Deputy Vice Chancellor of RMIT University), Professor Dongke Zhang FTSE (Foundation Professor of Chemical Engineering and Director of the Centre for Energy at the University of WA) and Professor Shi Xue Dou FTSE (Director of the Institute for Superconducting and Electronic Materials (ISEM) at the University of Wollongong).

The Sydney Symposium will focus on strategic topics of interest to both countries, including education, science and technology without borders, technology transfer, big data and new materials technologies.

STARPORTAL STEM WEBSITE LAUNCHED

STARportal is a searchable database of science, technology, engineering and mathematics (STEM) activities, resources and events throughout Australia – and ATSE’s STELR program is part of it.

STARportal connects students, parents and teachers with STEM events in their local community, as well as online activities. It is a free service for users and STEM event providers, with more than 330 activities already listed – including a range of STELR activities.

Students and parents can search for STEM events near them. Teachers can search for classroom resources, such as the suite of STELR modules or for extracurricular resources and programs.

The Office of the Chief Scientist, working with Engineers Australia, developed STARportal with support from some of the nation’s biggest employers. The BHP Billiton Foundation,

the Commonwealth Bank of Australia and Telstra are founding partners in the project, along with the Australian Mathematical Sciences Institute.

Industry, Innovation and Science Minister Senator Arthur Sinodinos AO launched STARportal at Parliament House in Canberra, as part of National Science Week. Australia’s Chief Scientist Dr Alan Finkel AO FAA FTSE and Engineers Australia CEO Mr Peter McIntyre were there.



STELR on STARportal.

ATSE IN ACTION

Australia can lead climate change response

Australia is well-placed to meet the challenges and be a leader in capturing the opportunities in effective climate change mitigation and adaptation – but this will need strong leadership from government and active participation by industry.

Australia's mitigation and adaptation efforts will be strongly enhanced by the timely adoption and further advancement of science and technology innovations, supported by government policy settings that encourage investment in technologies already available.

These are key elements of a recent ATSE Position Statement on Australia's response to climate change.

It says mitigation efforts must increase

to avoid the significant dangers posed by an accelerating and irreversible global warming.

The innovation required for effective climate change mitigation and adaptation efforts offers immense opportunities for the creation of social, economic and environmental benefit, ATSE says, noting the need for a cross-sectoral roadmap to achieve net zero carbon emissions by 2050.

ATSE HAS IDENTIFIED FOUR KEY UNDERPINNING PRINCIPLES:

1 Adopt long-term, bipartisan policies and programs that encourage the actions and investments needed to mitigate greenhouse gas emissions and adapt to the impacts of climate change.

2 Inform and test mitigation and adaptation responses, using leading edge climate modelling and prediction techniques (which should be enhanced in areas where Australia has recognised leadership or unique needs).

3 Increase support for low-emissions technology research, development and demonstration, prioritising areas where Australia has recognised leadership or unique needs.

4 Support Australian participation in cooperative international programs focused on developing solutions to climate change.

The Position Statement is online (see Featured items on the ATSE Home Page – 'Australia's response to climate change').

MAJOR AWARDS TO BE PRESENTED AT ORATION DINNER

Two important awards administered by ATSE will be presented at the Academy's Oration Dinner on 24 November in Sydney.

One of Australia's best young engineers will win the 2017 **Batterham Medal**, which is an early career award for a graduate engineer who has achieved substantial peer/industry recognition for his/her work in the past five years.

The Academy administers the award on behalf of the Group of Eight Deans of Engineering and Associates. The award consists of a medal (The Batterham Medal) and a cash prize of \$5000.

The Batterham Medal recognises Professor Robin Batterham AO FREng FAA FTSE, an Australian science and technology leader who was Chief Scientist of Australia from 1999 to 2006, President of the Academy from 2007 to 2012 and is Kernot Professor of Engineering at the University of Melbourne.

Associate Professor Andrew Fleming (38), from the University of Newcastle, won the 2016 Batterham Medal. He is a recognised expert in the modelling, control and engineering of ultra-high precision imaging and fabrication systems.

Two of Australia's best young food and agriculture professionals will win the 2017 **ICM Agrifood Award**, an early career award for two outstanding agriculture or food scientists or technologists, sponsored by ICM Agribusiness, one of Australia's major agribusiness groups, and administered by ATSE.

One female and one male winner will each receive a cash prize of \$5000, acknowledging them having achieved substantial recognition for their work in a field critical to continued improvement of the Australian food sector in the past five years.

PAUL GAVINI WINS TEACHER AWARD

Paul Gavini, Senior Chemistry and Physics teacher at Adelaide's Marryatville High School, has won the the 2017 South Australian ATSE Teacher's Award. ATSE SA Chair, Mr Mike Heard, presented the award at the SA finals of the Science and Engineering Challenge in August 2017.

Mr Gavini's primary role is in chemistry and physics but he also teaches year 11 IT (programming) and junior science. He is manager of the STEM Professional Learning

Community at the school and a member of its IT Committee. He has helped school staff through planned staff meeting training sessions on the use of various equipment – including light gate sensors, gas and pH sensors, projectile and centripetal motion apparatus, spectroscopic apparatus, voltage and current meters and force meters.

The SA Division of ATSE has sponsored the award annually since 2006 to raise awareness of the importance of STEM Teaching and of the Academy's support for it.



Mike Heard (right) presents the award.

WOMEN IN TECHNOLOGY

SAGE momentum builds with 44 participating

Momentum to improve gender equity and diversity in Australia's higher education and research sector continues to build with four new institutions joining The Science in Australia Gender Equity (SAGE) Initiative pilot of the UK-based Athena SWAN accreditation program.

The new participants are the Australian Institute of Marine Science, Murdoch University, Geoscience Australia and the University of Adelaide.

Their engagement with the SAGE program was announced by ATSE President Professor Hugh Bradlow FTSE at the 2017 SAGE symposium in Brisbane in September and by Industry, Innovation and Science Minister Senator Arthur Sinodinos AO.

"I'm encouraged that more than 40 Australian public research organisations, universities and medical research institutes have signed on to SAGE since it began in 2015, with each participating organisation setting and working towards achieving its strategies and goals for gender equity and

diversity, and having them accredited by SAGE," the Minister said.

"I'm confident that in time the SAGE initiative will lead to more female researchers in senior roles, and greater representation of women with STEM skills and capabilities in the broader workforce."

The new additions brings the total number of participants to 44, with 32 universities (representing 88 per cent of Australian universities), six medical research institutes and six publicly funded research agencies joining the SAGE Pilot Program.

Executive Director of SAGE, Dr Wafa El-Adhami, said the addition of four new members reflected a strong commitment to reversing gender inequality and supporting diversity through effective systematic solutions like Athena SWAN.

"It is also a testament to the sector's confidence in SAGE and our service," Dr El-Adhami said.

Geoscience Australia's Chief Executive Officer Dr James Johnson said his organisation was inspired by the UK experience in

implementing the Athena SWAN Charter, which has shown accredited organisations have a significant competitive advantage when it comes to attracting first-rate scientists.

"Our involvement in this program is a fantastic next step in our efforts to make our workplace more inclusive for everyone and to further Geoscience Australia as an organisation of scientific excellence and an employer of choice," Dr Johnson said.

Murdoch University Deputy Vice Chancellor Education, Professor Romy Lawson, said the university was proud to be advancing the careers of women in higher education and research through participation in the pilot.

"This is an important step for our university in supporting a diverse and highly talented workforce," Professor Lawson said.

SAGE is a partnership of the Australian Academy of Science and ATSE. Institutions participating in the SAGE Pilot undergo an intensive two-year program of data analyses and review of policies and practices with the aim of developing actions that address the issues and barriers identified within the institution.

The SAGE Symposium featured keynote addresses from diversity champions UNSW Professor Veena Sahajwalla FTSE, Swinburne University of Technology's Professor Alan Duffy and Aboriginal and Torres Strait Islander Social Justice Commissioner Ms June Oscar AO.

The Symposium attracted more than 300 attendees, including a raft of ATSE leaders – among them Director Dr Ros Dubs FTSE and Mr Michael Edwards FTSE. Speakers included Professor Bradlow, ATSE CEO Dr Margaret Hartley FTSE, Dr Adi Paterson FTSE CEO of ANSTO, and Ms Kathryn Fagg FTSE, President of Chief Executive Women.

Day 1 topics were 'Changing Culture from Within', 'Value in Equality', 'Empowerment for All' and 'Collective Action'.

Day 2 was an event for SAGE program participants which reviewed the SAGE program in a session titled 'Pressure Testing the Peer Review Process', which was followed by three workshops focused on 'Action planning', 'Building inclusive environments in STEM workplaces' and 'Capacity building/professional development'.

MCC: ACT TO CLOSE THE PAY GAP

More than 120 business, academic, government and sporting leaders have signed a new report, *Closing The Gender Pay Gap Report 2017*, prepared by Male Champions for Change (MCC), which backs salary equality and offers advice on how to achieve it.

"We call on all business leaders to measure their pay gap, take action to close the gap, advocate for others to do so, and do your part to deliver on the principle of equal pay for equal work," says the Report.

"Let's make equal pay for equal work a reality."

The Report urges business leaders to understand the overall pay gap in their organisations.

"This will tell you that there is an imbalance between men and women in leadership and higher-paying roles. However, we already know this by looking at our representation data.

"More revealing, and more immediately actionable, is ensuring women are paid the same as men for doing the same role (like-for-like analysis) and women and men are paid comparably against market rates for their role (market-based analysis).

"This is important because it is in our power and interests as executives, to close the gap for individual roles immediately."

The Report suggests a number of useful tools for successfully uncovering and addressing aspects of the gender pay gap.

MCC is a national initiative involving men of power and influence forming a high-profile coalition to achieve change on gender equality issues in organisations and communities.

The report is available on the MCC website (malechampionsofchange.com).

WOMEN IN TECHNOLOGY

Engineering awards highlight women

ATSE Industry and Innovation Forum Chair Ms Kathryn Fagg FTSE was one of three women recognised at the annual UNSW Women in Engineering Awards, when she won the Ada Lovelace Medal (see page 55).

The two other awards honoured Fellows prominent in engineering in Australia and overseas.

The Judy Raper Award for Leadership, named for Professor Judy Raper FTSE, went to Professor Cordelia Selomulya, leader of Monash University's Biotechnology and Food Engineering group.

The Maria Skyllas-Kazacos Young Professional Award for Outstanding Achievement, named for Emeritus Professor Maria Skyllas-Kazacos AM FTSE, went to Ms Narelle Underwood, the Surveyor-General of

NSW. The awards are part of a campaign by UNSW's Faculty of Engineering to attract more women to the profession. Since 2013, the faculty has boosted by 48 per cent the number of women starting first-year engineering at UNSW, and more than quadrupled the number of girls attending its annual Women in Engineering Summer Camp.

Professor Mark Hoffman FTSE, who became Dean of Engineering in 2015, has set a goal to raise female representation among students, staff and researchers to 30 per cent by 2020.

Currently, 23 per cent of UNSW engineering students are female (versus the Australian average of 17 per cent), which is up from 21 per cent in 2015.

In industry, only about 13 per cent of engineers are female



Maria Skyllas-Kazacos (right) with Narelle Underwood.



Judy Raper (left) presents the award to Cordelia Selomulya.



Genevieve Bell

GENEVIEVE BELL TO HEAD ANU'S 3A INSTITUTE

One of the world's top technologists, Professor Genevieve Bell, best known for her work at the intersection of cultural practice and technology development, will lead a new Autonomy, Agency and Assurance Institute, to be known as the 3A Institute, at the Australian National University.

She has also been appointed the inaugural Florence Violet McKenzie Chair at ANU, named in honour of Australia's first female electrical engineer.

The 3A Institute, co-founded with CSIRO's Data61, aims to bring together the best researchers from around the world and a range of disciplines to tackle complex problems around artificial intelligence, data and technology and manage their impact on humanity.

ANU Vice-Chancellor Professor Brian Schmidt said ANU was committed to help solve the most pressing problems facing the world and the new institute would drive innovation, research and policy responses.

Data61 CEO Adrian Turner said the 3A Institute would build on Australia's strengths in cyber systems.

"Australia has an opportunity to be a leader and to seed new industries of global relevance as IT, biological and advanced materials disciplines converge and become data-driven," he said.

Professor Bell said there was a critical set of questions to be answered around autonomy, agency and assurance if the world is to meet challenges of future technology.

"We, as humans, are simultaneously terrified, optimistic and ultimately ambivalent about what it's going to be like," she said.

"How are we going to feel in a world where autonomous agents are doing things and we aren't? How are we going to be safe in this world?"

"We will be looking closely at risk, indemnity, privacy, trust – things that fall under this broad term 'assurance'."

Real world impact through international collaborations.



University of
South Australia

Access to affordable, clean and secure power may not be as difficult as you think. A collaboration between University College London (UCL) and the University of South Australia (UniSA) could result in lower power costs for consumers while also protecting the electrical grid against extreme weather events.

Researchers from UniSA's Future Industries Institute, the School of Engineering and the School of Information Technology and Mathematical Science have been working with UCL's Dr Arni McKinley to examine how networks of neighbourhood rooftop solar and energy storage – managed by local software – match demand when the larger grid fails or cannot supply cheap, clean power.

"Keeping solar to oneself is not always the best solution to knocking down high prices," says UniSA's Associate Professor Peter Pudney. "Sharing your power with others in a community-embedded network may be a better idea."

Using micro-grids lowers emissions and alleviates stress on the larger power grid, researchers say.

The collaboration between UCL and UniSA will also include research and teaching linkages, an industry-focused PhD program, joint curriculum, student and staff exchanges, public engagement and joint academic appointments, such as the Fellowships for Female Researchers which is also in partnership with Santos.

"This partnership demonstrates how working together can deliver innovative and practical solutions to real-world challenges," Dr McKinley says.



Left to right: Professor John Boland (UniSA), Dr Arni McKinley (UCL), Lui Cirocco (UniSA) and Kirrilie Rowe (UniSA)

Urban floods intensifying, countryside drying up

A global analysis of rainfall and rivers by engineers at the University of NSW has discovered a growing pattern of intense flooding in urban areas coupled with drier soils in rural and farming areas.

The UNSW study explored how rising local temperatures due to climate change might be affecting river flows. It reviewed data collected from more than 43,000 rainfall stations and 5300 river monitoring sites across 160 countries.

It found warmer temperatures lead to more intense storms. A warming atmosphere means warmer air, which can store more moisture – so when the rains do come, there is a lot more water in the air to fall, and rainfall is more intense.

But the researchers were puzzled by why flooding is not increasing at the same rate as the higher rainfall.

The answer turned out to be the other facet of rising temperatures: more evaporation from moist soils – which are needed in rural areas to sustain vegetation

and livestock – is causing them to become drier before any new rain occurs.

Meanwhile, in small catchments and urban areas where there are limited expanses of soil to capture and retain moisture, the intense downpours become equally intense floods, overwhelming stormwater infrastructure and disrupting life.

“Once we sorted through the masses of data, this pattern was very clear,” said Professor Ashish Sharma, a professor of hydrology at UNSW’s School of Civil and Environmental Engineering.

“It’s a double whammy,” said Dr Conrad Wasko, lead author of the paper and postdoctoral fellow at UNSW’s Water Research Centre. “People are increasingly migrating to cities, where flooding is getting worse. At the same time, we need adequate flows in rural areas to sustain the agriculture to supply these burgeoning urban populations.”

Global flood damage was estimated at more than US\$50 billion in 2013, a figure expected to more than double in the next 20 years as extreme storms and rainfall

intensify and growing numbers of people move into urban centres. Meanwhile, global population over the next 20 years is forecast to rise another 23 per cent to nine billion, requiring added productivity and greater water security.

“We need to adapt to this emerging reality,” Professor Sharma said. “We may need to do what was done to make previously uninhabitable places liveable – engineer catchments to ensure stable and controlled access to water.

“Places such as California, or much of the Netherlands, thrive due to extensive civil engineering. Perhaps a similar effort is needed to deal with the consequences of a changing climate as we enter an era where water availability is not as reliable as before.”

“Climate change keeps delivering us unpleasant surprises,” said Professor Mark Hoffman FTSE, UNSW’s Dean of Engineering. “Nevertheless, as engineers, our role is to identify the problem and develop solutions. Knowing the problem is often half the battle, and this study has definitely identified a major one.”



**NEW COASTAL THREAT
IN 'SUPERSTORMS'**

Sydney's Collaroy Beach during the June 2016 storm.

Waterfront areas once thought safe are likely to be damaged as never before from storms, according to a new study, led by engineers at the University of New South Wales.

“If you have waterfront property or infrastructure that has previously been sheltered from the impacts of extreme waves, this is worrying news,” said Dr Mitchell Harley, report lead author and a senior research associate at UNSW’s Water Research Laboratory (WRL).

“What this study confirms is that, simply by changing direction, storms can be many times more devastating. And that’s what we’re facing in many locations as the climate continues to change.”

Professor Ian Turner, director of WRL and a co-author, said sea level rise was no longer the only factor at play when preparing for the impact of climate change on waterfront areas.

“Shifts in storm patterns and wave direction will also have major consequences, because they distort and amplify the natural variability of coastal patterns.”

The study, claimed to be the world’s most extensive study of a major stormfront striking the coast, relied on data collected during the June 2016 ‘superstorm’ that battered eastern Australia, one of the fiercest in decades. The 2016 storm inundated towns, smashed buildings, swept away cars and infrastructure and triggered hundreds of evacuations across a 3000-kilometre swathe from Queensland to Tasmania. Three people died and there were more than 80 rescues from stranded cars.

NEWS



Temperature stabilisation won't reduce El Niño

No sunset for El Niño.

Oceans Research, an international collaboration between CSIRO, Qingdao National Laboratory for Marine Science and Technology, the University of New South Wales, and the University of Tasmania.

Director of the Centre for Southern Hemisphere Oceans Research and report co-author, Dr Wenju Cai, said that this research continues important work on the impacts of climate change on the El Niño-Southern Oscillation, which is a significant driver of global climate.

"Extreme El Niño events occur when the usual El Niño Pacific rainfall centre is pushed eastward toward South America, sometimes up to 16,000 kilometres, causing massive changes in the climate. The further east the centre moves, the more extreme the El Niño," he said.

"This pulls rainfall away from Australia, bringing conditions that have commonly resulted in intense droughts across the nation. During such events, other countries like India, Ecuador, and China have experienced extreme events with serious socio-economic consequences."

Stabilising global temperatures won't reduce the frequency of El Niño events, according to new research.

It shows that if warming held to the aspirational 1.5°C target from the Paris Agreement, the frequency of extreme El Niño events could continue to increase, due to a continuation of faster warming in the eastern equatorial Pacific.

CSIRO researcher and research report lead

author Dr Guojian Wang said the growing risk of extreme El Niño events did not stabilise in a stabilised climate.

"Currently the risk of extreme El Niño events is around five events per 100 years," Dr Wang said. This would rise to about 14 events per 100 years by 2150, he said.

The research was based on five climate models that provided future scenarios past the year 2100 and conducted by researchers at the Hobart-based Centre for Southern Hemisphere



GE UNVEILS ITS LARGEST ONSHORE WIND TURBINE

The new GE turbine.

GE Renewable Energy has unveiled its new 4.8–158 onshore wind turbine, its largest high-efficiency turbine to date, targeting low to medium wind speed sites, such as found in Australia. The new 4.8 MW wind turbine, GE's first onshore entry in the 4 MW space, is equipped with a 158-metre rotor and a range of tip heights up to 240 metres. The combination of a larger rotor and tall towers enables the turbine to take advantage of higher wind speeds and produce more energy.

It features high-tech blades, improved loads and controls, and taller, more cost-effective towers.

The 77-metre-long LM Wind Power carbon blades enable flexibility, allowing GE to offer its customers a high-efficiency product while continuing to drive down the levelised cost of electricity (LCOE).

The turbine meets a lower standard of noise emission levels, achieving a 104-dB level during normal operations, and facilitates up-tower repairs and troubleshooting with an up-tower electrical system.

GE Renewable Energy, with more than 22,000 employees in more than 55 countries, has installed more than 400 gigawatts (GW) of capacity globally.

\$2M GRANT FOR FLEXIBLE PRINTED BATTERIES

Ultra-thin, flexible, printed batteries being developed by Brisbane-based company Printed Energy Pty Ltd will have applications in new products, including Internet of Things devices, wearable electronics, healthcare products and industrial-scale solar energy storage.

Printed Energy's \$12 million project received a \$2 million CRC Projects (CRC-P) grant that will allow the partners to continue developing the ground-breaking technology.

Industry, Innovation and Science Minister Arthur Sinodinos AO said Printed Energy's work meant that ultra-thin, flexible batteries for cheap portable devices and renewable energy were one step closer to reality. Once developed, the technology could revolutionise battery storage and reduce manufacturing costs by using abundant, non-toxic materials.

Australia awash with pumped hydro – ANU

Australia has enough untapped pumped hydro energy storage potential to support a 100 per cent renewable energy grid 35 times over, a team of Australian National University researchers has found.

The ANU team – led by one of Australia's key solar PV innovators, Professor Andrew Blakers FTSE – said it had mapped roughly 5000 potential pumped hydro energy storage sites around the country, and hopes to identify hundreds more, as part of an ARENA-funded study.

Professor Blakers said the energy storage potential of the sites already identified ranged from 0.9 gigawatt-hours (GWh) to more than 100 GWh, far eclipsing the capacity of the lithium-ion 'Big Battery' Tesla is currently building in South Australia.

In total, the sites charted by the team – across Queensland, Tasmania, the Canberra district, and in and around Alice Springs – are believed to have a combined energy storage potential of 15,000 GWh, which Professor Blakers said was 35 times larger than the capacity required to support a 100 per cent renewable grid.

"Each site has seven to 1000 times larger storage potential than the 0.13 GWh Tesla battery to be installed in South Australia," he said. "Additionally, pumped hydro has a lifetime of 50 years compared with eight to 15 years for batteries."

The ANU-led study, which received \$449,000 in funding from the Australian Renewable Energy Agency, aims to develop a nationwide atlas of potential off-river pumped hydro storage sites, as part of the broader quest to accommodate higher and



Andrew Blakers

higher levels of variable solar and wind energy generation on the National Electricity Market.

Queensland showed particular promise, with 2213 potential sites identified, with a combined energy storage capacity of about 100 times more than would be required to support a 100 per cent renewable electricity system in the state, the ANU report said.

Tasmania was similarly well-endowed, with 2017 potential sites identified by the research.

Professor Blakers said his team's work had revealed thousands of sites in Australia that "may be suitable" for establishing pumped hydro storage.

ARENA CEO Ivor Frischknecht said the project was part of ARENA's focus on supporting flexible capacity solutions to ensure a smooth transition to a renewable energy future.

"Storage is becoming more important and valuable as we move towards higher levels of renewable energy in our grids," he said. "Pumped hydro is the most mature form of energy storage, and studies like these are helping to determine whether it could play an even greater role in increasing grid stability."

ANU is partnering ElectraNet and VTara Energy Group to conduct the Atlas of Pumped Hydro Energy Storage Study and develop a cost model for short-term, off-river pumped hydro energy storage.

ELECTRIC-DRIVE TRUCKS BOOST

Victorian-based manufacturer SEA Electric has developed three electric-drive systems models that can be fitted to commercial vehicles to allow them to be converted to a 100 per cent electric operation.

It says the technology can be applied to businesses performing express freight, general delivery and waste collection duties around Australia.

It plans to boost its conversion of medium-duty trucks and commercial vans to electric vehicles,

using \$5 million in Clean Energy Finance Corporation (CEFC) finance though the Clean Energy Innovation Fund to purchase components and scale up its manufacturing business to meet growing customer demand.

SEA Electric integrates and assembles electric vehicle drive systems into a basic chassis and framework, including the cab, battery pack and electric motor. SEA Electric also fits the electronic infrastructure of the vehicle.

"Australia has the potential to become a global leader in the rapidly emerging electric vehicle industry, and this finance will help SEA Electric be part of that revolution," said SEA Executive Chairman Mr Tony Fairweather.

"Vans and medium-duty trucks are suited to electric vehicle technology because businesses using them typically have relatively fixed and known route distances and vehicles return to base overnight, which allows for recharging.

"With ongoing decreases in the cost of lithium batteries, our electric-drive systems are becoming increasingly cost competitive with equivalent petrol or diesel engines, which means that businesses using these vans and trucks can consider 100 per cent electric vehicles on a commercial basis as well as for their environmental benefits."

The CEFC has identified transport-related emissions as a critical focus area, particularly investments in projects that achieve industry-leading levels of energy efficiency, and contribute to the productivity of Australia's cities and regions.

Off-river pumped hydro works by storing water in an upper reservoir and running it through a turbine to a lower reservoir when electricity is needed – such as when the sun is not shining or the wind is not blowing. The water can then be pumped back uphill when electricity from renewables and other sources is abundant and cheaper. This technology currently accounts for a massive 97 per cent of energy storage capacity worldwide. It has specific geographical requirements, including a pair of reservoirs separated by an altitude difference of at least 300 metres and joined by a pipe with a pump and turbine.

NEWS

'Pollies' go back to school

Among the myriad activities around Australia to mark National Science Week in August, a highlight was more than 350 Australian schools that welcomed science, technology, engineering and maths (STEM) professionals into their classrooms – virtually and physically – to promote the importance of STEM to Australia's future.

More than 30 Federal parliamentarians also headed back to school for the day and joined students in the activities planned to underline the national importance of STEM for Australia's future.

The STEM in Schools event, run by CSIRO, saw classrooms across the country come alive with science as students participated in a virtual classroom discussion with STEM



Industry, Innovation and Science Minister Senator Arthur Sinodinos mixes it with students at Gundaroo Primary, near Canberra.

professionals working in the international space industry. Many also had the chance to take part in hands-on science activities with CSIRO scientists.

MEDICAL ENGINEERING DEGREE ON OFFER

The University of Newcastle will offer a Bachelor of Medical Engineering degree in 2018, which aims to equip students to address future healthcare problems.

The degree will offer four majors including medical biomechanics, medical computing, medical devices, and signal and imaging processing.

The UON's Faculty of Engineering and Built Environment Pro Vice-Chancellor, Professor Brett Ninness, said that an ageing population and advancements in technology were driving a need for engineers with specialised medical skills.

"Our population is ageing and new technology is saving the lives of people with challenging illnesses or injuries who require sophisticated therapy and care. At the same time, technologies like virtual reality and artificial intelligence are rapidly changing the way we live and work," Professor Ninness said.



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28,000 join in Moonhack

More than 28,000 students from around the globe broke the world record for the most number of kids coding in one day in the 2017 Moonhack in August.

First started in 2016, Moonhack is an annual Australia-driven event, powered by the Telstra Foundation, to give kids an opportunity to learn code and for coding whizz kids to flex some coding muscle and engage with their peers. The program advocates for digital literacy and the importance of kids learning to code.

The 2016 Moonhack set the world record, with 10,207 Australian kids all coding on the same day.

This year, Moonhack went global, with kids all over the world coding over a period of 24 hours. Participating countries included Argentina, Bangladesh, Canada, Egypt, Estonia, Guatemala, India, Iraq, Nigeria, Russia, South Korea, the UK and the US, with junior coders operating from their homes, at Code Clubs in their schools, local libraries and community centres.

Code Club Australia is a nationwide network of free, volunteer-led, after-school coding clubs for children aged 8 to 12, which provides tools and support for teachers and volunteers to provide free coding lessons. Currently, there are more than 65,000 Australian students across nearly 2000 Code Clubs in Australia, which now has the biggest network of clubs outside the UK.

NEW PHD AIMS FOR BETTER INNOVATORS

CSIRO, the University of New South Wales (UNSW) Sydney and industry partners are developing a new PhD program that aims to create a new breed of innovators and accelerate business and research working together.

A pilot of the Industry PhD program, coined iPhD, has been developed in collaboration with UNSW's Faculty of Engineering.

iPhD candidates will be given comprehensive access to supervisors from CSIRO, the university and an industry partner, to create a unique blend of mentoring across research and business disciplines.

The three-way partnership gives students access to world-class researchers, professionals and infrastructure, with an integrated six-month industry placement aimed at connecting research and business to deliver solutions to address real-world problems.

The iPhD aims to develop science professionals who are comfortable moving into and out of academia, industry and applied research organisations.

CSIRO says industry will be involved in helping to define the research area and shape the technical and professional development of the PhD candidates.

UNSW Sydney is joining with CSIRO to deliver the first round of the Industry PhD, which will be a pilot for a broader program.

Taking a new approach to PhDs.



UNIVERSITIES STAND OUT IN RANKINGS

Britain is home to the top two institutions in the *Times Higher Education World University Rankings* for the first time in the 14-year history of the table.

Oxford University has held on to the number one spot for the second year in a row, while Cambridge has jumped from fourth to second place, at the expense of the California Institute of Technology, which was number one 2012–16, number two last year, and now shares third position with Stanford.

The University of Melbourne ranked 32, followed by other Australian universities

– ANU (48), Sydney (61), Queensland (65), Monash (equal 80), NSW (85) WA (equal 111) and Adelaide (equal 134).

American universities (with 16 spots) dominated the Top 20 universities listed in the 2017 *Academic Ranking of World Universities (ARWU)*, released by ShanghaiRanking Consultancy. Three UK and one Swiss university round out the Top 20.

Harvard University remained the ARWU number one in the world for the 15th year, followed by Stanford. Cambridge University overtook MIT and Berkeley to be listed as

ARWU's third best university in the world.

Six Australian universities were in the Top 100: Melbourne (39), Queensland (55), Monash (78), Sydney (83), UWA (91) and ANU (97).

Two Australian universities were ranked in the Top 10 of the 2018 *QS Graduate Employability Rankings* – Sydney listed fourth and Melbourne ranked seventh. They were followed by NSW (36), Queensland (49) and UTS (69).

Stanford, UCLA, Harvard, MIT, Cambridge, Oxford, UCB and Tsinghua rounded out the Top 10.

NEWS

Nanotech solutions for inflammatory diseases

The autoimmune inflammatory disease rheumatoid arthritis (RA) develops in two per cent of the Australian population, with peak onset at age 55. The disease affects more than half a million Australians and costs more than \$2 billion each year in Queensland alone.

As Australia's population ages, prevalence of RA is anticipated to increase. Environmental factors increasing RA risk include the pro-inflammatory factors: smoking, chronic lung infection and obesity. Specific genes (known as HLA) confer high RA risk. The function of these expressed genes is to present antigens, to educate a person's immune system to control infection.

Inherited RA-risk genes were likely useful for survival of populations against infection as they evolved and migrated thousands of years ago. In RA this immune education against infection can be confused, leading to attack on the body's tissues. This is because, as we age, our infection-fighting immune cells become more likely to cross-react with our tissue cells.

RA-associated genes are more likely than non-RA-associated genes to produce confusion of the immune system and thus to promote attack on the body's tissues, as they age. As humans survive longer now than they did thousands of years ago, the compromises that the immune system has made in order to survive infection have become more apparent today.

IMMUNOTHERAPIES

However, HLA genes can be put to work for the development of immunotherapies that specifically target self-tissue damage in RA. Dendritic cells express high levels of HLA molecules and present antigens to the immune system.

In 2015, colleagues and I reported the development of a vaccine-style treatment (Rheumavax), which showed that the patient's own immune-modified dendritic cells were safe and could suppress inappropriate immune responses in RA.

Liposome nanoparticles are tiny fat bubbles that can be used to package immunomodulatory drugs and RA-associated antigen for delivery to dendritic cells in the lymph nodes draining the skin. The team designed a novel liposome technology for immunotherapy to re-educate immune cells to RA self-tissues. The strategy underpinning the use of a liposome immunotherapy is to reduce or desensitise the immune response to self-antigen, and thus to suppress the harmful autoimmune response

in RA, while leaving intact immune responses to infection.

Because the peptide to be desensitised is only 'visible' to the immune system of patients with RA high-risk HLA genes, the treatment is individualised to patients carrying those genes.

We anticipate that such treatments will be safe and provide long-lasting reduction in harmful immune responses and tissue damage.

The goal is that nanoparticle immunotherapies will be employed not only during the early stages of RA but also in individuals carrying high-risk HLA genes and who have intermittent or mild symptoms recognisable as 'pre-RA' in order to prevent the onset of full-blown RA.

Such nanotechnologies are applicable to a range of other autoimmune and inflammatory diseases, such as type 1 diabetes, multiple sclerosis, thyroiditis and coeliac disease.

The advent of such nanotechnologies would have a transformative effect on the approach to many chronic inflammatory diseases.

Emphasis would change from treating diseases once diagnosed, with the attendant toxicities and costs of drugs, to the identification of individuals at high risk.

To be feasible in the population, this will require cheap, rapid, high-throughput genetic, autoantibody and symptom screening, and symptom monitoring.

Evolving applications for screening will underpin the implementation of personalised nanotechnologies targeting individuals with greatest need.

An ideal strategy to implement potentially curative, preventative immunotherapies would be to couple their use with other strategies, such as family screening, along with lifestyle interventions, such as smoking cessation, and vaccination updates.

This article was prepared by Professor Ranjeny Thomas FAHMS, Arthritis Queensland Chair of Rheumatology at the University of Queensland. She addressed the 2017 ATSE National Technology Challenges Dialogue 'The Crisis in Ageing' in Brisbane on this topic. She researches autoimmune disease and restoration of tolerance. Through this work, she developed and tested the first rheumatoid arthritis vaccine. She has also contributed major insights into the pathogenesis of spondyloarthritis and autoimmune diabetes, leading to the development of disease biomarkers and therapeutic strategies. She is founder and a director of the spin-off company, Dendright, which is developing vaccines to suppress autoimmune diseases.



Ranjeny Thomas at the podium.

IMMUNE NANOTECHNOLOGY

New therapies targeting the immune system have revolutionised – and continue to revolutionise – our capacity to treat autoimmune and inflammatory diseases, like rheumatoid arthritis and inflammatory bowel disease. Such therapies are now revolutionising treatment of certain cancers. However, these treatments are expensive, generally not curative and may have side effects. With the advent of disruptive treatments based on nanotechnology, we will increasingly see treatments become more personalised, less toxic, more reliant on individual genetic and other data, and moving towards prevention in at-risk individuals. The benefits for healthy ageing will require considerable adjustment of providers and consumers to disruptions in approach.



UNSW's new Biological Sciences building.

New genome facilities at Ramaciotti Centre

The University of NSW has opened its new \$165 million Biosciences Building on its Kensington campus, which houses the Ramaciotti Centre for Genomics, which it says is the largest and most comprehensive university-based facility of its kind in Australia.

Established in 1999 with a grant from the Clive and Vera Ramaciotti Foundation, the Centre is one of the few dedicated genomics facilities in Australia that accommodates a full suite of genomics technologies and links these together using process management software.

NSW Chief Scientist and Engineer Professor Mary O'Kane AC FTSE officially opened the building.

"I am an engineer by training but I am a Big Data nut, so I get so excited about machines like this," she said, referring to the Centre's newest acquisitions – the Illumina NovaSeq 6000 technology that offers high-throughput sequencing and the PacBio Sequel platform, which can

sequence up to one million single molecules of DNA simultaneously.

UNSW geneticist Professor Marc Wilkins, director of the Ramaciotti Centre, said the new facility and platforms would deliver internationally competitive genomics to the Australian research community.

"The new facility is designed for future growth, to further support the genomics community in NSW and in Australia," Professor Wilkins said.

Credited with inventing a new field – proteomics, the large-scale study of proteins within living organisms – Professor Wilkins said the Ramaciotti Centre's co-location with proteomics, bioinformatics, flow cytometry and imaging facilities would better facilitate collaboration among its 500 users each year.

Professor Wilkins said collaborations spanned biomedicine, conservation, the environment, agriculture and biotechnology. The Centre was currently working with UNSW Professor Emad El-Omar and his team from the Microbiome Research Centre at St George Hospital to map the microbiota of the gut, which is linked to diseases including stroke, asthma, obesity, diabetes, mental health and pre-eclampsia in pregnant women.

The Illumina NovaSeq 6000 can sequence up to 3 terabases of DNA in a single run – the equivalent of sequencing one human genome 930 times, Professor Wilkins said.

The Centre is also launching a PacBio Sequel platform, an instrument that sequences single molecules of DNA.

"Remarkably, it can sequence lengths of DNA of up to 98 kilobases, and sequence up to one million of these simultaneously in one run. This type of sequencer is revolutionising genome sequencing of species that have, to date, been impossible to decode by other techniques."



(From left) Mary O'Kane, Dr Rebecca Johnson (Australian Museum Research Institute), Professor Nicholas Fisk (UNSW Deputy Vice-Chancellor, Research), Emad El-Omar and Marc Wilkins at the Ramaciotti Centre.

AI MAY HELP PREVENT DIABETIC BLINDNESS

Artificial intelligence (AI) may be the key to preventing blindness in the 1.7 million Australians living with diabetes after the successful trial of a world-first AI-driven technology in Perth.

The eye-screening technology, developed by CSIRO, enables GPs to test diabetic patients for diabetic retinopathy, a debilitating condition affecting one in three diabetic people that can lead to blindness if untreated. Currently only specialists can screen for the condition.

The trial, held at a suburban GP

Superclinic, was funded through an NHMRC grant and base funding from WA Health and CSIRO through the Australian Tele-health Research and Development Group.

During the trial, GPs successfully screened 187 diabetic patients, taking high-resolution images of their eyes, which were then analysed by the technology for signs of diabetic retinopathy.

Importantly, as a basis for comparison, the images were also analysed by an ophthalmologist, and the technology was found to be as effective as the specialist in

detecting signs of diabetic retinopathy and grading its severity.

Using the technology, GPs will be able to screen patients for signs of the condition and its severity, and refer them to an ophthalmologist for further investigation, prioritised by the severity of their symptoms.

The software has been licensed by TeleMedC, which will seek to make the technology commercially available – with plans to install it at a further 20 GP clinics in WA over the next few months, before expanding across Australia.

NEWS

M2 aims to accelerate medical breakthroughs

A new Melbourne facility that combines technology, research and medical science aims to accelerate Australia's medical breakthroughs including medical devices, vaccines and cell therapies

The new facility – named M2 – has been created by CSIRO, Monash University and Monash Health Translation Precinct (MHTP).

Industry, Innovation and Science Minister Senator Arthur Sinodinos AO launched the M2 precinct at CSIRO's new Biomedical Materials Translation Facility (BMTF).

"From life-changing cochlear implants, to life-saving vaccines and world-first 3D printed bone and tissue replacements, Australia has an incredible track record when it comes to

medical technologies and pharmaceuticals," Senator Sinodinos said.

"M2 will help to accelerate development of technology like this, not only vital for the improvement of the lives of Australians facing medical challenges, but also leading to job and economic growth for Australia."

Australia is home to more than 500 companies working in the Medical Technologies and Pharmaceuticals (MTP) sector. Many of these are small and medium enterprises, which can struggle to make the expensive, time-consuming transition from prototype to clinically tested product.

M2 aims to close this gap, providing a research ecosystem to

transition new discoveries from the bench to prototyping, pre-clinical testing, industry evaluation and commercialisation.

The MTP sector is expected to be worth almost \$3 trillion by 2025, while observers say \$18 billion and 28,000 new jobs could be added to the Australian economy over the next eight years.

The growing MTP sector.

PHOTO: CSIRO, NICK PITSAS



A CHEM LAB IN YOUR PHONE?

The mobile phone in your pocket could be used for medical diagnostics and environmental testing if Associate Professor Conor Hogan and his team from La Trobe University have their way.

This could be potentially life-changing for people in developing countries and remote areas with limited resources, by making such chemical measurements more accessible and extremely inexpensive.

"There are two ways you can bring the cost of medical diagnostics down," Professor Hogan told the RACI Centenary Chemistry Congress in Melbourne.

First, you can use less expensive materials and fabrication methods to make the sensors.

So his team has developed a microfluidic sensor printed on paper rather than using more traditional materials, like silicon or glass. Second, do away with the need for a scientific instrument and make the measurements using your phone.

The combination of these two approaches can bring the cost of chemical analysis to negligible levels. The team has demonstrated the possibility of diagnosing disease or detecting harmful chemicals in drinking water using only a disposable, paper-based sensor and a mobile phone.

"With mobile phone penetration now over 80 per cent in the developing world and close to 100 per cent worldwide, the idea is sensible," he said.

CARDIHAB APP BOOSTS HEART REHABILITATION

CSIRO's science and technology accelerator program, known as ON, has spun-out a new venture based on a cardiac rehabilitation app, Cardihab.

The Cardihab technology was developed by scientists at the Australian eHealth Research Centre, which is a joint venture between CSIRO and the Queensland Government and now underpins the Cardihab spin-out from CSIRO after raising venture capital investment of \$1.35 million in the new company.

Of the \$1.35 million invested in Cardihab, \$500,000 has come from Uniseed, a venture fund operating at the universities of Melbourne, NSW, Sydney and Queensland and CSIRO.

The remaining investment came from a private cardiology group and existing Cardihab shareholder Artesian Capital.

Cardihab is a smartphone app, connected to a clinic-based portal, used for remote patient management following a cardiac event. The app gives clinicians the ability to deliver more convenient, flexible and engaging cardiac rehabilitation meaning better outcomes for patients, clinicians and health service administrators.

Heart attack survivors who complete rehabilitation are 40 per cent less likely to experience another attack. Cardihab trials were shown to more than double the completion rates for rehabilitation.

LETTER

WHAT HAPPENS WHEN WE ALL LIVE TO 100?

In ATSE Focus 203 (August 2017) Dr Priscilla Rogers asked a question: "What happens when we all live to 100?"

A very similar question was asked by Dr Elie Metchnikoff, recipient of the 1908 Nobel Prize in Physiology, who was working in Paris, in the Louis Pasteur laboratories, where he developed his theory of ageing.

In one of his books, *Etudes sur la nature humaine* (1903) – which can be translated into English as 'Etudes on the nature of human beings' – he asks a question: "If medical science will become capable of curing all human diseases how long shall we live, and what will be the cause of human death?"

There have been numerous hypotheses on this subject developed since then, but it seems the answer will only be found when, or if, the medical science is capable of achieving this goal.

– PROFESSOR ALEKSANDER SAMARIN FTSE



UWA's Tim Fiori and Iain McIntyre.

alternating current (tACS), to stimulate better mental performance.

UWA Law student and CEO of HUMM Technologies, Iain McIntyre, said the start-up focused on expanding the potential of the human brain and making people's lives better by giving them more control of their cognitive function.

"The device provides EEG data just like you would see in a hospital, and determines which of those frequencies should be encouraged to assist in concentration and memory," Mr McIntyre said.

"It then stimulates the brain by providing a light electric current when a person loses focus to help them refocus and improve their concentration."

The device will initially target professional computer game players who need to concentrate for many hours at a time. Industries such as industrial safety, motor vehicle safety, aviation and accelerated learning have been identified as potential markets for the future.

Stimulating the brain

University of Western Australia innovators are developing a headset claimed to monitor human brain waves and stimulate the brain to improve concentration and boost the brain's performance.

The headset uses electroencephalography (EEG) technology to detect the state of the brain in real time and determine metrics such as concentration and fatigue, and then applies a small electrical current, known as a transcranial

METS LINKS WITH ATN

METS Ignited, the Growth Centre responsible for the Mining Equipment, Technology and Services (METS) sector, has signed an MOU with the Australian Technology Network of Universities (ATN) to enhance linkages.

The agreement, an Australian-first, was signed at Queensland University of Technology and will:

- encourage more undergraduate and postgraduate industry placements;
- assist the METS industry to employ the best and brightest STEM graduates; and
- support increased research partnerships.

The MOU supports the METS Ignited mandate to foster greater collaboration to accelerate commercialisation of innovation.

METS Ignited's Sarah Boucaut (left) with QUT Professor Arun Sharma and ATN's Renee Hindmarsh.



MINERALS SEARCH NEEDS A BOOST

Australia is an established and stable destination for mineral exploration, but its share of global exploration investment has been declining over the past two decades.

In 2002 it attracted 21 per cent of global exploration investment for commodities such as gold, copper and other metals. This had fallen to 12 per cent by 2013, due in large part to a lack of recent discoveries of large high-quality mineral deposits, such as Mt Isa, Broken Hill and Olympic Dam.

"Action is needed now to ensure the ongoing competitiveness and sustainability of the Australian resources sector," says Dr Andrew Heap, acting Chief of Geoscience Australia's Resources Division.

"The mining sector contributes significantly to the nation's export earnings, provides substantial direct and indirect employment and investment in regional and indigenous communities, supports downstream and service industries, and delivers essential revenue to all levels of government.

"An ongoing pipeline of mineral resource projects is needed to meet the future economic needs of our nation, as it currently takes over 12 years on average between the discovery of an economic deposit and the commencement of mine production."

Dr Heap was commenting on the 2017-22 National Mineral Exploration Strategy, aimed at ensuring the continuity and longevity of the mineral resources sector. GA played a key role in developing the Strategy, which draws on the nation's collective geological surveys to help identify prospective regions and unlock Australia's future mineral wealth.

NEWS

Cracking the code of megapests

Helicoverpa armigera, or cotton bollworm.



CSIRO researchers in collaboration with a team of national and international experts has mapped the complete genome of two closely related megapests, potentially saving the international agricultural community billions of dollars a year.

The researchers identified more than 17,000 protein coding genes in the genomes of *Helicoverpa armigera* and *Helicoverpa zea* (commonly known as the cotton bollworm and corn earworm, respectively). This level of detail makes it easier for scientists to predict the caterpillars' weak spots, how they will mutate and even breed plants they will not want to eat.

The bollworm and earworm are the world's greatest caterpillar pests of broadacre crops, causing in excess of US\$5 billion in control costs and damage each year across Asia, Europe, Africa, America and Australia. The bollworm, which is dominant in Australia, attacks more crops and develops much more resistance to pesticides than its earworm counterpart.

"It is the single most important pest of agriculture in the world, making it humanity's greatest competitor for food and fibre," CSIRO Scientist Dr John Oakeshott said. "Its genomic arsenal has allowed it to outgun all our known insecticides through the development of resistance, reflecting its name – 'armigera', which means armed and warlike."

In Brazil the bollworm has been spreading rapidly and there have been cases of it hybridising with the earworm, posing a real threat that the new and improved 'superbug' could spread into the US.

"Our recent analyses of the complete genome, its adaptations and spread over the years are a huge step forward in combating these megapests," said CSIRO Health and Biosecurity Honorary Fellow Dr Karl Gordon.

CSIRO, the University of Melbourne, the Baylor College of Medicine in Texas, the French National Institute for Agricultural Research (INRA), the Max Plank Institute of Chemical Ecology in Germany and the US Department of Agriculture – Agricultural Research Service (USDA-ARS) undertook the genome project.

NEW TECHNOLOGY TO CLEAN WASTEWATER

Researchers from Edith Cowan University in Perth have developed a way to modify the atomic structure of iron to create a metal that can strip impurities from water in just a few minutes. The breakthrough, published in the journal *Advanced Functional Materials*, offers new applications in the mining, textile and other industries where large amounts of wastewater are produced.

ECU says Associate Professor Laichang Zhang from its School of Engineering was able to change the atomic structure of iron to form what is known as metallic glass – with a

disorganised atom composition, rather than the ordered atomic structure of traditional metals.

A thin strip of the iron-based metallic glass developed by Professor Zhang can remove impurities such as dyes or heavy metals from even highly polluted water in just minutes.

"It works by binding the atoms of the dye or heavy metals to the ribbon, leaving behind useable water," Professor Zhang said.

"This offers a number of benefits compared to the current method of using iron powder to treat wastewater. Firstly, using iron powder leaves you with a large amount

of iron sludge that must be stored. Secondly, it is expensive to produce and can only be used once.

"In contrast, the iron-based metallic glass we have developed can be reused up to 20 times, produces no waste iron sludge and can be produced as cheaply a few dollars per kilogram."

He said the technology could have significant applications in the textile and mining industries, both of which produced large amounts of water contaminated with heavy metals and dyes.

'Water literacy' needed for a sustainable future

Professor Tony Wong FTSE, CEO of the Cooperative Research Centre for Water Sensitive Cities, has made a strong call to action on water and sustainability, highlighting the need for 'water literacy'.

Delivering the 2017 Deakin Oration at Victoria's Parliament House, he told a diverse audience of water company executives, academics, public servants, students and members of the public that a political climate of cooperation and collaboration was needed to tackle contemporary challenges in water management for our cities.

"The case for transformation is compelling; the consequence of doing nothing, disturbing," Professor Wong said. "If we can transform our cities into water-sensitive cities, we will be able to withstand the future threats of climate and water scarcity. And even more: we will be well placed to maintain our growth, prosperity and quality of life," he said.

"But realising those ambitions requires us to change our approach in infrastructure planning, city design, and community engagement and empowerment. A whole-of-government approach will be critical."

Professor Wong said water resources within a city's limits needed to be harnessed to supplement traditional sources of water.

"In the case of Melbourne, those 'internal' water sources include rainwater, stormwater and wastewater. It is a fact that the combined volumes of stormwater run-off and treated wastewater discharge far exceeds the total water used in the city. Why shouldn't we harness these water resources, especially for use that does not require a drinking-water standard?"

Professor Wong said citizens were "an incredible resource for shaping their own, more sustainable futures".

"While not a widely published fact, the efforts of Melbourne's citizens in water conservation behaviour during the Millennium Drought prevented Melbourne from completely running out of water by June 2009, some 12 months before the drought was to break. Thus, improving water literacy, and a genuine and meaningful engagement of local citizens in co developing and implementing water management strategies, is the approach we need to adopt in building resilience."

The Deakin Oration honours former Prime Minister Alfred Deakin.

\$45M TO SUPPORT SA IRRIGATORS

The Northern Adelaide Irrigation Scheme, expected to start delivering water to irrigators by early 2019, will get more than \$45 million in capital funding. This project aims to deliver more affordable and secure water supplies to farmers in the region, expanding irrigated agriculture and supporting high-tech greenhouse horticulture. Announcing the grant, the Deputy Prime Minister and Agriculture and Water Resources Minister, Barnaby Joyce, said the project would be funded under the \$500 million National Water Infrastructure Development Fund (NWIDF).

"This project is a real win for South Australia. It is expected to create more than 3700 new full-time jobs and generate more than half a billion dollars in economic activity. This project will be key to developing greater market access for South Australian producers to Hong Kong, Malaysia, Taiwan, the United Arab Emirates, Indonesia and Singapore."

GM DESERVES "BETTER-INFORMED DISCUSSION"

Mr Ken Matthews AO FTSE, Chairman of the Agricultural Biotechnology Council of Australia (ABCA), believes we need better-informed discussion about agricultural biotechnology and genetically modified (GM) crops.

Although the role of agricultural biotechnology and GM crops in meeting production and sustainability challenges was widely recognised by farmers, public discussion was not always based on factual and accessible information, he said, launching the third edition of *The Official Australian Reference Guide to Agricultural Biotechnology and GM Crops* at the AusBiotech AusAg and Foodtech Summit in Adelaide.

"This updated Guide provides independent, factual, science-based information to contribute to a more informed national discussion about agricultural biotechnologies," Mr Matthews said.

The third edition of the Guide was developed using the latest scientifically valid data and reviewed by ABCA's Expert Scientific Panel, which is chaired by Dr TJ Higgins AO FAA FTSE, from CSIRO. The Guide covers the science, performance, safety and regulation of commercialised GM crops, as well as products in the pipeline.

"Australia's agriculture sector is a significant exporter, employer and driver of rural and regional communities. The uptake of innovative and emerging agricultural biotechnologies allows the sector to remain competitive and innovative in the face of global challenges like a changing climate and a reduction in arable land," Mr Matthews said.

"Public policy and a regulatory environment that is guided by scientifically credible and factually correct information on agricultural biotechnology is crucial as Australian farmers and the world's farming sector seek to double production of food, feed and fibre to meet the nutritional demand of a growing global population."

A record 185.1 million hectares of GM crops were grown globally in 2016, and 60 per cent of the world's population live in the 26 countries growing GM crops. Despite the widespread adoption by farmers, the technology continues to stimulate considerable community discussion.

RIRDC IS NOW AGRIFUTURES

AgriFutures Australia is the new trading name for the Rural Industries Research and Development Corporation (RIRDC). AgriFutures says it is building on the strong foundation set by the RIRDC, forging "a bold new path" for Australia's rural industries.

"By anticipating global trends, discovering new knowledge, harnessing new technologies, and investing in people, AgriFutures Australia is set to transform these industries to meet future challenges and opportunities."

AgriFutures Australia is based in Wagga Wagga, NSW.



NEWS



The VPDaD technology.

Scaring critters with VPDaD

CSIRO scientists have developed a humane new technology that could help save Australian farmers' crops and livelihoods from damage estimated to cost the Australian economy up to \$1 billion a year.

Scientists are trialling the Vertebrate Pest Detect-and-Deter (VPDaD) technology in Australia against pests such as ducks, cockatoos, rabbits, wild dogs and more, starting in Queensland's Lockyer Valley. This follows its success scaring away elephants from farms and crops in Africa,

The technology works by detecting and identifying animals as they come close to farms or crops, and emitting a tailored series of sounds and lights to humanely scare them away before they cause damage.

The VPDaD technology consists of two systems: a motion sensor device, and a collection of cameras that can pick up images and heat signatures of an animal, with lights and sounds which function as the deterrent for pests. CSIRO technology specifically developed for the camera program allows the computer to recognise and classify animals based on the images captured.

In addition to looking at how animals respond to perceived threats, the scientists are also looking at longer-term aspects, such as analysing deterrent effectiveness and animal movements over seasons.

"One of the interesting issues with existing deterrent technologies is that, not only do animals become desensitised to them, but smarter ones can even learn to use the deterrents as an indication of a food source, which is the opposite of their purpose," CSIRO's Dr Ash Tews said.

"Our autonomous technology allows the system to recognise animal behaviours in response to deterrents and modify the deterrent strategy until the desired effect is achieved.

"This allows the system to be more effective over long periods of time such as the key threat times during crop growth."

\$3M FOR WA CROP RESEARCH HUB

GRDC funding will help establish a new crop research hub in WA, charged with improving grain crop productivity and disease resistance Australia-wide.

Murdoch University has received a \$3 million Grains Industry Infrastructure Grant to establish the WA Crop Research Hub under a collaboration with Curtin University and the WA Department of Primary Industries and Regional Development (DPIRD), each of whom will contribute a further \$2 million.

The grant funding will go towards the development of up to 18 glasshouses at Murdoch, along with 2.8 hectares of irrigated, netted field plots and additional infrastructure works.

"This innovative project will draw on the specialist research skills from each party to develop new research in crop pathology, plant physiology and genetic improvement," said Deputy Prime Minister and Minister for Agriculture and Water Resources, Barnaby Joyce.

"This partnership, of two universities, a State Government Department, the Federal Government and a rural R&D Corporation, is a perfect demonstration of genuine collaboration to address key grower priorities," said GRDC Chairman John Woods.



UNDERWATER CANYONS MAY BE FISH HOTSPOTS

Blue sharks have made homes in deep canyons.

Collaborative research has established that the underwater canyons of WA's coast may be critical and overlooked habitats for many commercially valuable species of fish such as tuna, swordfish and mackerel.

Research by scientists from the University of Western Australia, Geoscience Australia, Queensland University of Technology, the University of Tasmania and the Zoological Society of London used a decade of historical fishing records to map out the likely location of migratory fish hotspots around WA, from the remote Kimberley in the north to the Great Australian Bight in the south.

The study is claimed to be the first to show the importance of underwater canyons for large ocean creatures other than whales, dolphins and seabirds.

The research identified the Argo-Rowley, Ningaloo, Perth, Bremer and Albany canyons, among other sites, as having an abundance of fish, providing a foundation to consider appropriate fish protection measures.

Researchers say the next step will be to determine why not all canyons provide favourable habitats for fish and what conditions make some canyons more attractive than others.

Funding and infrastructure boost for Synchrotron

The Australian Nuclear Science and Technology Organisation (ANSTO) has secured \$80 million in new funding to expand the research capabilities of the Australian Synchrotron.

The funding boost came from the New Zealand Synchrotron Group Ltd (representing funding from the New Zealand Government and 10 New Zealand universities and research institutions), the Defence Science and Technology Group (DSTG) and 19 universities and medical research institutes across Australia.

The new funding will expand the number of beamlines at the Synchrotron from 10 to as many as 18, increasing research output at the facility and helping keep up with significant researcher demand for the state-of-the-art facility.

The first stage of the expansion will see the construction of the Micro-computed Tomography (MCT) beamline and the Medium Energy XAS (MEX) beamline. These beamlines will be followed by a Small Angle X-ray Scattering (BioSAXS) beamline.

Supported by the New Zealand



Arthur Sinodinos and Adi Paterson at the announcement.

Synchrotron Group's significant \$25 million investment, the beamline will allow for detailed protein studies focused on improving drug design and validation processes.

Industry, Innovation and Science Minister Senator Arthur Sinodinos AO, announcing the funding, said the scale of the contributions highlighted the extremely significant role the Synchrotron plays in Australia's science and innovation ecosystem.

"The Australian Synchrotron is one of our most important pieces of landmark research

infrastructure, which on a daily basis delivers practical benefits across a variety of vital areas," Minister Sinodinos said. "This is applied science at its best, with applications for medical researchers, the environment and industry."

"ANSTO has been working to secure more than \$100 million in capital funding to ensure the facility remains world-class and continues to meet the needs of researchers and industry," said ANSTO CEO Dr Adi Paterson FTSE.

"This is a great first step, and we look forward to continuing to work with industry and government to support the vitally important work of our scientists and researchers."

ANSTO will continue to work with universities and other stakeholders to secure the remainder of the required funding.

The Synchrotron is owned and operated by ANSTO. Using a particle accelerator, it has 10 experimental stations known as beamlines, each of which harnesses light a million times brighter than the sun to examine the structure and function of samples in unprecedented detail and unrivalled accuracy.

It reveals to researchers how matter fits together, moves, interacts and changes. Each beamline uses detectors, which are like highly specialised cameras, characterising a diverse range of samples from proteins to paintings, advanced materials and agricultural samples.

STARFISH FOSSIL RATED 275 MILLION YEARS OLD

A WA research team has discovered a 275-million-year-old fossilised starfish-like creature in the town of Gascoyne Junction, more than 1000 kilometres north of Perth.

The study, undertaken jointly by researchers at the University of WA and Curtin University, sheds new light on the driving force in the evolution of these starfish-like marine animals, such as the role of predators but also on evolution before the great Permian/Triassic mass extinction event, known as 'The Great Dying'.

The fossil site in Gascoyne Junction, 173 km east of Carnarvon, is claimed to be one of the most spectacular in Australia, with vast bedding surfaces covered by sea lilies and starfish the size of dinner plates.

"All these animals are perfectly preserved, frozen in time, in the very spot they died, submerged by sediment during an underwater storm," said Dr Aaron Hunter, an Adjunct Research Fellow in UWA's School of Earth Sciences.

"Although it's a dry bush landscape today, during the Permian period this was a polar seabed close to modern-day Antarctica.

"It gives us a unique window to the seas of the polar past, and how, like animals in the Southern Ocean today, they responded to climate change and global warming.



The starfish fossil.

NEWS

Without chemistry there's no hope

Chemistry is vital to our prosperity and our chemists should be dear to our hearts. Being anti-chemistry is not just un-Australian. Without chemistry, there's no hope for the world.

These sentiments came from Australia's Chief Scientist Dr Alan Finkel AO FAA FTSE when he opened the Royal Australian Chemical Institute Centenary Congress in Melbourne in July. Applauding the practice and processes of chemistry Dr Finkel said:

"To be truly chemical-free, you would have to go back nearly 14 billion years to the Big Bang and eliminate anything produced afterwards by any process, either naturally occurring or man-made. To be free of the science that enables us to understand and harness these processes – chemistry – you would have to go back at least as far as the 1600s."

He noted that, without chemistry in Australia:

- the Sydney Harbour Bridge would rust;
- Vegemite would never have been invented;
- our plastic banknotes would be paper; and
- there would be no Aerogard, no Speedos, no wine in casks, no white tiles on the Opera House and no zinc cream.

Farms would be far less productive, fuels far less efficient, foods far less nutritious and pharmacies would be without most of their stock.

Dr Finkel said chemists should follow a mantra of three Ps:

- Permission – seeking and earning a social licence to operate and accepting effective regulation;
- Purpose – seeing beyond a product or process to its applications; and
- Perspective – avoiding perfection and compromise, rather optimising their work through listening to others and understanding their concerns.

RAN GOES FOR DEAKIN FIREFIGHTING SYSTEM

Australian Navy firefighters are set to benefit from FLAIM Trainer™ – a virtual reality training system – after Deakin University's Institute for Intelligent Systems Research and Innovation (IISRI) was awarded a \$2.16 million contract by the Federal Government's Defence Innovation Hub.

IISRI will develop and demonstrate a next-generation, virtual reality, hot fire training system, aimed at safe, repeatable and realistic immersive training of Royal Australian Navy (RAN) personnel.

At the heart of the deal is the IISRI-developed FLAIM Trainer™. Deakin says FLAIM Trainer™ can accurately represent heat, jet reaction and step-up forces, along with sound and visuals, to immerse a trainee in a 'real' fire – offering a cheaper, portable, safe and more effective training option for firefighters.

The system will also see the development of advanced breathing apparatus simulation, incorporating trainee performance monitoring, allowing the most realistic training experience possible.

It aims to provide RAN with the capability to train firefighters for situations and scenarios that are inherently unsafe and difficult to reproduce, may no longer be possible due to environmental constraints, and incur significant training cost in time, people and assets.



Shipboard firefighting.

EM SOLUTIONS SUPPLIES NAVY COBRA TERMINALS

Raytheon Australia has contracted Brisbane-based EM Solutions to supply its Cobra X/Ka tri-band Maritime Terminals and associated network infrastructure to the Royal Australian Navy as part of the SEA1654 program that will deliver two new supply vessels.

This order follows the successful deployment of the same Cobra platform on Australia's Cape Class Vessels, and



EM Solutions' Cobra.

enhances EM Solutions' position as an Australian SME delivering leading edge capability to the Australian Defence Force.

Dr Rowan Gilmore FTSE is CEO of EM Solutions and 2011 Clunies Ross Award winner Dr John Ness FTSE is its Chief Technology Officer.

The Cobra platform is part of EM Solutions' range of satellite-tracking terminals designed to find and acquire satellites even in rough seas.

"This is a significant step forward for our business given the complexity and value of the solution we are supplying," said Dr Gilmore, adding it would position the business for further future growth.

EM Solutions designs and supplies leading-edge satellite and microwave communication technology for customers in the global defence, maritime, broadcasting and telecommunications sectors and has a customer base of more than 200 of the world's largest system integrators and telecommunication companies.



New-look robotics: (from left) Bruce Blundell (UAP), Dr Glenda Caldwell (QUT), Matthew Tobin (UAP) and Dr Jared Donovan (QUT).

A robot to create public art pieces

Training a robot to create large-scale, bespoke public art pieces that until now were impossible to produce economically is the aim of a national collaboration.

The \$8 million research project aims to develop vision-enabled, agile and adaptable robots that SMEs can use easily to make high-value products that open export opportunities and create more jobs in Australia.

The first robot is being trained at Brisbane's Urban Art Projects (UAP) to set a new direction for robots, which for more than 40 years have been the workhorses for manufacturing giants – pre-programmed to perform one task repeatedly in a highly controlled environment like an assembly line.

"We build big, one-off, high-quality art pieces for organisations around the world," said UAP founder and managing director Matthew Tobin.

"We really love what we do but we are challenged by every project – each is very different from the last and each involves a lot of hand-crafting techniques to design the pieces, which we then have manufactured in China before we assemble and install them.

"While our team certainly has the skills to deliver these artworks, the cost of making these increasingly complex pieces is becoming prohibitive, particularly given the rising manufacturing costs in China.

"Having a robot on site with the intelligence to see what it's working on and make adjustments on the fly will allow us to manufacture more of the pieces here in Brisbane, broaden the scope of designs we can achieve and employ more designers and technical staff."

Queensland University of Technology is leading the five-year design robotics project in partnership with UAP, the Innovative Manufacturing Cooperative Research Centre (IMCRC), RMIT University and construction company Laing O'Rourke.

Melbourne-based IMCRC says manufacturing has entered a fourth industrial revolution.

"This offers vast opportunities for Australian companies to create new products and services, expand into new supply chains and markets at home and around the world, and attract and develop a new generation of skilled employees," it says.

AUSTAL WINS \$150M FERRY CONTRACTS

Austral Ltd, the Perth-based shipbuilder, has won a \$108 million (€73 million) contract to design and build a 109-metre, high-speed vehicle passenger ferry for Fjord Line of Norway.

The all-aluminium catamaran will be its 8th large high-speed commercial ferry. It will transport 1200 passengers at up to 40 knots and features the company's largest ever vehicle-carrying capacity – with a beam of 30.5 metres enabling 404 cars to be carried across two decks.

The new vessel will have several key performance and comfort innovations, including a new hull form to minimise fuel consumption and wake wash when operating on the Skagerrak Sea between Hirtshals, Denmark, and Kristiansand, Norway, and a business class lounge for up to 184 passengers, a duty free shop, two bistros, two bars and a children's play area.

Fjord Line's latest addition will join its fleet of four commercial passenger ferries following delivery from Austral's Australian shipyard in January 2020.

Austral has another 109-metre, high-speed vehicle passenger ferry (for Molslinjen of Denmark) currently under construction at the Australian shipyard and a 56-metre, high-speed passenger ferry (for FRS of Germany) under construction in the Philippines.

Austral has also won its first commercial contract award in Taiwan, valued at A\$44 million.

The contract is for two 550-passenger, 50-metre, high-speed catamarans for Taiwan's Brave Line. The contract includes an option for a third vessel of the same design.

The Brave Line catamarans will be designed by Austral in Australia and will be built in Austral's shipyard in the Philippines.

LOCAL FIRMS DEVELOP 'FIGHT RECORDER'

Two Australian companies will collaborate with Defence to develop a 'Black Box' equivalent for soldiers, known as the 'Fight Recorder'.

Start-up telecommunications company Myriota and wearable technology company IMeasureU were selected from 47 industry and university applicants from across Australia and New Zealand to develop the Fight Recorder.

The Fight Recorder would be a soldier-worn system aimed at capturing valuable data on the battlefield and would act as an emergency beacon to reduce the time taken to reach and treat battlefield casualties, said Defence Industry Minister Christopher Pyne.

When fully developed, the Fight Recorder could provide benefits in other physically demanding occupations, including emergency services and law enforcement.

The two companies will receive \$700,000 from the Next Generation Technologies Fund, launched in March.

NEWS

Parliamentary inquiry backs vehicle automation

A Parliamentary committee has recommended to the Government that it encourage trials of automated vehicles in Australia, particularly trials that enable the public to experience automated vehicles on public roads.

The Standing Committee on Industry, Innovation, Science and Resources noted “the range of benefits automated vehicles are likely to bring and the need for public acceptance of the technology”, but recommended Government further investigate the issue of data rights for consumers, vehicle manufacturers and third parties such as insurers and government agencies.

It recommended that Commonwealth, state and territory governments and local councils, consider funding of trials of automated vehicles with a public transport application, in both metropolitan areas and regional locations.

It urged consistent regulations and policy settings and the establishment of a working party with industry and academic stakeholders to identify industry needs and implement a strategy to ensure that Australia is best placed to exploit emerging opportunities.

The Committee called for a dedicated national body or cross-agency taskforce to coordinate Australia’s preparation for the introduction of land-based automated vehicles and said it should address:

- public engagement to ensure that concerns about automated vehicles are addressed and benefits are explained;
- employment ramifications;
- the benefits for disabled and older Australians and those in regional and rural areas;
- infrastructure needs; and
- ownership, use and security frameworks and legal liability and insurance implications.

ATSE’s submission to the inquiry said there were compelling benefits from full automation of Australia’s road system and recommended early implementation.

SYDNEY TRIALS THE DRIVERLESS BUS

A driverless bus carrying passengers is set to take to NSW roads for the first time as Sydney joins the trial of driverless buses started in Perth last year.

By the beginning of next year it is expected that the small shuttle bus will have passengers on board and be using roads around Sydney Olympic Park.

The two-year trial, part of the NSW Government’s push towards “technology-enabled transport”, involves intelligent transport company HMI Technologies, the NRMA, Telstra, IAG and Sydney Olympic Park Authority.

“We want to use the trial to help develop

the systems that will enable automated vehicles to be connected to our infrastructure, like traffic lights, and to our customers through their devices and applications,” said NSW Roads Minister

Mrs Melinda Pavey. The trial will focus on observing how automated vehicle technology can improve the mobility of customers and interact with other people within the precinct.

It aims to understand what supporting technology and infrastructure is needed to

\$5 MILLION TO PUSH INNOVATIONS

A process to convert waste plastics into fuel and chemicals and a new energy storage system are among eight Australian innovations to share in \$5 million to help them become commercial reality.

The assistance under the Entrepreneurs’ Program Accelerating Commercialisation element aims to help turn the business ideas into marketable products through market trials, upscaling, proving new technology, and connecting with markets.

This funding is offered on a dollar-matched basis to help Australian businesses turn their ideas into commercial realities in Australian and international markets.

Successful applications include:

- technology with the potential to divert end-of-life waste plastics from landfill to conversion into a Plasticrude, which can be distilled into valuable fuels and chemicals;
- a commercial-scale demonstration system for a low-cost and highly scalable energy-storage system that can be sited anywhere on an electricity grid, including small industrial sites;
- a fashion fitting solution that allows customers to know if the clothing they want to buy online will fit;
- commercialisation of a blockchain-enabled commodity management and finance solution creating efficiencies for those in the agricultural supply chain including managing contracts, deliveries and inventory; and
- an electromechanical load management system that replaces human-held rope taglines making crane operations safer in construction and logistics industries.

Accelerating Commercialisation Director Mr Larry Lopez said 242 Australian innovators had accessed more than \$122 million in assistance from the Entrepreneurs’ Program.



Sydney’s driverless bus.

operate an automated shuttle, how it interacts with other users and how it integrates with the broader transport network.

Australia’s first driverless shuttle bus trial began last year along the foreshore in South Perth.



Cartman takes the cake for Amazon robots

The Australian Centre for Robotic Vision (ACRV), headquartered at Queensland University of Technology, has taken the US\$80,000 first prize at the 2017 Amazon Robotics Challenge in Japan – thanks to its custom-built Cartesian robot, Cartman.

“Not bad for a robot that was only unpacked and reassembled out of suitcases a few days before the event, with at least one key

Driving Cartman to victory.

component held together with cable ties,” said ACRV COO Dr Sue Keay.

The Amazon Robotics Challenge aims to fill a gap in Amazon.com’s automated warehousing processes. While Amazon is able to quickly package and ship millions of items to customers from a network of fulfillment centers, the commercial technologies to allow robots to pick items and stow them in boxes in an unstructured environment are yet to be developed.

The robots were scored by how many items they successfully picked and stowed in a fixed amount of time.

Team ACRV leader Dr Juxi Leitner said the Centre’s secret was an innovative Cartesian manipulator, ‘Cartman’, built from scratch. Cartman can move along three axes, like a gantry crane, with a rotating gripper that allows the robot to pick up items using either suction or a simple two-finger grip.

“We were the only team with a Cartesian robot at the event. Cartman was definitely a large reason for our success,” Dr Leitner said.

“With six degrees of articulation and both a claw and suction gripper, Cartman gives us more flexibility to complete the tasks than an off-the-shelf robot can offer. “The robot is robust and tackles the task in an innovative way and is also cost-effective. I think it would have been the lowest cost robot at the event!”

Fifteen members of the Centre’s 27-strong team of researchers, from QUT, the University of Adelaide and the Australian National University, were in Japan for the event. Team ACRV beat home 15 other teams.

GEELONG MAY BECOME ‘COMPOSITE VALLEY’

Deakin University has done what it tags a “\$58 million deal” with LeMond Composites that aims to revolutionise the use of carbon fibre across the world through licensing technology from Deakin’s world-leading carbon fibre research centre, Carbon Nexus.

The technology has the potential to reduce the energy used in carbon fibre production by 75 per cent and reduces the production process time from around 80 minutes to under 15 minutes. In addition, the specialised carbon fibre production machinery required is expected to cost around 50 per cent less than current equipment.

The smaller equipment footprint makes possible a 70 per cent reduction in the size of a carbon fibre processing plant.

Mr Greg LeMond, the American who in 1986 became the first cyclist to win the Tour

de France on a carbon fibre bike – then won it twice more – has been a household name among cyclists for three decades, selling carbon fibre bikes under his own brand around the globe.

He established LeMond Composites last year to realise his vision of affordable carbon fibre bicycles for everyday riders.

Mr LeMond said the ability to scale-up low-cost carbon fibre production had been the biggest hurdle to bringing the material to the masses.

“Deakin University’s manufacturing process will make it possible to localise manufacturing and make carbon fibre technology more accessible to a wider range

of industries like transportation, renewable energy and infrastructure or any industry that benefits from using lighter, stronger, safer materials,” he said.

Mr LeMond said it was difficult to fully grasp the global impact the technology would have on consumers.

“What Deakin and Carbon Nexus have invented here will feed the world with low-cost carbon fibre and help make carbon fibre available to the masses – this could make Geelong the new Composite Valley.”



LeMond – world name in carbon fibre bikes.

NEWS

UNSW launches quantum development company

The University of NSW (UNSW) has established Australia's first hardware quantum computing company, Silicon Quantum Computing Pty Ltd, to advance the development and commercialisation of its quantum computing technology.

The NSW Government has joined the \$83 million venture, pledging \$8.7 million from its recently announced Quantum Computing Fund.

The State Government commitment builds on earlier investments from UNSW and its quantum computing researchers (\$25 million), Commonwealth Bank of Australia (\$14 million), Telstra (\$10 million over two years) and the Commonwealth Government (\$25 million over five years) through its National Innovation and Science Agenda.

Working alongside the Australian Research Council (ARC) Centre of Excellence for Quantum Computation and Communication Technology (CQC2T), Silicon Quantum Computing Pty Ltd will operate from new laboratories within CQC2T's UNSW headquarters.

Its purpose is to drive the development and commercialisation of a 10-qubit quantum integrated circuit prototype in silicon by 2022 as the forerunner to a silicon-based quantum computer.

UNSW says CQC2T is home to an incredibly strong team of silicon quantum computing researchers – the only group in the world that can make atomically precise devices in silicon.

Silicon Quantum Computing Board members are: Professor Michelle Simmons FAA FTSE, who heads CQC2T; Professor Hugh Bradlow FTSE, Telstra's Chief Scientist and ATSE President; Mr David Whiteing, CBA's Chief Information Officer; Ms Glenys Beauchamp, Secretary of the Department of Industry, Innovation and Science; and corporate lawyer and company director Mr Stephen Menzies (Chair).

Professor Simmons said Australia had enormous strength in quantum information research.

"It's an exciting time to invest in this new industry that will shape the

21st century. With Silicon Quantum Computing Pty Ltd now incorporated we are fully committed to developing a 10-qubit silicon prototype. We are open for business and open to further investment from interested partners.

"The public-private venture establishing Silicon Quantum Computing Pty Ltd seeks to develop a quantum information ecosystem here in Australia. It will involve leading scientists and engineers at UNSW and the University of Melbourne, which together with other institutions that are part of CQC2T will develop a scalable, error corrected quantum computer in silicon," Professor Simmons said.



Michelle Simmons in the CQC2T laboratories.

WE'RE READY FOR IOT AND AI IN COMMERCE

More than half of Australians would prefer to use fingerprints, voice or retina scans in place of PINs when making payments and a quarter are ready for artificial intelligence to do their shopping, says the global payments technology company Visa.

According to new research commissioned by Visa, 29 per cent of Australians are ready to use an internet-connected device, like a smart home virtual assistant or connected fridge to make payments on their behalf. This number has grown dramatically in less than a year, from 12 per cent in September 2016.

This sharp increase is proof that Australia is a nation of enthusiastic adopters of new ways to pay, says Stephen Karpin, Group Country Manager for Visa in Australia, New Zealand and South Pacific, adding that, as technology continues to enable innovative experiences, Australia is on the brink of a new era of commerce.

"As the Internet of Things and biometric capabilities become integrated into our everyday experiences, we'll experience a significant shift in how payments are made," Mr Karpin says.

"In our lifetime, we will see infinitely more choice in how Australians pay, from watches, fridges and mobile phones, to eyes and fingers. And we'll experience personalisation that we never thought possible, powered by artificial intelligence."

Many of the new payment methods are enabled by the use of biometrics as authentication – the most common example of this being the fingerprint scanner on a smartphone. More than half of respondents surveyed by YouGov (56 per cent) said they were comfortable using their thumbprint, voice or retina for payment.

NEW DIGITAL ID TECHNOLOGY

Australia Post has launched Digital iD™ technology to offer Australians a more convenient way to verify their identity.

Job outsourcing site Airtasker, Australia's largest credit union CUA, foreign exchange company Travelex and the Queensland Police Service will adopt Australia Post's identity platform, which allows Australians to verify who they are safely and securely, without needing multiple forms of identification. Digital iD™ allows people to verify their identity information once, so they can then easily prove who they are online and in person through the platform's smartphone app.

Airtasker will use Digital iD™ to allow its users to obtain an identity 'badge' to prove who they are. CUA will adopt the technology to verify new members applying for selected savings accounts online or via their mobile device, enabling more people to complete the process digitally without visiting a physical branch. Travelex will use the technology as part of its Know Your Customer Checks, while Queensland Police Service will incorporate Digital iD™ into its national police clearance certificates process to be launched later this year.



Guilherme Tosi (left) and Andrea Morello.

Flip-flop qubits: radical new quantum design

Engineers at the University of New South Wales have invented a radical new architecture for quantum computing, based on novel 'flip-flop qubits', that promises to make the large-scale manufacture of quantum chips dramatically cheaper – and easier – than thought possible.

The new chip design, detailed in the journal *Nature Communications*, allows for a silicon quantum processor that can be scaled up without the precise placement of atoms required in other approaches. Importantly, it allows quantum bits (or 'qubits') – the basic unit of information in a quantum computer – to be placed hundreds of nanometres apart and still remain coupled.

The design was conceived by a team led by Professor Andrea Morello, Program Manager in the UNSW-based ARC Centre of Excellence for Quantum Computation and Communication Technology (CQC2T).

He said fabrication of the new design should be easily within reach of today's technology.

Lead author Dr Guilherme Tosi, a Research Fellow at CQC2T, developed the pioneering concept along with Professor Morello and co-authors Dr Fahd Mohiyaddin, Dr Vivien Schmitt and Ms Stefanie Tenberg of CQC2T, with

collaborators Assistant Professor Rajib Rahman and Professor Gerhard Klimeck of Purdue University in the US.

"It's a brilliant design, and like many such conceptual leaps, it's amazing no one had thought of it before," Professor Morello said.

"What Guilherme and the team have invented is a new way to define a 'spin qubit' that uses both the electron and the nucleus of the atom. Crucially, this new qubit can be controlled using electric signals, instead of magnetic ones. Electric signals are significantly easier to distribute and localise within an electronic chip."

Dr Tosi said the design sidesteps a challenge that all spin-based silicon qubits were expected to face as teams begin building larger and larger arrays of qubits: the need to space them at a distance of only 10 to 20 nanometres, or just 50 atoms apart.

Researchers at UNSW already lead the world in making spin qubits at this scale, Professor Morello said.

"But if we want to make an array of thousands or millions of qubits so close together, it means that all the control lines, the control electronics and the readout devices must also be fabricated at that nanometric scale, and with that pitch and that density of electrodes. This new concept suggests another pathway."

At the other end of the spectrum are superconducting circuits – pursued for instance by IBM and Google – and ion traps. These systems are large and easier to fabricate, and are currently leading the way in the number of qubits that can be operated. However, due to their larger dimensions, in the long run they may face challenges when trying to assemble and operate millions of qubits, as required by the most useful quantum algorithms.

"Our new silicon-based approach sits right at the sweet spot," Professor Morello said. "It's easier to fabricate than atomic-scale devices, but still allows us to place a million qubits on a square millimetre."

In the single-atom qubit used by Professor Morello's team, and which Dr Tosi's new design applies, a silicon chip is covered with a layer of insulating silicon oxide, on top of which rests a pattern of metallic electrodes that operate at temperatures near absolute zero and in the presence of a very strong magnetic field.

At the core is a phosphorus atom, from which Professor Morello's team has previously built two functional qubits using an electron and the nucleus of the atom. These qubits, taken individually, have demonstrated world-record coherence times.

Dr Tosi's conceptual breakthrough is the creation of an entirely new type of qubit, using both the nucleus and the electron. In this approach, a qubit '0' state is defined when the spin of the electron is down and the nucleus spin is up, while the '1' state is when the electron spin is up, and the nuclear spin is down.

"We call it the 'flip-flop' qubit," Dr Tosi said. "To operate this qubit, you need to pull the electron a little bit away from the nucleus, using the electrodes at the top. By doing so, you also create an electric dipole."

"This is the crucial point," Professor Morello adds. "These electric dipoles interact with each other over fairly large distances, a good fraction of a micron, or 1000 nanometres."

"It will take great engineering to bring quantum computing to commercial reality, and the work we see from this extraordinary team puts Australia in the driver's seat," said Professor Mark Hoffman FTSE, UNSW's Dean of Engineering.



BY IAN RAE
iandrae@bigpond.com

Taking a hard look at agriculture education



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This book has its origins in the Society of Old Agricultural Fellows (OAFS) that, if you have taste for agricultural puns, might

be termed an underground organisation.

Lindsay Falvey (Professor Lindsay Falvey FTSE) has brought together the contributions of the OAFS and given structure to this account of the vicissitudes of the Faculty of Agriculture at the University of Melbourne.

It's a faculty that has struggled to find its place in the university and in the broader sphere of agricultural education, and the book is in many ways a lament about lost opportunities, successful competitors and urban-rural tensions.

If farmer children (of course, it was all boys at first) go to university, they often don't come back to work on the farm. To drill down to student choices, it was Parkville and city life versus Dookie and the pigs. Much of agricultural education was regarded by other faculties of the university as VET/TAFE and not really higher education, despite the presence of a strong (and growing) research culture in the faculty.

The Victorian Government brought the state's agricultural colleges into the Victorian College of Agriculture and Horticulture (VCAH) – a gumboot version of the Victorian Institute of Colleges that swept up the Techs and CAEs. The VCAH became part of the university and the then Vice-Chancellor, Professor Alan Gilbert, promised no closures, thus worsening a financial position that had long been unsustainable.

It fell to Frank Larkins to do the untangling, but the university held on to Dookie, Creswick (the Forestry School) and Burnley Gardens. A pithy assessment of Burnley in the 1920s noted that its "student cohort was bifurcated between girls with good academic records from private schools who regarded Burnley as a finishing school,

Agricultural Education in Victoria & the Faculty of Agriculture, University of Melbourne by Lindsay Falvey and eight others, OAFS, 2017 (x + 220 pp)

and boys who chose Burnley because their academic results were inadequate for the University". Later, "the School remained best known for its pruning demonstrations". It's still true: I've been there, done that!

The Faculty of Agriculture changed name often in the 20th century as shifting allegiances were played out and desperate attempts were made to adapt it to changing circumstances. Environment came and went, as did Geography; so did Deans, a number of them resigning in despair or disgust. "Devious disloyalty of some Faculty staff" added to the difficulties of the faculty. One wonders how long the current manifestation – the Faculty of Veterinary and Agricultural Sciences – will last.

Professor Falvey writes that the University of Melbourne is positioning itself among the elite universities of the world, few of which "include agricultural science in the manner valued by the profession". The potential conflict between scholarship and professional education plays out in other faculties, too – notably Medicine, Law and Education – with varying degrees of harmony and cohabitation, but only in Agriculture has it been destructive.

When the university introduced the Melbourne Model in 2008, with its six undergraduate degrees, most of the Agrioculture Faculty's offerings were subsumed under the BSc, but the BAg (Dookie based) was maintained outside that envelope. Another indication of how the faculty fitted into that new coursework regime was that Agriculture gained enrolments by offering 'breadth subjects' such as 'Food for a Healthy Planet' and 'Australia in the Wine World' in other degrees programs.

The references (358 of them!) are encyclopaedic. Professor Falvey, perhaps drawing on the words of his collaborators, provides some pretty blunt assessments of the university, his colleagues and the Victorian Government.

There's an air of 'whodunnit', or maybe 'whodidn't' about the book that makes it difficult to dip into. It's best read at a sitting or two, with an eye for the roles played by Academy Fellows Barlow, Egan, Falvey, Ferguson, Larkins, McMahon, Reeves, Shiel, Tribe and Tulloh*.

* Professor Snow Barlow FTSE, viticulture specialist; Professor Adrian Egan FTSE, now chair of the South West Science Council in WA; Professor Lindsay Falvey FTSE, chair of the International Livestock Research Institute; forestry expert Professor Ian Ferguson FTSE; Emeritus Professor Frank Larkins AM FAA FTSE, former Deputy Vice Chancellor and Faculties Dean; hydrologist Professor Tom McMahon FTSE; Professor Tim Reeves FTSE, Chair of ATSE's Agriculture Forum; Professor Margaret Sheil AO FTSE, Provost of the University of Melbourne and ATSE Director; the late Professor Derek Tribe AO OBE FTSE, Foundation Fellow and first Executive Director of The Crawford Fund; and animal husbandry expert Professor Norman Tulloh AM FTSE.

A limited number of hardback copies of the book are available free of charge for Fellows – contact lindsay.falvey@gmail.com. The full text can be read online at <https://oafs.live/> under 'initiatives'.

Professor Ian Rae FTSE, an Honorary Professional Fellow at the University of Melbourne, is a former technical Director of ATSE. He was President of the Royal Australian Chemical Institute (2006–08) and served for a decade as a technical adviser to the UN Environment Programme. He is co-editor of the AAS journal Historical Records of Australian Science.

ATSE PEOPLE



Salah Sukkarieh adjusts the Ladybird robot.

Salah Sukkarieh takes Eureka Leadership Prize

University of Sydney Professor Salah Sukkarieh FTSE has won the 2017 CSIRO Eureka Prize for Leadership in Innovation and Science.

He was recognised for his work translating cutting-edge robotics and intelligent systems research into real-world applications. Working across aviation, agriculture, mining, aerospace and logistics, his work places Australian innovations in autonomous systems on the global map.

Professor Sukkarieh is the Director of Research and Innovation at the Australian Centre for Field Robotics (ACFR) at the University of Sydney.

He is also the Director for the Rio Tinto Centre for Mine Automation and the Horticulture Innovation Centre for Robotics and Intelligent Systems. He leads a project on

smart farming systems for nutrition at the Charles Perkins Centre and leads a project on nanorobotics at the Australian Institute for Nanoscale Science and Technology (AINST).

He is an internationally recognised expert in the research, development and commercialisation of robotic systems.

Professor Sukkarieh has significantly advanced the fundamentals of autonomous systems science and his research has provided impactful solutions to barriers in important large-scale engineering operations across various industries. His key technological breakthroughs have included developing better navigation systems for aerial and ground robotics, better prediction of fuel consumption for flight systems, and developing better environmental management tools.

Professor Sukkarieh and his team at the

ACFR are currently working with Australian farmers to help grow their crops in smarter and more efficient ways. By using robotic devices to assess, maintain and ultimately harvest crops, they are improving food sustainability while battling the effects of climate change.

He has led a number of robotics and intelligent systems R&D projects in logistics, commercial aviation, aerospace, education, environment monitoring, agriculture and mining and has consulted to industry including Rio Tinto, BHP, Patrick Stevedores, Qantas, Queensland Biosecurity, Meat and Livestock Australia, and the NSW DPI amongst others.

In 2014 he was awarded the NSW Science and Engineering Award for Excellence in Engineering and Information and Communications Technologies.

Professor Sukkarieh wrote an article on robotics in agriculture in the August 2016 edition of *ATSE Focus* (197), available online (at Publications>Focus Magazines>2016).

The Eureka Prize winners were recognised for excellence in science, research and innovation, scientific leadership and engagement, and school science across a broad spectrum – from environmental and innovative technologies, to national security, citizen science and, for the first time, data science.

The winners were announced at a gala ceremony at the Sydney Town Hall, attended by Australia's Chief Scientist Dr Alan Finkel AO FAA FTSE, NSW Governor David Hurley FTSE, NSW Chief Scientist Professor Mary O'Kane AC FTSE and leaders from science, government, industry, academia, research and innovation.

VEENA SAHAJWALLA TAKES RESEARCH INNOVATION PRIZE

Her revolutionary approach to the recycling of toxic waste materials has seen UNSW Professor Veena Sahajwalla FTSE awarded the inaugural PLuS Alliance Prize for Research Innovation.

The award, one of two \$50,000 prizes presented at the *Times Higher Education World Academic Summit* in London, recognises outstanding innovation contributions that address global challenges facing society.

Professor Sahajwalla and her team at the UNSW Centre for Sustainable Materials Research and Technology (SMaRT) have developed technologies to convert complex waste materials, such



Veena Sahajwalla

as old tyres and disused electronic devices, into 'green' materials for use in industry.

"The work we've been doing to help global industries use green materials over virgin raw materials is vital to sustainability," Professor Sahajwalla said.

The PLuS Alliance is a collaboration between Arizona State University, King's College London and UNSW Sydney, which aims to "enable research-led solutions to global challenges while expanding access to world-class learning".

The World Academic Summit, held in September, was co-hosted by UNSW and coincided with the Future of Global Higher Education Symposium, which brought together university and policy experts from the UK, Europe, Asia and the US to discuss global higher education issues.

ATSE PEOPLE

We need smarter policy frameworks – Liveris

Business can solve today's intractable challenges says Dow CEO Mr Andrew Liveris AO FTSE, but Australia is falling behind

He says business can help make the world a better place by driving the solutions to problems like climate change, food security and rising energy demand.

"I firmly believe that the companies who will lead the 21st century will be the ones that invent solutions to these mounting global challenges," said Mr Liveris, speaking at the Royal Australian Chemical Institute (RACI) Centenary Chemistry Congress in Melbourne.

"More and more companies are seeing that we can do well by doing good," he said.

But we also need governments to set smart regulatory and policy frameworks that enable innovation to flourish, and that's not happening enough in Australia, he said.

He noted that, according to the World Economic Forum, Australia ranked 25th in the world in "business capacity for innovation" and we're also falling behind in our competitiveness in teaching young people maths and science.

"More and more companies are seeing that we can do well by doing good."

– ANDREW LIVERIS

CHLOE MUNRO HEADS AEMO PANEL

Ms Chloe Munro FTSE, the former Chair of the Clean Energy Regulator and panel member of the Finkel Review, will chair an Australian Energy Market Operator (AEMO) Expert Advisory Panel.

The Panel, comprised of leaders from across the energy industry, includes Ms Catherine Tanna FTSE, Managing Director of EnergyAustralia.

AEMO says the Panel will gain important perspectives from senior energy leaders during a period in which the energy sector is undergoing unprecedented and rapid change and support AEMO in delivering key initiatives and implementing the recently endorsed Finkel recommendations.

The Panel will also play a crucial consultative role across AEMO's broad remit of activity, it says, and support the recently established Energy Security Board "by helping AEMO drive industry reform, expediting critical issues and finding consensus where possible."



Chloe Munro

Australian quality of life would go backwards, he said, "if all we are is a farm, a hotel and a quarry".

Mr Liveris, a chemical engineering graduate of the University of Queensland, said the world needed innovation more than ever before, because of the daunting challenges it faced.

"By 2025, 1.8 billion people will live in regions where clean water is scarce. By 2030, 40 per cent of the Earth's people will lack adequate housing. By 2040, global energy consumption is predicted to nearly double – and unprecedented extreme weather events are likely to become the status quo, rather than outliers. And by 2050 – as the global population tops nine billion – demand for food will increase by 60 per cent.

"We are already getting a precursor to some of those challenges here in Australia, where climate change is degrading essential natural resources, destroying ecosystems that make Australia unique and causing extreme weather that threatens people's lives.

"And yet I am not scared and I am not



Andrew Liveris

depressed. Far from it. I am energised.

"Because, as the 2015 ratification of the Sustainable Development Goals demonstrated, there is increasing commitment to solving these challenges – from governments, from academia and, more than ever before, from businesses.

"In fact, these challenges provide a roadmap for a completely new business model – one where solving the world's intractable problems presents boundless opportunities.

"This is because of multiple breakthroughs. New technologies are allowing us to experiment more rapidly, and more boldly, than ever before. And digitisation is redefining how we process data and obtain new insights."

Mr Liveris said that, over his career, he had seen a remarkable evolution in the way companies thought about their responsibility to society – and the role business could play in solving problems and improving people's lives.

"It is time for us to put forth a new vision for humanity," he said, "one where:

- the challenges we face don't incentivise happy ignorance or resigned pessimism, but instead inspire tireless determination;
- we look to the great scientific achievements of the past not as remnants of some grand old age, but as stepping stones on a path to even greater discovery; and
- our idea of what is possible is, like the universe itself, in perpetual expansion."

ATSE PEOPLE

Judy Raper wins 2017 Chemeca Medal

The University of Wollongong's Deputy Vice Chancellor, Professor Judy Raper FTSE, has won the 2017 Chemeca Medal – only the second woman to win it in its 35-year history.

The Chemeca Medal is the most prestigious award in chemical engineering in Australia and New Zealand, and is awarded to a chemical engineer who has made an outstanding contribution to the practice of chemical engineering and who continues to serve the profession.

Professor Raper was presented with the award at the Chemeca 2017 Conference in Melbourne.

Professor Raper's prior appointments include Dean of Engineering at the University of Sydney, Division Director at the US National Science Foundation in Washington, and Chair of Chemical and Biological Engineering at the Missouri University of Science and Technology.

In 2012, Professor Raper was named by the *Australian Financial Review* and Westpac as one of Australia's '100 Women of Influence', and in 2015 was named in the 'Top 100 Influential Engineers' by Engineers Australia for the third year running.

She has been an ATSE Fellow since 2003.

Chemeca 2017 was something of a reunion for Professor Raper – attended by



(From left) Rose Amal, Judy Raper and Chris Fell.

both her former PhD student Professor Rose Amal FTSE, now Professor of Chemical Engineering at the University of NSW (who nominated her for the Chemeca Medal), and Professor Chris Fell AM FTSE, her own PhD supervisor.

In her Chemeca 2017 keynote speech, 'Mind the Gap: Addressing the Innovation Gaps', Professor Raper talked about how the representation of women in chemical engineering had improved since she began her career, and how it could benefit from further change.

"In 1983, as a young academic, I was asked to give a presentation at the Chemeca conference on 'The untapped sex',

about women in the industry. At the time, only about six to 10 per cent of chemical engineering students were female," Professor Raper said.

"It's now 35 or 40 per cent women, so chemical engineering has done really well. However, in engineering overall it's gone from six per cent women to 18 or 20 per cent, and if you look at senior positions, it's only 15 per cent women on company boards or in senior roles. So there is still a lot to be done to bring greater diversity to engineering.

"And when I talk about diversity, I don't just mean greater representation and opportunity for women; I mean diversity across the board: racial diversity, cultural diversity, diversity of backgrounds, diversity of experiences.

"Company boards need a lot more diverse representation as well, not just women but people with engineering and science backgrounds are very much under-represented on boards.

"If you bring people with different ways of thinking together it leads to better outcomes. That's how you get innovation in industry and innovation in academia – through diversity.

"Innovation comes about through thinking differently, so we encourage innovation by doing things differently," she said.

DREW CLARKE A DIRECTOR OF NBN AND CSIRO

Mr Drew Clarke AO PSM FTSE has joined the Board of NBN Co Ltd and the Board of CSIRO

Mr Clarke has extensive experience having served in a range of senior government positions. He served as Secretary of the Department of Communications from 2013 to 2015, where he was involved in the large-scale review and reform of the National Broadband Network (NBN) project and developed an in-depth understanding of the telecommunications market.

He also served as Secretary of the Department of Resources, Energy and Tourism from 2010 to 2013 where he made substantial contributions to public policy and was Chief of Staff in the Office of the Prime Minister from September 2015 to April 2017.

Mr Clarke has expertise in innovation and across various industry sectors, including AusIndustry, the government's business delivery agency. He was the Chair of the Spatial Information Council (ANZLIC), the Chair of the COAG Energy Council Standing Committee of Officials,

the Director of the Cooperative Research Centre for Spatial Information and a member of the International Energy Agency Governing Board.

Mr David Thodey AO FTSE, Chairman, CSIRO, said: "On behalf of the CSIRO Board, it is a great pleasure to welcome Drew to the Board. His depth of knowledge and experience as a senior leader in the public sector, as well as his extensive board experience, will enrich CSIRO's board."



Drew Clarke

ATSE PEOPLE

Earth scientist, author and shipwreck discoverer

Dr Phillip Playford AM FTSE, a former Director of the Geological Survey of Western Australia, was a luminary of the geological profession, an award-winning author and shipwreck discoverer.

His distinguished career with both Government and the oil exploration industry culminated in his appointment as a Director of the Geological Survey of WA (GSWA), a role which he held from 1986 until his retirement in 1992 – the year in which he joined the Academy.

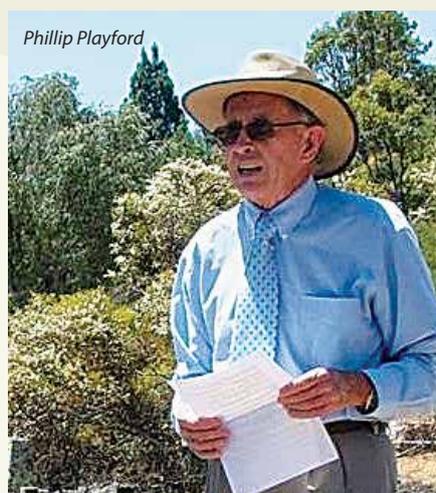
He was perhaps best known for his work on the Devonian reef complexes of the Canning Basin and geology of the Shark Bay area, which he documented as a co-author with Roger Hocking and Anthony Cockbain in the *GSWA Bulletin* 145. Another of his high-profile co-authored works was *The Geology of Shark Bay* (*GSWA Bulletin* 146).

Dr Playford held a BSc (Hons) in geology and an Honorary DSc from the University of Western Australia, and a PhD from Stanford University in the US, which he attended as a Fulbright Scholar.

Educated at Perth Modern School, he started his career as a geologist with the

Bureau of Mineral Resources before spending six years (1954–59) with WA Petroleum before returning to GSWA as Supervising Geologist (1962–70). He spent two years with Abrolhos Oil as Exploration Manager, then General Manager, before returning to GSWA in 1971 where he served in successively more senior positions over more than 20 years.

He achieved many awards and fellowships including the Gibb Maitland Medal (1990) and the Lewis G Weeks Gold Medal (APPEA) in 1995. Apart from being an ATSE Fellow he



Phillip Playford

was also a Fellow of the Australian Institute of Mining and Metallurgy (AusIMM) and a member of the Petroleum Exploration Society of Australia (PESA), Royal Society of WA, the American Association of Petroleum Geologists and the Society of Exploration Paleontologists and Mineralogists.

His nomination to the Academy described him as one of Australia's foremost geologists and head of one of the "leading geoscientific institutions" in Australia and an international authority on the world's Devonian reefs.

He lectured widely internationally – including in the UK, Canada and the US – and visited many remote parts of WA.

His many career highlights include being formally recognised as a co-discoverer of the *Zuytdorp*, the first of four early Dutch wrecks to be found and identified off the WA coast. His book, *Carpet of Silver: the Wreck of the Zuytdorp*, won the WA Premier's prize for literature.

Dr Playford died in Perth in July at the age of 85 after a long battle with cancer.

As a published tribute said – "He will be remembered for his enormous smile and infectious enthusiasm for rocks, wrecks and reefs."

30 YEARS ON: DEPARTMENT OF SCIENCE REUNION

When 16 'survivors' of the old Department of Science, abolished in 1987, celebrated 30 years since its demise, seven of them were ATSE Fellows of long standing – reflecting the importance of the Academy in its early days.

In its early years the Academy undertook a number of important studies for Government, including groundbreaking reports on the development of high technology enterprises (the 1983 Espie Report) and a space policy for Australia (the 1985 Madigan Report).

The links with Government were facilitated by the Science Ministry, which encompassed the Department of Science, CSIRO and a number of other statutory science bodies, which had been established by the Whitlam Government in 1972.

With the successive addition and removal of such functions as Consumer Affairs, Environment and Technology, the Department of Science provided the Academy's primary channel to Government until its abolition by the Hawke Government in July 1987.

The Department was headed by two Fellows – John Farrands (1977–82) and Greg Tegart (1982–87) – for most of its life, Fellows Paul Wild and Keith Boardman served in succession as Chairman and Chief



Thirty years on (from left) Mike Manton, John Zillman, Barry Jones, John Bell, Greg Tegart, Roy Green and Keith Boardman.

Executive of CSIRO during the same period.

Fellow Barry Jones, who served as Minister for Science from 1983 to 1987, has provided an account of the highlights and lowlights of his Department of Science years in the 'Ministering to Science' chapter of

ATSE PEOPLE

Peter Poole was a computing pioneer

Professor Peter Poole FTSE headed computer studies at the University of Melbourne for 27 years and is recognised as a national and international leader in computer science and software engineering.

Born in Rockhampton, he graduated in Science from the University of Queensland in 1951 and then worked for four years as a secondary teacher while completing a BEd. After graduating PhD in 1964 from the University of Sydney he spent seven years as head of the computer systems research group at the UK Atomic Energy Agency's Culham Laboratory, then three years as an Associate Professor in the Department of Computer Science at the University of Colorado.

His work at Culham had involved early use of time-sharing operating systems, and at the same time he had developed an interest in the design and implementation of large systems in general – the field that we now know as software engineering.

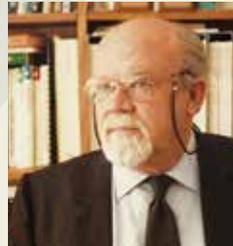
He then commenced his long association with the University of Melbourne in 1975, as the foundation chair of computing – the first professor appointed into the (then)

Department of Information Science.

The Department he joined had been established nearly two decades earlier, with the arrival in 1955 of the CSIR Mark 1 (later CSIRAC) computer on permanent loan from CSIRO. A 'Computation Laboratory' was established around that pioneering computer and immediately commenced teaching computer science subjects, including programming.

The successor to the Laboratory, the Department of Computation, was split in two in 1973 following a review, one part to be responsible for providing the university's computing services and the other part – the Department of Information Science – responsible for academic and teaching activities.

At his urging, 'Information Science' became 'Computer Science' in 1976 and quickly established itself as a leader



Peter Poole in about 1985.

within Australasia, including via a range of internationally recognised research projects, notably in the area of Machine Intelligence.

Another of his legacies was his early identification of the importance of open-source operating systems. He argued for the use of Unix on the Department's computers, and for portable operating systems in general. Professor Poole actively engaged with the university administration and served in a number of key roles, including as Deputy Dean of the Faculty of Science.

In 1989 Professor Poole was appointed Assistant Vice Chancellor (Information Technology), and given oversight of all IT policies at the university.

He resigned from the university at the end of 1992 to take up the post of Dean of the Faculty of Information Technology at Bond University, where he remained until his retirement at the end of 1997.

A Fellow since 1990, Professor Poole was inducted into the Pearcey Hall of Fame in 2010, and was awarded an honorary doctorate at the University of Melbourne in 2011.

He died in Perth on 19 August 2017, aged 85.

his 561-page 2006 Allen and Unwin autobiography *A Thinking Reed*.

Ten years on from its abolition on Bastille Day (14 July) 1987, a large group from the old Department got together in Canberra to look back on the achievements and camaraderie of their former Department.

A smaller group of senior figures from the 'abolition' held a 20-year reunion in 2007.

Almost the same group met again in Canberra in July. It included:

- Professor Barry Jones AC FAA FTSE FAHA FASSA;
- Professor Greg Tegart AM FTSE;
- Dr Roy Green AO FTSE (Deputy Secretary and later CSIRO Chief Executive);
- Professor John Zillman AO FAA FTSE (Director of Meteorology);
- Dr John Bell FTSE (Technology Development Division, on secondment to the OECD in Paris in 1987);
- Professor Mike Manton FTSE (Chief of the Bureau of Meteorology Research Centre); and
- Dr Keith Boardman AO FRS FAA FTSE (Chairman and Chief Executive of CSIRO).

Dr Green travelled from Perth for the event, with the group notching up an average age of 81.

SIDDIQUE WINS INDIAN AWARD

Professor Kadambot Siddique AM FTSE, Chair in Agriculture at the University of Western Australia and Director of the UWA Institute of Agriculture, received a Global Research Leadership in Agriculture Award in New Delhi in September.

The award was made at the at the Indian Council of Food and Agriculture's (ICAF) 10th Global Leadership Summit in Agriculture 2017.



Kadambot Siddique receives his award from the Governor of the Indian State of Haryana, Professor KS Solanki.

ATSE PEOPLE

ANZAAS Medal goes to Tom Spurling

Swinburne University's Professor of Innovation Studies, Tom Spurling AM FTSE, has been awarded the prestigious 2017 Australian and New Zealand Association for the Advancement of Science (ANZAAS) Medal for his contribution to the advancement of science over the past 55 years.

Most notably acknowledged for his role in the development and commercialisation of plastic banknotes, Professor Spurling is widely regarded as an expert in the commercialisation of research.

His extensive experience in managing the process of translating research into commercial products includes breakthroughs such as the 30-day contact lens and the MIEX water purification process.

Professor Spurling now works at the Centre for Transformative Innovation at Swinburne and has written extensively on science, technology and innovation policy and practice.

He was awarded a CSIRO Postgraduate Studentship in 1963 and a CSIRO Overseas Studentship in 1965, attending the University of Maryland.

He was a Lecturer in Chemistry at the University of Tasmania from 1967 until 1969 when he was appointed a Research Scientist at the CSIRO Division of Applied Chemistry at Fishermens Bend.

For many years Professor Spurling worked as a research scientist and then in a variety of senior roles at CSIRO from 1969 to 2002, including a year as Senior Private Secretary to Senator Gareth Evans (Minister for Resources and Energy, and now Chancellor of the ANU).

He served on the CSIRO Board (2008–15), was President of the Royal Australian Chemical Institute (RACI) in 1987, President (2005–07) of FASTS – the predecessor of Science and Technology Australia – and was a member of PMSEIC (the Prime Minister's Science, Engineering and Innovation Council)

at the same time.

He won the RACI Rennie Memorial Medal (1971) and Leighton Memorial Medal (1994) and managed the World Bank-funded CSIRO–LIPI Management Systems Strengthening project in Indonesia (1998–2001).

During his time at CSIRO he worked with Professor David Solomon AC FRS FAA FTSE on the development of polymer banknotes, providing statistical methods for validating tests, devising psycho-physical experiments to understand 'the feel of a banknote', and helping to develop optical variable devices.

Professor Spurling has been at Swinburne since 2002 and was Chief Executive of the CRC for Wood Innovations (2005–08).

The ANZAAS Medal is awarded annually for services for the advancement of science or administration and organisation of scientific activities, or the teaching of science throughout Australia and New Zealand and in contributions to science which lie beyond normal professional activities.

Professor Spurling is the latest in a long line of Fellows to win the ANZAAS Medal, including:

- Sir Ian Wark CMG CBE FAA FTSE (1973);
- Professor Eric Underwood AO CBE FRS FAA FTSE (1976);
- Sir Gus Nossall AC CBE FRS FAA FTSE (1982);
- Dr Paul Wild AC CBE FRS FAA FTSE (1984);
- Professor Ralph Slatyer AC CBE FRS FAA FTSE (1991);
- Professor John de Laeter AO FTSE (1992);
- Professor John Swan AO FAA FTSE (1994);
- Sir Arvi Parbo AC Kt FTSE (1996);
- Professor Don Watts AM FTSE (1999);
- Professor Ray Stalker AO FAA FTSE (2006); and
- Professor John Boldeman AO FTSE (2007).



Tom Spurling

EXTRACTS FROM TOM SPURLING'S ANZAAS MEDAL ACCEPTANCE SPEECH:

So what have I learned in my 56 years as a scientist?

Firstly, doing good science is a necessary but not sufficient condition for economic and social progress. But let's not forget that it is necessary!

Secondly, active participation by scientists in the political process is the best way of influencing our politicians to deliver the long-term policies and funding we need to ensure Australia's future prosperity.

Thirdly, I have learnt that professional organisations and societies, like ANZAAS and the RACI are essential in developing connections and networks within our own discipline and between disciplines.

I began my research career in 1961. This was a time of great optimism, particularly optimism that science would solve our economic and social problems. On the whole, politicians did not question the advice that scientists gave them. The public was convinced that investing in research and education was a key to future prosperity.

We live in a different time now. Scientific evidence is just one of the factors taken into account when governments make decisions. In 1961, we did not have to argue for the validity of scientific evidence: we do now.

"In 1961, we did not have to argue for the validity of scientific evidence: we do now."

– TOM SPURLING

ATSE PEOPLE

Mike Xie joins list of Michell Medal winners

RMIT Professor Mike Xie FTSE has won the 2017 AGM Michell Medal, awarded by Engineers Australia, for his highly significant work in the field of mechanical engineering that extends to lightweight aircraft structure, advanced medical technology, and engineering software development.

The medal comes on top of earning the prestigious 2017 Clunies Ross Award for Innovation. He said receiving the highest Australian honour in mechanical engineering was beyond his wildest dreams.

Professor Xie served as the head of civil engineering at RMIT from 2002 to 2012.

He is recognised globally as one of the most important contributors to the original development and subsequent world-wide adoption of a technology known as Evolutionary Structural Optimisation (ESO) and Bi-directional ESO (BESO).

He has applied ESO/BESO to such diverse research areas as aircraft wing design,

wound management, medical implants and advanced materials for armoured vehicles.

Deputy Vice-Chancellor Research and Innovation at RMIT, Professor Calum Drummond FTSE said the latest award was a tribute to Professor Xie's incredible body of work.

"Mike has worked incredibly hard and it is wonderful to see him receive this recognition, which is greatly deserved," Professor Drummond said.

The AGM Michell Medal is presented to one recipient each year for outstanding service to mechanical engineering. The award recognises highly significant contributions through technical innovation relating to the science or practice of mechanical engineering and long standing eminence in mechanical engineering science or practice.

AGM Michell Medal winners in recent years have all been ATSE fellows:

- 2016 Professor Yiu-Wing Mai AM FRS FREng FAA FTSE;
- 2015 Professor Martin Thomas AM FTSE; and

■ 2014 Professor Grant Steven FTSE.

Earlier winners included: Dr John Hart-Smith (2012), Dr Alan Baker FTSE (2011), Dr Francis Rose FTSE (2007), Professor Peter Joubert AM FTSE – deceased (2001), Professor Roger Tanner FAA FRS FTSE (1999), Mr Don Fry AO FTSE (1997), Dr Robert Brown AM FTSE (1995), Professor Bill Melbourne FTSE (1993), Professor Ray Stalker AO FAA FTSE – deceased (1991), Professor Alan Roberts AM FTSE (1989), Dr John Allen AM FTSE (1988), Professor Sam Luxton FTSE – deceased (1986), Professor Peter Fink FTSE – deceased (1985), Professor John Crisp AM FTSE – deceased (1984), Dr Arthur Bishop – deceased (1982), Mr Lionel Stern – deceased (1981), Mr Charles Warman – deceased (1980), Professor Kenneth Hunt – deceased (1979) and Dr M W Woods – deceased (1978).

Mike Xie



KATHRYN FAGG NAMED TOP ENGINEER

Ms Kathryn Fagg FTSE, a board member of the Reserve Bank and Boral and president of Chief Executive Women, has won the Ada Lovelace Medal for Outstanding Woman Engineer, a national award by the University of NSW that recognises the contribution Australian women have made to the engineering profession and to wider society.

Ms Fagg began her career with ExxonMobil and moved into consulting with McKinsey and Co before entering the banking sector, holding a number of roles at ANZ, most recently Managing Director – Global Transaction Services. She later took up senior roles at BlueScope Steel and Linfox, and now serves the board of the Reserve Bank of Australia and as Chairman at Melbourne Recital Centre, and holds non-executive director roles at Boral, Djerriwarrh Investments, Incitec Pivot and the Breast Cancer Network of Australia.

She is an active role model for women in business, serving as President of Chief Executive Women and speaking publicly on issues relating to gender equity in business.

As a highly successful woman, engineer and businesswoman, she has used her influence to smooth the way for women following in her footsteps.

"Kathryn Fagg is an outstanding member of the engineering profession who built a substantial

and impressive career in traditionally male-dominated worlds of petroleum exploration, steel-making, logistics and banking," said Professor Mark Hoffman FTSE, Dean of Engineering at UNSW.

"She is an inspiration to us all, particularly young women. She shows that engineering is a discipline that can take you anywhere."

"I cannot tell you how chuffed I am that this is called the Ada Lovelace Medal," said Ms Fagg. "What a role model she was, and continues to be. She was brave, she was courageous, and she was willing to go where no one had gone before."

"I'm delighted to accept this medal," she continued. "And I am so thrilled that UNSW is providing such support to its Women in Engineering Program, because we're going to be stronger society by drawing on the talent of all our people, and by reaching out to everyone who can make a difference."

The Ada Lovelace Medal honours Augusta Ada Byron, later Countess Ada Lovelace, an English mathematician who worked on Charles Babbage's revolutionary mechanical general-purpose computer, the Analytical Engine. Her remarkable notes on the engine in the 1840s include what is recognised today as the first computer algorithm, making her the world's first computer programmer.



Kathryn Fagg – Ada Lovelace Medallist.

ATSE PEOPLE

Let the scientists out of their boxes

This is an edited extract from an article by Dr Larry Marshall FTSE, CEO of CSIRO, which was first published in the Higher Education Supplement of The Australian.

We need to embrace a more diverse model for success if we're going to be competitive in an exponentially changing world.

People are so much more than the sum of their qualifications and it's one-dimensional thinking to try to label them or confine them to a box.

Not only is that absurdly narrow-minded, it's also hugely damaging for the next generation of science, technology, engineering and mathematics specialists – kids in school who see that and think 'Well, I like science but I don't want to be called a nerd'.

In the US, they don't call them nerds –

in fact they call some of them billionaires. They drive Ferraris and provide the wisdom and angel funding to the next generation of brilliant minds. They invest in bold, brave, risky new ideas, because they've done the maths – and the biology, or chemistry, or physics – to understand how these game-changing benchtop concepts can be turned into world-changing products.

You don't change the world by thinking the same as everyone else – diversity of perspectives is the compass to navigate the ambiguity of innovation.

This artificial separation of careers and capabilities has to stop if we're going to navigate the transition into an innovation economy.

Consider that there is a place in the world where the 'nerds' create multi-billion-dollar companies and still take time out to teach at



Larry Marshall

Stanford, and the bankers and lawyers chase them in search of the next unicorn.

So the next time you meet a mathematician, don't assume he's a professor – he might be the chief executive of Qantas. When you meet a computer scientist, don't assume the screen to which he's glued is full of numbers – he could be the chief executive of Netflix. Don't be surprised that a young woman studying maths and science became chief executive of eBay and later Hewlett Packard Enterprise, or that the chief executive of PepsiCo has a degree in maths and chemistry.

CELEBRATING 50 YEARS OF DEFENCE DEGREES

Former University of NSW Vice Chancellor and long-time Academy stalwart Sir Rupert Myers KBE AO FAA FTSE chalked up 50 years in July since one of his major achievements.

He led UNSW celebrations marking the 50th anniversary of the signing of an agreement to provide Australian Defence Force (ADF) officer cadets with degree studies for the first time.

The celebrations marked five decades since UNSW and ADF agreed to provide newly recruited Navy and Army officer cadets at the Royal Australian Naval College (RANC, Jervis Bay) and the Royal Military College (RMC Duntroon) with a chance to undertake degree studies for the first time.

Sir Rupert, a Fellow since 1979, was instrumental in setting up the agreement and today remains the last living personal link with Australia's longest-running educational partnership, following the death of former Army Minister and Prime Minister, Malcolm Fraser.

UNSW now enrolls around 2000 Defence-sponsored students in undergraduate and postgraduate coursework programs at its Canberra campus.

The 1967 agreement, in the context of a complex and controversial war that would not end for another five years, illustrated the need for uniformed officers to receive a balanced and liberal education.

Now aged 96, Sir Rupert fought to overcome resistance from his



Sir Rupert celebrates the anniversary.

own colleagues who felt an academic education could not be delivered in a military environment and from the leaders of other universities who feared the potential controversy generated by a link with the military just as the Vietnam War was becoming deeply unpopular.

In his time as UNSW Pro Vice Chancellor (1960–69) and then as Vice Chancellor (1969–81), Sir Rupert worked closely with the Services and with the Department of Defence especially after the Commonwealth Government

decided to establish a tri-Service Academy in Canberra. When a proposal to set up a separate university failed to secure the backing of the nation's vice chancellors, Sir Rupert responded enthusiastically to the Defence Minister's request for a continuing partnership with UNSW.

"My last official duty before retiring as Vice Chancellor in 1981 was signing the agreement to establish the University College (UNSW Canberra) that would operate within the Australian Defence Force Academy. It was a moment of immense pride and what I still consider as one of my most satisfying contributions.

UNSW Canberra Rector Professor Michael Frater FTSE says the relationship between UNSW and the Australian Defence Force has come a long way in 50 years.

"UNSW is now a Group of Eight university that includes a very substantial campus in Canberra with annual revenue now exceeding \$100 million," he says.

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dream large



Seeing is believing

The world's reefs are in a dramatic state of decline. More than 40% of corals have been lost over the last 30 years due to pollution, destructive fishing practices, ocean warming and ocean acidification resulting from a changing climate. In response, The University of Queensland's Global Change Institute is creating a record of the world's coral reefs. Through their research and the publicity generated, they aim to impact policy on ocean management.

In 2012 the first record was made at the Great Barrier Reef, and now the research has gone global. UQ researchers have worked with international partners including The Ocean Agency (Sydney), XL Catlin Group (London), National Oceanic and Atmospheric Administration (Washington DC), the International Union for Conservation of Nature (Switzerland), the Great Barrier Reef Foundation (Queensland) and Google to enable the mapping of reefs in more than 20 countries.

The huge store of photos that this collaboration has developed will allow changes in the reefs to be clearly monitored over

time. It will help scientists, global decision makers and the public to see and understand the issues facing reefs and work out what needs to be done to best protect them now and into the future.

Researchers at the Global Change Institute regularly collaborate at local, national and international levels to deliver innovative solutions to major global and local challenges. For more information visit gci.uq.edu.au

The Federal Government's 2015 Excellence in Research for Australia exercise confirmed The University of Queensland as one of the nation's top three universities, measured by the quality of its comprehensive range of specialised research fields. UQ's outstanding critical mass offers researchers significant interdisciplinary capability.

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