

# FOCUS



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*Amanthi Thudugalage, The University of Melbourne*

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# CHANGE IT AT MONASH.

The daunting challenges we face as a society demand solutions that take all of us into account. As a research-intensive, top 100 university and home to Australia's top-ranked engineering faculty, Monash is ideally positioned to be at the forefront of change. Our diverse, interdisciplinary teams are tackling today's challenges and anticipating those of tomorrow.

**Right now huge opportunities exist to be agents of change:**

## **Environment and Human Health**

Engineering has the potential to be the biggest driver of social change in the world. From resource depletion to energy generation, from global warming to pandemics and antibiotic resistance, our wide-ranging, interdisciplinary research is playing a critical role in the continued survival of humans and the health of our planet.

## **Robotics and Artificial Intelligence**

As we enter an increasingly roboticised and data-driven future, it will be increasingly important to design systems and technologies that serve all of society. This is why we're focusing so hard on building diverse, gender balanced research teams, and seeking out the best and brightest from every part of the world.

## **New Processes and Materials**

Solving today's pressing problems and meeting tomorrow's challenges will require constant, disruptive innovation in processes and materials. Monash has the world-class infrastructure and the entrepreneurial ecosystem that are necessary for creative teams to stay ahead of the game. Join our winning team in the world's most liveable city.



Melbourne School  
of Engineering

**THE FUTURE  
OF TRANSPORT:  
WHERE CLEANER,  
SAFER AND FASTER  
SYSTEMS WILL  
KEEP OUR CITIES  
MOVING**



Our capabilities and collaborations are preparing Australian industry for the global marketplace.

Join our investment in the future

[industry.eng.unimelb.edu.au/  
join-the-leading-edge](http://industry.eng.unimelb.edu.au/join-the-leading-edge)

CRICOS: 00116K

# Deakin Engineering Strength from diversity



Did you know that industry-focused R&D is a core activity at Deakin University's School of Engineering?

Industry-specific problems provide context, drive, innovation and challenges for our talented staff and students. Utilising our state-of-the-art facilities within the Centre for Advanced Design in Engineering Training (CADET), we are able to tackle the toughest challenges of Australian industry.

We have specialists in many areas of engineering and take a holistic, end-to-end approach to problems. Working with industry, we can address the concerns that are of greatest importance to our community and assist in providing the solutions that will help to advance our society and strengthen our economy.

Email us at: [drinnovations@deakin.edu.au](mailto:drinnovations@deakin.edu.au)

Find out more  
[deakin.edu.au](http://deakin.edu.au)

Deakin University CRICOS Provider Code: 00113B





# Clunies Ross Awards

## CALL FOR NOMINATIONS 2019

The Clunies Ross Awards have a proud 28-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?

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### NOMINATE THEM FOR A 2019 CLUNIES ROSS AWARD

Nominations are now open and must be submitted by 2pm AEDT on Friday 26 October 2018.

In 2019 the Clunies Ross Awards will be awarded in three categories with a single winner in each category.

### CLUNIES ROSS ENTREPRENEUR OF THE YEAR AWARD

**OPEN TO AN INDIVIDUAL WINNER ONLY.** A typical awardee will have played an integral role in the discovery and translation of a major 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 and/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. The individual will have been associated with the development of the technology and have overseen its deployment into commercial use with economic returns to Australia. Such individuals display long-term commitment to achieve the successful end use of the technology they invent or develop.

*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

**OPEN TO AN INDIVIDUAL OR A SMALL TEAM (NORMALLY OF UP TO THREE PEOPLE).** For those who have been responsible for the discovery, development and adoption of a technology and for sharing their knowledge leading to commercialisation, for example by licensing, with a significant financially successful outcome.

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

### CLUNIES ROSS INNOVATION AWARD

**OPEN TO AN INDIVIDUAL OR A SMALL TEAM (NORMALLY OF UP TO THREE PEOPLE).** For those who have been responsible for the discovery, development and adoption of a technology that has significantly improved societal and/or industry capabilities. In this case, the primary outcome is not a direct financial benefit but has measurable broad community or industry impact.

*Typically, this could be a researcher or developer (or team) in a Public Funded Research Organisation, university or a 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.*

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**For further information: visit [atse.org.au/cluniesrossawards](http://atse.org.au/cluniesrossawards)**

**Submit your completed nomination form by 2pm AEDT Friday 26 October 2018**

The Australian Academy of Technology and Engineering (ATSE) administers the awards via an online nomination process. The Awards will be presented at the annual ATSE Innovation Dinner held in Sydney on 13 June 2019.

For more information contact the Clunies Ross Awards coordinator via email [clunies.ross@atse.org.au](mailto:clunies.ross@atse.org.au)

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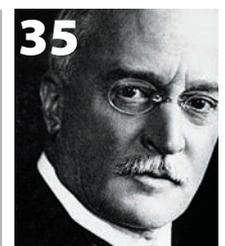
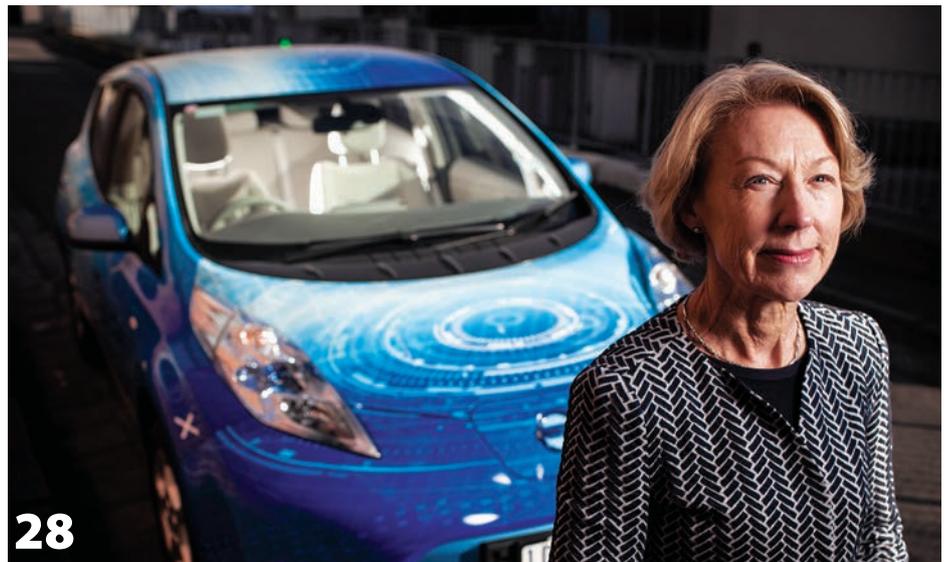


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[atse.org.au/focus](http://atse.org.au/focus)

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PHOTO: EAMON GALLAGHER



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# A transport utopia

In the 20th century, the mass production of the automobile dramatically changed the way we live. It gave us enormous flexibility for personal movement and allowed us to build cities with suburbs. But the automobile also created attendant problems like road accidents, congestion, pollution and significant infrastructure costs.

In the 21st century, however, we can overcome these deficiencies with new technology, providing we have the will to change our ways. So let me present a vision of mobility for the second half of the 21st century.

## MOBILITY-AS-A-SERVICE (MAAS)

How we are transported should be irrelevant to us. We should be able to specify origin, destination and timing and have the system take care of the rest. The mode of transport will be the provider's choice.

For example, if I need to be in central Brisbane at 3pm on Friday afternoon, departing from Melbourne, I should receive a message telling me when I shall be picked up and thereafter everything is taken care of without my having to book taxis, aeroplanes etc.

It is vital to note that MaaS does not replace the public transport and mass transit systems – it incorporates them.

## SHARING IS CARING

The vehicles used for MaaS should be shared wherever possible. We should introduce regulations and tariffs that discourage ownership of private vehicles in densely populated areas. Governments have already done this in cities such as Singapore and Shanghai.

Modelling by the International Transport Forum has shown that this would remove 90 per cent of cars from the road. Given that Australia has a quarter of a trillion dollars tied up in vehicle ownership, this would free up over \$200 billion of capital that we could use for things like healthcare and education.

## WE NEED TO ELIMINATE HUMAN CONTROL

Some 94 per cent of road accidents are from human error, so, in theory – and likely in practice – eliminating human control from vehicles should save about 1000 lives and 45,000 hospitalisation injuries in Australia every year.

## CONGESTION BECOMES A THING OF THE PAST

A connected autonomous transport system should also enable us to make congestion a thing of the past and thereby give predictable journey times, yielding a significant productivity saving.

However, a vastly bigger saving will come from avoiding the need to be building ever larger roads because connected autonomous vehicles (C-AVs) will be much more efficient in how they use roads.

It is all very well to have a vision, but is it feasible?

There is scepticism, but the fact is that companies are currently investing billions of dollars to make this happen. From a technology perspective, the most challenging aspect will be achieving what the Society of Automotive Engineers call "Level 5" autonomy: a vehicle that can operate itself safely without human intervention under all circumstances in all geographies.

This is not about artificial intelligence

(although that comes into it), but a synthesis of four sets of technologies, namely:

- 1 Algorithms – machine learning and others.
- 2 Situational awareness technologies – sensor fusion involving acoustics, machine vision from radars, cameras, lidars and future technologies such as terahertz rays.
- 3 Centimetre-accuracy location and mapping systems.
- 4 V2X (vehicle-to-everything) communication systems, which can operate both in cellular and infrastructureless modes.

Development of these systems is challenging, but the good news is that as we gain more experience, they get better. Human drivers, on the other hand, cannot be "reprogrammed" and we just keep on committing the same errors.

The rewards for the society that achieves this vision first will be dramatic. Not only because of the above benefits, but because it is bound to spur new growth industries that will create employment and wealth.

## INSIDE

*In this bumper issue of Focus, you'll find transport explored in depth by some of Australia's top minds.*

*Doreen Thomas and Iven Mareels delve into the future of electric vehicles and how Australia might already be equipped to handle their growing popularity.*

*In an extended interview, Graham Currie discusses why public transport is the future, and autonomous vehicles are "over-hyped".*

*May Lax writes a retrospective on how 19th century transport shaped the way we travel today.*

*And Peter Sweatman describes what it will take for autonomous vehicles to become a reality on our roads.*



PROFESSOR HUGH BRADLOW FTSE



## New international researcher–business funds awarded

A new way to radically revolutionise counter-drone technology and an overseas expansion of resilient Australian almond varieties are some of the exciting initiatives being funded by the 2018 Priming Grants.

Managed by ATSE, Priming Grants, each of \$7000, are a program of the Global Connections Fund as part of the Australian Government's Global Innovation Strategy.

The purpose of the program is to apply research and technology innovation to real-

world settings. Many use the grant to travel to meet international partners.

The grants support early stage international researcher–SME engagement in key industry priority areas: advanced manufacturing; food and agribusiness; medical technology and pharmaceuticals; mining equipment, technology and services; and oil, gas and energy resources.

In feedback on the program, one participant wrote: "Being on the ground and having several days to learn, discuss, plan and get to know researchers and companies

in your field are invaluable to realising your research dreams."

Announced in June, this year's round saw 38 projects being funded – 23 Australian researchers and 15 Australian SMEs.

"The Priming Grants provide flexible and targeted funding to allow researchers and businesses to pursue early stage commercialisation engagement opportunities globally and have been in strong demand from those working in the five industry priority areas," ATSE CEO Dr Margaret Hartley FTSE said.

## ACTION STATEMENT HIGHER ED MUST BE REVAMPED FOR AN INNOVATION-LED ECONOMY

Australia's innovation agenda needs more postgraduate STEM knowledge and research training, according to a recent Action Statement by ATSE. In our vision for the future of education, Australia's innovation-led economy will have more high-performing professionals with advanced STEM skills and qualifications.

These professionals will have the high levels of creativity needed to tackle complex and multidisciplinary problems, and many will take leadership roles in both private and public sectors. Their knowledge will come from higher education and work-relevant training.

But getting to this point won't be easy.

There are low numbers of Australians completing postgraduate courses in IT and engineering. In 2016, national figures show international graduates outnumbered Australians in both postgraduate coursework and research in IT and engineering.

There are also low translation rates into industry. Australian industries will benefit from graduates in priority areas like artificial intelligence, cybersecurity and biomedical engineering. But the benefit of graduate training and the translation of research into Australian

industry and business is poorly rated in terms of commercialisation.

And a low number of women completing postgraduate STEM studies is also obstructing ATSE's education vision. Women, on average, graduate from STEM bachelor degrees with higher levels of achievement than their male peers. But they remain a distinct minority in most areas of STEM postgraduate study and research.

A transformation of current STEM postgraduate coursework and research degrees is imperative to address these three challenges.

The Academy advocated for the following initiatives:

- improving the value of postgraduate coursework degrees and research degrees for Australian students;
- ensuring that STEM postgraduate coursework and research degrees provide attractive and valuable career pathways; and
- encouraging further participation of women in STEM postgraduate degrees, especially in the physical sciences, mathematics, engineering and IT.

Read the full action statement on the ATSE website, [atse.org.au](http://atse.org.au)

# NEWS

## Diversity matters

Too many people working in STEM-related careers look like me – male, white and, shall we say, of a certain age.

Too many women and members of minority groups are squeezed out of STEM careers by structural barriers and organisational culture.

Those barriers can include all-male executive teams, outdated opinions of women scientists and engineers, not taking into account that many women will pause their careers to have children or for other family reasons, or assuming women are not as serious about their careers.

It is fundamentally unfair. And it is a colossal waste of talent.

The good thing is that more and more people are determined to change the situation.

We at the Academy of Technology and Engineering are among them and I am proud to report that we have adopted a Diversity and Inclusion Policy.

On these pages, some of our Fellows share their thoughts on why diversity is important to them.

Now the challenge is to turn words into deeds. I'm confident we're up to the task.

DR BRUCE GODFREY FTSE  
VICE-PRESIDENT, DIVERSITY

BRONWYN FOX

The only way to create a high-performing team is to ensure diversity. Diversity of thought, diversity of disciplines, diversity of age and experience, as well as gender and nationality. The most productive, creative teams I've been part of have contained all of these many facets and have sparkled like a diamond as a result.



Bronwyn Fox

EWA GOLDYS

DIVERSITY IS THE MERIT-BASED  
ANTIDOTE TO UNJUSTIFIED  
PRIVILEGE.

# NEWS

## RAVENDRA NAIDU

I grew up in a Fijian farming village, where a career in STEM was a far-from-traditional path. I found myself at age 40 leading a research team in Australia. It didn't occur to me that I was contributing to diversity in STEM.

Now I understand that one of my most important responsibilities was as a role model, making the path I travelled a little easier for others like me. For many years now, I have made a concerted effort to build a diverse team, in terms of both gender and cultural background. I have not done this to foster diversity for its own sake, but because I know that the more diverse our people, the stronger our STEM will be.



Alan Joyce

## ALAN JOYCE

As a gay CEO, I know the importance of being able to bring my whole self to work. The more visible LGBT executives can be, the easier it becomes for others to feel safe and proud in being themselves. And the more we can do to encourage diversity in all its forms, the better it is for business.

## MARGARET HARTLEY

Early in my career, I found that one way of dodging sexist barriers was to sign correspondence as Dr ML Hartley – and if the recipient assumed I was a man, as they usually did, then it reflected on them, not me.

It's a sign of progress that I could emerge from behind the initials to be Margaret. But no young woman establishing her career in STEM should ever have to play that kind of game again.



Rose Amal

## ROSE AMAL

Diversity is the result of a melting pot of different backgrounds and ways of thinking come together. If there's only a single school of thought, it's much harder to unlearn practices that are no longer relevant and STEM needs this to pioneer the future. Engineers are at risk if they lack diversity, as they need different perspectives to cover their blind spots and challenge their ideas to come up with fully formed solutions.

## LACHLAN BLACKHALL

Growing up, the only engineer I knew was my mother and it was her passion for engineering that ultimately led me to become an engineer myself. It therefore came as a huge surprise to me when I discovered that, as a woman, my mother was a rarity in the professional engineering community.

It always strikes me that we are missing out on so many great ideas and perspectives that would come from having a truly diverse and representative engineering community.



Lachlan Blackhall

## At a glance

### ATSE'S DIVERSITY AND INCLUSION POLICY

- Our first priority will be to address the imbalance in gender in STEM. ATSE's future diversity priorities include age, Indigenous Australians and ethnicity in STEM.
- Women should constitute 50 per cent of all new Fellows elected to the Academy by 2025.
- ATSE's awards, meetings and events will reflect gender diversity and promote inclusion.
- ATSE will support programs that promote diversity and inclusion across schools, university and industry.
- ATSE will promote the achievement of women in STEM.
- ATSE's recruitment and selection processes will be structured so that a diverse range of candidates is actively considered.
- ATSE will be accountable by publicly and regularly reporting our performance statistics.

To read the policy in full, visit [atse.org.au/diversity](http://atse.org.au/diversity)



## **WE'RE PASSIONATE ABOUT INCREASING THE UPTAKE OF STEM EDUCATION**

As the world's largest provider of commercial explosives and innovative blasting systems, we provide expert services to the mining, quarrying, construction, and oil and gas markets.

The STEM disciplines – Science, Technology, Engineering and Mathematics – are critical to the future of a company like Orica, which is why we are committed to increasing the uptake of STEM in schools. With the aim of getting students interested in careers in science and technology, we're proud to be the principal sponsor of ATSE's STELR project, helping around 700 schools across Australia engage students in STEM through hands-on, inquiry-based and in-curriculum learning.

[orica.com](http://orica.com)



# STELR videos to inspire girls into STEM careers

The wide-reaching impact of STELR – ATSE’s initiative to bring hands-on, inquiry-based STEM education into classrooms – continues to grow, with more than 690 schools around the world now participating.

Among its many projects, STELR has produced 20 videos profiling inspiring women in STEM fields, as part of the government’s Women in STEM and Entrepreneurship (WISE) grants.

These videos will be used to showcase the range of career options girls with an interest in STEM can navigate – while noting that some may not yet exist.

From fire safety engineering and robo-biology to digital agriculture, opportunities in STEM abound, demonstrating how the future of boosting women’s participation in the STEM sector is promising.

One career profile of water design engineer Ella Gross, who shared her video on LinkedIn, received almost 5000 views. And views of the rest of the videos continue to gain traction as they’re shown across conferences, such as the National Science Teachers conference, and at an upcoming launch.

The videos are now available to watch on the STELR website, on Australia’s Science Channel and on the Digital Technologies Hub website.

Visit [stelr.org.au](http://stelr.org.au) to learn more.

*This poster is available to download on the STELR website.*



## MENTEES MEET MINISTERS IN QUEENSLAND

Mentees from the Industry Mentoring Network in STEM (IMNIS) visited Mackay to meet with top influencers in Australia’s resources sector for networking at the Queensland Mining Awards Gala dinner and the Queensland Mining Expo.

The Minister for Resources and Northern Australia, Matthew Canavan, and top industry leaders attended, supporting these rising stars of STEM.

IMNIS is a flagship initiative of ATSE that brings together PhD students and industry leaders in a one-year mentoring partnership. The goal is to prepare Australia’s PhD graduates to lead and excel within the STEM ecosystem.

“Every one of these talented future leaders were confident, professional networkers who readily engaged, communicated their STEM expertise and research, and collected a deck of business cards,” IMNIS Executive Director Dr Marguerite Evans-Galea said.

Following the Queensland Mining Awards Gala, the six mentees – Mutah Musa, Jomana Al-Nu’airat, Zakia Afroz, Manuel Herduin, Sangita Bista and Kasia Sobczak – met with the Minister for Jobs and Innovation, Michaelia Cash, at the Queensland Mining Expo.

In its first year, IMNIS has grown to have more than 400 active participants around Australia; more than 200 industry leaders volunteering and giving back to the next generation; and more than 200 PhD students who will accelerate their professional development.

“IMNIS is about people. People make research and innovation happen. People embrace opportunities and drive transformational culture shifts,” Dr Evans-Galea said.

In-line with ATSE’s Diversity and Inclusion Policy, IMNIS has achieved gender parity at a national level, establishing an inclusive and



*The IMNIS program is gaining traction around Australia.*

diverse cohort of mentors and mentees.

It was recently announced that BHP is now a sponsor of IMNIS, and MTPConnect will continue to fund IMNIS over the next two years. IMNIS will use these funds to help expand its existing programs, service regional and rural Australia, explore virtual mentoring options and establish its Alumni program.

IMNIS launched its national 2018 program in May. Visit [imnis.org.au](http://imnis.org.au) to learn more.

# NEWS

## Submissions from the Academy

ONE OF ATSE'S IMPORTANT FUNCTIONS IS TO HELP DEVELOP EFFECTIVE PUBLIC POLICY IN AREAS WHERE SCIENCE, TECHNOLOGY AND ENGINEERING ARE INVOLVED. THIS IS OFTEN DONE WITH SUBMISSIONS TO GOVERNMENT AND PARLIAMENTARY INQUIRIES AND LEGISLATIVE INITIATIVES, CALLING ON THE EXPERTISE OF OUR FELLOWS.

To read them in full, visit [atse.org.au](http://atse.org.au).



### ATSE LEARNS FROM KOREA'S TRANSPORT INNOVATION

**A**TSE and the National Academy of Engineering of Korea participated in a joint workshop in Korea in June on the future of transport. The experience will help inform the ARC-funded LASP project on industry technology readiness in the transport sector. It brought together high-level Australian and Korean experts; the Australian delegation visiting sites highlighting Korean excellence in public transport policy and planning. Among the visits was K-City – a pilot city for autonomous vehicles that showcases

## HERE ARE SOME OF OUR RECENT SUBMISSIONS.

### Research and Development Tax Incentive

#### *Treasury's Draft R&D Tax Incentive Amendments*

To drive greater collaboration and wider benefits for Australia, the R&D Tax Incentive should offer a premium rate for research and development undertaken with Australian publicly funded research organisations.

Our other key points include our support of the proposed clinical trials exemption and that outcomes should be monitored to ensure that the amendments do not negatively affect business investment in research and development, with resourcing of the Australian Bureau of Statistics to monitor these outcomes improved.

### Inquiry into funding Australia's research

#### *House of Representatives Standing Committee on Employment, Education and Training*

Australian research is an important part of Australia's economic, social and environmental wealth. The Academy encourages efforts to increase the efficiency and effectiveness of Australia's research funding systems.

Australia's gross funding for research and development as a percentage of GDP is below the OECD average. While we support effort to reduce fragmentation and duplication in Australia's funding systems, Australia needs a diversity of funding mechanisms to reflect the diversity of research fields.

### Food derived using new breeding techniques

#### *The Food Standards Australia New Zealand (FSANZ) Consultation*

In a joint submission with the Australian Academy of Science, this submission addresses the new technologies and techniques arising from better understanding of breeding and genetics.

The purpose of the consultation is to assist FSANZ consider food products of new breeding techniques and whether these techniques are sufficiently captured by the Code, and if not, if they should be.

The specific techniques being considered include: genome editing, GM rootstock grafting, cisgenesis and transgenesis, and techniques involving null segregants.

### The management and use of Commonwealth environmental water

#### *House of Representatives Standing Committee on the Environment and Energy Inquiry*

High-quality research and development and improved monitoring and evaluation are essential to improve environmental water programs and optimise the protection and restoration of Australia's environmental assets.

The Commonwealth Environmental Water Holder's role in managing environmental water is not only incredibly important, but also technically challenging – the science of environmental water management is relatively immature.

Australia needs stable and adequate investment in strategic research supporting improved environmental water management, solve its many unique challenges and develop and maintain expertise.

South Korea's position as a global leader in autonomous transport. The ATSE team rode in an autonomous vehicle that travelled up to 215 kilometres per hour. K-City is a 320,000-square-metre test site designed to simulate highways, downtown areas, city outskirts and communal environments. There, autonomous vehicles must navigate potholes, narrow streets, tunnels and pedestrian crossings, among other obstacles. The Transport Operation and Information Service (TOPIS) in Seoul, the general transport control centre responsible for operating and managing the city's overall traffic, left a great impression on the Australian delegation.

## A 10-YEAR-PLAN FOR MORE WOMEN IN STEM

**A**TSE and the Australian Academy of Science are developing a Decadal Plan to increase the participation of women in STEM education and careers, with support from the Australian Government.

Work on the project has begun, with extensive mapping of more than 300 STEM programs for women already in place in Australia, and the assembly of an Expert Working Group (EWG).

The EWG will begin consultation with stakeholders in September, including an open call for submissions and face-to-face meetings in capital cities.

The Decadal Plan will provide a roadmap for sustained increases in women's STEM participation from school through to academic and industry STEM careers. Its preliminary recommendations will inform a Women in STEM National Strategy being developed by the Australian Government.

# INNOVATION DINNER 2018



*Is it real gold? Clunies Ross Entrepreneur of the Year and ATSE Fellow Dr Erol Harvey sinks his teeth into micro- and nanotechnology as the founder of MiniFAB. He is with Clunies Ross Commercialisation Award winner Professor David Huang, who led the development of a life-saving leukaemia drug, and Clunies Ross Innovation Award winner Dr Jim Aylward, who invented a skin cancer drug used by more than one million patients worldwide.*



*Associate Professor Madhu Bhaskaran is the first female winner of the Batterham Medal, awarded for her ground-breaking research into flexible, unbreakable and transparent electronic devices. Read more on page 48.*



The winners and presenters at the Innovation Dinner. (Standing, from left) Dr Jim Aylward, Dr Erol Harvey, Associate Professor Madhu Bhaskaran, Professor Elizabeth Taylor, Professor Michelle Simmons, Professor Robin Batterham, Professor Lindsay Falvey, Chris Crewther, Adjunct Professor Elizabeth Croft, Dr Margaret Hartley, Professor Hugh Bradlow. (Seated, from left) Professor David Huang, Dr Amanda Caples, Dr Angela Van de Wouw and Dr Shu Kee Lam.



The ICM Agrifood Award winners hold their certificates. Dr Angela Van de Wouw is saving the canola industry from the most severe canola disease in Australia, blackleg, by discovering new ways to control it. And Dr Shu Kee Lam is leading research on how higher levels of atmospheric carbon dioxide impact Australia's agriculture and food security from the perspective of soil nitrogen management.



ATSE Fellow and Australian of the Year Professor Michelle Simmons left the audience enthralled with her keynote about quantum computing and what its future might mean for Australia.

Swinburne's Virtual Dynamic  
Transport Modelling Platform

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Virtual Dynamic  
Transport  
Modelling  
Platform

# Smarter Cities.

## Addressing the modern-day demands of urban living and mobility.

Our Smart Cities Research Institute is embracing the fourth industrial revolution by focusing on the grand challenges facing fast-growing cities in Australia and internationally.

The Future Urban Mobility program researches the disruptive technologies that will enable step-changes in urban transport. Using our innovative transport modelling platform and data feeds from urban sensors, we can test prototypes in simulation environments, leading to rapid deployment of appropriate smart transport technology.

We have a vision for making cities more accessible to their populations through discovering innovative connections between social, physical, economic and informational infrastructures.

To find out more about research at Swinburne or how you can be part of the solution, visit:  
[www.swinburne.edu.au/research-institutes/smart-cities/](http://www.swinburne.edu.au/research-institutes/smart-cities/)



## Primary school kids learn from ATSE Fellows

Nine-year-olds from a Queensland school will be privy to some of the latest technologies and ideas from three ATSE Fellows: Professor Mary-Anne Williams, Professor Thorsten Trupke and Professor Lyn Beazley.

Manly State School Year 4 teacher Scott Anderson arranges STEM experts to take part in a Skype session with his class to show the students how classroom curriculum connects with bigger picture applications.

"These experts can directly explain their journey from the classroom to their positions of excellence in a way that is inspiring and achievable if a student has the aptitude, resilience and persistence," Mr Anderson said.

Professor Trupke has already discussed renewable energy. Professor Williams will share her expertise in robotics and artificial intelligence, and Professor Beazley will discuss neuroscience.

These topics might sound a little complex for primary-aged children, but Mr Anderson said experts were always amazed at how capable the students were at understanding and responding to complex ideas if they were framed in an age-appropriate way.

"The students almost always go home and research ideas that

were discussed during the Skype and talk regularly about how 'awesome' it was," he said.

"Parents pull me aside and thank me for the effort and say that the Skype session has opened their children up to a new world of ideas and ways of thinking."

So what might a typical session look like? Before it begins, the students build some knowledge on the topic and learn some terminology. The experts talk about what they do, how they became interested in the field, what they were like at school and share some interesting anecdotes. "From there the students go to a seat at the front of the class for a one-on-one interaction. They introduce themselves and ask a previously crafted question," Mr Anderson said.

Mr Anderson contacted ATSE to help find experts who might be interested in taking part. "I have called and sent literally hundreds of emails to universities and organisations knowing that if even a few respond it is worth the effort for the kids."

**If you're a Fellow and would like to take part, email [anthea.batsakis@atse.org.au](mailto:anthea.batsakis@atse.org.au).**

## NEW POLYMER SCHOLARSHIP REWARDING PhD EXCELLENCE

ATSE will administer a new "top-up" scholarship for outstanding PhD students with impactful research relating to polymer science or engineering.

The Ezio Rizzardo Polymer Scholarship is named after the internationally renowned polymer chemist and ATSE Fellow, Dr Ezio Rizzardo AC FRS FAA FTSE. He was the inaugural director of the CRC for Polymers when it was

launched in 1992, and was continually involved throughout its 25 years of operation.

The scholarship is being funded from the funds remaining after the wind-up of the CRC for Polymers earlier this year.

The scholarship is planned for launch later in 2018 and will be open to PhD students researching polymer science at any of the 14 universities that were members of the CRC.

Along with Dr Rizzardo, the scholarship selection committee includes a number of ATSE Fellows prominent in the polymer community, including Dr Peter Coldrey (chair), Dr Ian Dagley, Dr Leonie Walsh and Dr Anita Hill.

The scholarship is planned to provide top-up and travel funds to outstanding polymer research students. Further details will be forthcoming in the coming months.

## NEWS

# Why the future of health tech relies on data

The Internet of Things, big data and machine learning are set to revolutionise the healthcare industry.

Professor Hugh Bradlow FTSE, ATSE President and former Chief Scientist of Telstra, discussed the importance of data in future healthcare in his keynote speech at an event held by the Committee for Economic Development of Australia (CEDA).

As more devices become connected to the internet, huge amounts of data about the real world will be created. Imagine the

*Applying machine learning to health measurements on the Apple Watch can be used for diagnostics.*



wealth of information that can be generated from smart cars, smart infrastructure and, importantly, smart bodies.

Machine learning can navigate big data, deriving patterns from data with no obvious mathematical causal relationship.

One example, Professor Bradlow explained, was the impact of machine learning on speech recognition.

Speech recognition software has been around for years but has been unusable. Developments over the past five years, however, have meant that machines can now recognise speech roughly as accurately as a human being.

This has led to an explosion of devices, such as Amazon Echo and Google Home, which allow a person to talk to their house.

So how will big data, machine learning and the Internet of Things (IoT) redefine healthcare?

Smartphones, for instance, can double as medical devices, reducing the costs of medical instruments such as microscopes, ultrasound and otoscopes.

Professor Bradlow explained how a team at Massachusetts General Hospital created a smartphone accessory for fast cancer diagnosis. The device attaches to a smartphone and uses the phone's camera as a microscope to examine the sample cells, and has an imaging module with a battery-powered LED light to focus.

In pilot tests at the hospital, the device performed as accurately as pathologists, with results available almost immediately.

The way health is monitored will also be transformed as wearable technology advances. For some years wearables, such as the Apple Watch or Fitbits, have provided basic heart rate measurements, focusing on health and fitness rather than medical information.

The US start-up Cardiogram has shown that by applying machine learning algorithms to the heart rate measurements of the Apple Watch, they can infer a diagnosis for a number of conditions, including atrial fibrillation (with 97 per cent accuracy), sleep apnoea (90 per cent accuracy) and hypertension (92 per cent accuracy).

But while the implications are exciting, these results should be treated with caution, Professor Bradlow said. It's not clear, for example, whether the results can be used for early diabetes detection or just to confirm what the wearer already knows.

This connectivity, both internally and externally, may one day be like having a personal physician 24/7, as most of the remote monitoring examples involve a Bluetooth connection.

## 'MESOSCIENCE' SPEARHEADED BY ATSE FELLOWS

An emerging research area, "mesoscience", was recently discussed at a meeting in Beijing by 32 international scientists, including former ATSE President Professor Robin Batterham AO FREng FAA FTSE and Foreign Fellow Professor Jinghai Li FREng FTSE.

Coined by scientists from China, the term mesoscience refers to the science concerning all mesoscales – the unit between elemental particles and the observable universe.

The assembly of scientists met to

discuss the status and pathways forward for mesoscience and, supported by the Chinese Academy of Science, an ongoing panel was set up.

Models and simulation methods based on mesoscience have shown to be promising for the design and optimisation of industrial processes and engineering.

And successful models have been established in systems such as gas–solid fluidisation, gas–liquid bubbling flows and turbulent flows.

Professors Li and Batterham said they were convinced of a wider applicability of the principle.

The field, they said, deserved much more awareness and attention from the scientific and technological community for future development.

It is only by having more studies on the application of mesoscience that we might discover if there are common underlying themes amenable to the mesoscience approach.



Dr Rebecca Yee finds ways to turn waste oil into fuel.



Dr Mark Blaskovich is fighting to stay one step ahead of the bacteria resistant to antibiotics.

## Targeted grants breach walls of academia

A grant administered by ATSE connects researchers and SMEs to solve global problems.

The risk of bacteria becoming resistant to antibiotics is fast emerging as a global crisis. Dr Mark Blaskovich, a medicinal chemist from the University of Queensland, is finding ways to suppress the potential pandemic.

In 2016 he was among 73 innovators to receive a Global Connections Fund Priming Grant – a \$7000 grant that creates international partnerships of researchers and small to medium enterprises (SMEs).

Dr Blaskovich used the grant to connect with Visterra Inc in Boston, USA.

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,” Dr Blaskovich said. “Now, with a guided missile, you can selectively just hit that factory and avoid killing all the innocent people surrounding it.”

This is one example of how a targeted grant can boost the real-world outcomes of research that might not otherwise leave the walls of academia.

Priming Grants enable Australian SMEs and Australian researchers to physically meet with their international partners. Designed to “prime” the commercialisation or application of a particular idea, the grants sparked ongoing collaborations in almost all cases.

The co-founder of Biofuel Innovations, Dr Rebecca Yee, was also a recipient.

Her organisation buys oil derived from low-grade trap grease – oil and grime that gets separated from wastewater in industrial kitchens – and transforms it into a replacement for diesel, redirecting masses of waste.

A byproduct of biodiesel is glycerol, a non-toxic chemical found in many household products.

The Priming Grant meant she could collaborate with a researcher from Zurich, Switzerland, to process this byproduct into other valuable chemicals.

“There are a couple of different avenues glycerine can be made into, because it’s quite a basic molecule, so it’s easy to convert into other useful things,” Dr Yee said.

“We’re in a position now where we’re communicating the details of the legalities of a joint venture, looking at the market and working out a business case of the development.”

Visit [globalconnectionsfund.org.au](http://globalconnectionsfund.org.au) for more information.



*The Priming Grant meant Rebecca Yee could collaborate with a researcher from Zurich, Switzerland, to process a byproduct of biodiesel production into other valuable chemicals.*





# Graham Currie: Autonomous vehicles are 'over-hyped', public transport is the future

**ARE WE ON TRACK?** One of the world's top minds in transport research weighs in on transport evolution in Australia.

**T**wenty-eight years ago Douglas Quaid, played by Arnold Schwarzenegger, jumped into a "Johnny Cab" and demanded it drive away from gun-wielding assailants. The humanoid robot driver cheerily replies: "Will you please repeat the destination?"

*Total Recall's* vision of autonomous vehicles in 2084 may be touched by Hollywood glow, but the film does have an enduring truth: autonomous vehicles won't be user-friendly or ready for our roads in the near future.

Professor Graham Currie FTSE, a renowned international public transport researcher and policy adviser, says driverless cars are "over-hyped" and not necessarily the future of transport many believe them to be.

Instead, he says public transport is the only real shared mobility and, with enough investment, will help Australia's cities cope with a swelling population.

In this interview, Professor Currie explores the reality of autonomous vehicles, the future of public transport in Australia and what infrastructure might look like with changing transport options.

Professor Currie is the founder and Director of the Public Transport Research

PHOTO: FAMON GALLAGHER

## “The average Uber occupancy in traffic is 1.6, including the driver; so 40 per cent of the time they have no passengers and are adding to traffic congestion for no good reason.”

Group at Monash University, which, in 2015, was identified as among the top three research groups in this field in the world.

**In your article ‘Lies, damned lies: AVs, shared mobility and urban transit futures’ you call discussions around the future of public transport “a gigantic lot of nonsense”. What do you wish more people knew?**

I wish people understood that public transport is the only real shared occupancy mode. Cars rarely carry more than one person, but just one train carries more than 1000. Our cities are turning into supercities and there is only one way to carry high volumes of passengers efficiently, and that’s with public transport.

All technologies need a proving period before value can be realised. Yet there is also a trend towards promoting ideas which are not proven. A major part of that is not thinking about how humans will use or react to new technology.

Driverless cars are not in practical use for daily travel in cities anywhere on Earth yet. But it’s claimed they will take over travel in cities. Some also state public transport will lose out as a result since it’s not using advanced technology.

The truth is public transport dominates driverless vehicle technology today: more than 25 per cent of all urban rail in Asia has no drivers. This rate is increasing and Sydney will soon have Australia’s first driverless trains. Hundreds of millions of people now use driverless trains every day – so how can public transport be behind when it’s the only practical application of the technology today?

My concern with “shared mobility”, like Uber, bike share or car share, is the use of the word “shared”. It implies efficiency in urban travel since people can travel together in congested cities.

But these shared mobility modes don’t involve shared occupancy at all – the average Uber occupancy in traffic is 1.6, including the driver; so 40 per cent of the time they have no passengers and are adding to traffic

congestion for no good reason.

Australian cities really need more sharing of vehicles, but our trend has been very low with more and more traffic carrying less and less people.

**How might people travel to work in 50 years?**

Unless we invest in much better public transport it’s likely Australian cities are going to remain private-vehicle-dependent in the middle and outer suburbs, but central areas will be increasingly dominated by mass transit, walking and cycling. One truth is that transport infrastructure doesn’t change overnight. Even on a 50-year horizon, we will be relying mostly on infrastructure that exists today.

The future will almost certainly involve using new forms of energy and fuel. Electrification of private vehicles is close even today, but fuel-cell technologies may be a viable alternative. It’s very unlikely we will be using oil-based fuels in 50 years.

**Could you please explain your concept of “auto-no-emotion” and why you developed this term?**

I wanted to push back on the over-hyped and unproven ideas around driverless cars by inventing a new word to describe how they have been over-marketed. That’s what the new word “auto-no-emotion” describes.

I put the phrase “no-emotion” in there to emphasise the inhuman aspects of the technology at present because the human aspects and interfaces have yet to be developed, solved or even considered.

Yet without human acceptance, this technology cannot succeed.

The best and most successful technology applications have seamless intuitive human interfaces and, until driverless cars develop this, they will not be a worthwhile or even feasible mobility option.

**How will infrastructure change if autonomous vehicles dominate the roads? For instance, the potential elimination of car parks and petrol stations.**

In theory, a driverless-car city won’t need parking since vehicles can drop you off and drive to the next user themselves. The problem with that is commuter car occupancy today is just above one person per car in Australia. Yet it could go below one as driverless cars reposition without anyone in them.

I’m not sure we need fewer people in congested streets and empty cars clogging them up, but we might get a bit more road space by removing kerbside parking. Off-street parking makes up a bulk of city real estate, but removing and repurposing this real estate provides an opportunity for improved urban economic productivity.

Autonomous vehicles are likely to be electric or fuel-cell-powered, so conventional petrol stations won’t be needed. Repurposing petrol station land to other uses again presents an opportunity to use that land in more productive ways.

In practice I suggest that safety is the biggest single infrastructure barrier.

Streets are just too complex an environment for safe autonomous movements of vehicles that can kill people. I suspect a more feasible outcome is selective adoption in defined controlled areas under managed conditions.

Dedicated and segregated freeway lanes for long distance trucks might be an example of sections of an urban area where only autonomous vehicles are permitted, and where pedestrian movements are carefully managed.

My benchmark for this is driverless train stations in operation today. They all have platform doors carefully managing the human-machine interface to ensure no unexpected human movement onto tracks – why would we not also do this for autonomous cars?

**What are the main challenges autonomous vehicles must still overcome?**

Human interface issues – including human acceptance – remain major concerns. They also have to prove they can help make cities better. I think they have a likely potential to

increase urban traffic congestion and I can't see why we would permit that when traffic has been eroding city liveability.

**Is Australia leading or lagging behind the developed world when it comes to public transport? What should Australia do to improve?**

The size and quality of public transport in Australia is not as good as in European cities, but those cities have much higher urban density of activity and much lower car ownership. It's comparing apples and oranges.

Some aspects of Australian public transport are renowned as best practice internationally: Brisbane's busway network is often cited as world-leading and Melbourne's legacy tram network is the largest in the world. Many world cities are investing big in new light railways, but they can only dream of having the scale of network Melbourne has.

That's not to say improvement isn't possible or even essential. My big ask is to increase service investment. We need to expand the footprint of mass transit beyond inner city and rail corridors into the suburbs

to give people better choice of options for travel.

Central areas need more metros and bus frequencies must be upgraded. We have much investment in public transport at present, but our research shows the quantity of service provided is not even keeping pace with population growth.

In effect, per capita service levels are in decline so we aren't even keeping pace with growth.

**You've been involved in transport planning for all the summer Olympic Games since 1996 and the Hajj pilgrimage in Mecca. Do you have a particular stand-out story from these experiences?**

These are real-world examples of the future of Australia's booming cities. Olympic host cities and Mecca face the largest single mass volume of travel demand in their history – far in excess of their limited and congested capacity to handle these demands.

The only possible way these cities can handle this is using mass public transport movement. So these cities change the day-

to-day conventional transport rules because they have no choice.

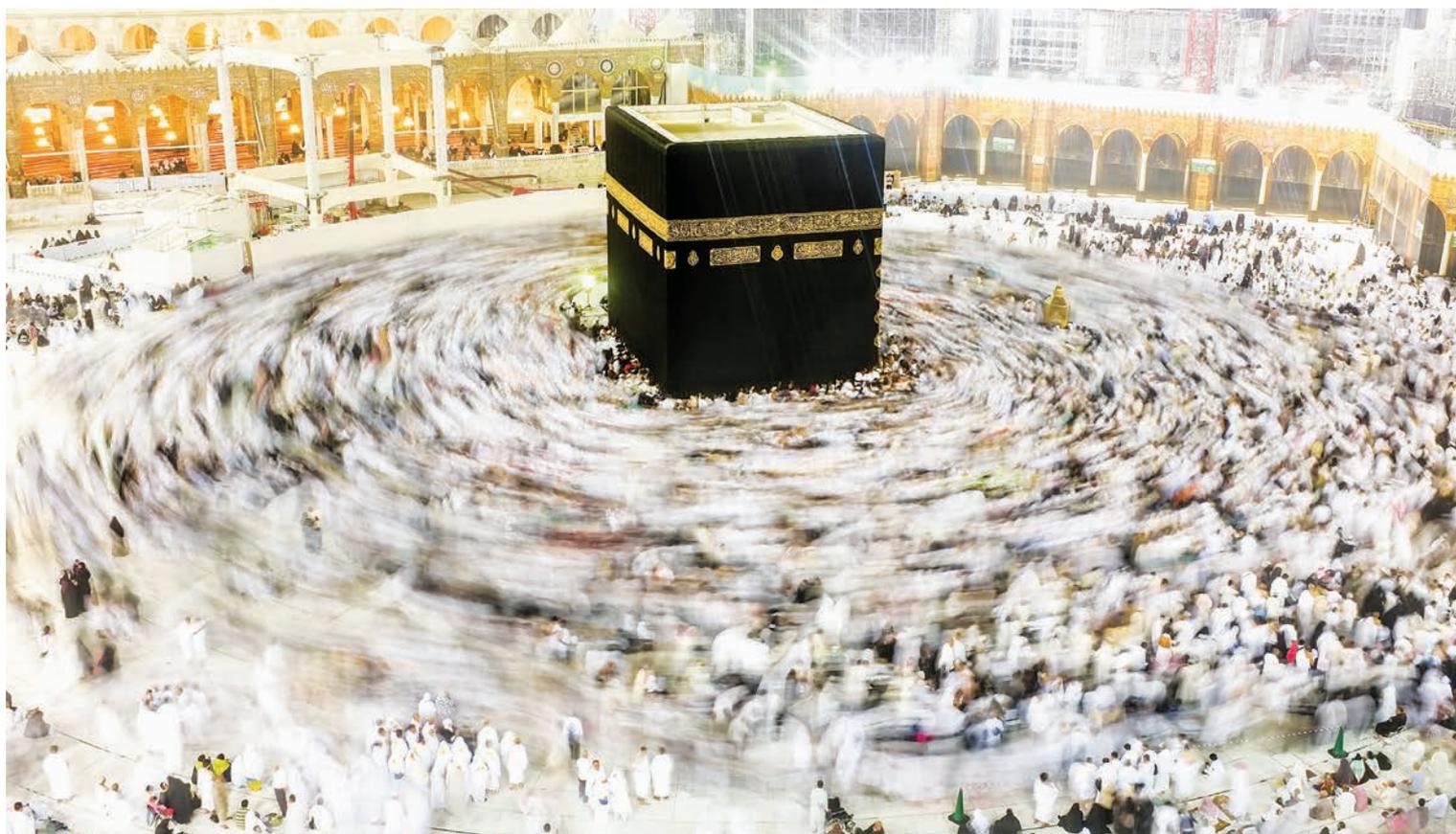
Cars are banned, vast sums are invested in quality rail solutions and mass public transport movement is the only accepted option.

My stand-out story is that it works. It's not a theory, it actually works. If you want to see how Australia's future mega cities will work in 2050, go and look at central Tokyo during the 2020 summer Olympics.

We won't be using empty and single occupancy private cars to create gridlock; mass rail transit is the only feasible option. [📍](#)

*Professor Graham Currie FTSE is a public transport research leader, policy adviser and the Director of the Public Transport Research Group. He has published more research papers in leading peer journals in this field than any other researcher, and is Chair of the Light Rail Transit Committee of the US Transportation Research Board. He has won numerous research prizes including best research paper at the 14th World Conference on Transport Research, the William W Millar prize for best research paper at the TRB conference (on two occasions – the only person to do so) and the Research Impact award from the Australian Road Research Board in 2017.*

Mecca.





BY MAX LAY



Elizabeth Street, Melbourne, in 1900.

PHOTO: STATE LIBRARY OF VICTORIA

# HOW 19TH CENTURY INNOVATORS TRANSFORMED TRAVEL TECH

**ARE WE ON TRACK?** Personal travel changed in leaps and bounds.

The transport revolution of the 20th century was incremental when compared to the wide-ranging transport technologies that emerged in the 19th century. The invention of bicycles, trams, trains, ocean-going steamers and cars dramatically changed our capabilities as humans.

Dr Maxwell Gordon Lay FTSE, author of *The Harnessing of Power: How 19th Century Transport Innovators Transformed the Way the World Operates*, explains that the ability to routinely travel long distances quickly was not an important human need and received little evolutionary priority. In other words, humans evolved in a “low-speed world”.

This is an edited extract from the book, exploring the history of personal travel technologies.

For most people, walking was the only available means of travelling within towns and between towns. It was still a very common means of long-distance travel in the 18th century. For instance in England many soldiers would be encountered being redeployed around the country or travelling to and from training camps and embarkation ports.

A revealing mid-18th century travel example occurred when the famous blind

## “The Roman philosopher Seneca said that his carriage travelled so smoothly that he could write whilst on a journey.”

English road-builder John Metcalf was in London with his local member of Parliament, Colonel Liddle. Liddle offered Metcalf a ride home to Knaresborough in his carriage, a journey of some 300 kilometres. Metcalf declined and said he preferred to walk home.

Blind, on foot, and unfamiliar with the route, he completed the journey in six days. The Colonel and his carriage took eight days.

Personal travel by riding on the backs of animals or in animal-drawn vehicles was a matter of perceived convenience and not of time saving. Until the 18th century, there was little difference between vehicular personal travel and freight haulage as both used wagon-style vehicles which travelled at walking speed.

### THANK THE CELTS FOR TRANSPORT TODAY

Much of the technology appears to have been of Celtic origin. The Celts began building light and sophisticated wheels in about 700 BC. Key features were spoked wheels with applied wear-resistant running surfaces and iron was widely used in Celtic vehicles and harnesses.

A prime example of an early Celtic vehicle with many advanced features is the Dejbjerg wagon from about 50 BC and found well-preserved in the 1870s in a Danish swamp.

Wagons for transporting people came into prominence in the 13th century, although many of the innovations were reinventions of much earlier Celtic technology.

A key need was to provide passengers with a smooth ride. However, a wagon with four rigidly attached wheels will always provide a rough ride on road surfaces which are not perfectly flat planes. This is because, as a matter of geometry, the rigid wagon can only make contact at three points. The fourth point is poised above the road surface, ready to descend with a rattling bump.

The Celts found a way around this problem. They had developed good

leatherworking skills for harness making, and were able to make leather straps to suspend the vehicle cabin. This reduced the previous abruptness of the bumps and the Roman philosopher Seneca said that his carriage travelled so smoothly that he could write whilst on a journey.

The term “suspension” is still used to describe ride-softening devices in modern vehicles, although they no longer work as suspension devices.

Vehicle technology only slowly improved over the next millennium. The main developments were better harnesses and lighter and stronger wheels.

### HOW IRON QUICKENED OUR PACE

Increases in travel speed above walking began to occur early in the 17th century, mainly as a consequence of greater demands by the wealthy for personal travel and, at the supply end, to a wider use of iron in vehicle construction. This use of iron introduces a main thesis of this book.

Iron had many useful transport applications. However, iron making was still a craft rather than a manufacturing process, so its spreading use in vehicles indicated strong market demands. The use of iron for bits and stirrups greatly enhanced the usefulness of horse riding.

For vehicles, iron rivets simplified the attachment of the hauling part of the harness to the vehicle being hauled. Iron studs and plates were used to prevent the rapid wear of wooden rims, and iron pins were used to retain the wheel on the axle.

The wearing surface between the wheel and the axle was a major operating problem. The bearing surfaces themselves were heavily lubricated with animal fats and occasionally employed some cylindrical metal pieces, although these were more likely to have been the softer bronze rather than iron.

Iron coil springs were invented in England in 1625 and were soon used to support coach bodies at each of their four

corners. A major advance demonstrating the increasing availability of useful pieces of iron occurred in the 1660s in Prussian Berlin where Philip di Chiesa, a person of Italian extraction born near Avignon, greatly improved the rideability of coaches by hanging the leather suspension straps from cantilevers made of flat iron.

Such leaf springs are still used in many current vehicles. Di Chiesa’s vehicles were called Berliners. They were relatively large with an enclosed passenger area. The leather straps were subsequently replaced by iron links.

Germany was then the centre of quality coach-building. Increased competition from the German Berliners led to further developments in Britain, including the work of the multi-talented Robert Hooke and his definition and scientific measurement of the elasticity of iron in the 1670s.

Elliptical leaf springs were developed by Obadiah Elliot in London in 1804 and later I describe how they produced a quantum jump in coach performance.

Elliot was a well-known coach-maker who patented his invention in 1805. The introduction of iron rim brakes in 1690 allowed larger teams of horses to be used to power the coaches. However, braking as we now know it was never a serious issue at the speeds of a horse-drawn coach and the brakes’ major role was to slow vehicles descending steep hills. ☺

### Visit [www.cambridgescholars.com/the-harnessing-of-power](http://www.cambridgescholars.com/the-harnessing-of-power)

*Dr Maxwell Gordon Lay AM FTSE is a widely recognised expert in both road technology and road history. His Handbook of Road Technology is now in its fourth international edition, and his world history of roads, Ways of the World, has been a major work in this field for two decades. In 2005, Dr Lay was appointed a Member of the Order of Australia and in 2000, the Australian Road Research Board named its library the ‘M.G. Lay Library’ to honour “his passion for the dissemination of high quality professional information”. In 2014, Dr Lay was awarded the Peter Nicol Russell Medal, the highest award offered by the Australian engineering profession.*



BY DOREEN THOMAS AND IVEN MAREELS

**A**ustralia needs to clean up its roads. Transport is the third largest polluter, responsible for nearly a quarter of all greenhouse gas emissions – and almost half of this is due to cars.

If Australia achieves green electricity, electric cars are certain to improve Australia's renewable energy credentials. But unlike rooftop solar photovoltaic (PV) panels, the adoption of electric vehicles is very slow in Australia. Is there a need for government to intervene in the market with policy?

#### WHAT GROWTH CAN WE EXPECT?

Australia ranks the worst for transport energy efficiency in the developed world, edging out Saudi Arabia, according to a scorecard by the American Council for an Energy Efficient Economy.

Worsening over the years 2016 and 2017, emissions from road transport grew at twice the rate of GDP, whereas the European Environment Agency found most developed countries' road-related emissions remained stable.

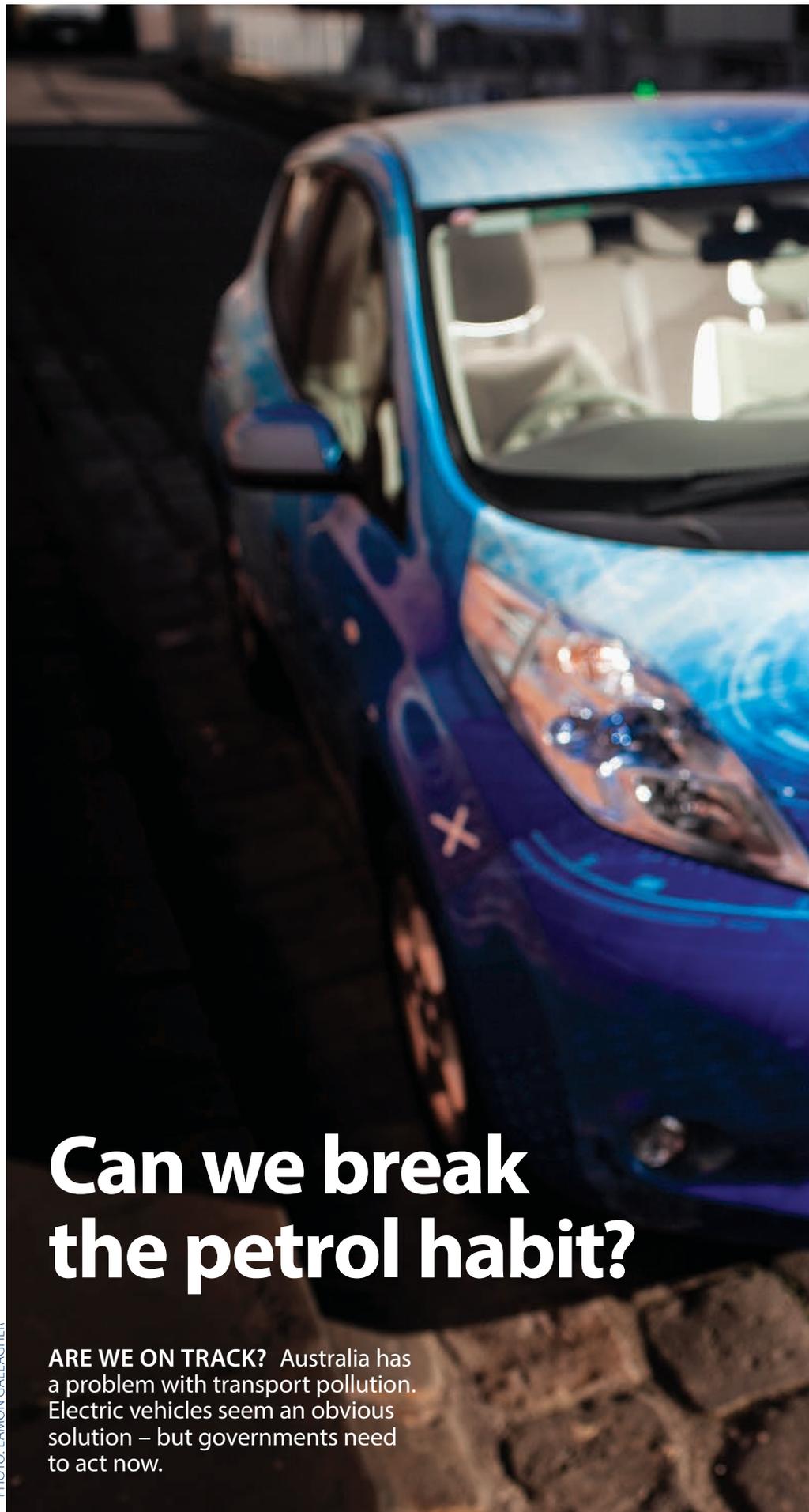
The backdrop of this poor performance is Australia's astonishing lack of mandatory vehicle efficiency standards, adopted by 80 per cent of the world. This lack of regulation allows foreign manufacturers to offload their least efficient cars in Australia, as a 2018 Australian Electric Vehicle Market Study showed.

Australians generally travel longer distances by car and are comparatively poor users of public transport because of the relatively low government spend on it.

Predictions differ somewhat in the likely growth of electric vehicles (EVs) in Australia, at least in the short to medium term. Presently, EVs account for about 0.2 per cent of all new car sales in Australia.

The Department of Environment and Energy's current prediction is that EVs will make up one-fifth of new vehicle sales by 2030. Similarly, CSIRO predicts one-fifth by 2035, and the Australian Energy Market Operator's Integrated System Plan works with a more moderate uptake of around 10 per cent, in their neutral scenario, in the same timeframe.

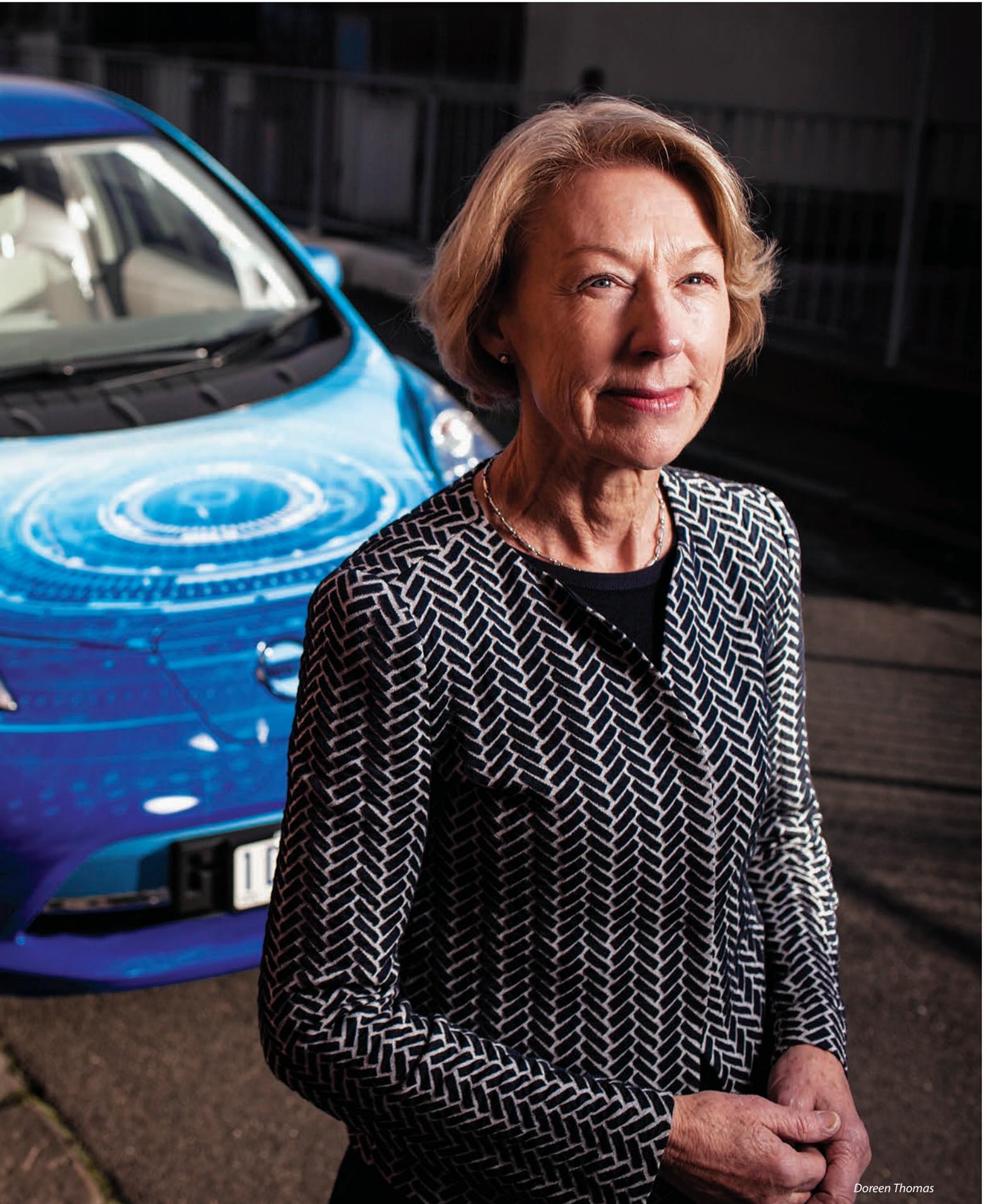
However, in a recent report, luxury carmaker Jaguar predicts that almost two-thirds of Australians could own an EV within 10



# Can we break the petrol habit?

**ARE WE ON TRACK?** Australia has a problem with transport pollution. Electric vehicles seem an obvious solution – but governments need to act now.

PHOTO: EAMON GALLAGHER



*Doreen Thomas*

years, a figure that is significantly more bullish about the uptake of EVs than other analyses.

Globally, there are a growing number of car manufacturers developing EVs, so clearly there is already a market for EVs and one that will only grow.

Battery pricing, improved battery technology and putting EVs at the forefront of new designs are making a difference. In the UK, for instance, it's believed electric cars will participate in balancing the day/night load – increasing the utility of the grid.

The apparently inevitable rise of the electric car has prompted Infrastructure Australia Chief Executive Philip Davies to warn of falling revenues from the petrol excise. He highlights a need for planning policy for an expected rapid uptake of EVs.

But the reality is that unless federal policy changes, Australians are extremely unlikely to opt wholly for EVs. Far from worrying about alternatives to petrol excise, international examples suggest subsidies and incentives are required to shift us towards low-emission cars.

China and Norway lead in this space. Impressively, in Norway, 40 per cent of new car sales are electric, making an important contribution to lowering carbon emissions.

What policy initiatives incentivised Norwegians? Among others, an exemption from both stamp duty and VAT (high, at 25 per cent) compared to a high stamp duty on internal combustion vehicles; exemption from road tolls; free car ferry travel; free recharge sites; free parking; and access to bus lanes.

On the other hand, Australians have very few incentives to buy electric, and presently, the major barrier is therefore simply the extra cost for an electric vehicle above the equivalent internal combustion one, as made abundantly clear in a recent RACV report.

Provided the right incentives are in place, a recent analysis from Bloomberg New Energy Finance suggests that EVs could account for half of all new cars sold by 2040 – EVs are cheaper to run because of the declining cost of batteries.

The implications are far-reaching – adding nearly 11 per cent to electricity

demand by 2040, but potentially offering more flexibility into a renewables-dominated grid. It may well be the win-win situation needed to evolve towards 100 per cent renewable electricity generation.

### DEMAND IS KING

In Australia an EV will add between 10 and 15 kilowatt hours (kWh) to the daily energy demand of a household, nearly doubling average consumption.

Alongside this added electrical energy demand, EV ownership is likely to come with the ownership of rooftop PV and battery storage. This shift to consumer-driven energy, with very different grid dependency, is a welcome evolution.

By and large, the electrical power grid was conceived at the end of the 19th century to connect a few large generators to consumers via a transmission and distribution network. It essentially consisted of wires, transformers, capacitors and switches, as well as safety equipment.

This was the conventional picture expounded in every 20th century electrical power engineering textbook – the “demand-is-king” paradigm.

Embedded generation or distributed generation – including wind power and solar PV – is marring this classical picture from the supply side.

Unlike thermal power plants, renewable energy sources pose problems given their inherent and uncontrollable availability of power. Currently, these generators don't contribute much compared to the conventional grid and often they are simply considered as part of the demand side, that is, negative demand.

Effectively, this means these generators are not relied upon to maintain grid integrity. And this attitude fundamentally limits the amount of renewable energy that can be incorporated in the grid. It is not a tenable situation.

The bulk of electrical power is associated with energy storage, such as cooling and heating of large domestic or commercial spaces.

This energy storage, combined with

the batteries in EVs, as well as stand-alone stationary batteries, provides a sufficient base for changing the operational paradigm from power supply follows power demand, to one of energy supply being matched to energy demand.

Power demand and power supply are shaped to match each other and, in this scenario, consumers become “prosumers”, people who produce and consume energy, and shape demand and supply as part of an overall energy market. EVs add another dimension of intervention.

### HOW TO MANAGE WHEN EVs BECOME POPULAR

But the increased uptake of EVs, PV, battery storage and renewables more generally comes with its challenges. And these are complex from the spatial and temporal variations on a scale not experienced before. The main challenges to the (local) distribution grid arising from the increased uptake of EVs, PV, battery storage, and renewables more generally, is one of complexity due to spatial and temporal variations on a scale not experienced before.

Smarter grid management is called for. This is a nontrivial problem that has not been completely resolved, but initial pilot projects have proven successful.

In a project that was part of the Victoria Electric Vehicle Trial, a utility successfully managed EV charging centrally to maintain grid integrity and meet demand requirements over time. Controlling EV charging in this manner implies that existing networks can sustain high EV uptake rates without the need for more infrastructure.

The same network that started to fail at only a 10 per cent uptake with uncontrolled charging can sustain more than an 80 per cent uptake when vehicle charging is controlled using simple, but effective, optimisation.

AI-based control strategies would determine when and how EVs are charged, and this implies not having to heavily invest in upgrading network infrastructure.

If we can design proper incentives for EV owners to let their charging be controlled, and if the regulatory environment can enable and even promote such control, then most of the existing networks should be able to handle EVs for many years to come.

Such a framework will also enable vehicle-to-grid and vehicle-to-house power

**“Given the pace of change globally, we cannot maintain the status quo. Change will happen.”**

The electric vehicle charging socket.

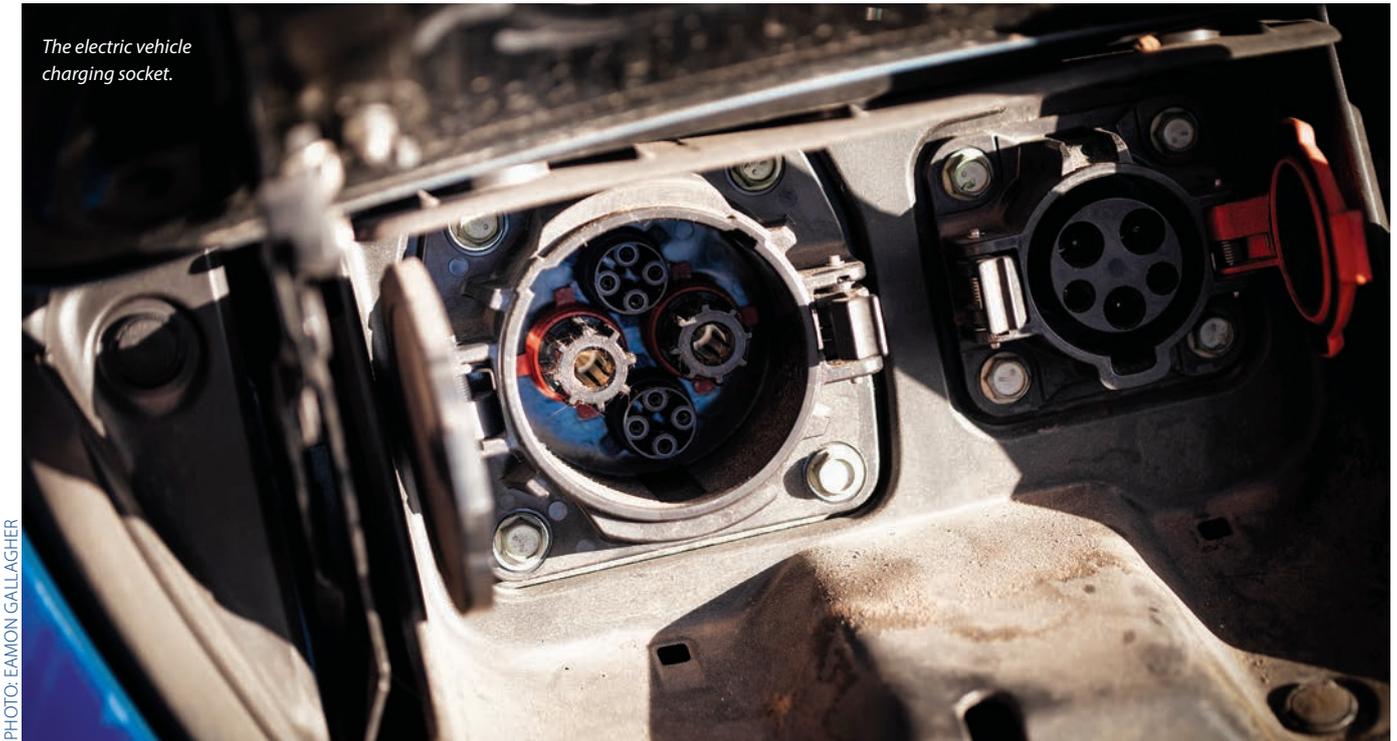


PHOTO: EAMON GALLAGHER

generation, where vehicle batteries act as distributed storage units that can also be used to power your home or feed energy back into the grid when it is required.

Aggregating consumers in this manner provides for more flexibility and will lead to the creation of new energy markets. Dr Lachlan Blackhall wrote in the April 2018 issue of Focus on this topic in his article 'People-powered grids'.

A year-long study in Denmark conducted by Nissan and Italy's biggest utility, Enel SpA, demonstrated that utilities can use parked EVs to deliver power into the grid and provide owners with a monetary return for doing so, without unduly affecting battery life and serviceability.

Nissan and Ovo, one of the UK's largest energy suppliers, will offer the vehicle-to-grid service to buyers of the carmaker's new Leaf next year. According to Stephen Fitzpatrick, Chief Executive Officer of Ovo, savings from vehicle-to-grid services would cover the annual cost of charging an electric car.

This shows that vehicle-to-grid services can be effective. In fact, transportation costs and electricity bills could be reduced with vehicle-to-grid services.

Start-ups such as Relectrify provide an environmentally friendly way to extend battery life beyond their use in the car.

Indeed, in more stationary applications where total available charge is of less critical importance, ex-car batteries may have a very useful life in supporting grid stability and other aspects of grid quality of service.

### COMPLEXITY, MARKETS AND OPPORTUNITIES

To add to the already complex scenario, we may expect autonomous vehicle technology to mature in the same timeframe. This will create another significant disturbance in the economics of car ownership and transport services.

Completely new modalities for transport services, such as shared transport, will take shape and blur further the public-private transport divide.

This confluence of transport and electricity services, based on renewables, will present a complex management future, but one with great economic opportunities in which emerging technologies such as the internet of things, 5G networking and AI services will play a critical role.

Future options for EVs supplied with energy from renewable sources are plenty, despite their complexity, and the economics of ownership appear to work in the not-so distant future.

Early adopters will lead the market and reap the benefits. To be an effective

participant, Australia will require policy intervention in the present electricity market.

A modest moderation, providing incentives to overcome the present cost barriers, is essential.

Enabling the market to form early in Australia will create a platform for Australians to play a role in shaping the merged future of transport and electricity grids. Without such incentives, the ideas will be developed elsewhere, and Australia may altogether miss the economic opportunities. ☺

*Professor Emeritus Doreen Thomas FTSE was Head of the School of Electrical, Mechanical and Infrastructure Engineering at the University of Melbourne. She holds a DPhil (Mathematics), University of Oxford. She was a founding director of a spin-off company MineOptima, through which her mining software has been commercialised. She has been recognised with a national teaching award for her contribution to engineering education and mentorship. She is a Fellow of ATSE and Engineers Australia.*

*Since Feb 2018, Professor Iven Mareels FTSE is the Lab Director of IBM Research Australia and an honorary Professor at the University of Melbourne. Prior to this he was the Dean of Engineering at the University of Melbourne (2007–18). Iven is a Commander in the Order of the Crown of Belgium; a Fellow of ATSE, Engineers Australia, the Institute of Electrical and Electronics Engineers (USA) and the International Federation of Automatic Control and Engineers Australia. He is a Foreign Member of the Royal Flemish Academy of Belgium for Science and the Arts.*



BY PETER SWEATMAN

# The road to a CAV future

**ARE WE ON TRACK?** Connected automated vehicles (CAVs) will be on our roads sooner than you think.

**O**ur century-old system of roadways plied by human-controlled vehicles is going to change much faster than many realise. Automation, connectivity, artificial intelligence and distributed computation are combining with new service-based business models to create a new mobility economy. This economy will potentially boost improvements in safety,

efficiency and affordability. The opportunity for dramatic improvements across several dimensions of transport as we know it is truly transformational.

For that reason, many countries are trying to find ways for typically sedate policy processes to keep up with the rapid pace of connected and automated technologies, many of which are nearing market readiness.

And the technologies themselves create a

complex web of functionalities varying widely in their state of development and proximity to commonly held ideals of "driverless" transport.

But many of the questions about how close we are to significant disruption in transport must be qualified in terms of the level of automation, the roadway environment and the business model. For instance, will they be privately owned or fleet-operated?



## CAV TESTING

Despite the volume of media devoted to the subject, actual numbers of HAVs operating on or being tested on public roads are small.

HAV legislation that was recently introduced in some US states refers to both HAV “testing” and “operation”.

In reality, however, we are at the stage of “field operational testing”, implying non-commercial operation in a realistic environment and on a scale sufficient to provide confidence in HAV performance capabilities.

We are now beginning to see a dramatic increase in the scale and “realism” of these tests.

Rather than being measured in hundreds of vehicles, these deployments will be in the hundreds of thousands. And they will be carried out by large companies with mobility credentials, rather than by automakers or their suppliers.

The first big moves in CAV deployment will therefore break the current automotive mould of private car ownership.

This trend is likely to continue, with households dividing their transport expenditure between motor vehicle ownership – at a lower level than at present – and increased use of on-demand services.

CAVs will undoubtedly be marketed widely as vehicles to be privately owned by automotive customers.

They will need to meet national safety and emissions standards – building on long-established tradition, with significant twists – but also meet state and local traffic and infrastructure rules.

We can already see that automotive mandates will migrate to a quality assurance approach.

Notions of customer loyalty will need to make way for trust-building in HAV technology. Iron-clad vehicle approval systems will evolve to more explicit roles for more players in risk management.

The vehicles’ aura of autonomy will reduce in this brave new world of automotive products, barriers to entry will reduce and century-old automotive bastions will begin to erode.

## CAV CITIES

As the automotive world morphs, a new world of mobility will arise, based on data and services rather than products.

The cities we live in – and where many of our companies are located – are ripe for a transformation based on data, analytics and communication fulfilling human aspiration, talent and interaction.

The resulting interactive wealth creation will outstrip the old transactional economy.

The fusion of desirable skills, as well as their range and accessibility, will create new businesses much faster. The “smart cities” movement has begun to use technology, attract high-value companies, develop educational centres and house talent and accomplishment.

It comes as no surprise, then, that many cities recognise CAVs as at the cutting edge of enabling a better living and working environment.

The deployment of CAVs in cities starts for many with locations, precincts and campuses where low-speed driverless shuttles are introduced. And as we learn more about these technologies, we can expand locations and operational parameters, such as speeds.

The widely distributed, diverse and even haphazard nature of such deployments is anathema to the old automotive model.

Increasingly, the technological onus will fall on the companies and institutions benefiting from CAV deployments and their risk-management partners.

At least some of these partners need the ability to take data from geographically dispersed and divergent environments and create effective risk-management processes.

For a wide range of companies to take part in the new transport ecosystem, we need more and larger field operational tests. Active public-private consortia are needed to work on the big questions of data sharing, risk management, quality assurance and liability.

And we cannot rely solely on technology in vehicles to assure the safety of the transition to the CAV era: infrastructure technology must also play a critical role. ☉

*Dr Peter F Sweatman FTSE is a co-founding principal of CAVita and International Enterprise Professor in Transport Technology at the University of Melbourne. He has more than 30 years’ experience in transportation research and innovation, and the application of R&D. He is a trusted national voice on safety, ITS, transportation research and education, connected and automated vehicles, and freight technology and policy. His professional experience covers private industry, academia and government. He has worked extensively in Europe and Asia-Pacific as well as in the US.*

In the US, the subject is often simplified to “connected and automated vehicles” (CAVs).

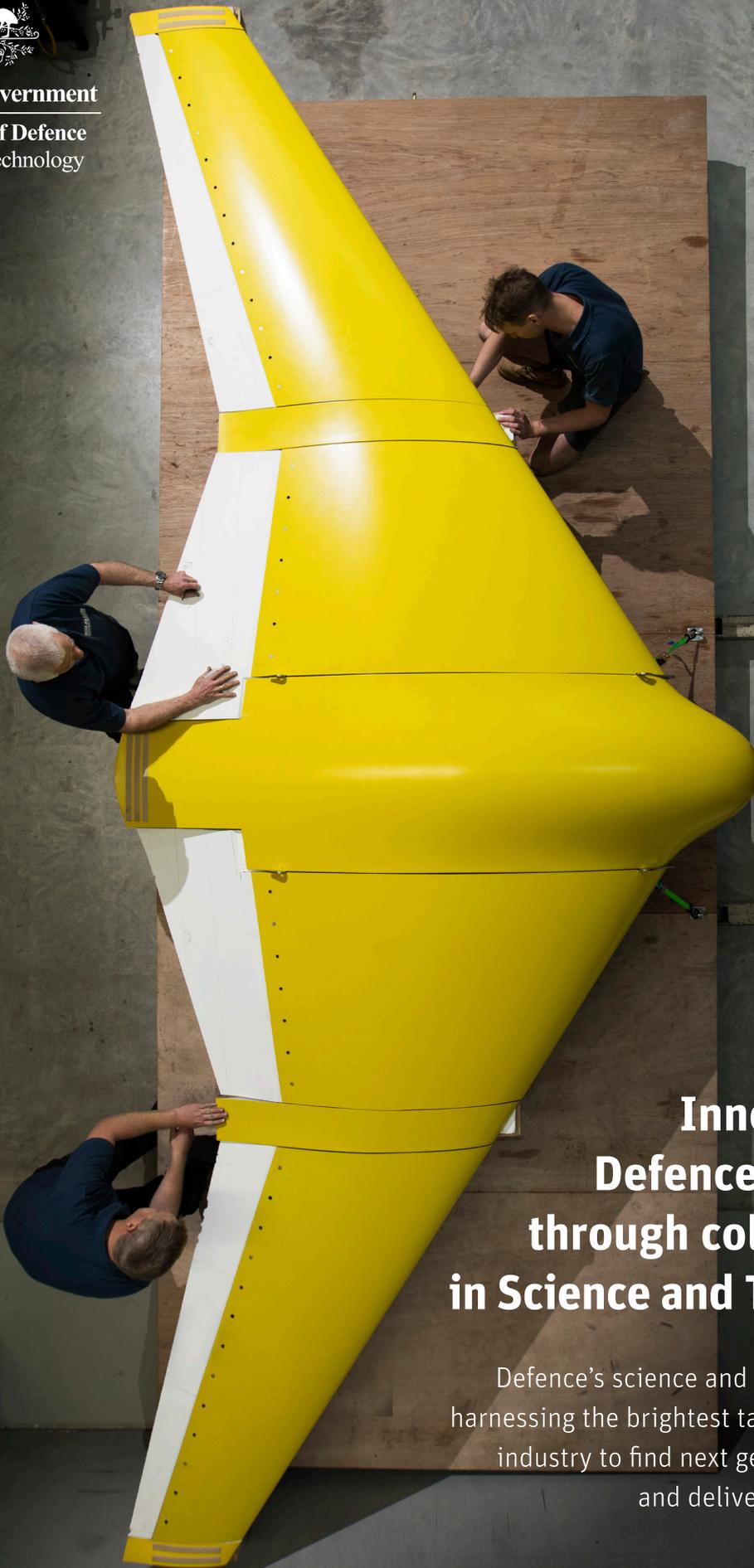
This implies a highly automated vehicle (HAV) benefiting from low-latency connectivity. At the present time, that connectivity is in the form of Dedicated Short Range Communication (DSRC).

While other viable options are likely to become available, the main emphasis is on the automation rather than the connectivity.



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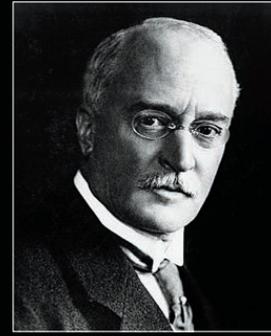
*DST's Unmanned Underwater Vehicle  
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# I CAN'T BELIEVE IT'S NOT DIESEL

**ARE WE ON TRACK?** Biofuel has the potential to redirect tonnes of biomass from landfill. Here are a few examples already setting the wheels in motion.

BY ANTHEA BATSAKIS, FOCUS EDITOR



Rudolf Diesel (1858–1913).

**W**hen you come home at night and turn on the lights, watch TV or cook dinner you probably aren't thinking about the electricity system: an extraordinarily complicated technical and financial system that generates and transports the electricity powering your home.

Rudolf Diesel built the first diesel engine in 1892, but would never know how much it would fundamentally transform transport. Rudolf died in 1913 – under mysterious circumstances – and his product didn't begin to proliferate until after World War I. By 1939, diesel powered a quarter of global sea trade.

His engine, however, was equipped to handle a range of fuels, including coal dust and vegetable oils. In fact, Rudolf predicted that vegetable-oil-based fuel would one day become just as common as petroleum, and at

the Paris World Fair in 1900 he showcased his engine with peanut oil. This interest in biofuel has resurged as it may help mitigate our greenhouse gas emissions. With plant-based sources like wheat and sugarcane, biofuel is renewable and can be grown locally, possibly reducing fuel imports.

Biofuels are also expensive to produce, may put strain on water resources and compete for land with agriculture.

Either way, the exciting range of biofuels shows the potential to redirect biomass that might otherwise end up in landfill. Here are three examples of biomass that may soon power our cars.

## WHISKY RESIDUES

Waste from one of Scotland's most prized exports is being transformed into a new advanced sustainable biofuel, called biobutanol.

Distilling whisky produces two major byproducts: draff (water-soaked barley kernels) and pot ale (a yeasty, copper-containing liquid). Every year, Scottish distilleries produce around 750,000 tonnes of draff and two billion litres of pot ale.

A start-up, Celtic Renewables Ltd, applies microbiology and modern technology to a century-old fermentation process to create biobutanol, converting these unwanted residues into something valuable.

Biobutanol is a direct replacement for

petrol and diesel, with no engine modification required. And the company recently received a \$15 million grant from the UK Government to bring the technology to an industrial scale.

## POOP

We could be flushing away a valuable replacement for diesel – raw sewage and organic waste can be repurposed and used for transport.

In the past, turning poop into fuel used incineration, but as technology advances, more sustainable, environmentally friendly methods are being developed.

The Pacific Northwest National Laboratory, for instance, pushes sewage through a tube at high pressure and temperature, transforming it into different phases.

One liquid phase is oil-rich and, like crude oil, can be refined into a liquid fuel that can power different types of motors.

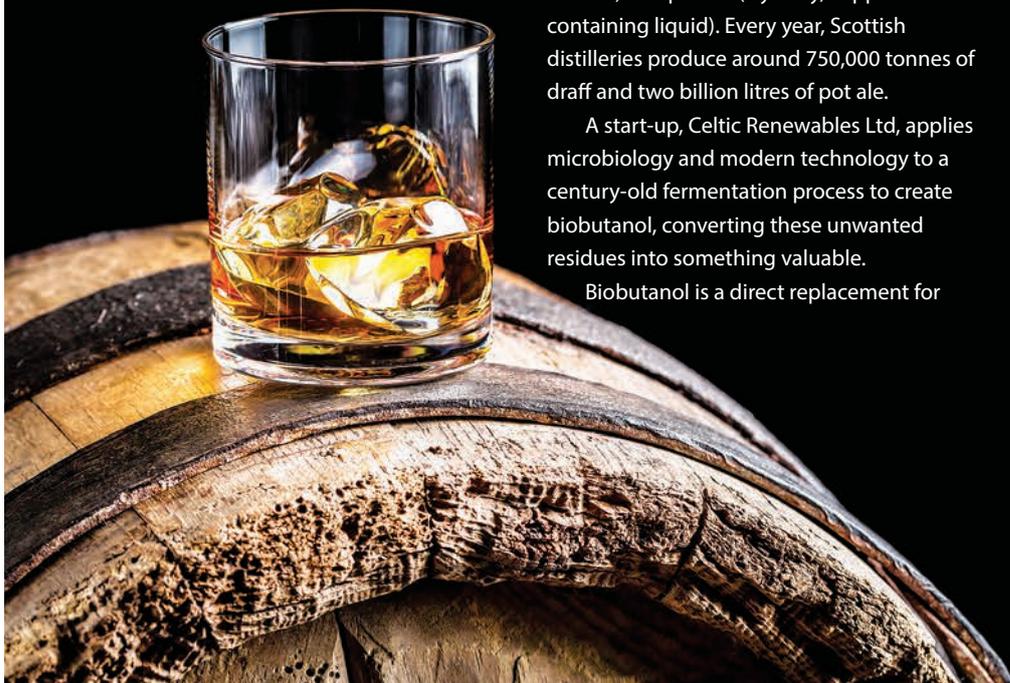
This process may not be carbon neutral, but it doesn't have the added environmental costs of oil drilling and extraction. It can also redirect this biomass, when there's an oversupply, for farmers to use as fertiliser.

## KITCHEN GREASE

Oil and grime separated from wastewater in industrial kitchens can be transformed into biodiesel, saving it from being thrown away.

Biodiesel is a clean burning alternative to diesel commonly sourced from vegetable oils, animal fats or recycled greases. And it can be used in its pure form in a diesel engine.

This is the foundational idea that the Melbourne biotechnology start-up, Biofuel Innovations, is built on. Co-founder Dr Rebecca Yee was a recipient of an ATSE Priming Grant in 2016, which she used to collaborate with a scientist from overseas to process the byproduct, glycerol into other useful products. ©





BY DIMITY DORNAN

# Vision splendid

## OPINION

Integrating bionics into humans holds out the prospect of fuller participation by people with previously untreatable conditions.

*A life changed by Hear and Say.*

I see an image of the dark eyes of a sturdy toddler gazing back at me. In a twist of fate, a recent diagnosis of Usher syndrome for this youngster, now well into manhood, has followed rapid loss of his sight and soon he will not only be profoundly deaf but possibly also legally blind.

It is bleak news indeed, and yet I am struck by a level of optimism only made possible by the many breakthroughs in human bionics I see unfolding, breakthroughs which prompted me to found Hear and Say in Queensland.

In celebrating Hear and Say's 25th anniversary this past year, I've looked back at images and stories like this one that show the legendary achievements of so many children who have received a bionic ear and have learned to "hear and speak".

If this young man is eligible for bionic eyes as well as his current bionic ears, is it just possible – even probable – that his treatment could be coordinated across two separate signal processing systems?

The convergence of humans and bionics is fast changing our vision of humankind. Now, more than ever before, we can envisage new bionic pathways back to optimal health.

Professor Graeme Clark's multi-channel

bionic ear was first implanted in a child with profound hearing loss in 1987.

It was in anticipation of the possibilities for auditory brain access which this Australian innovation could bring for children born severely or profoundly deaf that I founded Hear and Say.

Helping children and their families to access and benefit from this life-changing technology became my life's focus.

Since then, thousands of young children have passed through our doors, learning to listen, speak and read. They have gone on to receive a typical education in the school of their parents' choice, attend university and forge careers.

Following his very first implantation of a bionic ear, Professor Clark's words were: "It is the first time the human brain, the human consciousness and a replaced human sense have been interfaced."

It was also the first successful commercialisation of a neuromodulation device – a technology that acts directly upon nerves.

More recently, this interface between humans and bionic devices has expanded to cover not only the ear, but also many other areas of the body, vastly increasing the potential for bionics devices to treat

previously untreatable medical conditions.

Human bionics has the potential to not only transform the lives of people with organ problems, brain disease, blindness, limb amputation, paralysis or other disorders, but also to become a high-growth, science-based industry for Australia.

The Monash Vision Group (MVG), for instance, led by the electrical engineer Professor Arthur Lowery, has developed a wireless multi-electrode prosthesis to be implanted in the visual cortex to restore vision in blind individuals. Professor Jeffrey Rosenfeld and the MVG are planning for the first-in-human trial in 2019.

Each part of the manufacturing chain, from innovative research, supportive exponential technologies, engineering and medical skills right through to the commercialisation of medtech products slots neatly into Australia's key assets and talents.

Delivering these outcomes will necessitate not only new hybrid professionals and new cross-compatible devices, but also regulatory changes, new production and manufacturing organisations and facilities, and commercialisation practices.

This is the backdrop we must create to enable that young man with those

captivating dark eyes now suffering Usher syndrome to capitalise on the visual memory he has of today's world.

Most importantly, he will need a program of yet-to-be-invented brain training so he can use his bionic eye to comprehend the new visual images he receives.

He'll also need a new regulatory environment enabling bionic procedures to be performed safely and ethically. And, timely funding to enable new partnerships between science, product development and clinical practice.

The promise of the Health 5.0 revolution for digitised, personalised accessible health must be delivered for this young man soon. As his vision wanes, neuroplastic changes to this brain caused by delayed treatment could make useful visual experiences more difficult and slow for him to acquire.

A key challenge in responding to the immediate needs of this young man (and many others like him) are the silos of endeavour that exist across seemingly unrelated research groups, engineering and technology hubs that, once unified, can accelerate an array of human bionics breakthroughs.

These are just some of the reasons why I created Australia's Human Bionics Interface (HBI) alliance in 2013.

It is vitally important for a national overarching bionics group to connect the needs of end users or patients with the clinicians, scientists, technologists, device manufacturers, start-ups, policy-makers and investors who have a mutual interest in bionics solutions.

Bringing all parties together in an expanding human bionics "living laboratory" will enable people in all corners of the globe to lead more fulfilling lives.

The HBI alliance will coordinate, facilitate and accelerate Australia's role in delivering personalised human bionics solutions and customised healthcare services globally.

And our national scientific endeavours in human bionics have accelerated. In June

this year, Bionics Queensland was formally incorporated.

As a not-for-profit incorporated entity with DGR status, Bionics Queensland has an ambitious long-term vision, a strong suite of partnerships and a measured and realistic strategy to deliver results.

And I have an equally ambitious vision for Australia's HBI alliance, as the founder of Bionics Queensland.

With an estimated value of US\$10.53 billion (A\$14.47 billion) in 2016, the bionics market is expected to reach US\$21.37 billion (A\$29.36 billion) by 2021, with especially high growth in Asia-Pacific.

A powerful alliance across multiple Australian states and territories has the potential to deliver a much wider suite of new and enhanced bionics solutions, advocating collectively for government and private sector funds and capitalising on our shared and distinctive scientific and commercial expertise.

The HBI alliance will strive to give health consumers early access to breakthroughs in bionic vision, hearing, the bionic heart and brain, artificial limbs and organs and medical wearables that interface with the brain. Digital and real-world collaborative platforms will connect and energise projects, resources and people across all fields of bionics to deliver ground-breaking solutions.

A new action plan for bionics industry development will underpin new and emerging medtech devices, artificial organs and limbs, medical wearables and customised healthcare services.

Exponential technologies such as machine learning, artificial and augmented reality, quantum computing and biofabrication will converge with human learning, advanced engineering, neuroscience, brain mapping and robotics to define and integrate the future of bionics healthcare.

Participants in the HBI alliance could potentially contribute to Global Health Care Equivalency (GHCE). According to molecular manufacturing specialist Frank Boehm: "Our working together might culminate in

a positive critical mass on a global scale" which will finally transform lives to "support all in our natural unalienable right of optimal health for life".

Boehm also sees the potential for women in STEM fields like bionics to be major contributors to GHCE. The next 10 years will require all the planning and oversight that groups like the HBI alliance can offer.

By 2028, I anticipate that our concept of "human" will have been tempered by the advent of new bionics devices which could alleviate a medical issue or enhance human performance. But ethical policies will have been developed with some urgency to govern their use.

Whatever the technologies and related developments, while humans are in the driving seat, we must make certain that the future will not be all in coding but focused on human empathy.

Nowhere is the need for acceleration, collaboration and co-ordination of the bionics industry more humanised than in the words of engineer, Bionics Queensland Board member and quadruple amputee, Matthew Ames.

"Everything I do from the moment I wake up each day involves some form of device. My bionics are part of me. They need to be expertly designed, locally sourced, easy to repair and masterfully programmed to help me live life to the fullest.

"This requires great communication, expertise and collaboration between many bionics industry professionals. There are still many challenges to overcome and improved devices will transform not just my life, but the lives of many." ☺

*Dr Dimity Dornan AO FTSE is an entrepreneur, bionics activist, speech pathologist and researcher. In 1992 she established Hear and Say as a leading not-for-profit for deaf children learning to listen and speak, particularly with surgically implantable hearing technology. In 2013 she created an Australian national alliance, Human Bionics Interface, and also in 2016, founded Bionics Queensland, which was incorporated in 2018. Both of these groups seek to promote and accelerate the bionics industry and help bring new bionics solutions to market for the benefit of people with previously untreatable medical problems.*

**"This is the backdrop we must create to enable that young man with those captivating dark eyes now suffering Usher syndrome to capitalise on the visual memory he has of today's world."**



BY PETER JOHNSON



# Grenfell: never again

**OPINION** The tragic fire at Grenfell Tower in London sparked the world into action. Now we need fire safety engineers to take the lead.

## OPPORTUNITIES

The Warren Centre project for fire safety engineering was launched in July by Professor Peter Shergold AC, Chancellor of Western Sydney University.

There are many opportunities for governments, companies and individuals to sponsor and support the project in various ways, including:

- Undertaking some aspects of the research
- Providing case studies on infrastructure that has benefited from performance-based fire safety engineering
- Participating in research report workshops to review findings and recommendations
- Involvement in wider professional and industry engagement activities
- Involvement in future conference, training and other educational activities beyond the project completion.

Many people in the industry hope that the research developed for fire safety engineering may be broadly applicable to other engineering and architectural disciplines facing similar challenges following Lacrosse and Grenfell.

This means any participants outside fire safety engineering are especially welcome. If you'd like to learn more or discuss opportunities, contact Ashley Brinson, Chief Executive Director, Warren Centre for Advanced Engineering at the University of Sydney [ashley.brinson@sydney.edu.au](mailto:ashley.brinson@sydney.edu.au).

both cases, the building façade materials appeared to be combustible and contribute to the rapid fire spread.

And we recognised that Lacrosse had some advantages, with two separate staircases, sprinklers and a rapid evacuation plan, although there was risk the building sprinkler system might have been overwhelmed due to the fire spread.

The Grenfell building, on the other hand, had no sprinklers, only one staircase and planning based on the "stay put" philosophy became seriously compromised once non-combustible façade elements had been replaced with combustible materials.

In Australia post-Grenfell, all State and Territory governments immediately lifted their efforts and began to try to determine which buildings had combustible façades, the risks, what action was required, and if so, who was going to pay. They've started this process, but it's still very messy and confusion reigns.

At the same time, many building owners, managers and tenants wanted to know if they were at serious risk in their residential buildings or places of work.

This situation continues to present great challenges to fire safety engineers, certifiers and other practitioners. And there are still great uncertainties for building occupants as the whole industry grapples with varying risk-assessment techniques, differing solutions and upgrade costs, and questions of liability.

Governments and professionals also recognise they have to examine the broader and more fundamental regulatory and cultural issues in the design and construction industry.

Failure to prevent the Lacrosse Building, Grenfell Tower and other similar fires internationally has simply become the trigger for much larger policy concerns.

The report of the Victorian Cladding Taskforce is one example, highlighting serious deficiencies in certification and compliance of external wall construction and other building issues.

But at a more fundamental level, this report also questions the adequacy of the whole building regulatory system in Victoria and the role of the building certifiers, fire safety engineers and other industry practitioners who need better competence.

This was no surprise to many senior fire safety engineers, as many of us had expressed

**"It took the tragic events in June last year at the Grenfell Tower in London, with the loss of 71 lives and many injuries, to spur the whole world into action."**

**T**he fire that spread up the facade of the Lacrosse Building in Melbourne in 2014 accelerated from an eighth-floor balcony to the 21st floor in some 11 minutes. Falling debris ignited two more floors below.

But there were no fatalities or serious injuries and, as a result, this fire failed to generate a great deal of government, regulatory or industry reform in Australia, although there was a Senate Inquiry into non-conforming products, including combustible façade materials.

It took the tragic events in June last year at the Grenfell Tower in London, with the loss of 71 lives and many injuries, to spur the whole world into action.

For me and other fire safety engineers in Australia, the immediate question was, why did the Grenfell tragedy have such a terrible outcome compared to the Lacrosse fire? Or was Lacrosse a major "near-miss" in terms of the potential for significant loss of life for occupants or firefighters?

While not wanting to pre-empt any official inquiries, we can clearly see that, in

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Peter Johnson (left) and Peter Shergold (right) speak at an event at the Warren Centre.



concern about accreditation and registration schemes, and the level of competency of some fire safety engineers, for a number of years.

Our concerns were not only with the quality of buildings and their design, but also with public safety.

In London, esteemed engineer Dame Judith Hackitt led an inquiry into the UK regulatory system and examined building compliance, including matters of fire safety and certification.

Her report, delivered in May, was entitled *Building a Safer Future: Independent Review of Building Regulations and Fire Safety*. She concluded that the key issues were ignorance, lack of clarity of roles and responsibilities, and inadequate regulatory oversight.

These “helped create a cultural issue across the sector, which can be described as a ‘race to the bottom’ because the system does not facilitate good practice”.

She added: “There is insufficient focus on delivering the best quality building possible, in order to ensure that residents are safe, and feel safe.”

Dame Judith sought international comparison on similar building regulatory systems, and ATSE members provided advice on such systems in Australia to the Hackitt Inquiry through colleagues at the Royal Academy of Engineering. She drew significant parallels to problems equally evident in the UK and Australia.

In August 2017, soon after the Grenfell Tower fire, the Commonwealth Government, through the Building Ministers Forum, arranged for a major inquiry to be held.

Their charter was to “undertake an assessment of the effectiveness of compliance and enforcement systems for the

building and construction industry across Australia”. The resulting Shergold/Weir report of February 2018 generated a total of 24 recommendations.

The report highlighted major concerns with roles and responsibilities, competence of practitioners, education and training, accreditation, and auditing and enforcement of fire safety engineers.

Issues of private certification, building inspections and design documentation were also raised as major matters of concern.

### THE WARREN CENTRE PROJECT

In late 2017 The Warren Centre of Advanced Engineering at the University of Sydney, an independent thought leader that undertakes strong evidence-based research, had initiated early stage planning to deliver a major research project into the need for proper professionalisation of fire safety engineering.

Fire safety engineering plays a critical role in performance-based building design – a fact that had been identified by the Productivity Commission, provided professionals are competent and regulatory systems are robust.

It was opportune, therefore, for members of the Warren Centre fire safety engineering project team, including ATSE members Dick Kell, Jose Torero and myself, to prepare a submission to the Shergold/Weir Inquiry.

Our submission put a spotlight on major issues in the built environment, not only regarding fire safety, but also waterproofing, indoor air quality, and mould and spores. We offered reasons for failure and potential solutions.

The submission emphasised that addressing some of the key fire safety concerns emerging from the inquiry findings

would benefit Australian governments, regulators and practitioners.

Members of the Warren Centre team briefed Professor Shergold and Ms Weir, the report and inquiry authors, to reinforce that improving competency in fire safety engineering was at the heart of more resilient buildings and superior infrastructure, and better fire safety outcomes for Australia.

The Warren Centre project for fire safety engineering is now underway, examining the role of the fire safety engineer, required skill levels, the necessary education and training, the most appropriate accreditation system and the audit and enforcement provisions.

A team of world-class researchers and broad industry participants, led by Professor Jose Torero and myself as Senior Technical Advisers, are using evidence-based research to examine all of the key issues under three main headings:

- The state of fire safety engineering regulation, control and accreditation in Australia
- The state and future role of performance-based fire safety engineering
- The effective professionalising of fire safety engineering.

A total of eight key tasks and reports will be developed and the first two are already commissioned.

A series of recommendations on remedies and initiatives required for proper professional practice of fire safety engineers to flourish will be framed so State and Territory governments accredit fire safety engineers on a nationally consistent basis.

This is a long-held goal of many in the design and construction industry, and the full program is expected to be completed in six months.

The Grenfell, Lacrosse and other serious fires compel us to do everything we can to improve fire safety engineering and raise the quality of buildings and infrastructure to minimise the risk of such future tragedies. ☉

*Peter Johnson FTSE is an Arup Fellow and former global leader of the fire engineering practice of the international consulting firm of Arup. He has worked in Australia and internationally on the design of buildings and airports, railways, road tunnels and other infrastructure. Peter is a Fellow of ATSE, a Fellow of the Society of Fire Protection Engineers, a Fellow of Engineers Australia, and currently one of the Senior Research Advisers to the Warren Centre Project on Fire Safety Engineering and Professionalism.*



BY IAN LOWE

# CLIMATE OF DENIAL

**OPINION** Ian Lowe reflects on how the media has let us down over global warming.

**F**or more than 40 years, I have been researching Australia's future energy alternatives. When I began, there were already significant environmental issues associated with energy supply and use: acid rain, urban air quality and the direct pollution associated with mining and burning coal.

I gave public lectures and published newspaper columns in the 1970s, arguing for an energy policy that would assure our future. A coherent approach would take account of limited oil resources as well as the economic, environmental and social issues involved in energy supply and use.

Climate change only became an issue outside the small community of relevant scientists after a 1985 conference in the Austrian town of Villach. The conference statement suggested a possible relationship between human activity and the changing climate.

Within a few years, it became clear climate change would demand a new approach to energy supply and use. The 1987 report of the World Council on Environment and Development, *Our Common Future*, concluded that new energy systems were needed to power human development, but noted that the changes would require "new dimensions of political will and institutional cooperation".

CSIRO scientists led by ATSE Fellow Professor Graeme Pearman AM FAA FTSE organised a national conference in 1987 to examine potential impacts of climate change. And the Minister for Science in the Hawke government, Barry Jones, established the

Commission for the Future to work on long-term issues that would be significant for Australia.

I was the Commission's Acting Director in 1988, when we worked with CSIRO on a national project to educate the community about climate change and its implications.

There was a huge demand for information about the problem. During 1988 and 1989 I spoke to an average of two gatherings a week, in venues ranging from schoolrooms to luxury hotels. Most of the communication started with the basics.

The Swedish scientist Svante Arrhenius had coined the phrase "the greenhouse effect" in the 1890s when he recognised that trace gases in the atmosphere behave like glass in a greenhouse, allowing light to warm the interior but preventing heat from flowing out. The effect makes the average temperature of the Earth about 33°C warmer than it would be if, like our moon, we had no atmosphere.

Arrhenius warned burning fossil fuels might eventually increase the levels of carbon dioxide in the atmosphere and so change our climate. I explained the science, which

was well established, and the measurements showing that the levels of greenhouse gases were indeed increasing significantly.

I observed that climate changes were becoming apparent: increasing average temperatures, more very hot days, fewer very cold nights, changes in rainfall patterns and so on, as well as outlining the consequences projected by climate scientists.

I also pointed out that cautious scientists thought it was too early to say with confidence that the changes to our climate were being caused by the increasing levels of greenhouse gases.

Scientists agreed that increasing levels of greenhouse gases would inevitably change the global climate, but there were different views about the likely rate and scale of change. Some people were uncomfortable with the uncertainty and wondered whether we should act.

Barry Jones wisely said prudent decision-makers should weigh up the consequences of being wrong. If the climate scientists are wrong and we listen to them, he said, the worst that could happen is that we would use cleaner but more expensive energy. If the science is right and we don't listen, the results could be catastrophic.

So he invoked the precautionary principle to argue it would be prudent to develop responses, despite the uncertainty. State governments agreed and began planning for cleaner energy supply and more efficient use.

There were only a few dissenting voices like the Queensland Chamber of Mines, which claimed that the concern about climate change was unjustified hysteria caused by misinformation from wild-eyed environmentalists. Even the Murdoch press, less ideologically blinkered than it is now, reported the science and published columns written by me and by other scientists.

***"The Australian featured on its front page a sun-tanned Bondi surfer who said he had not noticed any rise in sea level, as if this anecdote cancelled out decades of analysis of about 10,000 tide gauges around the world."***

Misinformation from the media: many still believe that the science of climate change is still uncertain.



The science advanced rapidly. In 1992, the Rio Earth Summit concluded that the problem was urgent and developed the Framework Convention on Climate Change. Our government set up the National Greenhouse Advisory Panel.

As a member of that body I continued to address public meetings and write columns for various publications.

By 1997, the science was convincing enough for the global community to negotiate the Kyoto Protocol. That agreement was reached despite concerted opposition from energy-intensive industries, the commercial world generally and a few recalcitrant nations like Saudi Arabia and Australia.

The Australian delegation eventually voted for protocol and PM John Howard claimed it was a great deal for Australia. It may have been, but it was a bad deal for the planet, as our delegation had held out for a uniquely generous target.

Despite that favourable treatment, Howard joined the Bush administration in refusing to ratify the agreement, so the treaty did not become legally binding until Kevin Rudd ratified it in 2007.

The Howard Government also disbanded the National Greenhouse Advisory Panel and did little to rein in Australia's rapidly increasing greenhouse-gas production.

The late 1990s saw the beginning of a well-funded campaign by the fossil fuel industry and other vested interests to muddy the water, leading many to believe to this day that the science is still uncertain.

That is an amazing achievement, given there is no credible challenge to the science.

The 2016 Paris agreement was recognition by political leaders from all around the world that we face a serious collective problem, demanding concerted global action to slow climate change.

A small group still say the science is uncertain, but a recent review pointed out the obvious fact that there is no coherent alternative theory. As it concluded: "Some blame global warming on the sun, others on orbital cycles of other planets, others on ocean cycles, and so on. There is a 97 per cent expert consensus on a cohesive theory that's overwhelmingly supported by the scientific evidence, but the 2 to 3 per cent of papers that reject that consensus are all over the map, even contradicting each other.

"The one thing they seem to have in common is methodological flaws like cherry picking, curve fitting, ignoring inconvenient data, and disregarding known physics."

As one journalist said, if one person says it is raining and another says it is fine, the task of the media is not to report the two views but to look out the window and see who is telling the truth.

We are now seeing a determined campaign of misinformation by the Murdoch press.

At one level, it consists of putting forward amateur contrary views as if they hold equal weight with the science. *The Australian* featured on its front page a sun-tanned Bondi surfer who said he had not noticed any rise in sea level, as if this anecdote cancelled out decades of analysis of about 10,000 tide gauges around the world.

At another level, it is deliberate misrepresentation. When I was interviewed on ABC Radio and asked if Cyclone Yasi was a sign of climate change, I gave a careful reply: no one event by itself a demonstration of climate change, but the overall pattern of more frequent and severe extreme events is what the science has been predicting for decades.

The next day I was deliberately misrepresented by two Murdoch columnists, each taking half of the reply out of context.

One said even an alarmist like me had to admit that extreme events were not a sign of climate change. The second seized on the other part of my reply and said alarmists like me blamed climate change for everything, whether it was a cyclone or a bushfire, a flood or a drought.

There is now no real possibility of communicating climate science through our commercial media. So the task of communication has shifted to social media, to conferences and public meetings.

Communicating with the public is an important duty for an academic. If the task of researchers is, as one analyst observed, "to seek the truth and make it known", making your findings known is essential.

I still use all available channels to inform people of the science and its implications. The good news is the community overall has clearly moved on and the denialists in power are increasingly out of touch with reality. ☉

*Ian Lowe AO FTSE is Emeritus Professor of Science, Technology and Society at Griffith University and an adjunct professor at two other universities. Among a wide range of advisory roles for all levels of government, he directed the Commission for the Future in 1988 and chaired the council that produced the first independent national report on the state of the environment in 1996. The International Academy of Sciences, Health and Ecology recently awarded him the Konrad Lorenz Gold Medal for his contributions to sustainable futures.*



BY LINDSAY FALVEY

# Food for thought

**OPINION** Agricultural science courses are changing, but the challenge to feed the world continues to prompt bright minds to take up postgraduate study.

**W**e who have experienced the old undergraduate agricultural science courses that were based on demanding, intensive study may lament their passing. However, we need to understand changes as part of the overall social environment. From an Australian perspective, what began as a necessity to service a novice European culture adapting to an alien environment became an innovative means of integrating sound science across disciplines.

This has served the nation very well. The spirit may have been waning in some institutions by the early 1960s, but received a fillip later that decade and into the 1970s with global awareness of the precariousness of world food supply.

Morally, starvation motivated many young scientific minds to enter the profession, even as society saw agricultural science as less prestigious than law or medicine – and later, even less than commerce.

## IS A GLOBAL MODEL THE RIGHT FIT?

Over the past three decades, major Australian universities that usually contained strong agricultural science faculties have moved towards a global model.

As these universities aligned with elite international universities, agricultural science was overlooked. It was poorly represented in prestigious US institutions, had been dissolved into other departments in Cambridge and Oxford, and was often allocated to specialist institutions in Europe.

The once waxing awareness of the need to apply agricultural science knowledge to the populous food-deficit regions of the world is in a waning phase as Western nations again move towards protectionism.

Perhaps it is poised for disruption by unplanned immigration linked to food shortages, but today's university courses are seldom formed in advance of demand.

So, rather than bemoan the demise of old agricultural science courses, it is better to ensure society's needs are met in the new environment.

## URBAN STUDENTS INFLUENCE AGRICULTURAL SCIENCE COURSES

Today's universities and students have little time for an agricultural science course that requires sound understanding of physics, chemistry, biochemistry, statistics, economics,

applied social science and much more in four intensive years of study.

Such courses were once referred to with pride, and graduates excelled in diverse fields of science beyond agriculture. But this became its Achilles' heel as the age of specialisation, industry relevance and student choice advanced and university courses have become less scientifically demanding.

The agricultural scientists of today are increasingly graduates of four-year general degrees containing sound science and humanities who have continued into demanding postgraduate agricultural science studies.

It is important to also note, however, that university agricultural science education in Australia is a strangely urban phenomenon – only one older university is located in a rural city.

In the 1980s nine universities offered agricultural science, expanding to 22 campuses before a reduction to 11 institutions, with the culling of about 100 agricultural academic staff. Since 2009,

however, there has been an upward trend with a marked shift to female students.

#### AGRICULTURE TODAY

Filling demanding university courses that service agricultural sectors with capable young minds relies on them being guided into the field. And ATSE has recommended the uptake of agricultural science school subjects.

Yet there is scant attention to the agricultural sciences in school geography, history, mathematics and science curricula, and school-leaver STEM skills remain lower than in the heyday of agricultural science courses.

Such neglect, combined with society's urban orientation and nostalgic conceptions of farming, helped drag down national intakes into agricultural science courses – in

2012 numbers had declined 45 per cent from the early 1990s.

Rather than assume the current resurgence in agricultural science enrolments is sustainable, it may well be an Indian summer between hoped-for survival and dissipation into science and humanities subjects serving agriculture.

Opportunities exist created by “the world food crisis”, the aspirations of the emerging Asian middle class and free trade agreements that have rekindled interest in Australian food production.

This is likely to remain at a high level for the coming decade, providing a degree of certainty to educational providers that demand for graduates will continue. And a country reliant on agriculture as its major export needs strong postgraduates in agricultural science.

Their research training must build on an integrated understanding, forged in undergraduate years.

The only difference from the past is that undergraduate agricultural science courses would not be the same rounded,

demanding courses. And agricultural science faculties would become coordinating bases for subjects from other faculties while primarily focusing on strong postgraduate programs.

This vision relates more to the major universities, but also places greater responsibility on technical agricultural colleges.

In any case, we must find ways to continually adapt to ever-new pests, climate and other variables while efficiently increasing food production for expanding populations from reducing lands, water and mined resources.

The past century's experience suggests that our responses to agricultural science education today may be one yardstick by which our contribution to human civilisation is judged in the future. ☺

*Professor Lindsay Falvey FTSE FAIST was Dean of Agriculture, Forestry and Horticulture at The University of Melbourne, where he continues in an honorary role. His career has spanned government, academia, research and the private sector, and he has authored some 15 books. He is currently engaged in voluntary roles including Chair of the Board of the International Livestock Research Institute with 16 centres across the developing world. For ATSE, he is Chair of the ICM Agrifood Award selection panel.*

**“The past century's experience suggests that our responses to agricultural science education today may be one yardstick by which our contribution to human civilisation is judged in the future.”**



BY ROBERT VERTESSY

# Murray–Darling Basin: the case for more science, not less

**OPINION** As drought grips eastern Australia, Professor Robert Vertessy calls for more investment in water research.

**T**he drought that has gripped large swathes of eastern Australia – in some cases for up to seven years – is bringing the question of water security once again into sharp focus. Our nation's water resources are in a constant state of flux, being impacted by population growth, development and climate change.

In particular, the health of the Murray–Darling Basin affects farmers, regional communities and entire ecosystems. It's important that we get it right.

The Murray–Darling Basin Royal Commission, currently underway in South Australia, is investigating the operations and effectiveness of the Basin Plan, agreed to by the Basin states in 2012.

In Commission hearings, there has been criticism directed at the technical assessments underpinning the Basin Plan and, in particular, the allocations to environmental flows.

The assessments were based on a rigorous scientific process and involved expert science teams undertaking sophisticated modelling that was founded on a sound conceptual understanding of the hydrologic, ecologic, economic and social dynamics of the Murray–Darling Basin.

Those undertaking that work know, of course, that their assessments can be subject to uncertainty, as some of the many complex relationships and processes being modelled are not completely understood and the models themselves are necessary simplifications of reality. In some areas, there is also a lack of data to support modelling of these complex systems.

The determination about how much water is to be apportioned between environmental and consumptive uses is not only influenced by the technical assessments but also by economic and social considerations.

Where the science is “inexact”, as is often the case, and other factors contribute to

decisions, it is normal for there to be a range of views within the science community. Such divergence in views should not be used to undermine the integrity of the original technical assessments themselves.

Our understanding of the environmental, economic and social dynamics in the Murray–Darling Basin is continually improving and the Basin Plan makes provision for adjustments based on new knowledge.

Under the plan, Basin managers are expected to undertake “adaptive management”, whereby new observations and improved understanding are monitored and used to refine policy and management settings when appropriate. This is reflected both in legislation and governance arrangements.

The Basin Plan should be viewed as the start of an ambitious journey and recognised as a world-leading example of large basin-scale water planning. Many of the world's large water basins face severe water security

challenges and very few have attempted what is now being implemented in the Murray–Darling Basin.

Measures include the use of sustainable diversion limits, extensive rollouts of efficient irrigation technology, the creation and active management of a large environmental water reserve and reforms to water trading.

These are bold reforms, introduced at a time of crisis (the Millennium Drought) to address profound problems that were decades in the making. As with the underpinning science, these actions will be reviewed and improved over time.

At a time when Australia is again

experiencing drought, it is vital that the Murray–Darling Basin Authority is supported in its mission to improve the health of the Basin and has adequate resources to undertake effective monitoring and evaluation activities incorporating the best available science and technology.

Understanding the impact of climate change on the Basin’s water resources and the complex relationships between environmental flow regimes and ecosystem health remain open scientific challenges.

That’s why the Australian Academy of Technology and Engineering advocates increasing investment in water research (now

at its lowest level in 30 years) to improve our ability to diagnose problems and identify solutions before they develop into crises.

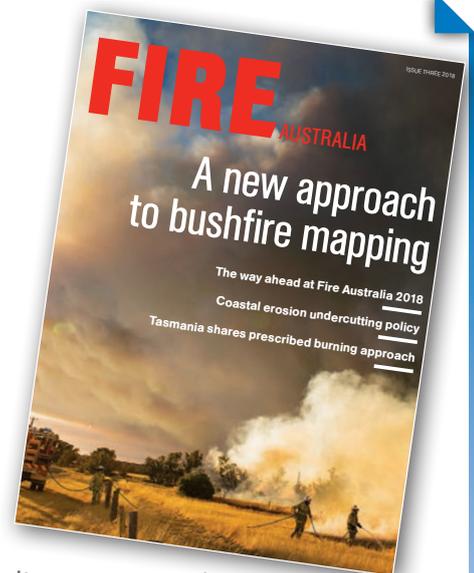
We need strong science teams with strengthened capabilities across our nation helping governments to refine their current water management plans and to envision new ones. ☉

*Professor Robert Vertessy FTSE is an Enterprise Professor in the School of Engineering at the University of Melbourne and an Honorary Professor in the Climate Change Institute at the Australian National University. He is undertaking research on water security and climate change. Professor Vertessy is also the principal of his consulting firm Global Change Advisory, and chairs ATSE’s Water Forum.*

**“Understanding the impact of climate change on the Basin’s water resources and the complex relationships between environmental flow regimes and ecosystem health remain open scientific challenges.”**

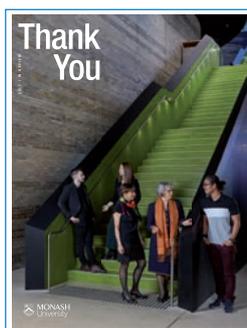
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## WOMEN IN TECHNOLOGY

# Breaking stereotypes, not electronic devices

Associate Professor Madhu Bhaskaran is a champion of women in STEM, pioneering research into flexible, unbreakable, transparent devices.

When you picture an engineer, what comes to mind? According to one particular group of students, the image of an engineer is a man in a hard hat. That was what RMIT University's Associate Professor Madhu Bhaskaran found when she recently presented at a girls' school.

"Five or six girls came up to me and said 'I never thought that what you're doing is engineering.'"

She said the girls envisioned engineering as only related to civil and infrastructure, rather than a science applicable to a vast pool of disciplines like electronics, materials and even biology.

"If we can dissolve those misconceptions, we'll get a lot more girls doing engineering. Their idea about what engineering is needs to change."

Associate Professor Bhaskaran is an electrical engineer pioneering research into oxide-based flexible electronics – unbreakable transparent electronic devices.

These electronics have an enormous range of applications, from bio-dissolvable devices that can reveal detailed information about the body, to gas sensors that can monitor pollution.

"It's not just about creating new products, but enhancing what you

already have. Rigid electronics have their own set of advantages and functionalities but they also have their own set of limitations. They're almost the polar opposite of the stretchy polymeric bases we're trying to combine them with," Associate Professor Bhaskaran said.

With so many potential applications, however, it can be a challenge to know what direction to take, she added.

"It's a very nice field to be in, because it's advantageous to society in the long run, no matter what application it's used for."

And the stretchy unbreakable devices won't necessarily be costly. She said there's a pervading misconception that anything to do with electronics is expensive.

"The message that needs to get out there is that you can have these things made at a lower cost, you don't need billions of dollars of investments. This is a new wave of electronics, and we can't afford to go offshore for things like this. It's something that will obviously become an integral part of peoples' lives. And if we can make a difference, why lose all the innovation to overseas? It makes sense to retain the intellectual property here," she says.

Associate Professor Bhaskaran moved to Australia from Chennai, India, when she was 21 and has since won numerous awards and prestigious recognitions for her research.

She was recently the first woman to be awarded the Batterham Medal, a \$5000 prize for engineers under 40, administered by ATSE.

## COMMITMENT TO EQUALITY IN STEM

New initiatives to build gender equality in STEM will be rolled out as part of a new \$4.5 million package to support girls and women in STEM. Unveiled by the Minister for Jobs and Innovation, Michaelia Cash, and the Minister for Women, Kelly O'Dwyer, in May, the long-term action plan includes:

- a women in science strategy to boost women's participation in science and technology;
- a decadal plan for women in science that ATSE will help develop;
- a girls in STEM toolkit for school-age girls to learn what a STEM career involves; and
- a women in STEM ambassador who will advocate for gender equity in the sector.

"We must draw on the entire skill set of our community and make the best use of the tremendous knowledge and skills of women researchers, engineers, innovators and entrepreneurs," Minister Cash said.

"Only by involving all Australians can we take big strides in science and technology, ensuring our nation benefits from the huge contribution these discoveries will make to our future lives."

The Government also announced the recipients for round two of the Women in STEM and Entrepreneurship grant program, with 22 Australian organisations receiving more than \$4 million in funding.

ATSE won grants in round one of the program to develop a project creating 20 career profiles of women in STEM and entrepreneurship. You can find them on the STELR YouTube page.

## '500 WOMEN SCIENTISTS' TAKE ON BIAS

Being interrupted in meetings. Receiving a hug from an older male colleague you don't know well after a professional presentation. Having older, senior male colleagues comment on your "prettiness". White, male lab members complaining that there are no opportunities for white males.

Sound familiar?

These are examples of structural discrimination, subtle biases and overt harassment highlighted by 500 Women Scientists – an unapologetically feminist organisation working towards a society where science is inclusive and the contributions of women are valued.

It began when four women rallied together to collect 500 signatures for an open letter. Their goal was surpassed within hours, and now their movement consists of more than 20,000 women in STEM and supporters from more than 100 countries.

Their website has a number of resources to help boost the visibility of women scientists and end discrimination.

This includes: a list of women scientists for anyone needing scientific expertise, such as educators, policy-makers and journalists; communication resources for writing op-eds and public speaking; and what you can do to help end harassment in STEM.

And launching soon are 500 Women Scientist Pods – support spaces for women experiencing difficulties in their careers.

Consider signing up and join the movement at [500womenscientists.org](http://500womenscientists.org).

# WOMEN IN TECHNOLOGY

And having only completed her PhD eight years ago, Associate Professor Bhaskaran is not only changing the course of electronics, but also is a champion for women in STEM and leadership.

She is a director for Women in STEMM Australia and co-leads the Functional Materials and Microsystems Research Group at RMIT.

Madhu Bhaskaran



**“It’s not just about creating new products, but enhancing what you already have.”**

PHOTO: RMIT UNIVERSITY

## WOMEN IMPACTING AFRICA'S TECH BOOM

The African Women in Technology conference in July connected leading women in technology with budding entrepreneurs in Kenya.

Technology is booming in Africa, and it's transforming the possibilities for life on the continent. Around one-fifth of Africa now has access to the internet and some of the world's tech giants are investing there, including IBM, Google and Microsoft.

This revolution has spurred the launch of the African Women in Technology (AWIT) conference, bringing together the African women who are impacting the technology ecosystem.

AWIT founder and entrepreneur Anie Akpe says smartphone adoption has made the biggest difference to the continent.

“It has led to the rise of fin-techs (financial technologies) like M-PESA in Kenya, provided unconventional employment opportunities like Uber and also opened up the continent to the world, in terms of communications and creativity,” Ms Akpe said.

“African millennials use social media to show off the uniqueness of the continent every day.”

The tech boom across Africa is particularly prevalent in Ghana, where Google will soon open an AI centre, the first in Africa.

Ms Akpe added that Kenya, South Africa and Nigeria are also leading the tech revolution.

“Kenya, based on their quick adoption of technology and infrastructure; South Africa, due to the impact of the diaspora; and

Nigeria, which produces so much talent, and also the amount of funding the country's start-ups have raised from both local and global venture capitals.”

Now in its third year, the AWIT conference is aimed at connecting, encouraging and empowering young women, girls and inspiring entrepreneurs in technology.

So what can women in particular bring to the technology sector?

“A lot! It all depends on the company's needs. Women bring a new perspective. Women are intuitive, smart, creative and observant. Being integral parts of families and communities, women also experience a lot of the problems start-ups try to solve, and can bring in viewpoints that lead to solving these problems,” Ms Akpe said.

The conference was held in Nairobi, Kenya, and provided opportunities in mentoring, networking, internships and funding.



*A networking event at last year's African Women in Technology conference, held in Mozambique.*



# VICTORIA: THE PLACE FOR SPACE

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## WOMEN IN TECHNOLOGY

# Female science video hosts face trolls on YouTube

**A NEW STUDY QUANTIFIED THE SEXISM RAMPANT ON YOUTUBE FOR WOMEN IN STEM CREATORS. HERE'S HOW WE CAN BETTER SUPPORT THEM.**

BY ANTHEA BATSAKIS, FOCUS EDITOR



“Never read the comments!” As a young female writer, I’m often told to beware of the comments on social media when any of my articles are posted, and for a good reason. “Trolls” – people who post hate speech online – can make the internet an ugly place for women showcasing their work.

But it’s not always bad. Social media comments can also be supportive and provide an opportunity for the public to engage in a way that wasn’t possible a decade ago.

Inoka Amarasekara – a science communicator who coordinated videos of inspiring women in STEM and entrepreneurship for ATSE – dove into the black hole of YouTube comments and emerged with a published paper.

She explored how female science communicators were unfairly treated on YouTube compared to their male counterparts by looking at more than 23,000 YouTube comments.

“It must feel incredibly rewarding for YouTube creators to encourage curiosity and discussion about science, and to have people engage with their content,” Ms Amarasekara said.

“I can also only imagine how it must feel to be on the receiving end of certain kinds of hostility and sexism. I have a lot of respect and admiration for the YouTube creators who endure that to pursue their goals.”

Published in the journal *Public Understanding of Science*, Ms Amarasekara found women who create science videos on YouTube generally face a tougher environment than men.

They elicit more comments per view than men and a higher proportion of critical comments. In fact, about 14 per cent of comments for female on-camera hosts were critical, compared to about 6 per cent for male hosts.

They also received far more comments about their appearance, or comments that were sexist or sexual.

On the other hand, female hosts received more likes and subscribes per view.

Here, Ms Amarasekara discusses her research and how we can better support women in STEM on the internet.

### Was there anything in your research that surprised you?

When I first started scrutinising YouTube and popular channels, I was surprised by how few women there were in science-related YouTube videos and how they’re less visible. I wanted to investigate that gap and find out whether I could detect if audiences really do respond differently to science content by men or women.

Also, the comments that were analysed were the public-facing ones and there was no definitive way to tell if comments were being filtered.

I found it interesting how people could use words that on their

own don’t mean much, but put together in ways that became borderline hate speech!

### How can we be better allies to women in STEM on YouTube?

It’s important to question the norms of what is considered “good” or “successful” if we want to promote diversity, inclusion and equity.

If you think someone is doing good work, let them know. When I come across something I enjoy on YouTube, social media or even in life in general, I try to engage positively by liking it, subscribing or following. It’s so easy to do!

And broadening what you read, watch and listen to is important. We need to actively look for different kinds of perspectives in our consumption of information and entertainment, perhaps a bit like research practice.

### Do you think women in STEM should avoid making videos on YouTube altogether?

Definitely not! But I think it’s important to acknowledge barriers or problems women face in order to take steps to overcome them.

YouTube presents a great opportunity for those who want to participate in science communication, with its global reach, huge earning potential and innovative career opportunities.

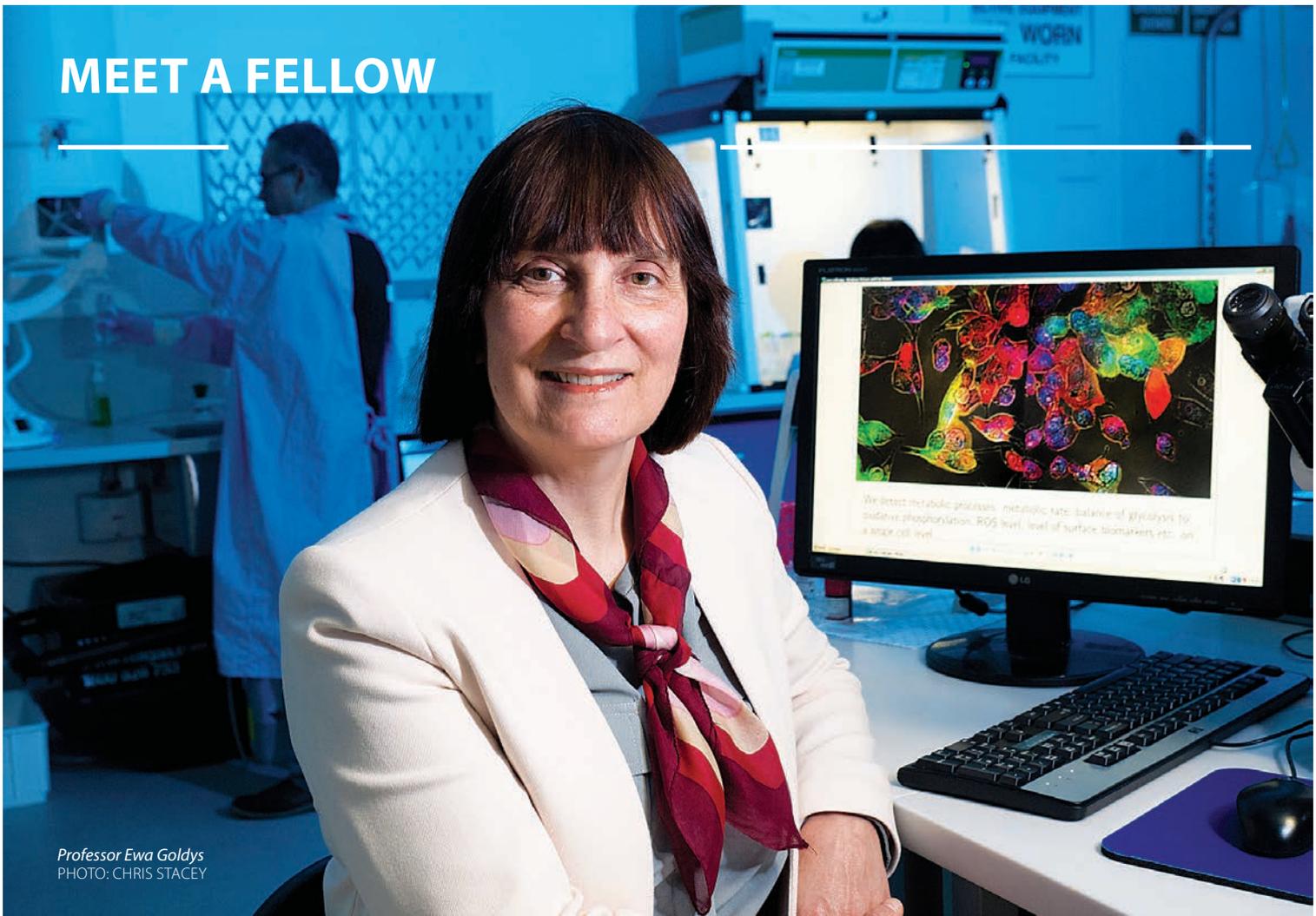
Given the under-representation of women in STEM in general, their lack of visibility and marginalisation around ethnicity, class, sexual orientation, physical ability and non-cisgender presentation in the STEM industries, there is a long way to go.

Diversity and inclusion is especially important to improve STEM practice to promote diversity in thinking and innovation.

And unless people actively participate, the status quo will continue. ☹

**“I can also only imagine how it must feel to be on the receiving end of certain kinds of hostility and sexism. I have a lot of respect and admiration for the YouTube creators who endure that to pursue their goals.”**

# MEET A FELLOW



Professor Ewa Goldys  
PHOTO: CHRIS STACEY

## Ewa Goldys: making light work of disease

Humans have an innate ability to make decisions based on colour. We know when a child is sick from the colour of their face, if a fruit is ripe or if a mushroom is poisonous.

University of NSW Professor Ewa Goldys FTSE draws inspiration from this ability, but uses it on a much smaller scale – using technology to go beyond the capability of the human eye.

By looking at the colour of cells and tissues under fluorescent microscopes, she can learn detailed information about their biochemistry and determine whether a patient is sick or healthy, and how they'll respond to treatment.

"Humans are just not very good at matching colours. We can match colours if they're drawn side-by-side on a wall, but to carry the memory of that colour to Bunnings, that's when we need technology," she says.

The technique, known as "hyperspectral imaging technology", is non-invasive, easily accessible and can be used in areas as diverse as cancer, diabetes and neurodegenerative diseases.

For pioneering this technique, Professor Goldys and her colleague Dr Martin Gosnell won the 2016 ANSTO Eureka Prize for Innovative Use of Technology.

"The colour of cells and tissues has been an underutilised characteristic in science," Professor Goldys says.

The interdisciplinary approach to hyperspectral imaging technology – it draws on chemistry, physics and biology – is a testament to the wide scope of her expertise.

Professor Goldys has been a full-time researcher since she joined academia, naturally transitioning from theoretical physics early in her

career, to semiconductor physics and then to nanotechnology, which led her to become interested in biophotonics.

"The science of light is actually quite intriguing, and there are so many sophisticated technologies waiting to be deployed, but you need to know what the problem is," Professor Goldys says.

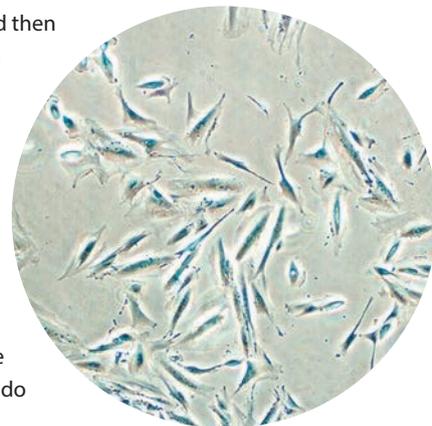
"This is why I became so interested in light sciences, to bridge between what the technologies can do and what is really required."

In particular, she says, the ability to quantify colour and make objective colour observations can yield real-world translational outcomes, opening a new window into the body.

"My mission in life is to enable more objective judgements and determinations," she says.

"Computers don't forget. They maintain the same standards, are less prone to errors and are able to handle the diversity and heterogeneity in biology."

Professor Goldys is an ATSE Fellow, the Deputy Director of the ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP) and a SHARP Professor (Strategic Hires and Retention Pathways) at the University of NSW. ☺



Olfactory neurosphere cells taken from the body, analysed for subtle differentiation of colour.

PHOTO: CNBP

## Martin Green wins Global Energy Prize

Scientia Professor Martin Green AM FRS FAA FTSE has become the first Australian to win a prestigious Global Energy Prize, topping a shortlist that included Tesla's Elon Musk.

Professor Green is Director of the Australian Centre for Advanced Photovoltaics at the University of NSW. His group has held the record for silicon solar cell efficiency for 30 of the past 34 years.

Often called the "Father of Photovoltaics", he won the prize for revolutionising the efficiency and cost of solar photovoltaics, and making it the lowest-cost option for bulk electricity supply.

"We need to maintain the pace of research in Australia, not only to keep our international lead, but also to benefit society by providing a cheap, low-carbon source of electricity," Professor Green said.

"Given the quality of the candidates on the shortlist, receiving this prize is a great honour, and will spur on our efforts. I look forward to the presentation in Russia in October."

UNSW said Professor Green had been selected from 44 contenders from 14 countries by a committee of leading scientists to share the \$820,000 prize with Russian scientist Sergey Alekseenko, an expert in thermal power engineering.

He'll be presented with his prize in October by President Vladimir Putin or his nominee.

Professor Green's record-breaking achievements stretch across decades. In 1989, his team supplied the solar cells for the first photovoltaic system with an energy conversion efficiency of 20 per cent. And in 2014, he headed the development team that first demonstrated the conversion of sunlight into electricity with an energy conversion efficiency of 40 per cent.

Professor Green's earlier honours include the 1999 Australia Prize, the 2002 Right Livelihood Award (also known as the Alternative Nobel Prize), the 2007 SolarWorld Einstein Award and the 2016 Ian Wark Medal from the Australian Academy of Science. 



PHOTO: COURTESY OF UNSW

## CALUM DRUMMOND WINS WARK MEDAL

Former ATSE Board member, Professor Calum Drummond FTSE, has been awarded the Ian Wark Medal.

Professor Drummond, Deputy Vice-Chancellor Research and Innovation at RMIT University, has been a Fellow since 2006.

The Ian Wark Medal and Lecture commemorates the contributions to Australian science and industry of the late Sir Ian William

Wark CMG CBE FAA FTSE. It is administered by the Australian Academy of Science.

The award recognises research that contributes to the prosperity of Australia and is normally made every two years. It includes a \$3000 honorarium.

According to the award citation, Professor Drummond has made outstanding contributions to advancing the fundamental

understanding of the key factors governing molecular assembly, and particle and surface interactions in liquids.

This research has enabled the development and commercialisation of advanced high-performance materials in areas including energy storage, medical therapy and diagnosis, household consumer and industrial large-scale uses.

## ATSE PEOPLE

# Robot conference brought down under for the first time

Two ATSE Fellows brought the International Conference on Robotics and Automation (ICRA) to the southern hemisphere for the first time since the global event was launched in 1984.

Queensland University of Technology's Professor Peter Corke FTSE and Chief Defence Scientist Dr Alex Zelinsky FTSE were behind bringing the conference to Brisbane, which saw a record 3000 people attend.

"There has been a lot of great work in robotics in Australia and we both felt it was time the conference came down under. We pitched the conference four years ago with Alex as General Chair and myself as

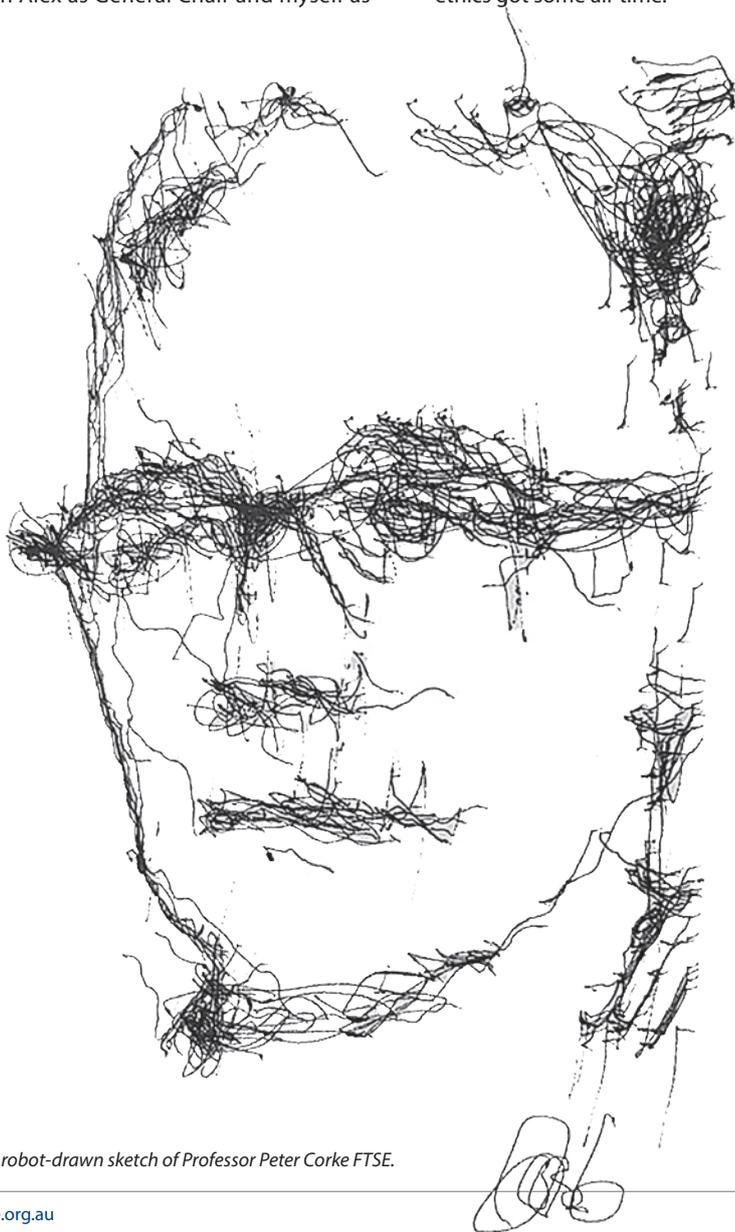
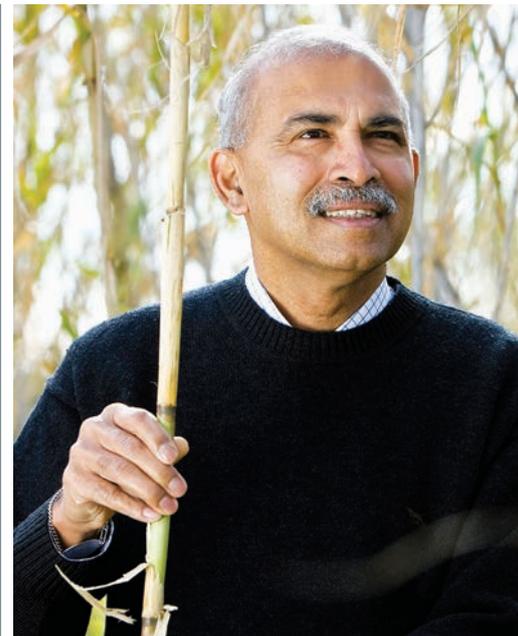
Program Chair," Professor Corke said.

Among the concepts on show was an art installation: 3 Robots Named Paul, by Patrick Tresset. Conference visitors would sit for around 45 minutes and have their portrait sketched by three robots whose 'eyes' were digital cameras or low-resolution webcams.

Professor Corke's portrait is below.

"It was nice to be forced to sit still for a while – running a major conference like that literally involves a lot of running around," he said.

"We had great plenary and keynote speakers, the exhibition was great and very well attended, and I was happy that art and ethics got some air time."



### RAVI NAIDU IS ONE OF AUSTRALIA'S MOST INNOVATIVE ENGINEERS

**E**nvironmental pollution kills more people in the world every year than all war and violence, smoking, hunger and natural disasters combined.

On the front lines is University of Newcastle Professor Ravi Naidu FTSE, a global leader in contamination studies. He investigates the presence of contaminants in the environment and the route they take to receptors.

For his impactful research, Professor Naidu was among 30 people listed in Create Digital's Australia's Most Innovative Engineers 2018.

Professor Naidu is the Global Innovation Chair and Director of the Global Centre for Environmental Remediation, University of Newcastle. And he is the Managing Director and CEO of the Centre for Environmental Risk Assessment and Remediation (CRC CARE), an independent organisation that develops technologies and policies that assess and prevent soil, water and air contamination.

His research has led to the implementation of policy directives and new technologies that manage and remediate polluted groundwater and soil in Australia and overseas.

The robot-drawn sketch of Professor Peter Corke FTSE.

# ATSE PEOPLE

## Mary-Anne Williams leads UTS team to silver in RoboCup 2018

A University of Technology Sydney robotics team have taken home silver in the Social Robot Standard Platform League at RoboCup 2018 in Montreal.

To win RoboCup, teams must overcome several challenges. Their robot must: play a game of blindman’s bluff with humans, take drink orders at a cocktail party, undertake a range of tasks in a home setting, identify and find objects to help humans – and pass a surprise challenge.

Led by UTS Magic Lab Professor Mary-Anne Williams FTSE, the “UTS Unleashed!” team finished equal first in the cocktail party challenge and first in the tour guide challenge.

Professor Williams created her first RoboCup team in 2002. This year’s team includes six undergraduate students, nine PhD students and some of Australia’s leading social roboticists.

“With our research focus on developing safe and secure robots for human-centric business environments, we are looking



Professor Mary-Anne Williams and her team.

for ways social robots operate in human-centric environments and require not just the intelligence to optimise and perform physical tasks but to work with humans in safe and enjoyable ways,” Professor Williams said.

All teams must use a Pepper robot to compete in the league – the UTS Pepper is known as “Banana Habanero”.

UTS Unleashed! are gearing up for RoboCup 2019, which will be held in Sydney, where Professor Williams will chair the RoboCup 2019 Symposium. “We are looking for industry-sponsored scholarships to grow the team and enable more students to benefit from the transformative RoboCup experience. Please contact me if you would like to discuss student sponsorships/internships,” she said.

## FELLOWS ELECTED TO THE ROYAL SOCIETY

ATSE congratulates three Fellows who have been elected to the Royal Society: Professor Michelle Simmons, Professor Graeme Jameson and Foreign Fellow Professor Robin Grimes. The Royal Society is the oldest continuing scientific academy,

boasting a Fellowship that once included Albert Einstein, Isaac Newton and Stephen Hawking. Today, these ATSE Fellows have joined around 1600 of the world’s most eminent scientists.

### SCIENTIA PROFESSOR MICHELLE SIMMONS FAA FRS FTSE

As an internationally celebrated quantum physicist, Professor Simmons is honoured by the Royal Society for her pioneering work in quantum research.

### PROFESSOR GRAEME JAMESON AO FRENG FAA FRS FTSE

University of Newcastle Laureate Professor

Jameson is a chemical engineer and the Director of the University’s Centre for Multiphase Processes. He is renowned for inventing the Jameson Cell – a mineral processing technology used to remove fine coal from waste streams.

### PROFESSOR ROBIN GRIMES FRENG FRS FTSE

Imperial College materials physicist Professor Grimes is renowned for modelling nuclear materials. His primary research interest is in computer simulation techniques to predict structural and dynamic behaviours of ceramics, metals and semiconductors.



Robin Grimes Michelle Simmons Graeme Jameson

# ATSE PEOPLE



IMAGE: M3ARCHITECTURE

## Andrew Liveris's \$13 million gift to UQ

Global business leader Dr Andrew Liveris AO FTSE and his wife Paula Liveris have donated \$13.5 million to help establish the Liveris Academy at the University of Queensland (UQ).

They also pledged an additional \$26.5 million in support of UQ's "Not If, When" philanthropic campaign.

Located in UQ's Faculty of Engineering, Architecture and IT, the Liveris Academy will help develop the next generation of leaders of a sustainable future.

Dr Liveris, who retired as chair of DowDuPont in July, said he hoped the donation and initiative would allow students to garner a real-life understanding that many global challenges required large-scale innovation and leadership to create positive change for society.

"Paula and I hope the Liveris Academy will attract, support and develop many of the planet's smartest young people and finest minds in engineering and science, enabling them to reach their full potential while addressing major challenges facing society today."

UQ Vice-Chancellor Professor Peter Høj, who is also an ATSE Fellow, said Dr Liveris was one of UQ's most successful alumni, and naming the building after him honoured his career and his role as a consistent advocate for UQ.

*An artist's impression of the new Andrew N. Liveris Building.*

## CATHERINE LIVINGSTONE WINS LIFETIME ACHIEVEMENT AWARD

Prominent business leader and vocal advocate of science and education Dr Catherine Livingstone AO FAA FTSE was presented with the 2018 Australian Museum Research Institute (AMRI) Lifetime Achievement Award in July.

The AMRI Award recognises outstanding achievements in advancing public knowledge, communication and understanding of science. It was awarded to Dr Livingstone for her advocacy of science through numerous roles including President of the Australian Museum Trust, Chair of CSIRO, CEO of top 100 company Cochlear and Chancellor of the University of Technology Sydney.

In presenting the annual AMRI Lecture and receiving the award, Dr Livingstone said science had been at the core of the Australian Museum since it was founded in 1827.

"The Australian Museum is the nation's first museum and continues to contribute to science understanding on an international level through the work of the Australian Museum Research Institute," she said.

"It is an honour to receive this award in such illustrious company and I will continue to advocate for STEM at every opportunity as this is an area where I believe Australia can make a mark."

Director and CEO of Australian Museum Kim McKay AO said many people recognised Dr Livingstone for her roles as Chair of Telstra and the Commonwealth Bank, and as President of the Business Council of Australia.

"But it is her contribution and passion for science, technology and education that will leave a truly lasting legacy for the Australian business and science communities."

Dr Livingstone was elected to ATSE in 2002 and a year later was

awarded the Centenary Medal for Service to Australian Society in Business Leadership.

In 2008 she was appointed an Officer of the Order of Australia for service to the development of Australian science, technology and innovation policies for the business sector.



PHOTO: JAMES ALCOCK

*(From left) Kim McKay, Catherine Livingstone and Rebecca Johnson.*

## ATSE PEOPLE

PHOTO: CSIRO IMAGE LIBRARY

## ATSE Fellow leading Australians into space

CSIRO's Parkes Radio Telescope. With a diameter of 64 metres, it's one of the largest single-dish telescopes in the southern hemisphere dedicated to astronomy. The telescope is now 10,000 times more sensitive than when it began operating in 1961.

### MEGAN CLARK EXPLAINS WHY NOW IS THE BEST TIME TO LAUNCH AN AUSTRALIAN SPACE AGENCY.

The Australian Space Agency is in good hands with Dr Megan Clark AC FTSE as its head. The former CSIRO chief executive will lead the agency's first year after completing a government review of the space sector.

She said the space industry was helping every sector of the economy grow and would provide "one voice, one door" for Australia to work with our international counterparts. The Australian Space Agency will be one of the world's most industry-focused space agencies.

#### Australia was only one of two developed nations without a space agency. Why do you think it has taken so long to establish?

Some people say we're late to the party, but now is a great time to be establishing a space agency. We are witnessing a shift in the industry from billion-dollar government programs to an industry comprising a healthy mix of big, medium and small businesses providing a vast array of technology and services.

Technology has become cheaper and smaller, and the costs to get into space are lower. We also shouldn't forget that Australia has a proud space history. The Honeysuckle and Parkes observatories were an integral

part of the moon landing broadcast in 1969.

And Australia's Indigenous people have the oldest astronomy tradition in the world. We continue to learn more about the depth and complexity of Indigenous astronomy.

#### How will the Australian Space Agency be affected by small satellite start-ups or by other commercial space programs?

Space activities are a global business and many countries responding to this demand in different ways. We found a gap in Australia for an organisation to coordinate our space activities and be the first point of contact for international cooperation. For example, when NASA and the European Space Agency meet, we can have a seat at the table.

Part of the Agency's funding includes \$15 million dedicated to fostering international space partnerships. This will open the door to Australian businesses in every state and territory to participate in international space missions and projects.

#### Last year it was reported that Australia contributes only one per cent of the global space economy. How much do you expect we'll contribute once the space agency is established?

The global space economy is worth about \$345 billion. An important role of the Agency

is helping businesses win a greater share of the global space market by identifying opportunities internationally.

Australia already has a vibrant space industry, which employs about 10,000 people and was worth \$3.9 billion in 2015-16. The Agency will help triple the size of the space industry, to between \$10 and \$12 billion by 2030. This would create up to 20,000 new, high-tech jobs.

#### What do you wish more people knew about the Australian Space Agency? For example, how it will help our national security or our agriculture, etc.

We want to reinforce how space impacts on everyday lives. Space underpins every part of the broader economy, including communications, agriculture, mining, transportation and others. Space provides the essential data for banking, TV and internet access.

Many Australians use space technology – GPS – to get around every day. Space technology will continue to flow through to other sectors and open up new opportunities. For example, the Government is investing \$260 million to bring GPS accuracy from our current five metres to 10 centimetres across Australia and three centimetres in cities. This opens up some really exciting new uses for GPS.

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 white.

API

The Australian  
Power Institute

A collage of images related to power engineering. It includes: three workers in hard hats and safety vests looking at a laptop; a large industrial structure, possibly a dam or power plant; two workers in hard hats looking at a tablet; a large dam structure; a power transmission tower; and a group of people in a modern office setting.

*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

# ATSE PEOPLE

## Veena Sahajwalla launches world's first e-waste microfactory

What happens to broken printers and out-of-date phones when you throw them away?

Professor Veena Sahajwalla is a globally renowned materials engineer who is revolutionising recycling science, enabling global industries to reuse toxic waste as low-cost alternatives to virgin raw materials.

She recently launched the world's first e-waste microfactory at the University of NSW that will offer a solution to burning and burying waste that contains reusable materials.

These micro-factories extract the maximum value from e-waste, redirecting challenging waste streams away from landfill.

"Our e-waste microfactory, and another under development for other consumer waste types, offer a cost-effective solution to one of the greatest environmental challenges

of our age," Professor Sahajwalla said.

With her green manufacturing technologies, the microfactories can transform stockpiled waste, enabling local businesses and communities to not only tackle waste problems, but develop commercial opportunities.

"These microfactories can transform the manufacturing landscape, especially in

remote locations where typically the logistics of having waste transported or processed are prohibitively expensive. This is especially beneficial for island markets and remote and regional regions."

Professor Sahajwalla is the founding Director of the Centre for Sustainable Materials Research and Technology (SMaRT) at UNSW and heads the ARC Industrial Transformation Research Hub for green manufacturing. This year she was made a Fellow of the Australian Academy of Science.

Veena Sahajwalla  
PHOTO: COURTESY OF UNSW



## NINE FELLOWS AWARDED QUEEN'S BIRTHDAY HONOURS

Professor Rose Amal received the Companion of the Order of Australia, recognising her impactful research in catalyst systems. She leads a team that uses sunlight to transform carbon dioxide into fuel – a method that's both cost-efficient and mitigates greenhouses gases.

Also receiving the Companion of the Order was Professor San Thang, a polymer and materials scientist. He developed a new method of making polymers with a huge range of applications, from solar cells and cosmetics to biosensors and drug delivery.

Dr Erica Smyth was similarly awarded for her wide-ranging work in corporate governance roles, particularly in the mining sector, and for enabling and engaging women in business as a mentor and public speaker.

Foreign Fellow Professor John Loughhead received the Companion of the Order of the Bath for his services to Research and Development in the Energy Sector.

### COMPANION OF THE ORDER (AC)

- Professor Rose Amal AC FAA FTSE
- Dr Erica Smyth AC FTSE
- Professor San Hoa Thang AC FAA FTSE

### OFFICER OF THE ORDER (AO)

- Dr David Cook AO FTSE
- John Grace AO FTSE
- John Kerin AO AM FTSE
- Professor Paul Wood AO FTSE

### PUBLIC SERVICE MEDAL (PSM)

- Dr Janis Cocking PSM FTSE

### COMPANION OF THE ORDER OF THE BATH

- Fellow Professor John Loughhead CB OBE FREng FTSE

## IN MEMORIAM

### Graeme Bird leaves a legacy in aerospace

The life of Professor Graeme Bird AO FTSE was devoted to aeronautical engineering, and the sector has him to thank for developing a technique that continues to solve a wide range of aerodynamic and aerospace problems.

The technique, the direct simulation – Monte Carlo method (DSMC), is used for gas flow simulation, and DSMC calculations have helped the design of many space vehicles and missions.

Born in 1930, Professor Bird obtained a BSc in 1951, a BE in 1953, an ME in 1959 and a PhD in 1963. He served as a Scientific Officer with the Australian Defence Scientific Service (1953–59) before working with the University of Sydney for the rest of his career, teaching a generation of scientists and aeronautical engineers.

At only 34 he was appointed a Lawrence Hargrave Professor of Aeronautical

Engineering and Head of the Department at the University of Sydney, where he prepared graduates heading to government departments, the RAAF, airlines and the aircraft industry. He continued in this role until 1990.

For almost 40 years, he worked in close collaboration with NASA and held many temporary appointments at prominent institutions around the world. In 1990 he was one of the few non-Americans to be awarded the NASA Distinguished Scientist Award.

His contributions to science and engineering continue to be acknowledged by a biennial lecture given in his honour at the International Symposium on Rarefied Gas Dynamics.

Professor Bird published more than 160 articles and garnered about 8000 citations. In 2013, at the age of 83, he published his third



Graeme Bird

and final monograph, *The DSMC Method*.

Eleven months before he died, Professor Bird was named an AO for distinguished service to engineering, particularly to the field of gas dynamics, as a researcher and academic, to professional scientific organisations and as a mentor of young scientists.

Professor Graeme Bird died on 26 May, aged 88.

### TOM DENMEAD'S CAREER WAS DEVOTED TO AUSTRALIAN AGRICULTURE

Dr Owen Thomas (Tom) Denmead AO FTSE was a pioneer in the field of microscale meteorology, greenhouse gas emission and evaporation science, greatly advancing knowledge of mass and energy exchange between vegetation and the atmosphere.

Starting in 1955, Dr Denmead had a career at CSIRO that spanned 63 years, including 21 years as a highly productive Honorary Fellow. In 1993 he was appointed Chief Research Scientist.

At CSIRO, he established the foundational science in these scientific fields and guided agricultural policy and practice.

Dr Denmead made some of the first carbon dioxide flux measurements over forests and crops. Carbon dioxide flux refers to its movement out of soil, and is the primary function of soil respiration. It's a significant component of the total atmospheric carbon balance and an important variable in climate change studies.

And it was Dr Denmead's participating advice in 1995 that led to the establishment

of Fluxnet – a global network of tower sites that measure the exchange of carbon dioxide, water vapour and energy between the biosphere and atmosphere.

By the time Dr Denmead was elected to the Academy in 1989, he was already globally renowned for this interdisciplinary research. He retired from active involvement with ATSE in 2006.

Dr Denmead then took on the role of Honorary Fellow with CSIRO Land and Water. In this role he continued his broad international collaborations with the US Department of Agriculture, Agriculture Canada, the Chinese Academy of Science, the Chinese Academy of Agricultural Sciences and the China Agricultural University in Beijing. He contributed to projects relating to greenhouse gas emissions from beef production, sugarcane soils and nitrogen fertiliser management.

His career and lifetime commitment to science was recognised with an Officer of the Order of Australia in 2012, several years after his retirement. He was awarded

for distinguished service to environmental research in the fields of crop and soil sciences, physical ecology and micrometeorology, and through the development of improved agricultural practices.

The Australian agricultural industry is better prepared thanks to his lifetime of committed science.

Dr Owen Thomas Denmead died on 2 July at the age of 85.



Tom Denmead

## IN MEMORIAM

## In service of manufacturing

For Walter Stamm AM FTSE HonFIEAust CPEng, excellence began at a young age – he was dux of his high school before graduating with a BE from the University of Sydney in 1947 and later, in 1976, studying at Harvard Business School.

A year after graduating from his BE, he joined Email in Orange, at 22 as a Cadet Engineer. He rose through the ranks to Works Manager, Fans and Motor Division, leaving in 1960 after 12 years.

He then spent 15 years at the South Australian manufacturing company Pope Products, later Simpson Pope. He joined in 1961 and was later appointed to the position of General Manager of the Electric Motor Division. He moved to the role of Managing Director at John Shearer.

In his retirement, beginning in 1985, he co-founded a small consulting company, Bishop Stamm Associates. He was elected to ATSE that same year and remained an active member for many years, only slowing down in the last seven years.

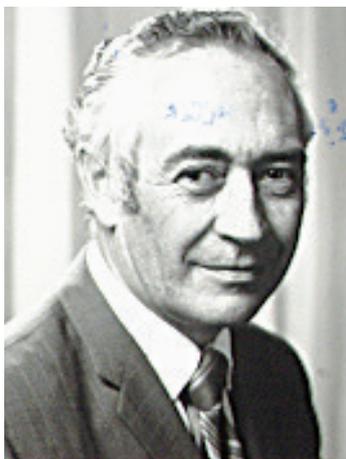
Mr Stamm served as Vice-President of ATSE (1992–96), chaired the ATSE Membership Committee and was a member of the South Australian Division Committee.

He also briefly served as President of the Institute of Engineers Australia, was a member of the Australian Committee of the International Cooperation in Advanced Manufacturing and a member of the Prime Minister's Science Council Committee on Manufacturing Technology.

Among his many accolades, he won the Jack Finlay National Award in 1982 – an award made “to a person, who by virtue of degree of his dedication, character and professional achievement, has made a significant contribution to the national welfare”.

In 1986 he was awarded the AM for services to engineering and in 1991 he was made an Honorary Fellow of the Institution of Engineers Australia.

Walter Stamm died on 26 March, aged 91.



Walter Stamm



Brian Cherry

### BRIAN CHERRY MENTORED GENERATIONS OF CORROSION ENGINEERS

Australia has Professor Brian Cherry FACA FIEAust FTSE to thank for keeping important infrastructure functioning, despite the dilapidating effects of corrosion.

Professor Cherry was a world-renowned expert in corrosion, whose lifelong commitment to engineering extended the life of the Snowy Mountain Hydroelectric Scheme, Tasmanian bridges and dams, the Sydney Harbour tunnel and many freeways around the country, among other projects.

Professor Cherry dedicated his career to understanding corrosion and how to prevent it. He received a grant from the then Federal Department of Science and Technology in 1981 to investigate the practical effect of corrosion on the Australian economy.

In his career, he also studied polymers and adhesives, and in 1981 he published a book, *Polymer Surfaces*.

In 2012, it was estimated that the financial benefit of his work for Australia equated to savings of \$21 billion a year. His research has, more generally, led to a greater understanding of processes critical to sustainment of Australia's infrastructure.

Professor Cherry developed and taught engineering courses at Monash University, and trained generations of engineers in corrosion since 1970. He was appointed as Associate Dean (Research) of the Faculty of Engineering at Monash University.

Some of his other appointments include editor of the journal *Corrosion and Materials* (1996–2012), Vice-Chair of the Australasian Corrosion Centre (1982–2001) and President of the Victorian Division of the Australian Corrosion Association (1985–87).

Among his many accolades, Professor Cherry was awarded the Corrosion Medal from the Australasian Corrosion Association (ACA) in 1995, and in 2010 the ACA Brian Cherry Award was established in his honour.

One of his last PhD students, Professor Nick Birbilis, provided a comment on Professor Cherry's passing for the ACA. He said Professor Cherry was instrumental in establishing modern postgraduate research degrees at Monash as a whole.

“Above all, he was a gentleman, an educator and a mentor to generations. He richly deserved the title of “Mr Corrosion” (actually, “Professor Corrosion”!!) in Australia and he will be greatly missed.”

# MOVERS AND SHAKERS



Rose Amal



Ben Eggleton



Paul Wood



Svetha Venkatesh



Margaret Hartley

## Ian Frazer

Professor Ian Frazer AC FRS FAA FTSE will lead an expert advisory committee for the \$500 million Australia Genomics Health Futures Mission. This project is the centrepiece of the Turnbull Government's National Health and Medical Industry Growth Plan.

## Svetha Venkatesh

Professor Svetha Venkatesh FTSE has been inducted into the Victorian Honour Roll of Women. This induction celebrates her work in translating machine learning and pattern recognition research into effective outcomes for health, security and aged care.

## Margaret Hartley

Dr Margaret Hartley FTSE, ATSE's Chief Executive Officer since 2009, has been made a Chartered Fellow of the Royal Australian Chemical Institute (FRACI CChem), joining a global network of more than 3500 members.

## Ramesh Mashelkar

Polymer science and engineering researcher Dr Ramesh Mashelkar FRS FTSE recently gave the 2018 KR Narayanan Oration on the theme 'Dismantling inequality through ASSURED innovation'. Dr Mashelkar is a National Research Professor, Chair of India's National Innovation Foundation and President of the Global Research Alliance.

## Lachlan Blackhall

Founder of Reposit Power Dr Lachlan Blackhall FTSE will lead a new Australian National University program on integrating battery storage with the electricity grid. The \$8 million research investment is funded by the university and the ACT Government.

## Ben Eggleton

Professor Ben Eggleton FAA FTSE has been appointed director of the University of Sydney Nano Institute. He replaces Dr Susan Pond AM FTSE, who moves to a board career.

## Rose Amal

UNSW School of Chemical Engineering Scientia Professor Rose Amal FAA FTSE has been appointed Chair of the Australian Research Council's Research Evaluation Committee for the field of Engineering and Environmental Sciences.

## Alessandra Pucci

Biochemist and founder of Australia's first biotechnology company, Australian Monoclonal Development, Dr Alessandra Pucci AO EF FTSE, recently published a book, *DEVOLUTION: The Young Self in the Face of Technology*. Her book uses neuroscience and immunology studies to explore mental health and identity in the digital age.

## Paul Wood

Professor Paul Wood AO FTSE has been appointed Chair of the Technical and Scientific Committee for the Global Alliance for Livestock Veterinary Medicines (GALVmed). The not-for-profit organisation's mission is to develop vaccines, medicines and diagnostics to benefit smallholder farmers in Africa and South-East Asia.

## Bronwyn Harch

Professor Bronwyn Harch FTSE has been appointed Deputy Vice-Chancellor (Research) at the University of Queensland. She joins UQ from the Queensland University of Technology, where she was a Professor of Applied Statistical Science and Executive Director of the Institute for Future Environments.

## Paul Heithersay

Dr Paul Heithersay PSM FTSE has been appointed Chief Executive of the Department of Energy and Mining. Dr Heithersay was awarded a Public Service Medal in 2012 for his outstanding public service to the growth and development of the mineral resources sector in South Australia.

## Tanya Monro

Professor Tanya Monro FAA FTSE has been appointed to South Australian Premier Steven Marshall's Economic Advisory Council. Professor Monro is Deputy Vice-Chancellor Research and Innovation and an ARC Georgina Sweet Laureate Fellow at the University of South Australia.

# MOVERS AND SHAKERS



Leonie Walsh



Cathy Foley



Hugh Durrant-Whyte



Alex Zelinsky



Anna Lavelle



Kathryn Fagg

## Kathryn Fagg

After a five-year term as a director of the Reserve Bank of Australia, Kathryn Fagg FTSE has been appointed Chair of Boral. Ms Fagg has worked across various industries for 25 years, including in engineering, banking, transport and steel, and has held executive roles at BlueScope Steel, Linfox and ANZ.

## Alex Zelinsky

Dr Alex Zelinsky AO FTSE has been named The University of Newcastle's next Vice-Chancellor, taking office in early November. A renowned computer scientist, roboticist and systems engineer, Dr Zelinsky has been Australia's Chief Defence Scientist since 2012.

## Hugh Durrant-Whyte

Professor Hugh Durrant-Whyte FRS FAA FTSE was appointed as the next NSW Chief Scientist and Engineer, replacing Professor Mary O'Kane AC FTSE, who is stepping down from the role after nine years. Professor Durrant-Whyte is known for his pioneering work in autonomous robotics and developing autonomous solutions for mine sites.

## Hong Hao

Curtin University Distinguished Professor Hong Hao FTSE has been awarded an ARC Linkage Projects grant of more than \$277,000. His project aims to optimise bricks to better withstand earthquakes, leading to stronger buildings.

## Wendy Craik

Dr Wendy Craik FTSE has begun her five-year appointment as a board member for the independent Reserve Bank of Australia. Dr Craik was formerly the National Farmers' Federation Chief, Chair of the Climate Change Authority and Chief Executive of the Murray–Darling Basin Commission.

## Mark Cassidy

After being appointed in February, Professor Mark Cassidy FTSE began as Dean of the Melbourne School of Engineering in July. Professor Cassidy currently holds substantive roles as an Australian Research Council (ARC) Laureate Fellow, the Lloyd's Register Foundation Chair in Offshore Foundations and Deputy Director of the ARC Centre of Excellence for Geotechnical Science and Engineering.

## Leonie Walsh

Dr Leonie Walsh FTSE is the only Australian judge for a competition by Mission Innovation Champions, a global initiative of 22 countries accelerating clean energy innovation and uptake. Dr Walsh is a leader and adviser in technological innovation with more than 30 years' experience, and her recent focus has been in the renewable energy sector.

## Anna Lavelle

Dr Anna Lavelle FTSE has been appointed as Chair of Medicines Australia. Dr Lavelle joined the Medicines Australia Board in January 2017 as its first Independent Director. Since her appointment, Dr Lavelle has acted as Deputy Chair of the Board and is also Chair of the recently established Independent Advisory Council.

## David Thodey and Glenn Wightwick

CSIRO and Jobs for NSW Chair David Thodey AO FTSE has named members of a NSW Government Taskforce that will develop the thinking behind a new Technology and Innovation Precinct in Sydney. The Deputy Vice-Chancellor (Innovation and Enterprise) at the University of Technology Sydney, Professor Glenn Wightwick FTSE, is included in the taskforce.

## Cathy Foley

Dr Cathy Foley PSM FTSE was named the new Chief Scientist at CSIRO. Dr Foley is an award-winning physicist who has made distinguished contributions to the understanding of superconducting materials. She is also the Chair of the Australian National Fabrication Facility Victorian Node Collaboration Committee and of the ARC Steel Hub Advisory Committee.

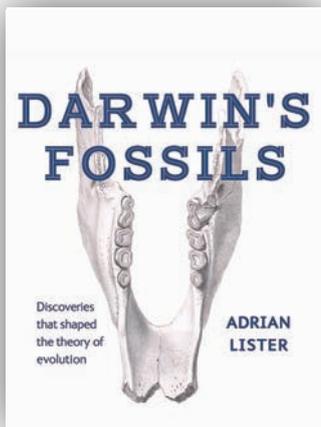
## REVIEWS

# What we're reading

BY INOKA AMARASEKARA AND DR EMILY FINCH

Inoka Amarasekara is an avid reader and science communicator who worked on STELR's Women in STEM and Entrepreneurship project, profiling inspiring careers for secondary students. Read about her research on page 51.

Dr Emily Finch is a policy analyst at ATSE with a PhD in geology and a love of literature. She coordinates ATSE's Minerals, Infrastructure and Health Forums, and is working on a decadal plan to boost the participation of Women in STEM.

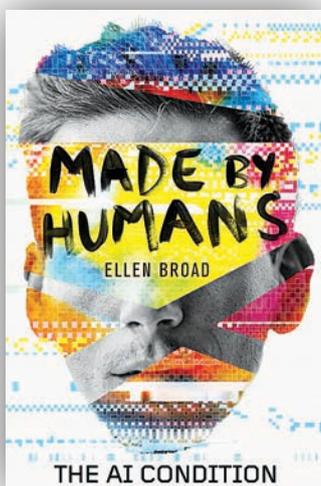


## *Darwin's Fossils*, by Adrian Lister

Charles Darwin is renowned for his work on Galapagos finches and the theory of evolution, but his pioneering work in palaeontology and geology is much less well known. *Darwin's Fossils* reveals the extensive contribution Darwin made to the fossil record, and how fossils played a crucial role in the development of his revolutionary ideas.

This beautifully illustrated book intertwines a highly enjoyable narrative of Darwin's four-year fossil-collecting voyage on the *HMS Beagle* with fossil data, excerpts from Darwin's letters to friends and family, and his personal and scientific journals.

The portrayal of Darwin's incredible enthusiasm for science in *Darwin's Fossils* encouraged me to learn more about this important historical figure, and made me want to be a better scientist. I have been recommending this book to anyone who will listen! – EF



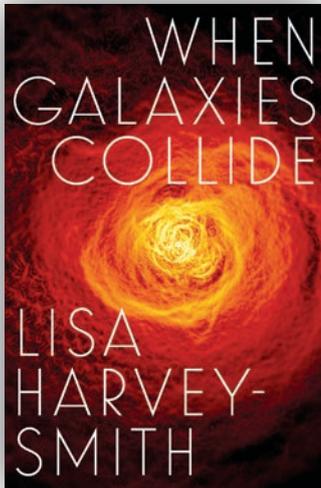
## *Made by Humans: the AI Condition*, by Ellen Broad

*Made by Humans* is a witty and engaging insight into how machines can be all too human, taking on the biases of the humans that create them.

In an increasingly automated world where we are giving up data about ourselves to governments and corporations, I would highly recommend this book as a very enjoyable way to learn about just what we're getting ourselves into.

The author, data expert Ellen Broad, explores our responsibility to acknowledge and mitigate against the imperfections of technology when harnessing automation. Broad provides her insight from discussions with world-leading experts on the ethics behind the design of machines, and our expectations of how our personal data are treated. – EF

# REVIEWS



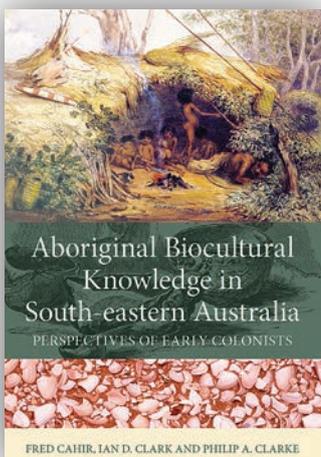
## *When Galaxies Collide* by Lisa Harvey Smith

Hurling towards us at 400,000 kilometres an hour is the Andromeda Galaxy, tugged by the gravity of the Milky Way. Professor Lisa Harvey-Smith's book vividly captures this oncoming collision. "In this tumultuous era the night sky will be packed with giant arcs – partially unfurled spiral arms. Like interacting tentacles, they will embrace planet-dwelling astronomers like a giant cosmic octopus."

A planet-dwelling astronomer herself, Professor Harvey-Smith looks 5.86 billion years into the future and illustrates the fate of Earth and its inhabitants. Will Earthlings evacuate to outer space to escape the swelling sun? Or will life spawn on another planet?

The book is peppered with personal anecdotes that bring the scale of the universe back to Earth. A vibrant science communicator, the author manages to make impossibly complex science an easy read that will reignite the childhood wonder of the night sky.

– Anthea Batsakis

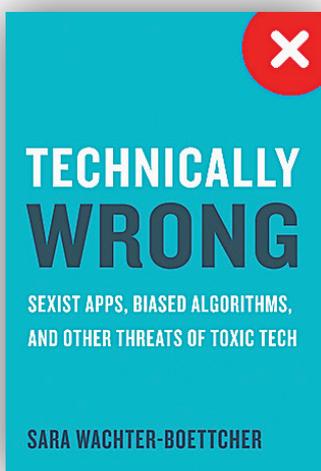


## *Aboriginal Biocultural Knowledge in South-Eastern Australia: Perspectives of Early Colonists*, by Fred Cahir, Ian Clark & Philip Clarke

With insightful analysis and interpretations, the authors have drawn from historical records of early colonial-settler interactions with Indigenous communities, and detailed the traditional knowledge of the environment, water, and plant and animal resources.

Notably, there is an absence of Indigenous voices. However, this book does contribute valuable information that will be useful to the national conversation about recognising Indigenous knowledge systems and how we might better inform sustainable management of Australia's biodiversity, land, natural resources, health, education and more.

– IA



## *Technically Wrong: Sexist Apps, Biased Algorithms and Other Threats of Toxic Tech*, by Sara Wachter-Boettcher

With important observations about prejudice and diversity in the tech industry, tech consultant Sara Wachter-Boettcher illustrates the social impacts of the status quo. She shows how unchecked biases and stereotypical assumptions can diminish, alienate and threaten tech users.

*Technically Wrong* curates many of the real-life examples and arguments of ethics and accountability in the tech industry with thought-provoking and sensitive commentary. And many of these examples may sound eerily familiar to tech users.

Also discussed are the more controversial and sinister uses of online technologies, such as surveillance and the mining of personal data, as well as the increasing controls offered to advertisers and discriminatory targeting.

This is an accessible must-read for both designers and users of digital technology looking for practical insight.

– IA

# WELCOME NEW FELLOWS AT THE ORATION DINNER

Orator: EnergyAustralia Managing Director  
*Catherine Tanna*

Friday 23 November, Melbourne

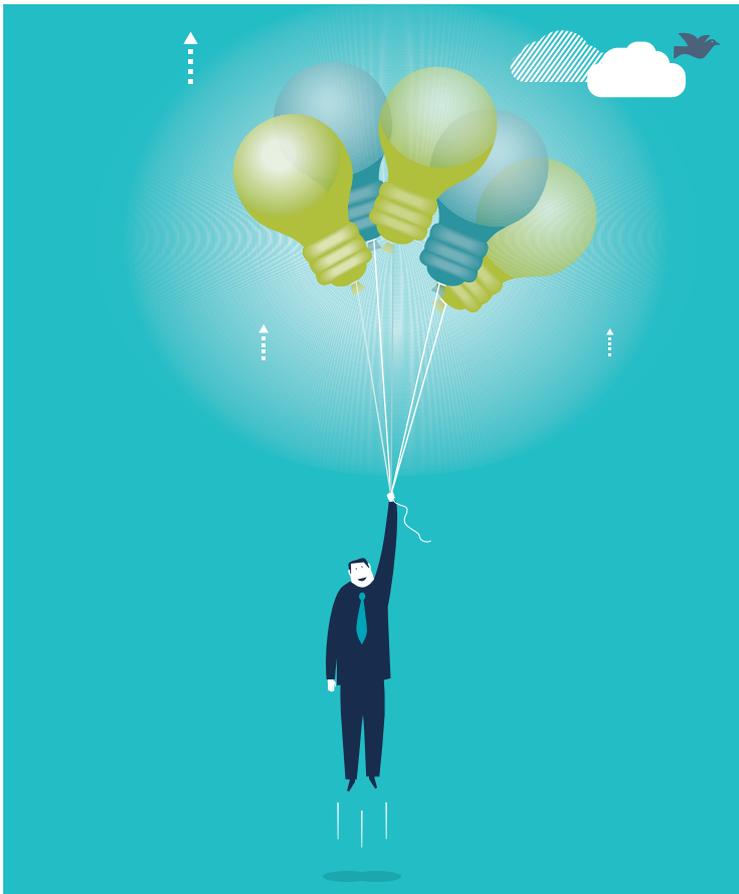
The Oration Dinner will follow the Academy's AGM.

**Register at [atse.org.au/AGM](https://atse.org.au/AGM)**

Fellows can attend the AGM, and Fellows and their guests are welcome at the Oration Dinner.



# WHAT'S ON



## SCIENCE MEETS BUSINESS

**DATE:** 11 October 2018  
**VENUE:** Hotel Grand Chancellor Brisbane

Leaders in STEM and private industry have a chance to connect and discuss how these complex sectors can intersect at this Brisbane event. And this year's theme is "high tech and big data".

Now in its fourth year, Science meets Business is aimed at making Australia a leader in the translation and application of its knowledge. But the exclusive event is restricted to just 200 delegates, ensuring direct opportunities to connect at senior levels of science, business and government.

Speakers include Professor Emma Johnston, Anand Gautam, Dr Catherine Ball and Professor Peter Quinn. Registrations close 2 October.

## THE FUTURE OF ENERGY IS TASSIE HACKATHON

**DATE:** 12-13 October 2018  
**VENUE:** Enterprize Hobart

Students, entrepreneurs, designers, engineers and anyone else interested in energy start-ups can attend this event, hosted by EnergyLab. This "hackathon" – a networking and learning event – is aimed at bringing together people interested in clean energy innovation to brainstorm, develop and demonstrate new business concepts.

Attendees can take advantage of new opportunities in energy innovation as customers start to look for new energy alternatives.

## NEGATIVE EMISSIONS CONFERENCE

**DATE:** 30-31 October 2018  
**VENUE:** The Shine Dome, Canberra

The Australian Academy of Science is hosting a conference exploring what negative emissions technology options are available, or could be developed in coming decades, to help mitigate greenhouse gases and stay within the 2°C warming target.

The conference aims to explore these technologies from a holistic perspective, taking into account practicality, feasibility, and environmental and social impacts. It will help ensure Australia plays a leading role and has a strong international voice on the issue of climate change.

## evokeAG

**DATE:** 19-20 February 2019  
**VENUE:** Royal Exhibition Building, Melbourne

evokeAG will bring together everyone from the food and agriculture sectors with an interest in how technology will shape the future. Launched by AgriFutures Australia, this inaugural event will showcase leading innovation from Australia and around the world, and facilitate the conversations needed to mature our innovation ecosystem.

So, if you're interested in agriculture or technology, whether you're an entrepreneur, a farmer, an investor, a producer, a start-up, or working in agribusiness, finance or IT, or just have a great idea, make sure you mark the event in your 2019 diary.





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Australia's  
Global  
University

# Let us take you there

**UNSW's Research Centre for Integrated Transport Innovation (rCITI) is your connection with tomorrow's transport.**

Get on board with rCITI as we take industry and government on a journey to the transport hub of the future. With our five core focuses on Transport Planning, Intelligent Transport Systems, Infrastructure, Energy & Fuel and Computational Sustainability, we provide a rigorous research, development and educational program for sustainable approaches to smart transport infrastructure and operations.

rCITI is conducting pioneering research in Smart Transport Technologies, Connected Automated

Vehicles, Big Data for Smart Cities using Crowd Sourced Data, Mobility as a Service and Travel Behaviour. Our world-first TRACSLab is equipped with state-of-the-art facilities to study the behavioural impacts of emerging and disruptive technologies.

rCITI's experience and expertise is driving our graduate education programs to train transportation professionals for the future of work in transport, ranging from insurance to government agencies and industry.

Visit [rciti.unsw.edu.au](http://rciti.unsw.edu.au) for more >

## AUTOMATED DRIVING CHANGES OUR DRIVING BEHAVIOUR

UNIVERSITY OF NEW SOUTH WALES

**How to navigate the transition to a future of automated transport.**



Associate Professor  
Vinayak Dixit

Driverless vehicles have captured the imagination of our society and automated driving is predicted to be transformational in improving safety on roads.

However, this opportunity also presents risks.

The Research Centre for Transport Innovation (rCITI) team, led by Associate Professor Vinayak Dixit, has been using simulation models, virtual reality and big data to study emerging risks in automated transportation systems.

They found increased trust in an automated driving system reduced the driver's ability to react quickly. This raises the important question of how to ensure occupants feel comfortable with driverless technology, while still being able to react appropriately in the case of an emergency.

Another shift in behaviour resulting from automated driver conditions will be the trade-off between travel cost and travel time.

Driverless vehicles allow individuals to free-up travel time to engage in other tasks. When the journey to work becomes more productive, for instance, people are happier to take a longer route to their destination, rather than paying expensive tolls to save travel time.

In the transition to a future where automated vehicles are the norm, there will first be a period where normal and automated vehicles co-exist.

Understanding how cyclists, pedestrians and other vehicles might interact with autonomous vehicles is key to informing algorithms and ensuring safe interactions between these entities.

The connected nature of autonomous vehicles also makes them vulnerable to cyber threats, with the possibility of data theft or control of the vehicle being taken over remotely. Understanding these vulnerabilities and safeguarding against them presents an important engineering challenge, one that needs to be fully resolved to instil trust in the technology.

Automated vehicles have the potential to significantly improve road safety, with extensive sensor systems that are able to perceive hazardous conditions and immense computational power to allow for quicker and more accurate reactions than a person.

Although there are risks to overcome, additional benefits of automated vehicles include driving down costs associated with insurance and fuel as a result of increased safety and efficiency, and improving accessibility to members of our society who are unable to drive, moving toward a future of mobility for all.

## CRITICAL PIPES

MONASH UNIVERSITY

**How Monash Engineering is fixing a hidden underground problem.**

Australia has 163,000 kilometres of buried water pipes – essential infrastructure with an annual maintenance bill of \$1.4 billion. The ageing network is a hidden problem with serious implications, as the failure of a large-diameter pipe can cause widespread disruption and costs to water authorities and the public, particularly on our roads.

Civil Engineering's "critical pipes" team is part of the award-winning Advanced Condition Assessment and Pipe Failure Prediction Project. The group collaborates with international water organisations, water utilities and other universities to develop technology to replace pipe assets at the optimal time, preventing the costly consequences of pipe failure.

Professor Jayantha Kodikara, Chief Investigator of the project and Deputy Head of Civil Engineering, said their goal was to reduce public expenditure and inconvenience from disrupted water pipelines, including traffic congestion caused by closed roads.

"Our technical innovations made a paradigm shift in the buried water pipe condition assessment globally and provided opportunities for pipe failure prevention through our discovery of 'leak before break' concept for buried water pipes," he said.

A "leak before break" failure occurs when there's a fracture in a large corrosion patch within a cast iron pipe. As the fracture grows through corrosion and pressure, a destructive burst can occur.

Another example of the group's work is a project intending to deliver trenchless rehabilitation techniques to around 10,000 kilometres of asbestos cement pipes, which could pose a safety risk if exposed.

The group is also researching "smart linings", a technology that could extend the lifespan of ageing pipes, preventing costly leaks.

"Over the past six years we ran a very successful collaborative research program involving all local major water utilities and two peak water bodies in the UK and the US," Professor Kodikara said.

"The exciting part is that we've been able to deliver paradigm shifts in both engineering practice and research collaboration."

Monash Engineering is focused on research that contributes to solving global challenges in transport, infrastructure, water, climate, energy, resources, food, health, communications and security.

The critical pipes research is an example of Monash's capability in delivering practical, sustainable solutions to real world challenges.



Pipes from a new research facility at Monash Engineering.

# Discovering secrets to unlock a better future

**We solve Australia's greatest challenges  
through innovative science and technology.**

In partnership with Deakin University, we launched Australia's first carbon fibre facility. Carbon fibre is used in aerospace, civil engineering, cars, health and the military.

**Collaborate with us today.**



[www.csiro.au](http://www.csiro.au)

## RISE OF THE MACHINES: DEAKIN REPORT EXAMINES FUTURE OF FREIGHT

DEAKIN UNIVERSITY

### Why we need a National Freight and Supply Chain Strategy.

Australians could get their groceries from autonomously driven mobile stores, while drones could replace postal workers in just 20 years, according to a Deakin University investigation into the future of Australia's supply chain.

Dr Roberto Perez-Franco, Senior Research Fellow at Deakin's Centre for Supply Chain and Logistics, was project leader for the scenario planning study – part of Australia's first Inquiry into National Freight and Supply Chain Priorities.

The Deakin team looked at possibilities of how mobile driverless grocery stores could replace supermarkets, while drones and "RoboPost" automatic delivery units could take over mail services.

The project identified about 200 future drivers of change through a series of interviews with experts in the supply chain industry. These guided the development of four imagined scenarios of the world in 2037. Dr Perez-Franco said the scenarios allowed industry experts to learn how Australia could be successful and competitive in the future.



Dr Roberto Perez-Franco

Dr Perez-Franco said a National Freight and Supply Chain Strategy, which will be informed by the Inquiry, is critical for Australia to keep pace with global development, growing automation, climate change and a rising population.

"This strategy will inform the development of infrastructure that will take several years to implement and then needs to last decades. So it's

critical we look deep into the future," he explained.

"But that's a very difficult thing to do; we really don't know what will happen in two decades' time. We can look at today's issues, but where we must go next requires a lot more analysis, and that's where scenario work like this comes in."

Dr Perez-Franco said Australia faces big issues managing a growing population centred in large cities.

"Urban congestion is a problem that will only get worse in the future, unless urban planners include provisions for freight and supply chains into their plans for cities."

But there are significant opportunities for Australia to stay ahead of the game.

"We can really set ourselves apart as a clean, green and ethical source of agricultural products if we make our supply chain a priority."

The scenario planning study can be accessed at: [infrastructure.gov.au/transport/freight](http://infrastructure.gov.au/transport/freight)

## JAR AEROSPACE TO RESHAPE INDUSTRY

DEPARTMENT OF INDUSTRY INNOVATION AND SCIENCE

### A new start-up that customises drone technologies will boost Australian innovation.

Australian start-up JAR Aerospace is becoming a major player in our country's aerospace engineering field. Not only is JAR Aerospace one of Australia's key developers of advanced autonomous flight platforms, it's working to diversify the applications for unmanned aerial technologies.

For JAR Aerospace, expanding its offering is about identifying tasks and industries that could benefit from its technology, and using its state-of-the-art manufacturing facility for researching techniques to customise products to fit the job.

JAR's multi-rotor Unmanned Aerial System (UAS) is a core element of its mission to expand, using customisability to suit the task at hand. Plus, it's designed with ease of construction and superior control in mind, making it ideal for use on short, inconvenient projects that may be inefficient or dangerous for humans to carry out.

By customising drone technologies, JAR Aerospace has the potential to reshape the future of work across a range of industries, including medical transport, search and rescue, agriculture, mining, construction, film, photography, electricity and gas industries.

Beyond this, JAR Aerospace sees unlimited potential for its innovations. It already has a spin-off firm called JAR Education, aimed at making STEM education more engaging for school students, and it plans to be in space within five years.

All of this is made possible thanks to JAR Aerospace's team of mechanical, manufacturing, aerospace and electrical engineers, as well as computer scientists and business development managers. Its Australian collaborators include the Advanced Manufacturing Growth Centre and the University of NSW. JAR's Advanced Manufacturing Growth Centre membership has helped expand its network with Australian manufacturers and researchers, and to further develop its ability to raise capital and train staff.

JAR Aerospace also received a contract through the Australian Government's Defence Innovation Hub to develop a hybrid, portable, fixed-wing UAS to be used by Australian soldiers for surveillance purposes. This UAS will include vertical take-off and landing capabilities along with target tracking, encryption and acoustic sensing technologies.

The Defence Innovation Hub connects Defence, industry, academia and research institutions to collaborate on innovative technologies that can be developed into advanced capability for Defence.



Advisers to the Malaysian Police Commissioner, Peter Scott (Defence NSW Director) and Sam Lewinson (JAR Aerospace COO).

For more information on the Defence Innovation Hub and other programs or assistance please visit [business.gov.au](http://business.gov.au)

# NEW ENHANCES AVIATION PERFORMANCE

Even the best pilots can only process a certain amount of information at any one time.

The University of Newcastle's Cognition Lab is working to accurately measure cognitive workload with new experimental technology – the Detection Response Task (DRT). In collaboration with sensor-house leaders Hensoldt and aviation giant Airbus, the DRT will measure the effects of degraded visual environment (DVE) on pilot performance in flight simulator scenarios.

This partnership highlights the importance of industry and academia coming together – working to develop new technologies for safer aviation operation.



THE UNIVERSITY OF  
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## CAN COMPUTERS INDEPENDENTLY PREVENT TRAFFIC ACCIDENTS?

UNIVERSITY OF MELBOURNE

**The Australian Integrated Multimodal Ecosystem brings the future of connected transport to life.**

The University of Melbourne is home to some of the world's most innovative research collaborations. From water and agriculture to computer science and biomedical innovation, our people are providing cutting-edge solutions for a cleaner, safer and smarter future.

A key example of research collaboration is the Australian Integrated Multimodal Ecosystem (AIMES). It brings to life the future of connected transport using innovative research and advanced technology. An AIMES live test – the first of its kind globally – took place on 11 July.

AIMES involves a live ecosystem in a CBD-adjacent setting, a test specifically focused on sensors in place around an intersection in Carlton. Attended by Australia's Federal Minister for Urban Infrastructure and Cities Paul Fletcher, the trial demonstrated real-life-use cases including speed management, intersection collision avoidance and vulnerable road user protection.

The trial was an important step towards the development of an interconnected transport system allowing computers to independently anticipate and prevent traffic accidents without the need for human intervention.

Professor Majid Sarvi, Director of AIMES, University of Melbourne, explained the significance of this testing was set to increase, at the same time as Melbourne's ever-growing population and rising congestion issues place more pressure on our road network.

"We're building up to a scenario where an intersection could know when there are dangerous conditions, such as wet weather or an accident, and tell cars approaching to lower their speed," Professor Sarvi said.

The trial was conducted in association with key AIMES partners including Cisco, VicRoads, Cohda Wireless, WSP and the Victorian Government.

The next major milestones for AIMES include the release of a White Paper and an upcoming trial of advancing connectivity in the transport ecosystem.

To find out more about the future of transport connectivity and University of Melbourne's research innovation, visit [industry.eng.unimelb.edu.au/aimes](http://industry.eng.unimelb.edu.au/aimes).

## PUTTING THE SUGAR INTO SCIENCE

CSIRO

**A passion for agricultural transport has led a CSIRO researcher to develop a logistics tool that could save the industry millions annually.**

Dr Andrew Higgins is a Senior Principal Research Scientist at the CSIRO Land and Water business unit, based in Brisbane. He joined CSIRO in 1996, with a passion for developing novel methods to optimise agricultural transport and logistics to increase profitability across the supply chains.

Dr Higgins started his career in CSIRO developing innovative tools to better manage seasonal harvest planning of sugarcane in Australia, and improving the logistics between harvesting sugarcane, transportation to the mill and marketing.

His research required him to work closely with the farming and milling sectors across various sugar-production regions to produce accurate model representations of real-world logistics under seasonal climate variability.

Some of the tools Dr Higgins developed more than 15 years ago for harvest management are still being used today at some mills.

From sugar, Dr Higgins expanded the logistics research to a range of other agricultural applications, including harvest planning of horticulture and monitoring food safety risks across the supply chain.

From 2012, Dr Higgins led the development of Transport Network Strategic Investment Tool (TraNSIT), which is a state-of-the-art model for assessing and optimising infrastructure investments (road upgrades, use of rail versus road, processing and storage facilities) and policy interventions in agriculture logistics.

It holistically estimates the transport benefits across the freight network, by analysing every possible vehicle and rail trip each year, and optimising routes between all enterprises in the supply network.

Beginning with livestock transport in northern Australia, Dr Higgins extended TraNSIT to all Australian agriculture and forestry through a range of Australian Government-funded initiatives.

The research has been used to inform a range of major infrastructure investments including the Beef Roads Program and Inland Rail, saving millions of dollars per year in transport costs.



Dr Andrew Higgins.

For more information, see [www.csiro.au/TraNSIT](http://www.csiro.au/TraNSIT)



**Australian Government**  
**Department of Industry,  
Innovation and Science**

# Business

*Innovation Connections helps businesses to understand their research needs, connect with the research sector and fund collaborative research projects.*

Up to \$50,000 in matched funding support is available to businesses that choose to fund their collaborative research project with the recommendation of the Innovation Connections facilitator.



For more information visit [business.gov.au/IC](https://business.gov.au/IC) or call **13 28 46**

This assistance is offered as part of the Australian Government's Entrepreneurs' Programme.

## SPOTLIGHT

## UQ IS EMBRACING SUSTAINABLE TRANSPORT TECHNOLOGIES

DR JAKE WHITEHEAD, A RESEARCH FELLOW IN THE UNIVERSITY OF QUEENSLAND'S SCHOOL OF CIVIL ENGINEERING

**Researchers are aiming to ensure they continue to stay ahead of the curve.**

UQ is leading by example in the adoption of sustainable technologies. By 2020, we are set to become the first major university in the world to offset 100 per cent of our electricity use through our own renewable energy assets.

We have already installed two solar-powered electric vehicle fast chargers – built and designed in Brisbane by Tritium, a tech company founded by UQ graduates. We also have a fully electric Tesla Model S, host a well-used car-sharing scheme and have halved our vehicle fleet since 2016.

But our research shows over the next decade, transport systems face major disruptions, including the arrival of shared, autonomous, electric vehicles (SAEVs).

Through our research, we have observed that most car manufacturers are rapidly electrifying vehicles due to the energy efficiency gains, low operating costs, simpler manufacturing requirements and zero tailpipe emissions.

These emission reductions are particularly important given that each year in Australia 40 per cent more premature deaths occur due to motor vehicle pollution than in road accidents.

In tandem with the electrification of vehicles, we have also been investigating driverless vehicles and the shift from private ownership to the sharing economy.

The dawn of SAEVs may signal the end of private vehicle ownership, opening the door for the creation of innovative transport business models.

Transport operators overseas are already offering subscription services, similar to mobile phone plans, where fixed monthly fees provide unlimited public transport, a set number of taxi trips and even car rental – with plans to include SAEV services in the near future.

SAEVs also have the potential to be much more than simply a vehicle. We are currently investigating how these vehicles could act as mobile battery packs, providing back-up power to communities during blackouts and supporting the uptake of renewable energy through smart bi-directional charging.

Through our research efforts we aim to position Australia as a leader in future transport technologies, and leading by example, continue to motivate staff, students and the broader community to continue to drive transport innovation forward.



Dr Jessica Allen

## DR JESSICA ALLEN IS FIGHTING GLOBAL WARMING

THE UNIVERSITY OF NEWCASTLE

**A new technology from the University of Newcastle is just what the planet needs right now.**

While global warming and the energy crisis threaten our planet's future, the odds don't faze University of Newcastle lecturer in chemical engineering Dr Jessica Allen.

Step by step, Dr Allen and her team are reinventing the way we produce energy and materials – with the potential for a profound positive impact on our environment.

Our current energy system, in Australia and globally, is not sustainable.

"The fossil fuels powering our world are limited and, more importantly, their use results in the dangerous emission of greenhouse gases such as carbon dioxide which contribute to climate change," Dr Allen said.

Dr Allen works on a technology called a Direct Carbon Fuel Cell (DCFC).

"DCFC cuts out the messy process of combusting fuels and harvesting their heat," she explained.

It eliminates the need to combust fuel sources like coal or waste biomass, instead harnessing the power from an electrochemical reaction that is both far cleaner and far more efficient. In fact, DCFC yields over twice as much power as burning coal.

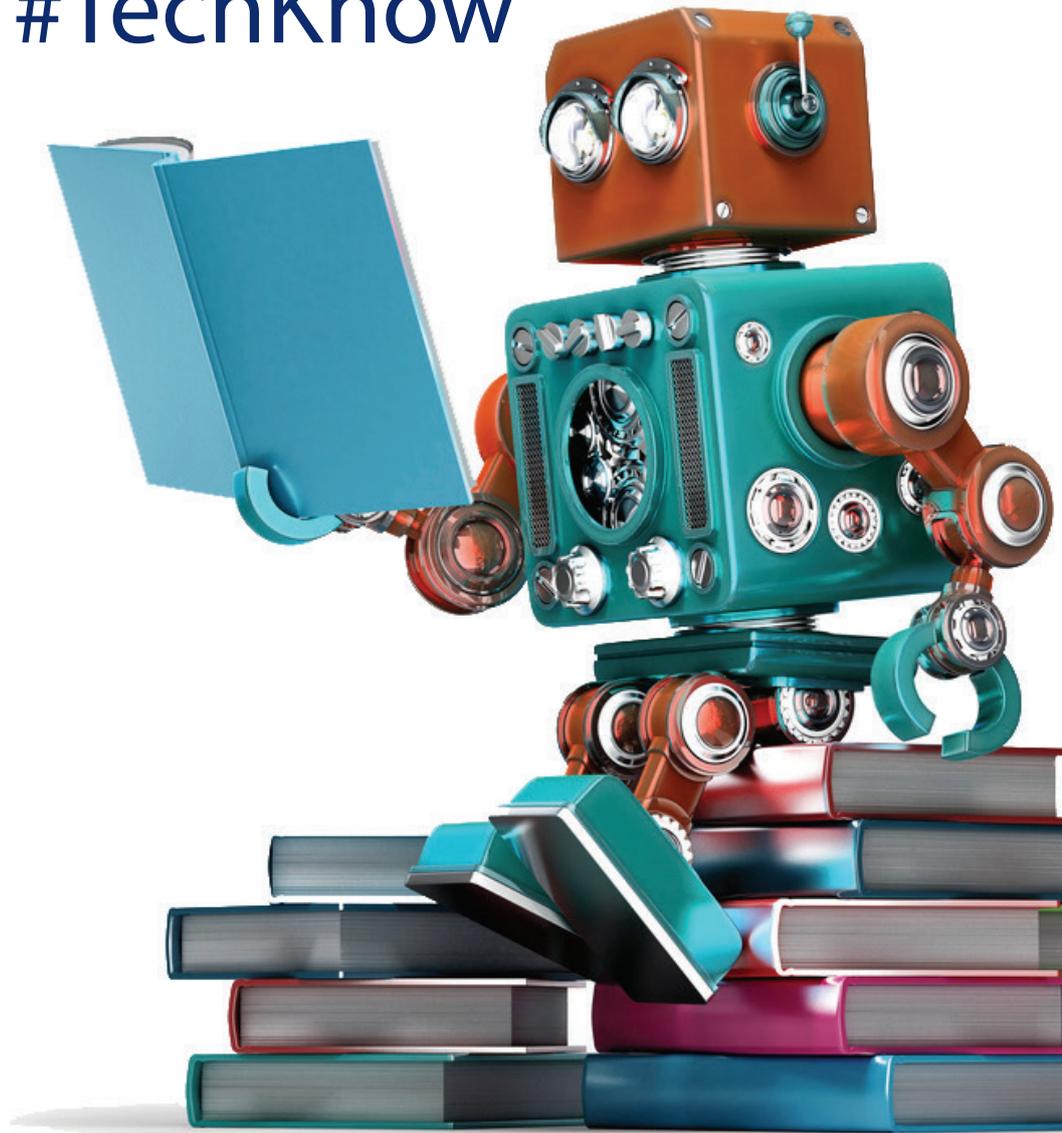
DCFC technology isn't commercially available yet, but its great promise earned Dr Allen and her team a major grant.

They hope to take it to market very soon in countries that rely on coal power such as India, China and Indonesia. There, it will help to greatly reduce the risk of cancer, asthma and other respiratory issues exacerbated by air pollution.

[Learn more at newcastle.edu.au/new](http://newcastle.edu.au/new)

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