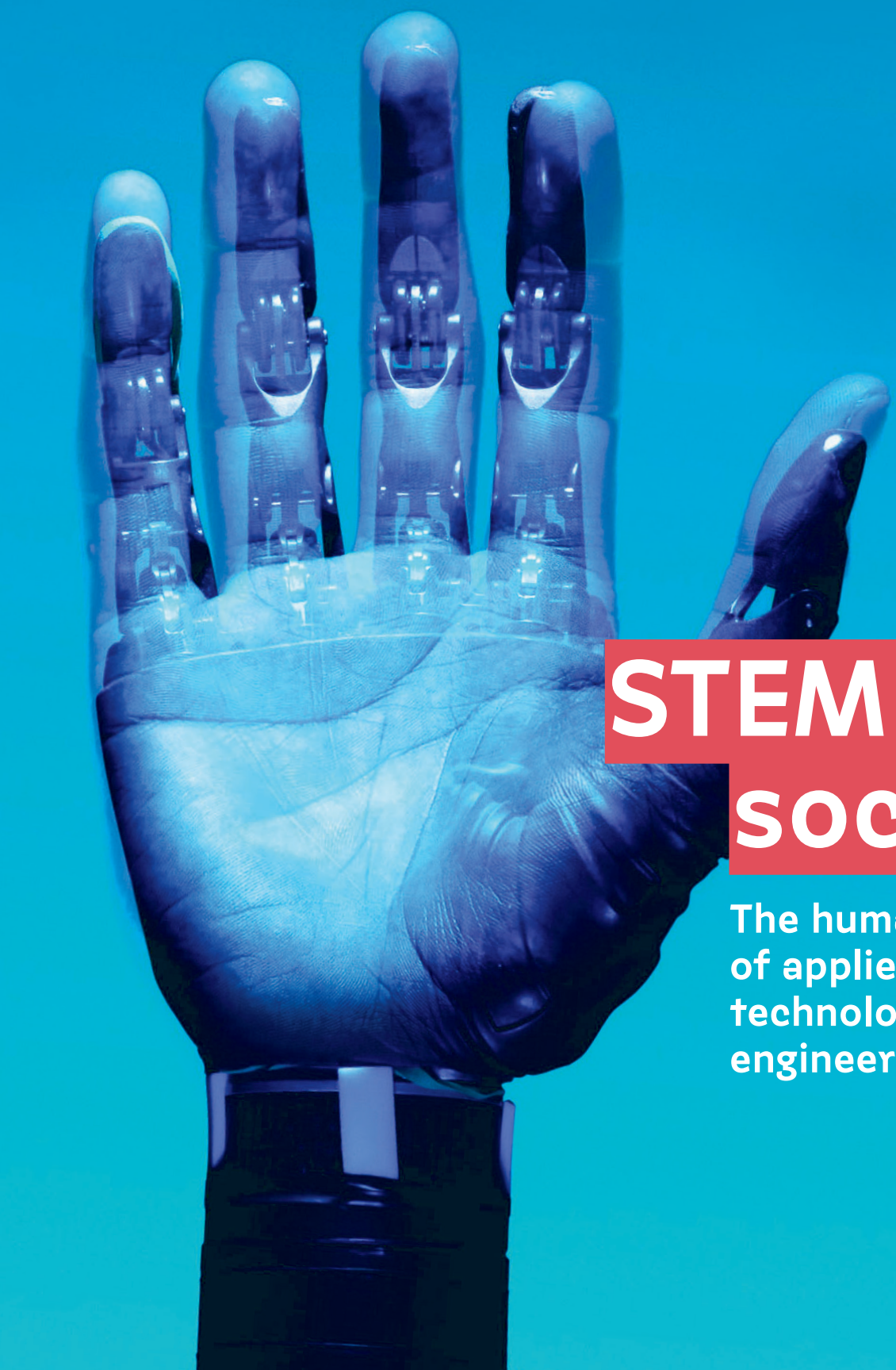
IMPACT
MAGAZINE OF THE AUSTRALIAN ACADEMY OF TECHNOLOGY AND ENGINEERING
ATSE.ORG.AU
NUMBER 212 | 2021



STEM and society

The human side of applied science, technology and engineering

ATSE commits to reconciliation

The Australian Academy of Technology and Engineering is proud to endorse the *Uluru Statement from the Heart*.

The Australian Council of Learned Academies (ACOLA), of which ATSE is a member, issued a response to the statement, which acknowledges that Indigenous sovereignty has never been ceded and emphasises the importance of voice, treaty and truth in the journey to reconciliation.

Along with Australia's four other Learned Academies, ATSE welcomes Aboriginal and Torres Strait Islander peoples' invitation "to walk with us in a movement of the Australian people for a better future".

We recognise that we must do more to acknowledge and understand the deep knowledge held by Indigenous peoples, which has developed over millennia. We commit to the meaningful inclusion of Aboriginal and Torres Strait Islander people, knowledge systems and perspectives in all our work.

We also recognise that throughout our history as a nation, Aboriginal and Torres Strait Islander peoples have often been the target of racialised and exploitative research, and that research institutions have played a role in colonial subjugation.

ATSE will actively listen, learn, reflect and engage, to reconcile with those harmed by this history of systemic injustice.

We commit to helping create a diverse national research culture, free from structural inequity, that supports the needs and aspirations of Aboriginal and Torres Strait Islander peoples.

We are currently developing a Reconciliation Action Plan.

We urge our Fellows, industry, academia, all levels of government and fellow Australians to support meaningful inclusion of Aboriginal and Torres Strait Islander people and embrace real change for the benefit of all.

"As a leader in the STEM sector, ATSE understands the significant role it has to play in reforming structures and assumptions that have often served to devalue the knowledge and aspirations of Indigenous people," CEO Kylie Walker said.

"We are making reconciliation, diversity and inclusion core business and strategic priorities."

Read ACOLA's full response to the *Uluru Statement from the Heart*
acola.org/acola-response-uluru-statement-from-the-heart

Cover photo by
ThisIsEngineering
RAEng — via unsplash

PUBLISHER
Australian Academy of Technology & Engineering
We are a Learned Academy of independent experts. We bring together Australia's leading experts in applied science, technology and engineering to provide impartial, practical and evidence-based advice on how to achieve sustainable solutions and advance prosperity.

ADDRESS
Level 2, 28 National Circuit
Forrest ACT 2603

POSTAL ADDRESS
PO Box 4776
Kingston ACT 2604

TELEPHONE
+61 2 6185 3240

EMAIL
communications@atse.org.au

CEO
Kylie Walker

EDITOR
Benjamin Hickey

EDITORIAL TEAM
Edwyn Shiell
Dr Esa Chen
Liz Foschia
Rebecca Kaye
Mitchell Piercey

DESIGN
Elizabeth Geddes

ISSN
1326-8708 (print)
2207-8223 (electronic)

PRINT POST
Publication number
100007367

DOWNLOAD AS A PDF
atse.org.au

Australian Academy of
Technology & Engineering

FEATURES

NEWS & REGULARS

Why social issues matter for technologists

You have no doubt heard my riff that "progress is indivisible", derived from Nelson Mandela's saying "freedom is indivisible".

I strongly believe that a society cannot have economic and technological progress without scientific and social progress. This edition of IMPACT magazine is devoted to the overdue recognition that technology operates in a societal context.

For example, I am sure many people would rate landing on the moon as one of the greatest technological achievements of the 20th century. However, when the US National Academy of Engineering ranked the 20 greatest engineering achievements of the 20th century, space exploration only ranked 12th.

Perhaps we can explain this with the lyrics of Gil Scott-Heron's song *Whitey On the Moon*:

I can't pay no doctor bill.
(but Whitey's on the moon),
Ten years from now I'll be payin' still.
(while Whitey's on the moon).

The impact of technology on society does matter. As technologists we have to make choices not only about our technology but also its impact. If we abrogate our responsibility for the latter can we truly be leaders in society, (which most of us as Fellows of ATSE clearly aspire to be)?

For example, I visited a laboratory in a totalitarian state where an engineer was working on a ridiculously expensive camera chip. When I queried who would buy the chip and why, he told me that the police would because it enabled them to identify people in the dark.

I often wonder whether he was embarrassed by working on a technology that was propping up a police state.

I am frequently told that our role as an Academy is not to volunteer opinions outside our sphere of expertise, as though being a technological expert somehow deprives you of your humanity.

This is a question of values. ATSE has a values statement which talks about integrity. Integrity begins with the golden rule: treat others as you would like to be treated yourself.

I don't believe you can have integrity if you ignore injustice and brutality in the society in which you live, in the selfish pursuit of your own interests. Where do we draw the line?

I am reminded of Pastor Martin Niemöller's post war confession about the Nazi era:

First they came for the socialists,
and I did not speak out —
because I was not a socialist.

Then they came for the trade unionists,
and I did not speak out —
because I was not a trade unionist.

Then they came for the Jews,
and I did not speak out —
because I was not a Jew.

Then they came for me —
and there was no one left
to speak for me.

For ATSE to be a leading Learned Academy of the 21st century, we need to empower responsible technologists — people who care about what their technological achievements do for our society (eg whether their AI technology improves the lives of their fellow citizens or just increases inequality).

We also need to show leadership and speak out about injustice, inequality, corruption, disinformation, etc wherever we find it. To achieve this we need to embrace diversity and inclusion.

If we do, we shall find the whole is greater than the sum of the parts and that our technological guidance is the better for it. ▶

Professor Hugh Bradlow
FTSE

Hugh Bradlow is the President of the Australian Academy of Technology and Engineering.

Shaping a brighter future through innovation, inspiration and example

Every day, I am privileged to read, hear and learn about extraordinary innovations developed by Australian scientists, engineers and technologists.

Every week, I speak to a Fellow of this Academy who is committed to applying their work to improve the lives of Australians, and people around the world.

Whether by reducing the methane emissions of livestock, creating tiny, powerful and long-living batteries, or turning trash into treasure. Or by pioneering technology to keep patients safer during surgery, protect nationally sensitive information and systems, or turn plastic back into oil. The fact that our Fellows are committed to making the world a better place, is indisputable.

ATSE awardees featured in this edition of IMPACT also show the promise of the future. Their innovations are supporting conscious consumers to be confident in the ethical provenance of their purchases, making power networks safer and more stable, side-effect-free cancer therapy, fire-proof high-rise cladding, plant-based food that appeals to a carnivore's palate and more. These outstanding scientists and engineers speak to the extraordinary potential of Australia's research and development.

The Academy is proud to support the game-changing work of Corey Tutt, the Deadly Science founder who's revolutionising access and achievement in STEM education for Aboriginal and Torres Strait Island children. Read how he's opening doors and extending a hand to the Australian research and development stars of the future, even as he builds pride and visibility for a deep history of engineering and scientific innovation in the world's oldest living culture.

This issue of IMPACT challenges Fellows to look up from the lab, screen, sandpit, paddock and workshop, and connect with colleagues to address some of the deepest challenges and inequities that persist across our society.

How can Australian innovators use artificial intelligence to improve service delivery and education for the marginalised and the poor? What does the shape of our engineering, applied science and technology workforce mean for how investment, application and up-scaling decisions are made? Why might it be useful to support and encourage STEM innovators into politics? What is our obligation, as experts, to not only invent zero- or negative-emissions technology but to advocate for its urgent application, so that our children and grandchildren might enjoy the same immense environmental and biodiverse privilege we have taken for granted?

Fellows featured in this issue pose these questions and others — and propose some solutions and approaches that the Academy, as an extraordinary Fellowship of leaders, should consider. With the collective passion, brains and will of the Fellowship, a cleaner, more inclusive, and higher functioning future beckons. ▶

Kylie Walker
Chief Executive Officer

Kylie Walker is the CEO of the Australian Academy of Technology and Engineering.

STEM & SOCIETY

By Drew Clarke, John Burgess and Rebecca Kaye

Down to zero

How ATSE is helping the tech-led transition to a net zero Australia

The science of climate change is unequivocal, and we're already experiencing its effects on the environment, industry, and everyday life. Humanity must urgently reduce greenhouse gas emissions to escape the worsening consequences of a heating earth.

The recent Intergovernmental Panel on Climate Change (IPCC) report Climate Change 2021: The Physical Science Basis emphasised that this problem is widespread, rapid and intensifying. According to the International Energy Agency, the global goal is a net zero emission economy as soon as possible, and no later than 2050.

With the recent announcement by the Commonwealth Government, all Australian governments have now committed to net zero emissions by 2050.

ATSE's Fellows recognise the action Australia must take and have collectively agreed that addressing climate change is our number one priority.

So what is ATSE doing, and how can Fellows contribute? Here we outline two current initiatives — our position statement on the transition to net zero emissions, and ACOLA's energy transition research plan — and suggest how Fellows can support this critical work.

A bold position

In September, ATSE published a position statement: *Australia's Technology-Led Transition to Net Zero Emissions.* The project drew on the broad expertise of our Fellows and was led by an Expert Working Group from the Energy Policy Forum. We considered the evidence and recommended three key actions the Federal Government should take.

1. **The Australian Government should set a more ambitious interim emissions target for 2030.**

This position is consistent with the IPCC analysis and reflects the commitments of the Australian states and territories, as well as many companies and industries.

Our statement urges the Government to use the November 2021 UN Climate Change Conference (COP26) as an opportunity to outline a national roadmap to net zero emission and more ambitious, technology-led emissions targets for 2030 and 2040.

2. **Australia should prioritise the immediate deployment of existing mature, low-carbon technologies which can make deep cuts to high-emitting sectors before 2030.**

Australia already has the technologies we need to drastically reduce emissions this decade. The path to net zero begins with their widespread deployment. The early priority sectors are electricity generation and transport, which make up more than three fifths of our emissions.

We can accelerate the roll out of key energy technologies like solar and wind right now, supported by more investment in battery and pumped hydro storage to store and secure electricity supply. We can make significant progress in these competitive areas while doing further work for future deployment of emerging technologies like carbon capture with utilisation or storage, and hydrogen.

3. **Australia should develop a national net zero emissions policy and implementation framework.**

Australia has an opportunity to leverage our abundant renewable resources and critical mineral resources to become a global clean technology leader. ATSE calls on the Government to further invest in these mature technologies to achieve this vision.

This technology-led transition will impact all sectors of the economy, communities, and society. At a minimum, Australian needs a net zero policy and implementation plan to give industry, researchers, and communities the support and certainty they'll need.

Building on these three, fundamental themes from the Position Statement, ATSE is embarking on a forward program of work 'Technology Towards Net Zero'. The series of papers and seminars will work to demystify mature and emerging technology opportunities for Australia to get our emissions to net zero as soon as possible.

Researching our energy future

A net zero economy requires a net zero energy sector. Energy currently contributes over 70 per cent of Australia's greenhouse gas emissions, and over 90 per cent of our energy consumption comes from fossil fuel.

The good news is that the energy transition has started. In some areas, like the uptake of roof-top solar, Australia is leading the world. More and better-focussed research can help make our energy transition a success.

In June this year the Australian Council of Learned Academies (ACOLA) published their first report on the Australian Energy Transition Research Plan.

This exciting program is being managed by a Committee of Fellows drawn from Australia's five Learned Academies, including two from ATSE. It's sponsored by CSIRO, the Australian Renewable Energy Agency and National Energy Resources Australia.

The first report presents a strategic research agenda to enable Australia's sustainable, reliable, affordable, and fair transition to a net zero energy system.

The research plan is the product of extensive consultation with the energy sector — industry, research, and government, including many ATSE Fellows. Its scope includes all forms of energy — electricity (from all sources), gas, oil and exported energy products.

Figure 1. Australian Energy Transition Research Plan Priorities

What we found

The initial consultation phase had four key findings:

1. While Australian researchers are undertaking critical and valuable research across all disciplines, there is an absence of a scalable and cohesive research agenda to focus efforts on Australian priorities.

   We need to better align our research efforts with the priorities for a successful transition.

2. While international developments will undoubtedly inform our national pathway, we cannot rely solely on international research to address uniquely Australian problems and needs.

   Our energy system, resources, markets, geography, economy and political system provide unique challenges and opportunities. We need Australian research to focus on uniquely Australian issues.

   A strong local research capability will also give us a seat at the international research table and enable us to adapt relevant international developments to our circumstances.

3. The energy transition is an inter-disciplinary challenge. Australia performs well in science, engineering and technology-related energy research, and ongoing developments in these fields will be critical. However a successful transition must also encompass the perspectives and wellbeing of people, in the context of their lives, communities, economy and employment, in a way that is fair.

   There are significant gaps in Australian research on the social aspects of the energy transition, particularly community engagement and social licence.

   We need to find ways to translate the widespread consumer acceptance of clean energy to community acceptance in regions the transition will impact heavily.

4. All sectors involved in the energy transition, from government, industry, research funders and research organisations, need to respond in a time scale that is reflective of the urgency and enormity of this issue.

   We also need to get better at translating the outcomes of energy research into impact at the policy, commercial and community levels.

Three pillars

From this foundation, ACOLA developed a research plan around three themes.

Energy system dynamics, which encompass:

- the technologies that we will need
- how they will be integrated
- the pathways for their deployment and the associated retirement of legacy systems.

Social engagement dynamics, which encompass:

- the policy and regulatory settings we need for the transition
- how to engage individuals, communities, regions
- how to develop and apply principles of equity, justice, and fairness throughout the transition.

Transition dynamics, which encompass:

- the governance structures we will need
- how to manage the economic, health and social risks
- how industries and employment will be transformed.

Within each of these three themes ACOLA identified three research topics, and for each topic three priority research questions. These 27 high-level priority research questions are classified as either urgent, where we need answers quickly, or strategic, where we need to start work now have the answers we'll need further down the track.

ACOLA is promoting the research plan to energy research funders, agencies and users, and will update the research plan as the transition evolves and new priorities emerge.

Future reports will include analyses of energy research funding and translation, and deeper dives on the three research themes.

How you can help

So how can ATSE Fellows support these net-zero emission initiatives? As our Position Statement says, we're continuing to work with government, industry, research organisations and other Academies to support the transition.

If you're a Fellow, our *Technology Towards Net Zero* series is an opportunity to contribute to more in-depth explanation of the key mature and emerging technologies Australia needs to get to zero. Reach out to the Secretariat and see how you can contribute to a paper or seminar for the series.

ACOLA is also consulting widely on the further development of its research plan. You can help identify future research priorities through consultation drafts and meetings — ask the ATSE Secretariat how to be a part.

Just as importantly, many Fellows will be able to promote the research plan at their government, industry, and research workplaces, or through their professional networks.

We encourage you to lend your voice to the ATSE Net Zero Emissions Position Statement, and the ACOLA Australian Energy Transition Research Plan, and reach out to a Policy Forum and contribute to a *Technology Towards Net Zero* paper or seminar. ▶

TECHNOLOGY TOWARDS NET ZERO

#NetZeroTech

The path to change starts with engagement.


The Guardian
For 200 years

News Opinion Sport Culture Lifestyle More

Environment ▶ Climate crisis Energy Wildlife Biodiversity Oceans Pollution Great Barrier Reef

Climate crisis

'Get on with it': Australia already has low-carbon technology and Coalition should embrace it, scientists say

Technology and engineering academy tells government not to wait for a 'miracle' and aim for net zero emissions now

Donna Lu, Royce Kurmelovs and Adam Morton

Thu 2 Sep 2021 03.30 AEST

▲ The Australian Academy of Technology and Engineering has called on the Morrison government to prioritise existing low-carbon technologies to make deep cuts to emissions. Composite: Carly Earl

Australia's leading scientists and engineers have told the Morrison government the technologies needed to make significant cuts in greenhouse gas emissions already exist – and the Coalition should immediately implement a national net zero policy.

In an explicit response to the government's "technology, not taxes" approach to reducing emissions, the Australian Academy of Technology and Engineering has released a position statement calling on the government to "prioritise the immediate deployment of existing mature, low-carbon technologies which can make deep cuts to high-emitting sectors before 2030".

The academy has also urged the government to set a more ambitious emissions target for 2030 ahead of the Cop26 climate summit in Glasgow, following calls by diplomats, scientists, business leaders, and backbench Coalition MPs Warren Entsch and Jason Falinski.

Drew Clarke
AO PSM FTSE

Drew is chair of the Australian Energy Market Operator (AEMO), a Director of CSIRO and the NBN, and a former Secretary of the Federal Department of Resources, Energy and Tourism. Drew chairs the ACOLA Steering Committee for the Australian Energy Transition Research Plan.

Dr John Burgess
FTSE

With 30 years experience in the energy sector, John is an Honorary Professorial Fellow in Chemical Engineering at the University of Melbourne and was Chair of the CSIRO Energy Advisory Committee 2016–2019. John chaired the ATSE Working Group that developed the Position Statement.

Rebecca Kaye

Rebecca is the Secretariat Project Manager for the Net Zero Position Statement. She a Senior Policy Analyst at ATSE, an accomplished biologist and an experienced Science Policy and Communications Professional.

MORE

MEDIA COVERAGE
The Science Media Centre held a journalist's briefing with Professor Bradlow FTSE, Professor Egan FTSE and Dr Söderbaum FTSE. The report garnered considerable media coverage, including a major feature in *The Guardian*.

atse.org.au/NetZeroTech

Australian Academy of Technology & Engineering

TECHNOLOGY TOWARDS NET ZERO

Transitioning to a net zero economy is one of the greatest technological projects in Australia's history.

Building on principles in our Net Zero Position Statement, ATSE is creating an exciting program of work to support this change: *Technology Towards Net Zero*.

This series of webinars, explainers and primers aims to demystify applied science concepts and innovative technologies that will help Australia reach net zero carbon emissions.

atse.org.au/NetZeroTech

A vital decade

The next steps for Australia's energy transition

Renate Egan
FTSE

Professor Egan is the co-founder Solar Analytics, leads the University of New South Wales activity in the Australian Centre for Advanced Photovoltaics, and represents Australia on the International Energy Agency's Photovoltaic Power Systems Programme. She is also a member of ATSE's Energy Forum working group.

Australia has committed to a technology-led transition to net zero emissions. The timing and steps to get there are the subject of ongoing discussion, but key pointers are already in place to guide when and how we should act.

The good news is we can achieve a lot in the next ten years.

ATSE's recent net zero position statement calls for ambitious interim emissions targets by 2030 on the path to net zero by 2050. It calls for immediate action on the deployment of existing technologies and the development of a policy framework to support the transition to net zero.

We can achieve significant change in the next decade by shifting most of our gas and fuel energy consumption to electricity, and shifting most of our electricity production to wind and solar.

Counting down

In 2020, Australia emitted 499 Megatonnes (Mt) of carbon dioxide equivalent (CO_2-e) greenhouse gas.

To get that down to net zero, we need to find low and no emission alternatives for most of our energy needs, and methods to off-set any remainder.

Most of our emissions — 60 per cent or 300 Mt — come from electricity generation, gas heating and transport.

We're already seeing the positive impact of the low cost of solar, wind, batteries and electric vehicles in bringing this down. Australia's adoption of rooftop solar and home-batteries is world class and a key indicator of where we're headed with electric vehicles.

The sun and the wind

What would it take to have a significant impact on that 60 per cent from electricity, gas heating and transport — and when could we expect to see this transformation happen?

Electricity consumption makes up most of our emissions (167Mt) because 70 per cent of our electricity comes from 24 coal fired power stations. Only five of those power stations were built since 2000 — which means that by 2030, most will be more than 30 years old, and some more than 50!

But if the growth in new solar and wind continues, we could shift as much 80 per cent of our current electricity generation to renewables by 2030. That would slash the need for coal-fired power and remove more than 140MT CO_2-e — a quarter — of our current annual emissions.

Saving money (and the planet)

Gas for home and industrial heating and fuels for transport are the next big opportunity to cut emissions. Together they make up a quarter of our emissions — 133 MT CO_2-e.

The solution is to shift the energy source from gas and fuels to renewably

sourced electricity. This will double our power demand, so we need to grow our wind and solar investments faster than current trajectories.

Evidence says this will be cheaper in the long run, since we can produce energy locally and won't have to buy from or compete with international gas and oil markets.

The capital cost for new equipment, from home heating to electric vehicles to industrial boilers, presents a challenge. But many of these items have ten-to-twenty-year lifetimes, so with the right information and policy direction, we can move a long way towards an all-electric economy over the next decade as items reach their end of life and are replaced.

Leading industrial players are already doing this. Australia's biggest aluminium smelter, Tomago, recently committed to using 100 per cent renewable energy by 2029.

Overcoming barriers

Many of the barriers to these rapid changes are already being addressed.

Challenges with balancing and storing energy from diverse sources are being solved with new electronics technologies as well as short and long-term storage solutions.

The Australian Energy Market Operator (AEMO) is anticipating a rapid change and is readying the market for these deployments.

State governments in Australia have plans for renewable energy zones and network investments to manage transmission and distribution of increasing amounts and diversity of electricity generation.

Getting on target

An ambitious national target for a 40 per cent reduction in emissions by 2030, in line with our international partners, would accelerate our progress. National co-ordination of investments in transmission networks would also help.

We can be optimistic that an ambitious national emissions target can be met. We just need to embrace the opportunity, maintain our momentum on new wind and solar installations, and set a direction for electrification of transport and heating. Federal and State government policy will help, and each one of us can act when we make investment decisions.

Immediate action with existing technologies can slash emissions by 2030 and reduce the burden and urgency on the path to net zero emissions by 2050.

Technologies such as solar and wind are already competitively priced for electricity generation. Power electronics and battery technologies are rapidly improving the balancing, stability and near-time shifting of solar and wind energy — and are also getting cheaper each year.

Plans are well progressed for long-term storage through pumped hydro. Energy markets are adapting, and plans are in place for investments in generation, transmission, and distribution.

Early action and success will inform and instill confidence in future pathways and technology options.

We can make most of our progress toward net zero emissions now with current technologies.

Simultaneously, we need to invest in future technologies like green hydrogen, ammonia generation and carbon capture use and storage to get us the rest of the distance in our journey to a sustainable future for all Australians. ▶

With the right information and policy direction, we can move a long way towards an all-electric economy over the next decade

STEM & SOCIETY

Windfarm in Albany, WA

Right to repair: ATSE strongly supports a legislated consumer right to repair products, as it will enable better outcomes for consumers and reduce environmental impact.

Submissions from the Academy

ACARA Australian Curriculum Review

July 2021

The world is undergoing a period of immense technological, social, economic, and environmental change. The 2021 ACARA review of the Australian curriculum was a timely opportunity to bring Australia's education system into line with contemporary challenges and emerging knowledge in science, technology, engineering and maths (STEM), and school education.

ATSE, together with Engineers Australia and the Australian Council of Engineering Deans, made a submission that advocates for changes to make the Australian curriculum more inclusive to all students. In particular, it calls for Australia to equip schools to build girls' capability and interest in STEM.

The collaborative submission was a headline feature in Campus Morning Mail.

Productivity Commission's Right to Repair Draft Report

July 2021

In June, the Productivity Commission released a 'Right to Repair' draft report that looked at the barriers consumers face in repairing goods, and whether a government policy response is required. ATSE strongly supports a legislated consumer right to repair products, as it will enable better outcomes for consumers and reduce environmental impact.

ATSE's report, *Towards a Waste-Free Future*, emphasises the critical importance of maximising the productivity of finite natural resources by deliberately designing products, systems, and infrastructure to make better use of these materials, including through repair and extending the life of products.

There is huge potential for technology to positively disrupt the waste and resource recovery sector in Australia and the manufacturing sector and support our transition toward a circular economy.

Alix Ziebell, Former Director Policy and Government Relations, presented in-person at the Productivity Commission's Canberra public hearing for the Right to Repair inquiry in July.

Growing industry internships for research PhD students through the Research Training Program Implementation Paper

August 2021

The 2021-22 Federal Budget included $1.1 million over two years from 2020–21 to introduce changes to Australia's Research Training Program (RTP) funding formula to incentivise industry placements for PhD students.

ATSE's submission strongly supports industry internships to increase industry engagement and cross-sector research collaborations.

However, the submission noted the program should be implemented in a nuanced manner to best accommodate the individualistic nature of a higher degree by research, while maximising benefits arising from end-user engagement. ATSE proposed a series of principles to guide the implementation of industry internships via the RTP.

ATSE's submission supported the Australian Council of Graduate Research's (ACGR) response and reflected similar points to The Innovative Research Universities lobby, and the Australian Academy of Science.

Inquiry into the Australian Manufacturing Industry

September 2021

Manufacturing is not just physical fabrication. It begins with research and development and continues through to recovery and recycling. A thriving manufacturing sector can therefore have economy-wide benefits. However, to take full advantage, the right settings and ecosystem need to be in place to allow businesses to flourish.

In response to an Inquiry into the Australian Manufacturing Industry by the Senate Standing Committee on Economics, ATSE had three broad recommendations: a focus on building a STEM-skilled workforce at all levels, leveraging off the economy-wide transformation that decarbonisation will require, and using effective policy levers to boost domestic manufacturing.

ATSE's submission echoed themes put forward in the Advanced Manufacturing Growth Centre's submission.

MORE

Details
Read our recent submissions online at atse.org.au/research-and-policy/publications

ATSE Awards 2021

World-class research putting cancer cells to sleep, preventing catastrophic bushfires and improving the flavour of plant-based food options has been celebrated at the Australian Academy of Technology and Engineering's ATSE Awards 2021.

The ATSE Awards recognise the successful application of Australian research. The work of this year's winners — from a range of fields, including fintech, biotech, engineering and agriculture — has the potential to improve countless lives and build major new Australian businesses.

Awardees include a team of researchers from the Walter and Eliza Hall Institute and Monash University who have found a way of stopping the proliferation of cancer cells, without any of the harmful side effects caused by traditional therapies.

Among the winners are also the inventor of Early Fault Detect technology capable of locating and shutting down potential threats to power grids to avoid them sparking bushfires, and a biochemist who is manipulating yeast strains to provide tasty, sustainable protein alternatives.

ATSE President Professor Hugh Bradlow warmly congratulated all the award winners.

"One of the key objectives of the Academy is to celebrate excellence in using applied science, engineering and technology to create solutions for the betterment of Australian society," Professor Bradlow said.

"The 2021 ATSE Awards highlight the breadth of Australian talent and how it is enabling innovation success stories.

"Our awardees are improving existing Australian industries and creating new ones."

atse.org.au/ATSEAwards2021

CLUNIES ROSS AWARD
ENTREPRENEUR OF THE YEAR

Adjunct Professor Leanne Kemp

Leanne Kemp is a leading figure in the technology sector and recognised internationally as an innovator, entrepreneur and leader. She is the founder and Chief Executive of Everledger.

At Everledger, Leanne Kemp created an independent platform leveraging blockchain technology which provides a secure and permanent digital record of an object's origin, characteristics and ownership across many global supply chains and industries. She invented and patented the technologies which have proven to be a game changer for Everledger, impacting a number of industries helping to build confidence in claims of origin, legality, environmental protections and human rights.

Leanne Kemp has also just completed two terms as Queensland's Chief Entrepreneur where she shared her experience and knowledge with thousands of start-up businesses and SMEs. She is an appointed advisor for the OECD, the United Nations, the World Economic Forum and a Director for the World Trade Board.

CLUNIES ROSS AWARD
INNOVATION

Professor Alan Wong

Professor Alan Wong is an inventor and innovator whose new approach to identifying fire risks in power networks has spawned an international business.

Professor Wong designed and developed Early Fault Detection technology which is able to detect and locate potential threats to power grids, allowing these threats to be addressed before the grid fails, protecting against potential catastrophic outcomes.

Since being patented and introduced to the market, the technology has been taken up by companies in Australia, Asia and North America. It's detected numerous failing high-voltage conductors and prevented potential bushfires and electrocution.

Ninety-five per cent of the Early Fault Detection product is manufactured locally in Victoria, generating high-tech and advanced manufacturing jobs.

CLUNIES ROSS AWARD
KNOWLEDGE COMMERCIALISATION

Professor Anne Voss
Associate Professor Tim Thomas
Professor Jonathan Baell

Professor Anne Voss, Associate Professor Tim Thomas and Professor Jonathan Baell have developed an entirely new approach to cancer treatment that essentially puts cancer cells to sleep, without the harmful side effects caused by conventional therapies.

Cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths in 2020. It kills through unrestrained and abnormal cell proliferation. The team from the Walter and Eliza Hall Institute and Monash University has developed a new class of inhibitors which arrest that proliferation, without causing DNA damage.

The team's discovery has led to a licencing deal with a major pharmaceutical company and a drug that has now entered clinical trials.

Image left to right: Baell, Voss and Thomas

BATTERHAM MEDAL
FOR ENGINEERING EXCELLENCE

Dr Kate Nguyen

Dr Kate Nguyen is an early career researcher whose ground-breaking work is making buildings safer and construction more sustainable.

The 2017 Grenfell Tower blaze in London that claimed 72 lives exposed the dangers of aluminium composite cladding. In the aftermath of the disaster, and in collaboration with industry, Dr Nguyen came up with a light-weight, cost-effective alternative cladding material using ceramic particles that will not combust during a structural fire. She has also developed various nano-based construction products that were analysed in commercial buildings, such as the City Hall in Utrecht, the Netherlands.

She has also quickly established herself as a national expert in advancing the sustainability of fire-resistant construction materials. Partnering with industry, Dr Nguyen has provided a solution for the safe removal and transformation of combustible construction waste into high value, fire-retardant pre-fabricated building materials.

Dr Nguyen is currently the leader of the Innovative Fire and Facade Engineering Group at RMIT University, collaborating closely with some of the major construction partners who are end-users of her innovative research.

ICM AGRIFOOD AWARD

Dr Anna El-Tahchy

Dr Anna El-Tahchy is an innovator and respected bio-chemist who is leading efforts to revolutionise the flavour and sustainability of plant-based food.

There's been an explosion in demand for plant-based food options in recent years but many of the new products lack flavour and an appealing mouthfeel or texture. Dr El-Tahchy has been directly involved in the establishment of Nourish Ingredients (founded by former CSIRO scientists), which has created a new science area to address this need.

Using their proprietary technology, Nourish delivers fat alternatives through the genetic manipulation of yeast strains. Using a fermentation process, these fats can be tailored to exactly match the flavour profile of beef, pork, chicken, seafood and dairy products.

Nourish Ingredients currently employs around 20 people but is growing fast with Dr El-Tahchy responsible for building its team of scientists and driving innovation and opportunities for scale, including partnering with innovative brands and leading food technology organisations to unlock the potential of the plant-based space.

EZIO RIZZARDO POLYMER SCHOLARSHIP

Hayden Robertson

Hayden Robertson's PhD program is improving the current understanding of how stimulus-responsive polymers that are grafted onto a substrate to form a "brush" behave in complex media.

Polymer brushes can be used to coat various surfaces including silicon, gold, metal oxides and other polymers. Because their behaviour can be easily controlled and tuned by the presence of different salts or solvents, they have application in many fields, including targeted drug delivery, lubrication, altering the conductivity of a material's surface and controlling the transport of small particles. They can also be used as anti-fouling agents to keep ship hulls free of contaminants and for organic light emitting diodes in television screens. Improving the understanding of how stimulus-responsive polymer brushes react in different environments is important as it will lead to the deployment of polymer brushes as smart interfaces with tuneable properties.

As well as conducting his research, Hayden Robertson has also acted as a Student Ambassador for the Bachelor of Science program at the University of Newcastle and been part of the university's SMART program, delivering science and engineering shows to the general public.

ICM AGRIFOOD AWARD

Dr Lindsay Bell

Dr Lindsay Bell is a world leader in farming systems research whose innovations have helped dryland crop and livestock farmers manage climate variability.

Dr Bell's research focuses on redesigning cropping systems and re-integrating crops and livestock to more efficiently use highly variable rainfall to increase profitability and reduce losses during droughts.

He has been instrumental in developing dual-purpose canola and designing protocols to help farmers graze their grain crops at a time that reduces the risk of grain yield losses and optimises income from both grain and livestock. His research has shown this system has the potential to increase crop returns by up to 75 percent and farm profits by up to $200 per hectare.

Dr Bell is widely regarded for his communication of science to a range of audiences and his research has been highly cited in scientific and wider literature.

EZIO RIZZARDO POLYMER SCHOLARSHIP

Georgia Hunter

Georgia Hunter is an outstanding PhD student at Monash University with two STEM degrees — a Bachelor of Engineering and a Bachelor of Science — who is working to improve the properties of multi-polymer materials.

She is looking to harness design strategies found in nature and develop numerical models to achieve the most desirable combination of properties. With exciting possibilities unlocked with the advancement in multi-polymer 3-D printing, her research proposal could contribute to the manufacture of polymer materials that are as strong and as tough as natural materials. This has been difficult to achieve using 'conventional' manufacturing techniques.

Georgia Hunter is continuing her passion for STEM not only in her work but also by teaching the next generation of engineering students as a university tutor and demonstrator.

DAVID AND VALERIE SOLOMON AWARD

Dr Luke Djikic

Dr Luke Djukic is an outstanding aerospace engineer who is improving the safety and efficiency of transporting dangerous goods such as highly corrosive chemicals internationally.

Dr Djukic has dedicated his career to growing the Australian advanced composites industry, specialising in research and innovation. During the past five years he's worked as Chief Technical Officer at Omni Tanker and under his technical leadership this Australian enterprise has become internationally recognised for its high integrity, technology-based dangerous goods transport products.

Omni Tankers' thermoplastic-lined carbon fibre composite tank solutions are now servicing Australia, Europe, Northern America, New Zealand and Saudi Arabia in the form of United Nations portable tank containers, swap tank containers and road tankers.

Dr Djukic is a member of a United Nations working group which is developing transport regulations that will have substantial impact, bringing worldwide safety improvements as they permeate international standards.

PRESENTATION

You can watch the ATSE awards show and videos of all our winners on our website:

atse.org.au/ATSEAwards2021

Thank you to our MC Professor Veena Sahajwalla AM FTSE FAA, and to ATSE CEO Kylie Walker, and ATSE President Professor Hugh Bradlow FTSE who co-hosted the ATSE Awards 2021.

ASSESSORS

We are grateful to the following individuals who have volunteered their time to assess the Awards:

Prof Marilyn Anderson
Dr Mary Ann Augustin
Dr Julie Beeby
Prof Simon Biggs
Dr Amanda Caples
Prof Mark Cassidy
Dr Helen Cleugh
Dr Janis Cocking
Dr Peter Coldrey
Dr Ian Dagley
Dr Eileen Doyle
Prof Emer Lindsay Falvey
John Grace
Dr Erol Harvey
Prof Malcolm Hickey
Prof Emily Hilder
Dr Anita Hill
Prof Sandra Kentish
Prof Iven Mareels
Prof Eric May
Wayne Osborn
Dr Brett Phillips
Ross Pilling
Prof Laura Poole-Warren
Prof Timothy Reeves
Dr Ezio Rizzardo
Deirdra Shears
Prof Anne Simmons
Prof Emer Maree Smith
Prof Thomas Spurling
Dr Jenny Stauber
Dr Meryl Williams

SPONSORS

We express our gratitude to the following sponsors and their donations to the ATSE Awards

Go8 Deans of Engineering and Associates
Batterham Medal

ICM Agribusiness
ICM Agrifood Award

David and Valerie Solomon
David and Valerie Solomon Award

Polymer CRC Limited
Ezio Rizzardo Polymer Scholarship

GOLD SPONSOR

Australian Government
Department of Defence

SILVER SPONSORS

CSIRO

Australian Government
Department of Industry, Science, Energy and Resources

Australian National University
ANU College of Engineering and Computer Science

30 years of excellence

Sir Ian Clunies Ross — the first Chairman of the CSIRO — as depicted on the 1973 series Australian $50 banknote.

This year marks the 30th anniversary of the Clunies Ross awards.

The prestigious awards were established in 1991 to promote the development of science and technology in Australia. They've honoured a remarkable group of innovators in the fields of applied science, technology and engineering.

The awards are named in honour of Sir Ian Clunies Ross — the first Chairman of the CSIRO.

A foundation was set up to perpetuate his memory after his sudden death in 1959 and it established the awards in 1991.

In 2002, the Ian Clunies Ross Memorial Foundation came under the control of ATSE and it now administers the awards in three categories: Entrepreneur of the Year; Innovation; and Knowledge Commercialisation.

Who was Sir Ian Clunies Ross?

Sir Ian Clunies Ross was born in 1899 in Bathurst, the fourth and youngest son of two schoolteachers.

By his own account he was a moderate scholar who studied agricultural science at the University of Sydney, graduating with second-class honours.

He went on to conduct pioneering work in veterinary science, particularly in the field of parasitology. But it was as a science communicator and administrator that he made his name.

He played an important part in building the reputation of the CSIRO but also sought to use his experience of science and industry to build a better educated and more diverse society.

The former Chairman of the Australian Broadcasting Corporation, Sir Richard Boyer, described him thus:

"His mind and influence ranged widely over the contemporary scene and could not be confined within any official post, not even one so eminent as the Chairmanship of the CSIRO."

Early awardees

It was fitting that one of the first winners of the Clunies Ross award in 1991 was **Professor Mike Rickard FTSE**.

Professor Rickard developed the first genetically engineered vaccine against a parasite. His research overturned the accepted wisdom of the time that immunity to metazoan parasites could only be achieved in some cases after direct exposure to living parasites.

That year's other winner was **Dr John Gladstones AM FTSE** who became one of the world's leading authorities on lupin as a crop plant.

But he's probably most fondly remembered as identifying the Margaret River region in Western Australia as suitable for viticulture.

The first woman to win a Clunies Ross award was **Professor Susan Serjeanston AO** in 1992.

She had a distinguished career as a geneticist in the John Curtin School of Medical Research at the Australian National University.

Her research concerned the inherited susceptibility to disease and the human immune response to organ transplantation.

A predictor of future Chief Scientists

In seeking to recognise the best of the best, the Clunies Ross awards have been particularly good at picking winners who had the special skills needed to take on the role of Australia's Chief Scientist.

Dr Alan Finkel AO FTSE was recognised in 2005 for his invention of the Population Patch Clamp. This is a device capable of measuring the electrical signals from a single neuron and it aided rapid drug discoveries at pharmaceutical companies.

Dr Finkel went on to become President of ATSE and Australia's Chief Scientist from 2016 to 2020.

Australia's current Chief Scientist **Dr Cathy Foley AO FTSE** received a Clunies Ross award in 2015, along with **Dr Keith Leslie**, on the basis of their development of the LANDTEM device for mineral exploration.

Current crop

This year's recipients represent the breadth of research and technology that is being undertaken in Australia.

The Clunies Ross Entrepreneur of the Year is **Leanne Kemp** who is recognised internationally as an innovator and leader.

She founded and is Chief Executive of Everledger — a company that leverages blockchain technology to provide a secure and permanent digital record of an object's origin, characteristics and ownership across many global supply chains.

"This award means so much to so many," she says.

The Clunies Ross Award for Innovation went to **Professor Alan Wong** who has designed and developed Early Fault Detection (EFD) technology that is able to pick up and locate potential threats to power grids.

"As an academic as well as a CEO, doing research and running a business at the same time is very challenging," he says.

"It is great to have ATSE recognising the innovation behind the EFD technology and the work that I have put in to run a successful and international business."

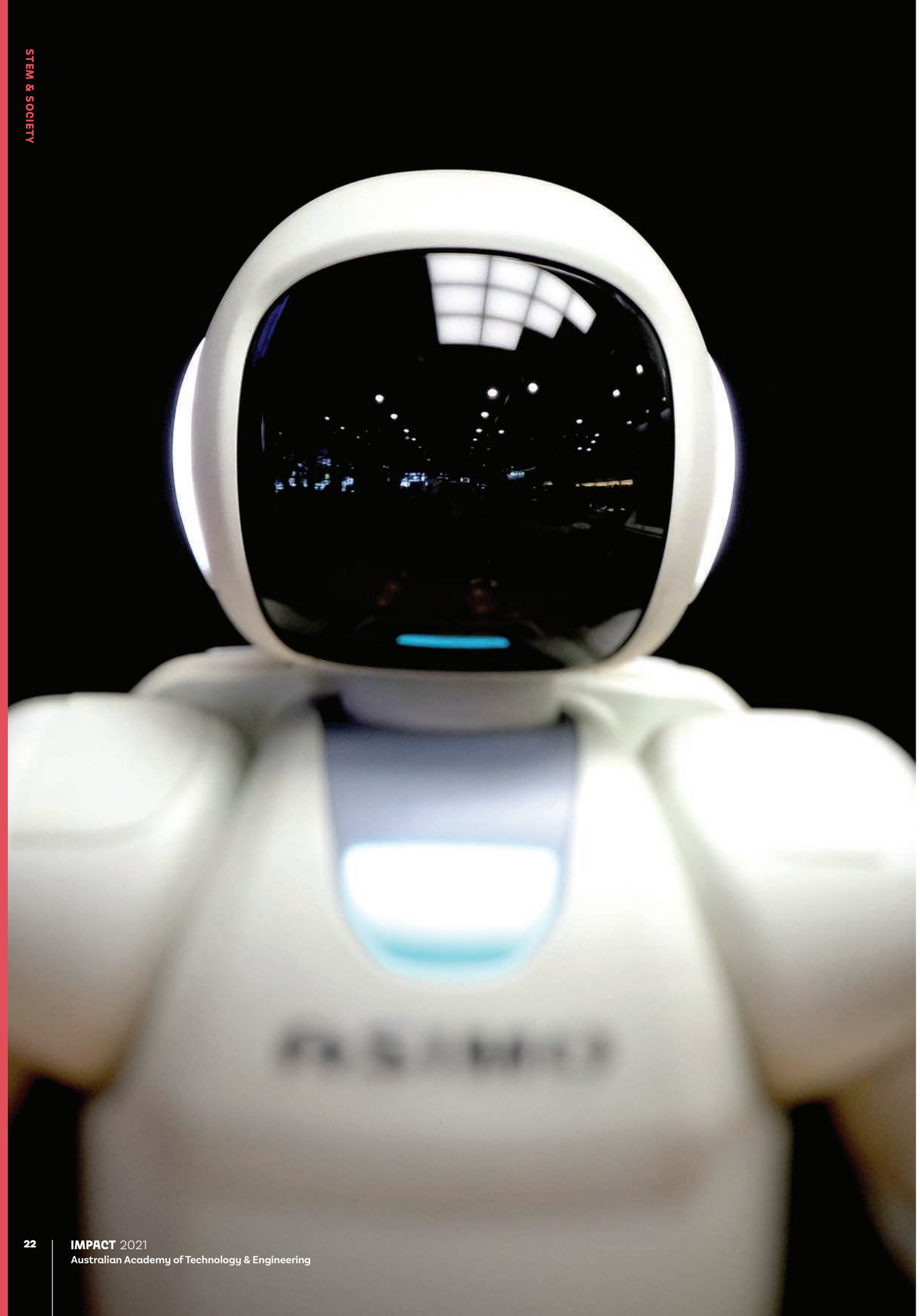
Professor Anne Voss, **Associate Professor Tim Thomas** and **Professor Jonathan Baell** are this year's recipients of the Clunies Ross award for Knowledge Commercialisation.

Along with a team of around 50 people, they developed an entirely new approach to cancer treatment that essentially puts cancer cells to sleep.

"The Clunies Ross award is really lovely recognition of our work, our effort and our persistence to this point," Professor Voss says.

"We started this project over 10 years ago and throughout that time there's often not the recognition because you can't publish initially — that comes at the end."

That sort of persistence and effort is the hallmark of a Clunies Ross Award recipient. ▶



By Shazia Sadiq

The crossroads for Australia's digital future

Shazia Sadiq
FTSE

Shazia Sadiq FTSE is a Professor of Computer Science at the University of Queensland. Her research focusses on data quality and effective information use. Shazia is currently Chair of the National Committee on Information and Communication Sciences at the Australian Academy of Science, and Director ARC Industry Transformation Training Centre on Information Resilience.

The other day, as I walked past my daughter's room, I heard her talking and laughing with someone. I didn't recall any plans for a friend coming over, so I popped in to see what was going on.

She was talking on her phone, and said, 'Mum, want to hear a knock-knock joke'? After telling me the joke, she continued her phone discussion about the origins and evolution of the humble headphone — the topic of a school assignment.

Her funny and knowledgeable friend was Siri. Siri, who many of us know as Hey Siri, is Apple's on-device Artificial Intelligence (AI) powered virtual assistant that uses a natural language user interface to provide answers, suggestions, and links to user queries through conversational dialogue.

The events of the afternoon took me back to one of my first lessons in my computer science undergraduate studies, on the theory of computation and the Turing Test.

This thought experiment by computing pioneer Alan Turing — made famous by the movie The Imitation Game — is a 'test of a machine's ability to exhibit intelligent behaviour equivalent to or indistinguishable from that of a human'. Indeed, the conversation my daughter had with Siri, could easily be mistaken for a conversation with a (human) friend.

Machine or Artificial Intelligence is a rising power that is disrupting and fundamentally changing the way we use technology, improving quality of life and amplifying human capability in the process.

The AI spring?

Those of us who have been in the field of computer science long enough have seen the rise and fall of AI twice before in what is known as the AI Winters.

In the 1950s the Turing Test triggered the first AI boom, which saw advancements in symbolic reasoning and information theory. But limited computational power, data and network capabilities meant growth stalled in the 1980s and 1990s.

The second AI boom emerged in the late 1980s with expert systems, knowledge engineering and a comeback of neural networks. But disappointing results caused a second AI winter in the 1990s.

The current upswing in AI — fuelled by recent successes such as AlphaGo and Jeopardy — are riding on the back of two significant advancements which previous booms did not have:

1. Access to cheap and elastic computational resources: the cloud, high-speed networks and fast processors.
2. The availability of large volumes and variety of digital information, or Big Data.

This makes the opportunities in the current AI boom both promising and sustainable.

Asymmetrical progress

However, progress is asymmetrical. While AI growth for consumer internet companies like Amazon, Google, Baidu, Alibaba and Apple has been

"The other day, as I walked past my daughter's room, I heard her talking and laughing with someone."

phenomenal, other sectors — including manufacturing, finance, and agriculture — have yet to harness the full potential current AI solutions can offer.

Scientific and industry leaders have highlighted a gap between successful AI proof-of-concept and the challenges in putting those systems into production, even though we now have tools (like Machine Learning Operations, or MLOps) that should make building machine learnings systems easier and faster than ever.

There are still fundamental scientific challenges we need to overcome to make AI more accessible to the broader span of businesses and industry sectors.

We need to centre the importance of quality data (not just big data) and develop new talent, methods and tools for Information Resilience.

This means empowering organisations to create, protect and sustain agile data pipelines which can detect and respond to failures and risks across the information value chain where data is sourced, shared, transformed, analysed and consumed.

A human-centred digital society

We also need to develop new knowledge, theories and solutions that give AI systems a human-centred-lens. This is not just essential to winning social licence and trust, but also to ensure AI systems are amplifying the human potential well beyond the benefits (and pitfalls) of automation.

We know that current AI solutions are highly contextualised, and their success lies in specialisation. Just look at precision agriculture, medical diagnostics and digital manufacturing.

The so-called technological singularity or super intelligence — a general-purpose AI problem solver capable of not just specific but all cognitive task — remains an aspirational goal. For now.

Australia has a strong community of early tech adopters, and the COVID-19 pandemic has accelerated our transformation into a highly digitised society. Nevertheless, emerging digital technologies such as AI continue to outpace social expectations and regulatory frameworks.

Unless we invest in the scientific leadership we need to guide the development of these technologies, we can't answer the crucial question posed by former Chief Scientist and Former ATSE President Professor Alan Finkel: "What kind of a society do we want to be?"

The right signals

AI alone could contribute up 15.7 trillion USD to the global economy by 2030. But it is just one of many emerging digital technologies.

The contribution of digital technologies to Australia's GDP is expected to reach $65 billion by 2023. Countries around the world are investing heavily in AI and other emerging digital technologies.

There are some good signs. The Australian Government's Digital Economy Strategy is investing $1.2 billion into key digital capabilities, including funding for artificial intelligence and drone technologies.

The Modern Manufacturing Strategy is further investing some $1.3 billion into key strategic areas of Australian manufacturing to make it more competitive, resilient and advanced.

These initiatives are a welcome signal from the Australian Government that investment in emerging digital technologies is a national imperative.

A digital push

Australia is at a crossroads. Our emerging digital technology research and development is strong. But opportunities for sector growth and sovereign capability are nascent and we need coordinated and strategic support.

With the wave of the global digitialisation, we have a critical opportunity to institute a strategic national approach, supporting fundamental research and engineering to drive innovation in emerging digital technologies.

We need a national vision for innovation and research in areas of national strength and strategic priority. One that is matched by a globally competitive level of commitment and investment.

To pursue and realise a digital future that we hold the reins of, and one that s not imposed on us, ATSE — working with the Australian Academy of Science released a *Australia's Digital Future: A Nation of Users or Leaders.* This Policy Primer outlines three critical recommendations:

Recommendation 1

Elevate emerging digital technologies as a national science and innovation priority.

This elevation would strengthen research and development capabilities and ensure sovereign capability and industry confidence, attract global investment, and catalyse Australia's technology innovation ecosystem.

Recommendation 2

Include research and innovation in emerging digital technologies in the 2021 Research Infrastructure Roadmap

This roadmap will address Australia's emerging research challenges. It is a significant opportunity to elevate the importance of building the scientific capabilities underpinning and enabling Australian innovation and development in emerging digital technologies.

Government infrastructure investment initiatives must recognise the need for investment in cross-cutting emerging digital technologies, independent of particular domain areas, to achieve multi-sectoral benefits. These mechanisms should be internationally competitive and comparable with those introduced by Australia's international peers.

Recommendation 3

Recognise emerging digital technologies as an independent growth sector

Alongside the physical, digital, and economic infrastructure needed to build research capabilities, new and existing funding and investment mechanisms should explicitly include emerging digital technology research. Australia needs to focus on driving collaboration and commercialisation opportunities in emerging digital technologies and improving access to international markets.

We can achieve this by recognising emerging digital technologies as a growth sector in its own right, and promoting it through schemes such as Innovation Connections, a dedicated stream in the Cooperative Research Centre Projects program, and including emerging digital technologies as a cross-cutting theme across Modern Manufacturing initiatives.

Creating the future

To grasp the incredible opportunities the emerging digital technologies sector presents, Australia must also strive to address the digital divide. We need to ensure equity of access to the benefits of digital technologies and meet the skills requirements for a future digital workforce.

Australia's emerging digital technology capabilities must receive this support to remain internationally competitive and ensure that we harness scientific leadership to shape our collective digital future.

In the words of a great pioneer of modern-day computer science, Alan Kay: "The best way to predict the future is to create it". ▶

MORE

Read the ATSE primer
Australia's Digital Future
— A nation of users or leaders?

atse.org.au/digital-future-primer

Diversity and ethics in AI

Dr Cathy Foley

The world is in the midst of a digital revolution. Artificial intelligence, machine learning and quantum technologies are accelerating quickly.

Dr Catherine Foley
AO PSM FTSE FAA

Dr Foley is Australia's Chief Scientist and formerly the Chief Scientist of the CSIRO. She holds a PhD in physics and contributed to the development of white light emitting diodes for low-energy household lighting. Dr Foley has won a multitude of honours, including a Clunies Ross Award, and is committed to tackling gender equality and diversity in the science sector.

These technologies will transform every aspect of our lives, and I am enormously excited about their potential. But we should take great care in the way we move forward.

It's crucial that issues of ethics and diversity top the list of considerations, not only for government but for everyone working in the field of AI and algorithm development.

This is an important area for research and for professional development to ensure that the opportunities opened up by artificial intelligence don't set off unwanted consequences that get away from us. We've all seen where that can lead in the case of social media.

Digital discrimination

Diversity is a crucial part of the equation as we adopt these technologies, for reasons more far-reaching than we often consider. We need to make sure machine-learning systems work with data that reflects the full human experience and treats everyone justly.

If the data used to train the algorithms is only partially accurate, reflects only some parts of our society, or indeed reflects inbuilt structural inequalities, the output will be wrong. This can entrench bias and disadvantage in insidious and unintended ways. It also offends science, where the aim is accuracy.

Skin colour is a case in point. We already know that deep-learning algorithms are poor at identifying the sex of people with darker skin, and especially women. Major facial recognition technologies misidentify darker-skinned women as much as one-third of the time, while correctly identifying white men more than 99 per cent of the time, in experiments at MIT.

Readers might remember the odd results when an AI algorithm tried to reconstruct Barack Obama's face from a pixillated image: he turned out white.

At one level this inaccuracy is obvious. At another it is too often ignored. The approximations that sit underneath any science are well known to those of us who work in scientific fields. But they're not always considered carefully enough when we spin off into practical applications.

Machine learning and human rights

This is why it's important for engineers and researchers to be involved in this conversation at the individual level — engineers are pivotal in designing our processes and systems that turn science into reality.

I know ATSE is active in this space. There is considerable work at the national and international level to strengthen transparency and governance of AI based systems.

The European Union proposal sets out a nuanced regulatory structure that bans some uses of AI, heavily regulates high-risk uses and lightly regulates less risky AI systems.

Earlier this year, the Human Rights Commission released its report on *Human Rights and Technology*, which stressed the importance of putting human rights at the centre.

The Department of Industry, Science, Energy and Resources has released an AI Action Plan, supported by an AI Ethics Framework. It will guide businesses and governments to responsibly design, develop and implement AI.

It's also good to see the focus of our research community on ethical AI and I was pleased to speak at the University of Melbourne's Centre for AI and Digital Ethics, which has launched a new cross-disciplinary program aimed at building the legal profession's capacity to respond to the challenges of emerging technologies.

I hope that all these initiatives will come together for a robust, sophisticated approach.

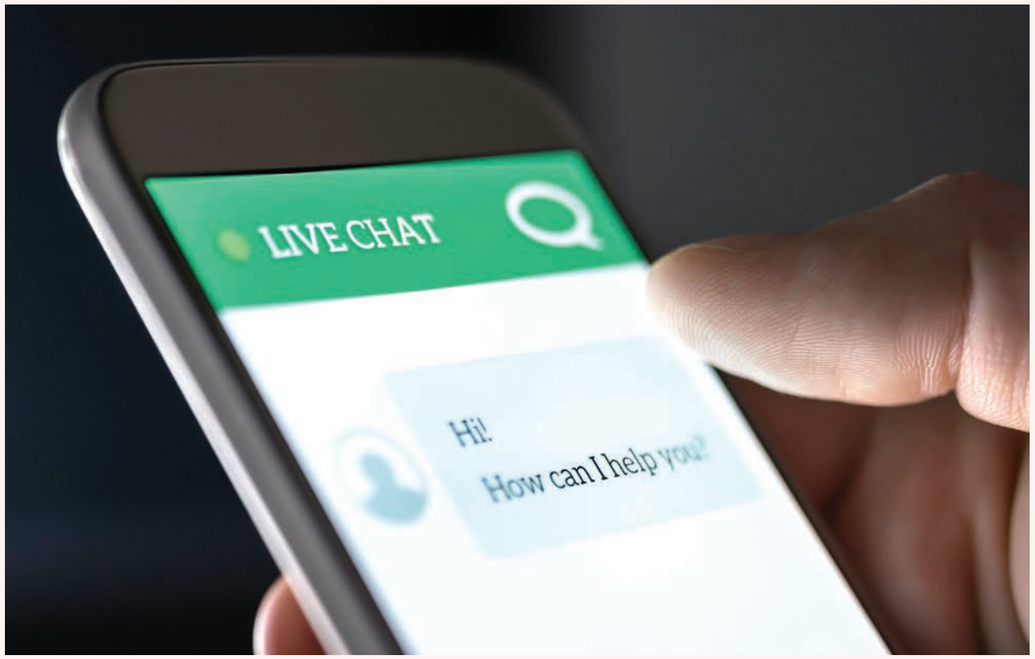
Defective data

One of the problems is that algorithms are learning using flawed datasets — datasets which contain inherent biases because of inequities in our society — in employment outcomes, incomes, crime statistics and so on.

Or they are built on one sector of society, for example where health information gathered from a particular group isn't easily extrapolated to others. An algorithm might be excellent at predicting heart attack survival in men in Sydney's eastern suburbs, but relatively poor at predicting risk in their female partners, or in men from Singapore or São Paulo.

AI can entrench these patterns. It is not only about flawed data; there is also a question around the parameters for learning. What criteria is the algorithm using?

In hiring decisions, for example, we don't jump to the conclusion that men make the best CEOs simply because the data shows that they make up 95 per cent of the CEOs of the top 200 Australian Stock Exchange-listed companies. Whereas we apply our human filter



to the information, the machine learns that CEOs are men.

Breaking the mould

As AI becomes part of our lives, it's imperative that algorithmic approximations don't start to control or define the way we live our lives.

To take the example again of employment, the use of AI to assess job applicants and even to interview them is likely to create new inequities. The well-off and the well-connected are less likely to be employed by algorithms because personal contacts are the currency of the rich.

Job interviews via AI platforms are a surprising and concerning practice. Bias is a long-term and significant barrier for women in the workforce, and I firmly believe that our hiring practices should be broader and encompass a much wider human experience than they have to date.

We need people from different cultural and socioeconomic backgrounds working in science and technology careers. We need people from different academic backgrounds, from the social sciences, to the arts, to design, philosophy and law. Bluntly, we need people who don't fit the mould.

The Human Rights Commission has done a deep dive into how algorithmic bias can arise in the commercial world — where AI systems are using incomplete and historical datasets to make models about the creditworthiness of certain groups of customers. Unsurprisingly, women, Indigenous people and young people are most likely to bear the brunt of the built-in biases.

Out of sight...

In fact, the approximations that surround deep learning are more complex still, because the work that goes on under the surface is not easily discoverable. Once the algorithm starts its work, the method and the steps to land in its final position are not easily available to users.

How do we know it has landed on the most appropriate optimisation point when the learning process is no longer observable? This is what's known as a black box system.

When a human is involved in extracting features for a machine to work on, we know what that algorithm is doing and how it is reaching conclusions. But in deep learning, humans are removed from the equation.

The machine is doing that work, independently identifying and organising data and learning to recognise patterns itself. It does that by a process of simplification and grouping, reducing the datapoints. It is not difficult to imagine how that can amplify inaccuracies.

I'd blush if I could

Chatbots are a high-profile example of flawed learning that have attracted much attention. Trained on internet datasets, they develop what has been referred to as "internet-scale biases".

The use of female voices for chatbots has also been the subject of considerable consternation, and understandably so, given the unfailingly polite, sometimes sexually playful, and always subservient way chatbots and AI assistants are trained to respond, even to inquiries that are abusive or sexist.

UNESCO has addressed this issue in an important report, *I'd Blush if I Could*, named for the response Siri gave to a sexist insult before the system was updated to the more neutral but still worryingly inadequate: "I don't know how to respond to that."

The issue with chatbots is more than entrenching bias and sexism. They are increasingly used in our interfaces with businesses, banks and institutions, even entering the arena of health, but the deep flaws in the way they are programmed to learn mean, as one researcher memorably describes it, that they "hallucinate". They omit information and make things up.

Certainly, humans do this as well, but when machines do it the implications are more serious.

A quantum leap

The solution is not to turn back the clock. On the contrary, I believe that Australia must embrace digital technologies and scale up quickly — understanding there are more on the horizon, including quantum.

These new technologies have significant potential to improve productivity, solve complex problems, improve service delivery and so on. There are immense applications in the medical and other spheres. We have top research and some highly innovative thinking and we need to seize the opportunity now, before we get left behind.

I also, however, want to see an equally urgent and simultaneous emphasis on diversity, accountability, transparency, reliability and safety. Initiatives to address these issues are underway in a number of countries, including Australia. We need transparency in the data and methodologies that underpin AI, and the situations in which is it deployed.

AI systems should reliably operate in accordance with their purpose. We need to consider options for accountability, including human oversight, the ability to identify and hold accountable those responsible for the different phases of the AI system, and think creatively about the auditing of algorithms.

People working in the sector should operate by clear professional standards, and the digital workforce must include social scientists, ethicists and others with insight on these issues.

Diversity across culture, sex, gender, age and life experiences will ensure that we are properly reflected, as a global community, in the emerging technologies. ▶

‘Science gives us hope and education gives us freedom’

How Deadly Science is changing the lives of Aboriginal and Torres Strait Islander kids across Australia.

Interview by Benjamin Hickey

Corey Tutt is a mentor, scientist, proud Kamilaroi man and the 2020 NSW Young Australian of the Year. He’s also the founder of Deadly Science: an initiative that provides STEM books and resources to schools in remote Aboriginal communities.

Corey and the Deadly Science team recently received the 2021 Australian Museum Eureka STEM Inclusion Prize for their life-changing work.

We spoke to him about inspiration, education and how the science sector can do more to empower Indigenous Australians.

You’ve had a pretty adventurous STEM career. You’re the Ambassador for STEM/STEAM at the UNSW Faculty of Medicine and Health, but you’ve also been a reptile wrangler and alpaca shearer. Why does science matter to you?

Science brings us together. If you have a passion and something you don’t quite under-stand, and you want to know more, that’s science.

A great scientist is someone who cares. If you want to be a doctor who cures an ailment causing grief to thousands of people, that starts with empathy. Sometimes we can forget that.

Anyone can be a scientist. Unfortunately, I think STEM is a victim of the past, and we’re playing catch up now. Subconsciously — and consciously at times — we’re still telling Aboriginal and Torres Strait Islander kids that they can’t do science. My mission is to change that.

Thanks to you, over 20,000 books and resources have been shipped to remote schools, some of which don’t even have libraries. Can you tell us about your journey with Deadly Science?

I thought my passion was animals and people, but I quickly learnt that it’s getting kids into science.

It was pretty personal in the beginning. I worked two jobs to fund Deadly Science, including night shifts at a pet hotel. I started sending these books and it went further and further.

It got harder to do everything by myself, so I started a GoFundMe campaign and reached out to people. That was tough because I’m a bit independent and felt shy asking for money and help.

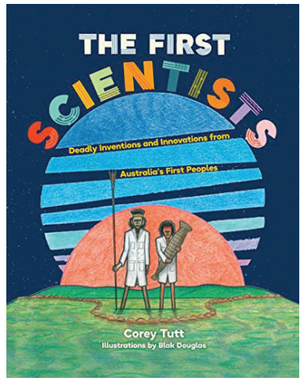
Deadly Science has gone on to mentor and change their lives, which is ultimately what I wanted. I tell young people that it doesn’t matter what road do you take, because you’ll get there in the end.

Sometimes the best news I get all day is a letter from a kid in community telling me that she or he wants to be a scientist. Or a parent saying, “thank you so much for giving my kids this bit of joy.” Or a mum who’s suffered from domestic violence saying, “you’ve given me hope.”

Science gives us hope, and education gives us freedom.

Mentoring is something ATSE also advocates through our IMNIS program. How have you found mentoring, and how have your mentors influenced you?

I never thought that I would ever become a role model, I just wanted to make change. It’s tough because I’ve lived with trauma. I’m 29 years old, but I’ve seen a lot. I never thought that those



Deadly Science has produced a range of science books

experiences would lead me to become a mentor. Being a good mentor is not about being perfect. There are some kids who I can't be a mentor for. But I can get them a book and I can get them access to a STEM professional who can be their mentor. And that's just deadly.

What drives you and where did you get your passion?

I always had passion for lizards and snakes, and other animals. I also had a number of very smart people in my Aboriginal family who have done a lot of good for the community. I've learned a lot off my Pop. In my school life I learnt to never take no for an answer. People told me I couldn't do things based on my race, upbringing, or what they conceived I was like, and I always pushed against that.

A careers advisor said that I couldn't be a zookeeper because I wasn't smart enough. The same person told my sister she should be a hairdresser: she's never cut hair in her life. I'm her younger brother and I would not want her anywhere near my head!

I was pretty stubborn. I left school in Year 10 and went to Western Australia to work at a Wild Sanctuary, which was a crazy place.

There I learnt responsibility for the first time, as a 16-year-old. I had to get up at six in the morning and feed joeys. If I didn't feed them, they died. Simple as that.

Whether it's the professor that tells me that "Deadly Science is a bad idea", I've always just wanted to prove people wrong and overcome those systematic challenges that I've faced.

Aboriginal and Torres Strait Islander people were Australia's first scientists, and the Budj Bim aquaculture system was recently heritage listed as a historic feat of engineering. How can we better embrace traditional knowledge today?

There's a lot of beauty, wonder, love and pride in our culture and our languages. Budj Bim, which you mentioned, and the Brewarrina fish traps, are older than the pyramids.

People should respect these sites and go and see them. We come from a country whose first people invented bread, designed fish traps, and were forensic scientists right up until the 1990s. Even today some police forces still use bush trackers.

ATSE is supporting Deadly Science to improve access to high quality STEM education resources in Indigenous schools.

It's time to stop calling our people only hunter gatherers and realise they were scientists: they studied and observed the land. We should be proud of that, as Australians.

To acknowledge the good, we also need to accept the bad things that happened. Descendants of settlers — and I'm in that boat too, because I've got white blood — need to acknowledge that our ancestors were responsible for heinous crimes against humanity.

To really take away those barriers of race, we have to have the difficult conversations. Sometimes the things we don't want to hear are the beacons that lead us to change.

Dispossession and colonialism have meant that rates of poverty, disease and deaths in custody are still shamefully higher for Aboriginal and Torres Strait Islander people in this country. What more do you think should be done to empower Aboriginal and Torres Strait Islander people?

We've got to start young. We've got to get our young kids thinking they're capable of following their dreams, because they are.

We also need to empower old people as well and listen to them. Our old people are beacons of knowledge, and we need to treat them with respect.

What does the STEM sector need to hear? What's been your experience as a Kamilaroi man in the sciences, and how can we support diversity and inclusion?

The STEM industry needs to let Aboriginal people inside to lead Indigenous programs.

Aboriginal people have a connection to their families and culture, and experience of disadvantage, beyond what non-Indigenous people can understand.

The sector needs to empower Aboriginal and Torres Strait Islander people — people like Karlie Noon or Kirsten Banks — to lead the way.

At the same time, don't burden them with too much work and pay them for their time. If you are doing work with Aboriginal people, you need to consult elders, but you need to pay them for their expertise in the same way you would pay any specialist to work on your project.

You've presented videos for our schools program, STELR. What you think is the best approach for STEM teaching in community, where English might be a kid's third or fourth language?

Hands-on teaching, because concepts may not be broken down in language. We need to make sure they have access to the things they need. If we get kids in community to do science experiments, it's much better to give them a kit where they can do something with their hands.

For kids at Robinson River, English is not their first language. But when they put those lab coats on, they flick a switch, and they are scientists. It takes away from the notion that you have to be a white, middle-aged male to wear a lab coat.

And when they put them on, they get a kick out of it and actually demand to do science. They love it. Language can be a barrier, but science can be an equaliser.

That school entered the Sleek Geeks prizes this year. They didn't make it to the finals, but for me, that's a huge win. How many Aboriginal and Torres Strait Islander community schools have entered the Eureka prizes? I can only think of one!

I want to remove the word "outreach" from our vocabulary. It says "I hold all the knowledge, and I'm dispersing it to them. I'm all mighty and powerful." It's not true at all. The gap is in resources and privilege, not knowledge or capacity.

These kids pick it up quicker than most kids. They have really good practical skills. They respect each other, probably more so than most kids in the city.

How does it make you feel to know you had a role in making that possible?

There are days where I'm hard on myself. I'm driven, and I will always be looking for the next big thing to try and educate our kids. Sometimes it's like quicksand – you try to help, and you find out that there's so much more to do.

I've had a number of occasions where my Deadly Junior Scientists, who I knew really well, have passed away or got into trouble. That's what we put ourselves through when we do this. You can't help but personally affected by it, and it takes time to heal.

It's a tough job. But I would not trade it for the world.

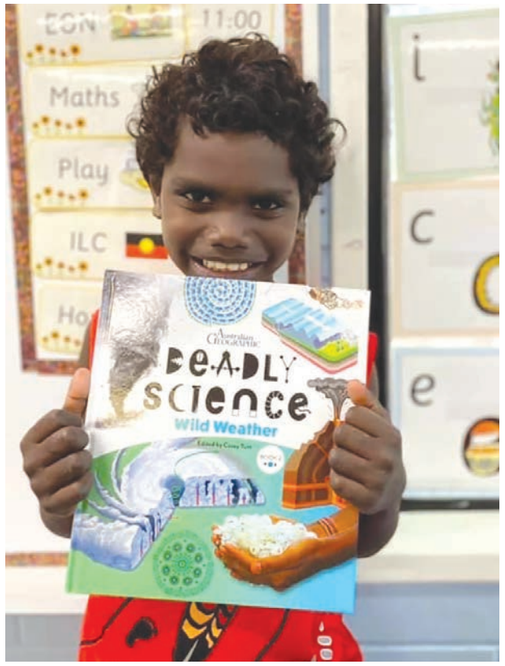
When I see these kids succeed, I'm so bloody proud of them. I've seen kids learn how to read. When you see a kid that you've worked with for four or five years turn into a little adult very quickly it's an amazing experience.

I never thought, when I started this, that it would dramatically impact someone so much that their whole life is probably going to change from this point on.

What's next for Deadly Science, and what's next for you?

We're doing a lot of STEM translations. We're working with Primary Connections at the moment for Our World, Our Stem. We have just obtained DGR (deductible gift recipient) status for Deadly Science, which is bloody exciting.

I've worked hard to make this into an organisation that is for everyone, not just Aboriginal people, and to connect others to our culture.



When people see these Deadly Scientists doing well and cheer them on our kids can feel 10 feet taller, because we don't get enough praise in life. I'm really proud of that.

This thing will outgrow me and be here long after I'm dead, because these kids are in-spired by Deadly Science. We've made science possible. And when you do that, anything is possible. ▶

MORE

Details
Find out how you can support Deadly Science:

deadlyscience.org.au

Images provided by Deadly Science

DEADLY SCIENCE

Crafting Australia's engineering identity

By Elanor Huntington

I was introduced, through the writings of Lewis Mumford, to the idea that technology only goes to scale when a society is ready for it.

Australia in late 2021 is two gruelling years into a global pandemic and staring into the face of a global climate "code red" report from the IPCC and the deteriorating geopolitical climate. We must increasingly look to our own resourcefulness as a nation to secure our future. A key part of that will be our technological strategic autonomy.

While this is not a new observation, we can perhaps use Mumford's idea to pose a usefully different question: "What kind of technology is Australian society ready to take to scale and to the world?"

Reggae, rockets and RAM

To illustrate what I mean, consider the trajectories of three different countries — the USA, the UK and Jamaica — following the disruption of the Second World War.

Citizens of all three countries signed up to serve the Allied effort during WWII. Social mores of the day meant that certain types of people were more likely to be assigned to non-combat roles, which paradoxically meant that marginalised groups such as people of colour, women and members of the LGBTIQ+ community were taught scientific and technical skills they'd previously been denied.

While it's too simplistic to draw a straight line between the two, women were better represented in computing in the UK up until the 1960s than they are now and demobilised RAF veterans returned to Jamaica with electrical technical skills that, as we shall shortly see, proved decisive in later decades.

"Science capital" — an idea which emerges from Pierre Bourdieu's concept of cultural capital — describes the accumulated science-related knowledge, attitudes, experiences and resources a person holds. It includes what science you know, your attitude towards it and how you engage with it every day — as well as who you know.

After WWII, the overall stock of science capital in the USA, UK and Jamaica went up very suddenly. The USA, through interventions such as the GI Bill, increased that even further. So, the conditions of possibility were set for a flourishment of technology in all three countries.

But the three countries went in radically different directions thereafter. The Cold War took the USA down the military-industrial complex, which lead — among other things — to the arms race and the space race, from which many things followed.

The UK took the early global lead in computing. But this was ceded to the USA in the 1960s, partly through ill-fated attempts to nationalise the UK computing industry (which pushed out women in the process) and partly because of Cold War America's voracious needs for computer power.

Meanwhile, in Jamaica, Reggae emerged at the nexus of Jamaica's own existing music traditions, the electrical technical skills of demobilised veterans, and the American music heard from radios in the network of village stores distributed across the country.

The contours of the possible

Standing from our current vantage-point, this story begs two questions. First: what are the conditions of possibility in Australia in 2021?

That Australia has good scientific capital should not be in doubt. We produce three per cent of the world's research while representing only 0.3 per cent of the world population.

Of 1,300 universities listed in the QS world rankings, Australia has 7 in the top 100; and a quarter of all Australian universities are in the top 200. In a little over a century, we have created a wide-ranging and comprehensive footprint of publicly funded research agencies from which global-scale outcomes such as CSL, WiFi and the black-box flight recorder have emerged.

But Australian Business investment in research and investment is at the back of the pack in the OECD — less than a third of that of the top countries.

Research by Industry Innovation Science Australia shows that Australia is underweight in research-led industries compared to other OECD countries.

And the recent industry roadmaps for the Modern Manufacturing Strategy frequently call out the difficulties Australia's industrial and R&D bases have engaging with each other.

This is more complex than the simple rhetoric of insular and elitist academics who need to be prompted out of our ivory towers. To illustrate this, consider one of the quirkier aspects of

Professor Elanor Huntington
FTSE

Professor Huntington is the Executive Director — Digital, National Facilities & Collections for the CSIRO. She was previously Dean of the College of Engineering and Computer Science at the Australian National University and holds a PhD in experimental quantum optics. She sits on ATSE's Governance Taskforce, Diversity and Inclusion committee and Reconciliation Action Plan committee.

Why isn't Australia a global technological powerhouse?

science, technology, engineering and mathematics (STEM) in Australia.

The roadmaps in the Modern Manufacturing Strategy also point to a STEM skills shortage that is inhibiting forward momentum in many of the priority sectors.

This shortage pre-dates the current pandemic-driven pause on skilled migration, and there has been no impediment to Australians choosing to take STEM qualifications to match industry demand.

It's remarkable that a country with such a significant STEM skills shortage would have only three quarters the rate of Canada — comparable in size and economic mix — when it comes to domestic students choosing to take engineering qualifications.

So, while science capital sets some of the conditions of possibility for technology, other factors determine what emerges from that. One such factor is cultural and societal infrastructure: as Goffe puts it, the "networks through which goods, ideas, waste, power, people and finance are trafficked".

Aspiration and inspiration

And so now we come to the second question. What guides where all the ideas that come out of Australia's stock of science capital go, and whether they'll go viral?

Or perhaps more poignantly, why isn't Australia a global technological powerhouse given all that science capital? That, of course, has been the subject of study after study.

One can view many interventions at Commonwealth and state/territory level as being structural attempts to remove impediments to that. Of recent times, these include:

- differentially funding commercialisation of R&D
- the Modern Manufacturing Strategy (MMS)
- changes to R&D Tax Incentives
- direct investment in priority R&D facilities or activities such as mRNA facilities and the Australian Space Agency.

The logic of those interventions is plain. But it's very rational, and one can't help but wonder about the messier human side of things.

Australia's perplexingly rubbery relationship between STEM skills demand and uptake in STEM qualifications should sound a note of caution. The scholars who introduced the concept of science capital did so while also considering inequality of access to that capital and what that meant for lifetime choices.

Scientific and technological skills, the technology of the day, and the socio-cultural infrastructure support people in their aspirations — not the other way around.

I posit that Australia will widen the space for possibility when the faces of those who hold science capital more accurately reflect the faces of contemporary Australia. From there, we might begin to fill in the blank spaces on the question about what kind of technology Australian society is ready to take to scale and to the world.

To that point, I'll give the last word to Clement "Sir Coxsone" Dodd. He was a pre-eminent post-war Jamaican "sound man" and founder of Studio One, which is considered by many to be the cradle of the global phenomenon that is Reggae.

"In America the Rhythm and Blues was kinda fading, dying out. Then came the Rock and Roll. But the Rock and Roll didn't go over strongly in Jamaica. So, about that time we realised we had to really make some music of our own to keep the people happy. So, we went into the studio and started recording...

"When we started, we didn't have an idea this could be a business... We knew it was suitable and we were always trying to satisfy our dance fans and things like that. (We were) innocent we didn't have a clue that these could really work out into something that was saleable." ▶

Why we need more scientists in politics

By Professor Emma Johnston and Kylie Walker

Professor Emma Johnston
AO FTSE

Professor Johnston is the Dean of Science and former Pro Vice-Chancellor (Research) at the University of New South Wales. She is a leading authority in marine ecology and has published over 100 peer-reviewed works.

Kylie Walker
ATSE CEO

Kylie Walker is the CEO of the Australian Academy of Technology and Engineering.

For 16 years, German chancellor Angela Merkel has guided her country through wave after wave of uncertainty, from the 2008 global financial crisis to Brexit, the imperative to drop fossil fuels, and of course the COVID pandemic. Her leadership of the European Union's largest economy has been described as one of assurance and sure-handedness and an anchor amid stormy times, and she has been called "the de facto leader of Europe".

Merkel has outlasted seven Australian prime ministers, and there can be no single explanation for her long stretch of success. However, her career and training as a scientist presents useful insights.

As Merkel declines a fifth term and leaves her office this month, world politics loses another scientist. In Australia we find ourselves wondering, yet again: "Across all our politics — where are the scientists?"

The scientist and the leader

Globally, there have been shining examples of scientists who have entered the world of politics to great success. What are the qualities of scientists that might make them powerful and effective leaders?

Merkel retained many traits that are common among scientists throughout her long political career. She is patient and discerning. She has vision and strategy, and understands the value of planning for the long term. She is rational and empirical. And she builds collaboration and cooperation.

Finally, Merkel is known for drawing a clear boundary around what is known. She does not overstate the facts but, rather, promotes the temporary embrace of uncertainty until the data can be gathered to inform a decision.

Merkel earned her doctorate in the field of quantum chemistry a specialisation within the broad field of quantum mechanics. Widely known for the macabre "Schrödingers cat" thought experiment, quantum mechanics is guiding scientists to discover and manipulate the characteristics of atoms and sub-atomic particles.

For many, Schrödinger's cat mystifies more than it enlightens, but the counterintuitive nature of quantum mechanics in fact reveals the strength of science. By collecting data and developing theory, by following the trail of irreconcilable observations, scientists develop and test models of the world.

And like the greatest scientific models, quantum mechanics predicts more than we can immediately explain. It is a tool that moves past our human shortcomings, of emotion-driven bias and impulse, and allows us to pry at greater truths.

Amid pandemics of viruses and misinformation, a distrust of authority and erosion of meaning, Australia has never had greater need of the tools of science and the qualities of its scientists.

Where are Australia's science-trained political leaders?

Just 17 of the 227 members of Australia's federal parliament have training in scientific, technical, medical or engineering (STEM) fields. That's only 7 per cent.

Australia faces grave threats from many of the world's most pressing challenges: climate change, the biodiversity crisis, pandemic variants, cybersecurity and AI challenges, and anti-biotic resistance.

To meet these challenges, our national decision-makers need to objectively assess complex information, discern fact from fiction, and build collaboration and approaches that will take years, or decades, to fully come into their own.

We also need just and bold leadership with the confidence to adopt and rapidly deploy new technologies to reduce carbon emissions, build new economic sectors, and keep Australia's digital assets safe.

What would a science-led Australia look like?

Can you imagine how things might be different if there were more scientists in Australia's federal parliament? We can.

Australia would have responded to the Intergovernmental Panel on Climate Change "Code Red" report by introducing more ambitious carbon emissions targets, and an infrastructure investment plan to achieve them.

It would have secured Australia's place as a world-class digital economy, growing jobs and wealth and improving equity of access to work, schools and health care for all citizens.

The government would be taking a strong, bold and evidence-informed approach to building our economy, by strengthening investment in research and development. It would provide incentives for others to do the same, generating strong GDP returns and lifting Australia from the bottom of the OECD rankings for government investment in research and development.

Australia would be rapidly building the manufacturing, energy and data infrastructure to fast-track a transition to an economy that generates no waste.

Scientists of Australia, we need you

That science and politics go "hand-in-lab-glove" is no coincidence. Both seek order in a world of frightening complexity. The challenges of the 21st century — from COVID-19 to global warming — appear to be consuming us from the inside out, our national unity deteriorated by misinformation. How can a scientist make change in politics?

Angela Merkel has said her strategy was to take "many small steps" and avoid extreme reforms.

Progress can be made by invoking the rhythms of science (where decades-long projects are commonplace), by making decisions on the best available evidence, by establishing cause and consequence, and by developing and testing our models time and time again. In this way we can benefit from the steady accumulation of increasingly detailed and reliable knowledge.

In just 16 years Angela Merkel transitioned Germany from a 10% renewable energy mix to the world's first major renewable energy economy. She established a net zero emission target by 2045 while making the German economy the fourth-largest in the world by GDP. This is one of many evidence-based changes implemented by her chancellorship and one of the many features of her legacy.

Science arose through necessity, as "a candle in the dark" from the dark ages. We have en-joyed the enlightenment in which science played a major role.

And as new shadows encroach on the world, science can help keep the flame alight. Australia's scientists: we need you. ▶

This piece was first published in The Conversation

STEM & SOCIETY

STEM & SOCIETY

Does carbon capture and storage make economic sense?

By Mark Toner

Above: Collecting a sediment core to assess carbon sequestration rates in the sediment of mangroves.

Dr Mark Toner
AM FTSE

Dr Toner is a management consultant with Toner and Associates and director at Gender Matters. A former CEO of Kvaerner Engineering and Construction Australia (now part of the Worley group), he spent 20 years in industrial process plant design and construction management. He is a member of ATSE's Energy Forum and a fellow of Engineers Australia and the Australian Institute of Company Directors.

The IPCC's 2021 Climate Report states "global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO_2 and other greenhouse gas emissions occur in the coming decades".

Meeting the 1.5°C Paris Agreement target, to which Australia has committed, will require deep cuts in global emissions to reach net zero emissions by 2050 or sooner. Yet progress is slow. Current emission trends will translate into 3°C or greater warming by 2100 if left unchecked.

Rapid decarbonisation, including deployment of technologies such as carbon capture and storage/sequestration (CCS), will be required as we transition to a low carbon renewable future. But do the economics of CCS add up?

Carbon capture and storage (CCS) is a proven technology for dealing with by-product carbon dioxide (CO_2) from oil and gas production. The International Energy Agency reports that CCS facilities around the world have the capacity to capture 40 million tonnes of CO_2 every year so CCS is an important mitigation option.

As a method of lowering CO_2 emissions from coal or gas fired electricity generation, however, the numbers don't add up.

CCS receives wide publicity as an important way to lower CO_2 emissions released into the atmosphere.

As a chemical engineer who has worked in the oil and gas industry, I believe it is important to explain that there are four fundamentally different applications of CCS, two of them economic and two of them not.

CCS TYPE 1

Injecting purified CO_2 into oil reservoirs to improve oil recovery

The first application of CCS is to inject carbon dioxide (CO_2) into underground oil fields to enhance oil recovery. Generally, the injected CO_2 remains sequestered in the depleted oil reservoir, but any escape to the atmosphere is not monitored.

This practice has been employed in North America for more than 50 years and has been profitable in its own right. The CO_2 can be brought in from external sources so, in those cases, it is not strictly CCS in the way the term is commonly used.

CCS TYPE 2

Injecting purified CO_2 into non-producing oil reservoirs

The second application of CCS began in the 1990s for the Norwegian offshore Sleipner natural gas field. The licence conditions prevented the producers (Statoil/Exxon) from releasing to atmosphere purified CO_2 produced as a by-product from treating the raw natural gas to meet sales gas specifications. In this instance, the producers were required to reinject the CO_2 into an isolated non-producing underground reservoir.

Similar licence conditions were applied to the offshore Western Australia Gorgon gas field development in 2009, which is now the world's largest CCS operation.

In both the Norwegian and Western Australian instances, the field producers were able to absorb the additional cost of capturing and sequestering the CO_2 by-product within the overall project economics.

However, even though this application of CCS is proven, it can be difficult to operate. For the giant $54 billion Gorgon project, the operator Chevron has claimed that technical difficulties have prevented it from sequestering a large amount of CO_2 (estimated by others at 7 million tonnes) as required under its production licence. This licence requires Chevron to capture and store only 80% of greenhouse gases coming from the reservoirs and none from gases burned for the considerable amount of energy needed to liquefy the natural gas for export as LNG.

CCS TYPE 3

Removing CO_2 from power plant flue gas

The third and most-discussed application of CCS is to remove carbon dioxide from the flue gas of coal or gas fired power stations to allow them to continue generating electricity for local grids.

Combustion of brown or black coal is inefficient, but as coal has been traditionally cheap to mine it has been the backbone of Australia's electricity generation.

Coal is burned in air to provide heat to generate steam which drives turbines directly connected to electricity generation machines. But since air is 78 per cent nitrogen, which is inert in the combustion process, the flue gas from coal combustion contains dilute CO_2 (typically 10-15 per cent by volume) as well as all the nitrogen.

Unlike the first two applications, which deal with purified CO_2, extensive and expensive processing is needed to separate CO_2 from the flue gas. The additional cost of this equipment (eg for an amine absorption process) and the required pipeline and CO_2 injection facilities have so far proved to be economically unviable.

An alternative to burning coal in air is to install an oxygen plant up front so the coal is combusted in oxygen and there is no nitrogen getting a free ride through the system. Another alternative is to partially oxidise the fossil fuel in a gasifier to produce syngas (CO and H_2).

These last two alternatives produce far less flue gas to process for CO_2 removal, allowing less expensive processing equipment. But oxygen plants and gasifiers are also expensive and, so far, have been uneconomic in this type of application.

I am not aware of any existing CCS operations in coal or gas fired power stations which are close to being economic, even though considerable government research funds continue to be allocated to this application. The need to dehydrate (to prevent corrosion in downstream equipment), compress and pipe the CO_2 to a nearby, suitable underground reservoir could also be a major disadvantage to retro-fitting existing or planning new power stations.

CCS TYPE 4

Direct air capture of CO_2

A new demonstration plant in Iceland is removing CO_2 directly from air, mixing it with water and burying it deep in underground caverns.

The concentration of CO_2 in air is very low (about 400 parts per million), and costs are reported to be extremely high at around $800-$1,100 per tonne CO_2.

Direct air capture may represent a future opportunity for Australia if developed and deployed alongside other mitigation options, yet the present costs are prohibitive.

I am not aware of any existing CCS operations in coal or gas fired power stations which are close to being economic.

— Mark Toner

Above: Direct capture of CO_2 at Hellisheidi power plant Iceland. Credit: Arni Saeberg via Carbfix Iceland ohf.

Clearing the air

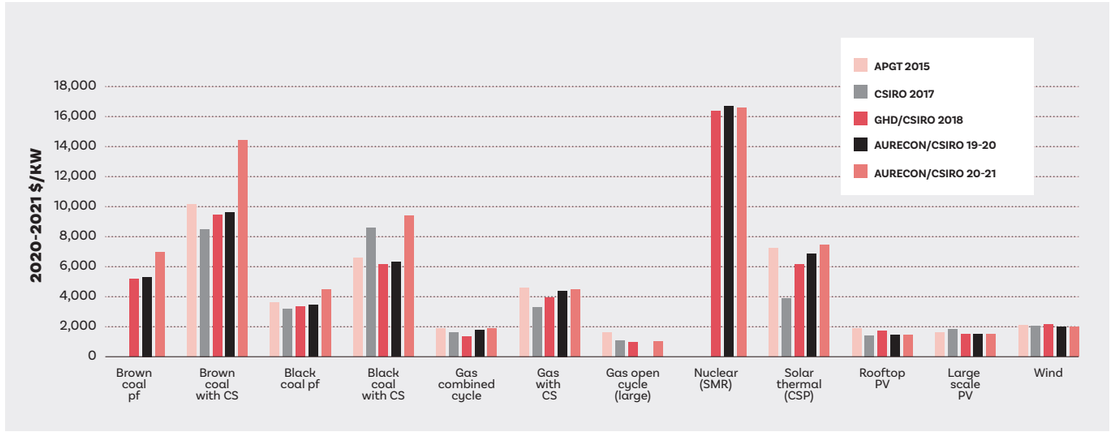
It is important to understand these different applications of CCS, because some people considering CCS for coal fired power stations say that it has been successfully demonstrated elsewhere, eg Norway. But this refers to the second type of CCS: for purified CO_2 from offshore gas production, not dilute CO_2 from power stations' flue gases.

This argument is therefore misleading and confusing for people considering the economics of fossil fired power stations in an environmentally sensitive world.

Finally, in CSIRO's GenCost Report 2020-21 dated December 2020 presents estimates from various reputable sources showing that capital costs of new power stations in Australia with CCS, fuelled by brown or black coal or gas, are all much higher than solar or wind fuelled power stations.

This is in line with a report issued in December 2020 by the Victoria Energy Policy Centre of Victoria University which states: "carbon capture and storage applied to coal generation in Australia can be expected to cost at least six times as much (and quite possibly very much more) per megawatt hour produced as comparably firmed renewable generation. The gap between gas generation (plus CCS) and comparably firmed renewable generation is even bigger".

Despite the poor economics, the current debate about the merits of CCS for fossil fired power stations will continue. In April 2021 the Australian Government announced a further $263.7 million to support the development of CCS projects and hubs. Time will tell if this investment makes sense for the environment and the economy. ▶



CSIRO's GenCost Report 2020-21 dated December 2020

On-demand virtual events

atse.org.au/videos

From the west coast to the Apple Isle, ATSE hosts dozens of fascinating events across Australia every year. Now you can enjoy them from the comfort of your home, whenever you like — for free.

Watch the brightest minds in applied science, technology and engineering explore the critical issues for Australia future, from climate change to the space race.

Climate challenges and the path to mitigation

Presented by the Tasmania Division and Royal Society of Tasmania

The scientific evidence for global warming is unequivocal. To avoid the widespread and dangerous impacts of climate change, strong action is required.

Mitigation responses are critical to reduce the rate of warming in the global climate system. Adaptation responses are necessary to reduce the impact of current and future climate-related stresses and manage future climate change risks.

The ATSE Tasmanian Division and the Royal Society of Tasmania brought together three standout speakers to take the audience on the path from climate crisis to sustainable future.

WATCH
atse.org.au/210623

Advances in Autonomous Technology

Presented by the Queensland Division

Automation has always been front of mind for industry as it strives to streamline, modernise, and grow. Recent advancements in autonomous technologies — driven by artificial intelligence, machine learning and robotics — are helping companies automate tasks and processes on an unprecedented scale.

Catch up with this exciting webinar featuring Dr Sue Keay and Professor Ross McAree FTSE to learn about the applications of advances in AI and robotics, and how autonomous systems are helping to automate Australia's industry.

WATCH
atse.org.au/210707

Australia's International Space Race

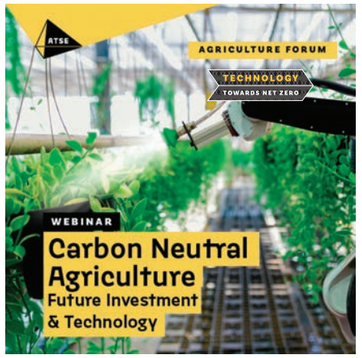
Presented by the WA, SA and NT Divisions

We've been in the race since Canberra's Honeysuckle Creek Tracking Station transmitted the first images of the moon landing back to earth.

Today we are creating a future space communications network using lasers. And along the way we've supported many individuals to have successful space careers here and abroad.

Join Katherine Bennell and Dr Sascha Schediwy as they explore Australia's contribution to international space exploration: past, present and future.

WATCH
atse.org.au/210818



Carbon Neutral Agriculture: Future Investment & Technology

Presented by the Agriculture & Food Forum

This webinar, the third in a series hosted by ATSE's Agriculture and Food Forum, explores the investments and technologies Australia needs to achieve carbon neutral agriculture by 2050.

Governments and industries will need to invest heavily in research and development to support this transition. But could innovations that increase soil carbon be a win-win for both the climate and farmers' bottom lines?

WATCH
atse.org.au/210803

Also watch:
Carbon Neutral Agriculture: Myth or reality
atse.org.au/210515

Disruptive Defence Technologies

Presented by the Victoria Division

Disruptive innovations in the defence domain have a long history of serving national security interests and protecting those in uniform.

The Federal Government has identified the defence sector as one of the priority industries to fuel the economic recovery from the impacts of COVID-19.

Dr Stuart Cannon FTSE and Kristen Raby engage in a great discussion on how disruptive Defence technologies can catalyse growth in a post-COVID-19 economy.

WATCH
atse.org.au/210805

Building public support for science, engineering and technology

Presented by ATSE

Breaking down the barriers between research and the public at large has always been a challenge. Researchers look to gain public interest, support, and trust across the research journey, but the public are exposed to multiple communications channels and some are trafficking in miscommunication.

How are the public supposed to separate fact from fiction and how are researchers to gain the much-valued public support and trust from concept through to accomplishment?

During the COVID-19 pandemic there has been a strong reliance by the public, politicians and media on the advice and research provided by scientific experts. Join our panel of ATSE Fellows who are striving to keep the momentum going.

WATCH
atse.org.au/210804

By Dr Sarah Pearson FTSE

Five ways to create better partnerships

Dr Sarah Pearson
FTSE

Dr Pearson is a leading thinker in industry, academia and government and was recently Chief Innovation Officer and Chief Scientist at the Department of Foreign Affairs and Trade.
Dr Pearson holds a PhD in particle physics and is the author of eight international patents, ranging from cancer diagnosis to novel confectionery.

Previous Department of Foreign Affairs and Trade (DFAT) Chief Scientist, Dr Sarah Pearson, explores why industry, academia, government and community need to collaborate to create a better world.

No matter how hard we try to control the world we inhabit, we can never beat entropy. Industrial, environmental, and social challenges — life itself — seems to be becoming more volatile, uncertain, complex, and ambiguous.

As we adapt to this changing world, enjoying and sharing the benefits of scientific progress will require many eyes, hands and minds.

If we want to encourage emerging industries to flourish, avoid extreme and life limiting climate change, build social structures that work for our children's children, and make sure no one gets left behind, we need to work together.

But for many reasons, we don't collaborate enough, nor as well as we could.

For instance, the divide between industry and research is still challenging for many. ATSE's leading Industry Mentoring Network in STEM (IMNIS) initiative is working hard to bridge that gap.

Here are five things I've learnt about how to create effective partnerships over my eclectic career.

1. Remember it's in the BHAG

The word 'collaboration' has possibly reached its use by date. I prefer 'partnering'. The difference between these ideas is the most important lesson I've learnt in my career: partners need a good reason to work together.

If you can make that reason a *Big Hairy Audacious Goal* — a BHAG — even better. A goal that energises people to keep bringing more to the partnership and keep their focus on where they're going, not any underlying competition.

In IMNIS, this goal is to help industry understand academia, and academia understand industry. Arguably the biggest barrier to partnering is differences in culture. INMIS mentors and mentees understand this and are committed to doing something about it.

The best example of mass partnering with an energising BHAG I've been involved in is the Canberra Innovation Network (CBRIN), set up in 2014. Its aims to diversify the ACT beyond government services and build a more creative economy.

Government asked the community what they wanted to do and encouraged local research and education providers to lead it together. Imagine that: competing universities, TAFEs and CSIRO partnering to transform the economy. Before we knew it, corporates joined in too.

We had all the ingredients in the ACT — great research, a bit of investment, fledgling support programs, a few generous serial entrepreneurs, talent and an engaged government. What was missing was strong connection across the ecosystem, celebration of success, and a movement that drew all of us together.

CBRIN delivered that. The fact that it was transparent, inclusive, and based on an exciting stretch goal drew thousands in to join.

People contributed whatever they could: 3D printers to set up a makers' space, angel capital, mentoring time, legal services, jobs, space and consultation from an Indigenous mob. We planned together, acted together and delivered together.

This led to Canberra being hailed as a 'hotbed of innovation' and the formulation

Opposite: Lake Burley Griffin, Canberra. The Canberra Innovation Network (CBRIN) aims to diversify the ACT beyond government services and build a more creative economy.

> **"BHAG (Big Hairy Audacious Goal)**
>
> **A goal that energises people to keep bringing more to the partnership and keep their focus on where they're going, not any underlying competition.**

of thousands of new businesses and new industries. CBRIN also arguably playing a leading role in the setting up of the Australian Space Agency. Canberra has recently been ranked the third most innovative city in the world.

2. Lead collectively

A leader in a partnership keeps their eyes on the BHAG and understands that it's not about them — its about the community they help build. They work to inspire, connect, and empower others without needing personal fanfare or glory. It's about reaching the goal together.

Collective leadership also means encouraging diversity and inclusion, knowing when to cede space to those who've been denied it. We saw this work well in the CBRIN supported 2015 Griffin accelerator: half of the mentors and four-fifths of the founders were women.

Inclusion is also about supporting others to bring their strengths when they may not see what their role could be. A colleague on a cutting edge-team I led years ago was close to retirement and not that interested in learning new things.

We needed to engage him and so found out what he loved — speaking with suppliers — and used his years of expertise and connections to help find new solutions. He loved it.

As we strive to solve complex challenges, from climate change to social unrest, collective leadership will be key.

3. Combine, don't just compete

As head of Open Innovation at Cadbury I heard a story about partnership I'll never forget.

Two major rivals in the Fast Moving Consumer Goods sector had separate technologies they couldn't bring to market by themselves.

So they overcame brand warfare and joined forces to create a lucrative new range of products with global reach.

These companies had to acknowledge that ideas can come from rivals, small and medium enterprises, researchers, or ingenious people with great ideas in their sheds on the other side of the world.

In a partnership, one party doesn't need to — and shouldn't always — own everything. Partnering means putting silos, egos and competitive behaviour aside for the sake of a bigger outcome.

4. Align your outcomes

Some people find the idea of partnering confronting, because they think it means that they're not enough. If you want people to join in on your partnership, align your goal with theirs.

I faced that challenge with the New Product Development team at Cadbury. How could I, a physicist who turns everything I cook brown, possibly help professional food technologists with their challenges?

My approach was to listen. What problems would the team love to see solved? We set up a list of ambitious challenges — such as the creating the multi-course chewing gum from Willy Wonka and the Chocolate Factory — and went about finding out of the box solutions from around the world, including from university researchers.

Because we aligned everything we did with their needs; product, marketing, and legal teams came on the journey to partner with others outside the company.

I also learned that sometimes it helps to set up partnerships under the radar and prove success before you try to get the whole organisations on board.

5. Understand your limits and the creativity of others

As Chief Scientist and Chief Innovation Officer at DFAT, I had to face fact that the world is $2.5USD trillion short of realising the UN Sustainable Development Goals.

We needed to solve health, education, environmental crises and create jobs to reduce poverty, all at the same time. Talk about a BHAG.

These are issues no-one can address alone. Instead of pushing solutions on to the developing world, we focused on empowering people on the ground who understood problems intimately and could see scalable solutions.

Solutions that would also employ people and bring in income. Solving issues, while also lifting people out of poverty.

The Australian Government didn't need to know all the answers, or even the questions. Our role was to create partnerships with communities, NGOs, entrepreneurs, investors, corporates, other governments, and research organisations to deliver lasting change.

The results speak for themselves. For instance the online platform Ruangguru has educated millions of kids in Jakarta, 40K Plus has brought personalised teaching to kids in Cambodian villages with no internet connection, and Pacific Island Master Chef has significantly improved healthy eating choices, which will in turn reduce disease for thousands of people in the Pacific.

STEM & SOCIETY

Filming of Pacific Island Master Chef. This program has significantly improved healthy eating choices, which will in turn reduce disease for thousands of people in the Pacific. The partnership was supported by the Government of Australia, the Government of New Zealand and produced by Pacific Island Productions.

We could never have created such massive and lasting change on our own.

Again, IMNIS has a role to play in this — mentors with goals for social impact get the chance to partner with mentees aligned to those same goals.

At DFAT we partnered with the World Mosquito Program at Monash University — a great example of government being able to achieve so much more in partnership with the research base.

It feels like an age ago that our country suggested we should get better at 'collaboration'. I'd like to see us learn the lessons and build global best practice in partnership here in Australia.

Maybe we need something like the UK's InnovateUK or Catapult Centres, but more attuned to our Australian ingenuity.

I believe our human capacity for partnering, coupled with amazing technological advances, is our best shot of tackling the ever-growing entropy of our challenges.

Maybe that's something we can keep pushing through this partnership we are part of: our wonderful ATSE Fellowship. It's certainly key to the vision of IMNIS. ▶

IMNIS CATALYST STELR

Taking students beyond the lab

By Camille Thomson, STELR National Program Coordinator and Sarah Crowe, IMNIS Project Administrator

In National Science Week this year the Australian Academy of Technology and Engineering launched REDI Careers: Beyond the Lab, a new schools engagement initiative designed to inspire the next generation of scientists, technologists, and engineers.

It's the first collaboration between IMNIS (Industry Mentoring Network in STEM, connecting PhD students with senior industry leaders) and STELR (hands-on secondary school science and technology education).

In the webinar series, IMNIS Catalysts — alumni mentees who have been selected as STEM ambassadors — answer audience questions and discuss their non-traditional career pathways with STELR Acting Director Camille Thomson.

Beyond the Lab allows Catalysts to apply the science communication skills they develop during their one-year ambassador program. A key element of IMNIS Catalyst is to engage with STELR students in Years 8 to 12 around Australia and share how their career goals have changed since High school.

IMNIS Catalyst and engineer **Dr Fatematuz Zohora** shared how even as a child she felt destined for a STEM career.

"I was a very curious kid and used to ask a lot of questions. Now as a researcher I can ask a lot of questions and find the answers... I am passionate about new learnings."

When IMNIS Catalyst and data scientist **Dr Greg Bass** was asked about what he enjoys most in his current job, he said:

"My job is figuring out how to design a tool, method or algorithm that answers some pressing biological or biopharmaceutical question. Often, I am working to understand how well a drug is going to work for patients, with the hope that ultimately it will lead to therapies for those who most need them.

"The problems I solve as a data scientist at CSL are interesting in themselves but at the end of the day, knowing that my work directly impacts the health of patients around the world is really motivating."

Catalyst **Dr Edith Botchway** grew up in Ghana. Mathematics had been her favourite school subject and she had considered becoming an economist before deciding in university to pursue a career in neuropsychology.

"I was keenly fascinated by the human brain and all the interesting things we can learn about it. More importantly, I was inspired by how my knowledge in this field could help children in my society who had neurological conditions," Dr Botchway said.

Now Dr Botchway is an Associate Research Fellow at Melbourne's Deakin University.

"I love that my research contributes to improving sleep and neurophysical outcomes in children with neuro-developmental conditions.

At the end of the event, IMNIS Catalyst and data scientist **Dr Samantha Papavasiliou** had some words of advice for the school students:

"Be kind to yourself: high school is tough. You learn a lot in a short period of time and it's ok to be overwhelmed by how much you learn and to not know what you want to do or where you want to be."

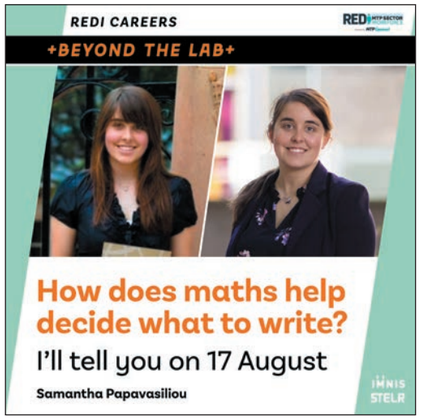
Students were highly engaged with the presentations and posed some challenging questions. All the webinars have been recorded and will be made available to 860 schools on the STELR channel, so all students and teachers affiliated with ATSE's programs have access to these talks and discussion.

ATSE is committed to fostering and inspiring a mobile, highly skilled STEM workforce drawn from all sectors of the community and this program helps the next generation understand the diverse career paths possible through a STEM qualification.

The success of this new collaborative initiative provides a strong foundation for STELR and IMNIS to develop and expand Beyond the Lab as new IMNIS alumni are selected for the Catalyst program in 2022.

IMNIS Catalyst is supported by MTPConnect's $32 million Researcher Exchange and Development within Industry (REDI) initiative made possible by the Medical Research Future Fund.

REDI DEVELOPING AUSTRALIA'S MTP SECTOR WORKFORCE



Above: Social media posts targeting high school students

Supporting STEM in underprivileged schools

The Academy of Technology and Engineering is proud to announce that in the 2020-21 financial year it helped 48 schools around Australia with limited funds gain access to high quality STEM teaching resources.

ATSE's school education program STELR (Science and Technology Education Leveraging Relevance) produces a range of curriculum modules — supported by Australian-designed kits — to facilitate hands-on, inquiry-based learning and foster a passion for STEM. Over 800 schools are engaged in the program.

Last financial year, a quarter of STELR kit sales were able to be subsidised because of the generous support of corporate partners, grant programs and donations.

Schools who are benefiting from the program are in every state and territory of Australia, including a significant number from remote and regional areas.

We would like to thank the following partners:

- **Australian Power Institute for supporting the API Solar Car Challenge**
- **Australian School Canteen Association**
- **Baxter Charitable Foundation, through the Perpetual IMPACT Philanthropy Program**
- **CIGRE Australia**
- **James N Kirby Foundation**
- **IXOM**
- **Motorola**
- **Orica**
- **ATSE NSW Division**

For more information about supporting schools through the STELR program, please email stelr.admin@atse.org.au

STELR

The STELR (Science and Technology Education Leveraging Relevance) Project is an in-school initiative of the Australian Academy of Technology and Engineering. Now in over 700 schools across Australia and the world, STELR delivers hands-on STEM teaching modules which focus on student-relevant issues like climate change and sustainability.

stelr.org.au

In April 2021, we were pleased to welcome to the ATSE family the world-class Computer Science (CS) in Schools program.

Coding Australia's future

CS in Schools is a free program that helps secondary schools build a robust digital technology capability in both teachers and students and aims to set the standard for computer science education nationally. Prioritising education for girls and regional schools, it matches computing professionals with teachers, helping them develop their coding skills in the classroom and providing innovative lesson materials.

By the end of June 2021, CS in Schools was in 42 schools and it officially became a national program. The program recently added Plumpton High School in NSW and Melba Copland Secondary College in the ACT to reach that milestone. The program is working with 150 teachers and over 9,000 students this year, a doubling in the program's size since 2020.

CS in Schools has an ambitious growth plan and is on track to be active in 64 schools by the end of the 2022 school year.

ATSE is grateful to the CS in Schools co-founders, Hugh Williams, Selina Williams and Kristy Kendall, whose continuing generosity, time and expertise are crucial to the success of this important program.

CS IN SCHOOLS

CS in Schools is creating sustainable change in Australian digital technology education. It helps schools create relevant and meaningful education by building industry connections with schools, providing a complete DigiTech pathway for all secondary students, and developing teacher confidence to teach digital technology.

csinschools.com
csinschools.io

Industry mentoring goes global

ATSE has launched a new program to help Australia's future leaders in science, technology, engineering and maths to connect with industry around the world.

The IMNIS International program will connect five outstanding PhD students at the vanguard of innovation in health technologies, agriculture and renewable energy with leading international experts to boost their career trajectories.

Industry Mentoring Network in STEM (IMNIS) is ATSE'S flagship industry engagement program. IMNIS has partnered with MTPConnect's Researcher Exchange and Development in Industry (REDI) initiative for this exciting expansion.

ATSE CEO Kylie Walker said IMNIS International will grow Australian awareness of STEM industries across the world, foster a deeper understanding of Australia's position, and forge global networks for our future leaders in STEM.

"ATSE is proud to create this opportunity for Australia's future STEM leaders to learn about international operating environments and promote inter-cultural competence, global awareness, and understanding," Ms Walker said.

"By connecting IMNIS mentees with international mentors, we're providing a unique industry engagement and professional development experience."

The five IMNIS International pilot mentees were selected through a competitive process. They are shown opposite.

REDI DEVELOPING AUSTRALIA'S MTP SECTOR WORKFORCE

IMNIS

The Industry Mentoring Network in STEM (IMNIS) is an award-winning industry-led initiative of the Australian Academy of Technology and Engineering. IMNIS connects motivated PhD students (mentees) in science, technology, engineering and mathematics (STEM) with outstanding high level industry leaders (mentors) in a one year industry mentoring program.

IMNIS provides Australia's future STEM leaders with the opportunity to engage with industry, extend their professional network, strengthen their implicit skills and get advice from an influential industry mentor. Student mentees learn what it takes to succeed in any part of the STEM ecosystem, gain a better understanding of how industry works and learn about career opportunities in other professional sectors.

imnis.org.au

MENTEES

Meysam Khodaparast Afarmajani
is a PhD candidate at La Trobe University. Meysam's PhD project explores rapid in-field detection of pathogens in wastewater.

Joanne Coyle
PhD candidate at Monash University. Joanne's research focuses on the relevance of certain protein sequences for liquid-liquid phase separation (LLPS).

Joao Mendes
PhD candidate at RMIT University. Joao's research is focused on solar energy.

M Arifur Rahman
PhD candidate at UQ. Arif is examining the immunopathology of mucosal tissues during chronic inflammatory and infectious diseases.

Devi Jenika
PhD candidate at The University of Melbourne. Devi's PhD investigates the potential of nanoparticles as vaccine carriers.

MENTORS

Dr Michael Zalunardo
Genetic Sciences Senior District Manager, North America with Thermo Fisher Scientific.

Dr Linda Somerville
Consultant for the UK Govt Innovation Agency (Innovate UK).

Dr Despina Anastasiou
Global Marketing Director, Growth Platforms with Dow Europe GmbH.

Dr James Rush
Global Director New Products with Novartis Pharmaceuticals AG in Switzerland.

Professor Bobby Gaspar
CEO of Orchard Therapeutics in the UK.

STEM CAREER PATHWAYS

Global
Connections
Fund

TechNOW podcast

Looking for some interesting listening? ATSE's new podcast series explores ground-breaking research and innovation that has been made possible through the Global Connections Fund. The fund — which is run by ATSE and supported by the Australian Government — provides crucial initial funding to catalyse collaboration between Australian researchers and international small to medium enterprises.

In each episode of TechNOW you'll hear how those collaborations are helping deliver everyday technology that is shaping the future: from an app that can help heal a broken heart, to sensors that monitor power flow through electricity grids in real time, to new blood tests that can individually tailor cancer treatment.

atse.org.au/technow

Dr Anna Hatton
Senior Lecturer, Physiotherapy
University of Queensland

Smart soles help diabetics take safe strides

Around one in 20 Australians suffers from diabetes, and the consequences can be serious. High blood sugar can damage crucial nerves and blood vessels in the toes and feet, making it harder for people with diabetes to walk safely.

But University of Queensland physio-therapist Dr Anna Hatton and UK-Danish health tech company Work With Path have designed a groundbreaking new technology to help diabetics better negotiate the road ahead.The app-controlled vibrating insoles, which contain custom-printed circuits allied with a range of sensors, provide robust and reliable feedback to wearers who are no longer able to rely on their own nervous systems.

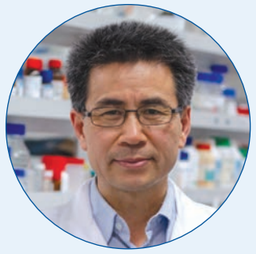
A/Professor Nicole Freene
Physiotherapy
University of Canberra

Phones and fitbits for healthier hearts

Heart disease is the leading cause of death in Australia. It claims 21 lives every day, and those who do survive heart attacks can take months to recover.

That's where University of Canberra physiotherapist Associate Professor Nicole Freene comes in.

In collaboration with Netherlands health technology design firm ONMI B.V, she's developed an app-based exercise program designed to improve the health of older people at risk of a repeat heart attack.



Professor Shanlin Fu
Centre for Forensic Science
University of Technology, Sydney

An on-the-spot test to stop overdose deaths

The number of Australians who die from unintentional drug overdose continues to rise every year.

Treatment can be complicated because it's not always known what substance has been taken. And there are new synthetic drugs hitting the streets all the time.

Imagine the benefit of a test that could quickly and accurately identify which drug is present. That's the life-saving tech Professor Shanlin Fu from the University of Technology is making a reality.

This round of the Global Connections Fund was part of the Global Innovation Strategy in the National Innovation and Science Agenda.
The program was administered by the Australian Academy of Technology and Engineering with the support of its expert Academy Fellows network.

Associate Professor Charlotte Conn
Research & Innovation Portfolio, RMIT

Breathable treatment for drug-resistant TB

COVID isn't the only pandemic threat we face. The infectious disease that killed the most people in 2018 wasn't malaria or HIV: it was tuberculosis.

Because of antibiotic resistance, a growing number of TB infections can't be cured by current methods. Rising fever, chest-pain, coughing up blood — without new treatments, this ancient sickness could become a future crisis.

But what if we could treat antibiotic resistant TB with a new drug delivered straight into the lungs by an asthma-puffer style device?

Thanks to new technology developed by Associate Professor Charlotte Conn, her team at RMIT, and their collaborators in India, this dream cure could become a reality.

Distinguished Professor Andy Ball
Director, Centre for Environmental Sustainability and Remediation, RMIT

Using human waste and native plants to restore contaminated mine sites

Australia's 60,000 abandoned mines range from poisoned goldrush-era mine shafts to huge, open-cut wounds on the natural landscape. Many pose grave threats to the health of our community and environment. But what if we could turn these mine sites back into thriving ecosystems, and deal with a major waste problem at the same time? Biosolids are the organic matter left over after sewage has been treated. Distinguished Professor Andy Ball, his team at RMIT and collaborators in India are turning this unappealing waste stream into a special kind of charcoal that could revolutionise mine restoration.

And in another incredible innovation, they're using native plant species to remove toxic contaminants from the environment.

Dr Jessica Duarte
Research Fellow, Olivia Newton-John Cancer Research Institute

A new test to tackle ovarian cancer

Most of us know someone whose life has been touched by ovarian cancer: it kills over 100,000 people each year and affects millions more.

But an Australian-invented blood test is giving us revolutionary insights into the differences between separate ovarian tumours. This could lead to life-saving early screenings and new treatments tailored to individual patients.

Dr Jessica Duarte from the Olivia Newton-John Cancer Research Institute and Adjunct Professor Els Meeusen from Federation University have worked with collaborators in Japan to create new ways to understand ovarian cancer at the immunological level.

Professor Heike Ebendorff-Heidepriem
Deputy Director Institute for Photonics and Advanced Sensing (IPAS),
University of Adelaide

Hollow glass fibres making lasers sharper

Once the stuff of science fiction, Carbon Dioxide lasers are now crucial to soft-tissue surgery and next gen manufacturing. But a laser is only as good as the glass fibre that carries it.

Professor Heike Ebendorff-Heidepriem from the University of Adelaide is developing a revolutionary new type of glass fibre to make the laser beams more efficient.

Dr Elizabeth Ratnam
Future Engineering Research Leader.
Battery Storage and Grid Integration Program, Australian National University

Associate Professor Lachlan Blackhall
Entrepreneurial Fellow and Head of Battery Storage and Grid Integration Program,
Australian National University

The power-flow tech revolutionising solar

Australia is one of the sunniest continents in the world, so it's no surprise Australians have embraced solar energy to cut their power bills and slow down climate change. One in five homes now has rooftop solar panels.

But all that extra energy being fed into the grid can be tricky to manage. Our infrastructure wasn't built for electricity to move in two directions. It's not impossible for electricity to flow backwards, but it must be managed or transformers can become saturated.

Dr Elizabeth Ratnam and Associate Professor Lachlan Blackhall have come up with a revolutionary new way of better monitoring power flow through electricity grids.

Global prize inspiring better STEM communication

A video detailing ground-breaking work to supply remote communities in Australia with fresh drinking water was a finalist in a global competition aimed at inspiring a new generation of technologists and engineers.

The International Council of Academies of Engineering and Technological Sciences (CAETS) has established two annual Communication Prizes to encourage STEM leaders to think more about engaging with the public about the significance of their work.

The Australian Academy of Technology and Engineering is a founding member of CAETS, which is made up engineering and technological science academies from more than 30 countries and six continents. ATSE was tasked with judging the Australian entries and choosing a finalist to compete against those from other countries.

The successful Australian video entry about Project Gilghi, submitted by Aurecon CEO William Cox FTSE, details an initiative to supply remote communities with energy-efficient, transportable water purifying treatment plants.

Project Gilghi is a solar-powered water treatment plant that can fit into a shipping container, so it can be easily transported, set up and be operational within just two to three days. The project is guaranteeing long-term water security and environmental benefits for remote Indigenous communities.

ATSE President Hugh Bradlow congratulated Mr Cox, saying it's a successful engineering story that deserves international recognition.

"Australia's technologists and engineers are doing incredible, innovative work, but this is sometimes poorly understood because it has not been explained in terms everyone can understand," he said.

"The Aurecon entry clearly articulated how technology and engineering is making a positive impact on these communities and solving real-world problems."

Mr Cox expressed excitement over the new milestone Aurecon and Project Gilghi have achieved.

"We are honoured to be representing Australia in the prestigious CAETS Communication Prizes," he said.

"Beyond an engineering success story, Project Gilghi is a story of renewing hope and uplifting equality for the remote Indigenous community of Gillen Bore by providing them with access to safe, sustainable drinking water.

"Together with our partner Ampcontrol, our hope for Project Gilghi is to be a catalyst that would bridge the water inequality gap on remote communities not only in Australia, but across the globe."

Launched in 2019, Project Gilghi also included a training program developed for local Indigenous people to operate and maintain the unit in an ongoing capacity. This has led to community ownership over the water supply.

The two winners of the CAETS Communication Prizes were announced on 23 September at the annual CAETS symposium, which was virtually hosted by Argentina.

The Engineering Success Stories winner is a video submitted by the Chinese Academy of Engineering, detailing the work of Professor Jing Cheng from Tsinghua University who along with his team at Capital Bio Corporation has developed a fully integrated "Lab on a Chip" system for rapid nucleic acid detection of SARS CoV-2.

The High Potential Innovations winner is a video submitted by the Netherlands Academy of Technology and Innovation, featuring Kaz Vermeer co-founder of Van Boven which has developed a method of predicting the growth of fresh open-field produce to optimise harvests. ▶

You can see all three videos at atse.org.au/CAETS-winners-2021

Honours

FELLOWS RECOGNISED ON QUEEN'S BIRTHDAY HONOURS LIST

Six Fellows of the Australian Academy of Technology and Engineering have been named in the 2021 Queen's Birthday Honours List.

The Honours recognise their extraordinary contributions to science, technology, engineering and Australian society as a whole.

From an IVF pioneer to Victoria's first woman head of two different university departments, these Fellows have changed thousands of lives over the course of their illustrious careers.

The Academy extends its hearty congratulations to the six honourees.

Officer of the Order of Australia (AO)

Emeritus Professors Alan Trounson AO FTSE
For distinguished service to medical science, and to in vitro fertilisation and stem cell technologies.

Professor Jim Williams AO FAA FTSE
For distinguished services to the physical science, to tertiary education, and to professional scientific organisations.

Member of the Order of Australia (AM)

Julian Cribb AM FTSE
For significant service to science communication.

Dr Bronwyn Evans AM FTSE
For significant service to engineering, to standards and to medical technology.

Emeritus Professor Doreen Thomas AM FTSE
For significant service to tertiary engineering education and research, and to women.

Professor Neil Turner AM FTSE
For significant service to agricultural and environmental science, and to education.

Movers & Shakers


1. Kadambot Siddique


2. Rose Amal


3. Simon Biggs


4. Tony Barry


5. Richard Kell


6. Denise Goldsworthy


7. Michelle Simmons


8. Eric May


9. Michael Tobar


10. Hala Zreiqat


11. Martin Green


12. Sally Gras


13. Thorsten Trupke


14. Peter Yates


15. Attila Brungs

1. Kadambot Siddique
Professor Kadambot Siddique was named Western Australian Indian of the Year 2021 at the joint Australia Day and Indian Republic Day ceremony held in January this year.

2. Rose Amal
Professor Rose Amal was awarded the 2021 Chemeca Medal by the Australian and New Zealand Federation of Chemical Engineers.

3. Simon Biggs
Professor Simon Biggs was appointed the next Vice Chancellor of James Cook University

4. Tony Barry and 5. Richard Kell
Tony Barry was elected President of the International Federation of Consulting Engineer and Richard Kell AM has won the federation's Louis Prangey Award.

6. Denise Goldsworthy
Edith Cowan University appointed Denise Goldsworthy AO as its next chancellor, commencing in January 2022.

7. Michelle Simmons
Professor Michelle Simmons AO was awarded the 2021 Bakerian Medal and Lecture from the Royal Society of London.

8. Eric May
Professor Eric May was named West Australian Scientist of the Year.

9. Michael Tobar
Professor Michael Tobar was awarded the Distinguished Lecturer for Frequency Control for 2021/22 by the IEEE Ultrasonics, Ferroelectrics and Frequency Control Society

10. 11. 12. & 13. Hala Zreiqat, Martin Green, Sally Gras and Thorsten Trupke
Professors Hala Zreiqat, Martin Green AM, Sally Gras and Thorsten Trupke were announced as funding recipients for the Australian Research Council Linkage Programs scheme.

14. Peter Yates
Peter Yates AM was appointed the Chair of American International Assurance in Australia.

15. Attila Brungs
Professor Attila Brungs was appointed President and Vice-Chancellor of the University of New South Wales, commencing in January 2022.

16. Bronwyn Fox
Professor Bronwyn Fox was appointed as Chief Scientist of the CSIRO and has been nominated for Victoria Australian of the Year.

17. Saeid Nahavandi
Professor Saeid Nahavandi was named Australian Space Researcher of the Year at the 2021 Space Connect Australian Space Awards.

18. Hala Zreiqat
Professor Hala Zreiqat AM was awarded a Fulbright Future Scholarship.


16. Bronwyn Fox


17. Saeid Nahavandi


18. Hala Zreiqat


19. Margaret Sheil


20. Ian Reid


21. Svetha Venkatesh


22. Gregory Clark


23. Hala Zreiqat


24. Sarah Ryan


25. Stuart Cannon


26. Shaun Coffey


27. Sarah Pearce


28. David Abramson


29. Kathryn Fagg


20. Alison Todd

19. 20. 21. 22. & 23. Margaret Sheil, Ian Reid, Svetha Venkatesh, Gregory Clark and Hala Zreiquat
Professor Margaret Sheil AO, Professor Ian Reid, Professor Svetha Venkatesh, Dr Gregory Clark AC and Professor Hala Zreiquat AM were named Fellows of the Australian Academy of Science.

24. Sarah Ryan
Dr Sarah Ryan was appointed to the OZ Minerals' Board of Directors.

25. Stuart Cannon
Dr Stuart Cannon has accepted a board position with the Australian Diver Accreditation Scheme, which provides globally recognised for occupational diver certification.

26. Shaun Coffey
Professor Shaun Coffey was named a Fellow of the Australian Institute of Agricultural Science and Technology.

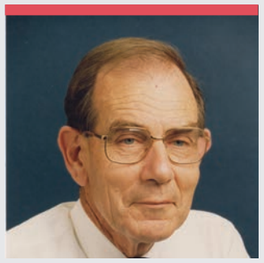
27. Sarah Pearce
Dr Sarah Pearce was named Director of the SKA Observatory's low-frequency telescope in Australia, the most senior SKAO operations representative in Australia.

28. David Abramson
The Association for Computer Machinery and the Institute of Electrical and Electronics Engineers Computer Society have given the 2021 ACM-IEEE CS Ken Kennedy Award to Professor David Abramson.

29. Kathryn Fagg
Kathryn Fagg AO has been appointed Chair of CSIRO.

30. Alison Todd
Dr Allison Todd's company SpeedX has been named AusBiotech 2021 Australian Company of the Year.

VALE



Alban Lynch

A legend in mining innovation

Emeritus Professor Alban Jude Lynch AO FTSE was an engineer, metallurgist and academic whose technical innovations transformed the mining sector in Australia and across the world.

Born in 1930, Professor Lynch studied Chemical Engineering part-time at the Sydney Technical College (soon to become the University of New South Wales) while working in the paint industry. In 1954 he joined the Zinc Corporation as a metallurgist, and soon earned a master's degree and PhD from UNSW.

He started work at The University of Queensland in 1959 in the newly established Mineral Research Facility at the UQ Mine Site at Indooroopilly, then no more than a tin shed.

Over the next few years Professor Lynch led a research team who formed the foundation of the Julius Kruttschnitt Mineral Research Centre, which was officially opened in 1971 with Alban as the first director — a role he held until 1990.

Professor Lynch was elected a Fellow of the Academy in 1979. He served Head of Mining and Metallurgical Engineering at the University of Queensland from 1988 until his retirement in 1993.

He continued to lecture on modelling and establishing research programs in countries such as Malaysia, Brazil, Mexico and Turkey.

Professor Lynch wrote a number of books and over 150 technical publications. In 1999 he was named an Officer of the Order of Australia "for service to the mining industry, particularly in the area of research and education".

Alban Lynch died on 17 September 2021 aged 91, five years after Barbara, his wife of 60 years. He is survived by his children Mary, Joe, Pat, Angela, Martin, Carmel and Suzy, 21 grandchildren and 10 great grandchildren.

With thanks to the University of Queensland

Chloe Munro

A clean energy visionary

Chloe Munro AO FTSE was a leading authority on the Australian energy market and global emissions reductions.

Born in 1955, she received her Masters in Mathematics and Philosophy at Cambridge University in 1976 and an MBA at Westminster University in 1987.

She dedicated her career to public service and excelled in a series of challenging roles with leadership, good humour and determination.

The inaugural chair of the Clean Energy Regulator from 2012-2017, Ms Munro held roles at the National Water Commission, AquaSure; Hydro Tasmania; Victorian Government Department of Primary Industries and Department of National Resources and Environment.

In 2001 she was awarded a Centenary Medal for outstanding service to public administration.

Chloe Munro was elected to the ATSE Fellowship in 2012 and went on to become a respected contributor to the Energy Forum.

She received in Order of Australia in January 2018 for "distinguished service to public administration through leadership roles in the areas of renewable energy, water and climate change process and reform, and to the performing arts".

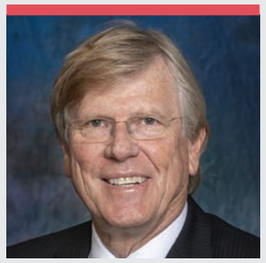
The same year the Australian Financial Review listed her in its "100 Women of Influence".

"She was a tireless contributor to our clean energy work and the author of our Emissions Explainer which is one of our most used documents," ATSE President Professor Hugh Bradlow said.

"Chloe was generous to a fault with her deep knowledge and wisdom," ATSE CEO Kylie Walker said.

"Her insights and advice provided clear and important guidance for our work to demystify emissions reduction targets and tracking, and to inform and educate leadership and the public around clean energy. She will be much missed."

Chloe Munro died on 23 June 2021, aged 65, and is dearly missed by her family and friends.



Menno Henneveld

An engineering great

Menno Henneveld AM FTSE was an acclaimed infrastructure leader with a people-centred approach to engineering.

Born in the Netherlands in 1946, he migrated to Australia with his family in 1952 and grew up in country Western Australia.

Menno completed a bachelor's degree in civil engineering at the University of Western Australia in 1969 and a Postgraduate Diploma in Administration from Curtin University in 1973.

A cadetship with the Western Australian Department of Public Works began his almost four-decade career with the water industry. He later became Chair of the Western Australian Energy Water Ombudsman and held an array of leadership position in state, national, and international infrastructure organisations.

In 2002 he was appointed Commissioner of Main Roads Western Australia. Over the next decade, Mr Henneveld was responsible for delivering more than $6 billion of road infra-structure projects, $5.5 billion of road services, and for managing the state's 18,000 kilometre and $42 billion road network.

He was elected an ATSE Fellow in 2008.

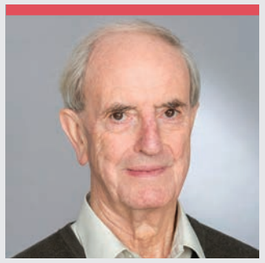
In 2012 Mr Henneveld was both the WA and National Professional Engineer of the Year. In 2015 he was named a Member of the Order of Australia (AM).

Menno's colleagues remember his intellect, humility, integrity, and commitment to providing justice for vulnerable Western Australians. When discussing his largest achievements in a 2018 interview with Engineering Heritage Australia, he said:

"I think that's something that sort of reflects the success I've had in my career is that I've always worked with really good people, and I guess my skill hasn't been so much an engineering skill but getting the best out of people..."

Menno Henneveld died on 6 June 2021, aged 75. He survived by Monika — his beloved wife of 50 years — his sons Jason and Marcus, and two grandchildren.

With thanks to Engineering Australia and the WA Energy & Water Ombudsman



Roy Jackson

An inspiration in applied chemistry

Emeritus Professor William Roy Jackson AM FTSE was an internationally renowned applied chemist and tireless educator.

Born in the picturesque town of Bacup in northern England, he received a Bachelor of Science from Manchester University in 1955 and a PhD in organometallic chemistry from the University of London in 1958.

He became an assistant lecturer in chemistry at Queen's University, Belfast, at the relatively young age of 24. Professor Jackson gained a DSc from the University of London in 1973. Shortly after he migrated to Australia to become Chair of Organic Chemistry at Monash University.

He later became Head of the Department of Chemistry and was named the first Sir John Monash Distinguished Professor in 1995. Known to his students as 'Prof', Professor Jackson's engaging teaching and positive attitude inspired hundreds of chemistry careers.

Professor Jackson was elected an ATSE Fellow in 1990.

He has international reputations in synthetic chemistry, especially catalysis and organo-transition metal chemistry, as well as energy chemistry. He also made major contributions to drug design and development.

With a passion for sustainability, Professor Jackson became the inaugural Director of the Centre for Green Chemistry in 2001. He believed that clever chemistry was the bedrock for national prosperity and championed the cause among the public and schools.

In 2013, he was appointed a Member of the Order of Australia (AM) for services to science in the field of organic chemistry as an educator and researcher. He continued to work part-time into his 80s.

A keen walker, Professor Jackson was equally at home in the bush as he was in the lab, and was famed for always going the extra mile — both physically and academically. His deep scientific knowledge, leadership, and jovial disposition are sorely missed.

Roy Jackson died on 3 November 2019, aged 84. He is survived by his wife Heather, children Tim, Martin and Catrin, and three grandchildren.

With thanks to Monash University

Tom McMeekin

A global champion of safer food

Emeritus Professor Thomas Alexander McMeekin AO FTSE was a world-leading food microbiologist whose expertise led to new systems of improving food safety around the world.

Born in Northern Ireland in 1945, Tom McMeekin completed his bachelor, PhD and DSc in Agriculture Science at Queens University in Belfast. He and his wife Jennifer moved to Australia in 1974. Though they originally intended to stay for only three years, Tom went on to became a stalwart in the Tasmanian scientific community.

His research into the chemical and physical factors behind bacterial food contamination helped pioneer the field of predictive microbiology.

"Prior to these predictive models, meat in a chiller in an export abattoir had to be cooled and then tested for the ecoli or whatever," he once explained. This meant "holding your product until you are sure nothing has grown on it."

"Now we can use the model as a surrogate for that testing, and the model gives you an answer in real time."

Professor McMeekin's research has improved meat testing standards in Australia and around the world, saving untold lives.

The Professor of Microbiology at the School of Agricultural Science at The University of Tasmania, he was instrumental in establishment in the Australian Food Safety Centre of Excellence.

Elected an ATSE Fellow in 1994, Professor McMeekin was a member of the Agriculture and Water Forums.

In 2013 he was made an Officer of the Order of Australia (AO) for "distinguished service to science, particularly in the discipline of agricultural microbiology." The year later he was the Tasmanian State Recipient of the Australian of the Year Awards.

Tom McMeekin died on 28 August, aged 76. He was dearly loved by his wife Jennifer, children Thomas and Jane, and four grandsons.

What we're reading

Recommendations by ATSE Fellows and Awardees

Looking for a scintillating summer read? We asked some of our Fellows and Awardees to recommend books they've recently enjoyed.

Professor Alan Wong
Winner of 2021 Clunies Ross Award — Innovation

Silence
Thich Nhat Hanh

This book talks about the importance of setting aside some time each day to not think about anything and let our minds rest. The simple practice of silence or "do nothing" can do a lot of good to our minds.

Dr Anna El-Tahchy
Winner of 2021 ICM Agrifood Award

The Rock of Tanios
Amin Maalouf

Little Red Riding Hood was the first that came to my mind — I was reading it for the nth number of times to Luna, my three-year-old, to encourage her to sleep! But to be more professional, I recommend *The Rock of Tanios* by Amin Maalouf, out of nostalgia. It takes me back to the origin.

Richard Bolt FTSE
Principal at Nous Group

The Weirdest People in the World: How the West Became Psychologically Peculiar and Particularly Prosperous
Joseph Henrich

Who'd have thought that the Catholic Church's marriage and family policies weakened kinship ties, grew individualism, seeded impersonal markets, and rewired our brains?

Professor Emma Johnston AO FTSE
Dean of Science at UNSW

All We Can Save
Edited by Ayana Elizabeth Johnson and Katherine K Wilkinson.

A thoroughly inspiring anthology of more than 40 women's writings about various aspects of the climate crisis. It's got anger, courage, and solutions — almost everything we need to save all that we can.

Adjunct Professor Leanne Kemp
Winner of the 2021 Clunies Ross Award — Entrepreneur of the Year

Under a white sky
Elizabeth Kolbert

A hopeful read about the future of humanity and how innovation plays a role in the next generation conscious understanding of the importance of community, planet and people.

Dr Sarah Pearce FTSE

The Cult of We: WeWork, Adam Neumann, and the Great Startup Delusion
Eliot Brown and Maureen Farrell

A fascinating book following how office company WeWork promoted itself as a tech start-up, rose to be worth tens of billions, and then fell as the marketing met reality.

Dr Kate Nguyen
Winner of 2021 Batterham Medal for Engineering Excellence

Fire Performance Analysis for Buildings
Robert W. Fitzgerald and Brian J. Meacham

For any professionals working with risk assessment of buildings relating to fire hazards. Like Anna, I also did think about my little one: she's obsessed with *The Elves and the Shoemaker* and even asked if I can my change job from an engineer to a shoe designer! The CRC project I'm leading is upcycling cladding waste into products like shoes and prefab panels, so maybe one day I can make that pair of shoes for my daughter.

Professor Willy Zwaenepoel FTSE

Educated
Tara Westover

A must-read for anyone interested in furthering higher education for people from less privileged backgrounds, which also sheds a light on where Trumpism comes from.

Professor Hala Zreiqat AM FTSE FAA
Professor of Biomedical Engineering, University of Sydney

Billion dollar loser
Reeves Wedeman

This book questions the justice and equality of the illogical risk taken to establish startups in the US.

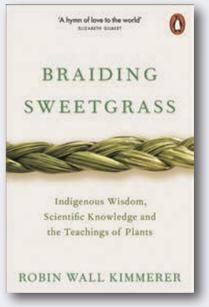
Professor Joanne Daly FTSE

Herding Cats Revisited
Garrett Geoff and Graeme Davis

This light-hearted read gives sage advice on leading research teams and research institutions, and why they are rather different to other teams and institutions. Quotes and anecdotes make it fun to read and easy to dip in and out of. Recommended for any aspiring research leader.

What we're reading

Reviews by ATSE Secretariat



Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants

Robin Wall Kimmerer (Penguin)

Robin Wall Kimmerer is a botanist and a member of the Citizen Potawatomi Nation. In *Braiding Sweetgrass* she aligns the lenses of western science and Indigenous knowledge to show the power of combining the two and the necessity the latter in facing the big problems of today.

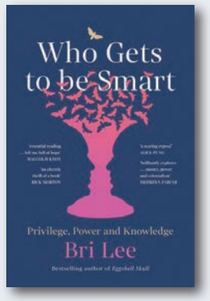
Braiding Sweetgrass emphasises living in a state of gratitude and reciprocity with the land and the world around us. It is a reminder that the world is not to be taken for granted: that its resources are not ours to take from endlessly, without giving anything in return.

It is also a warning of the consequences to come from continuing to live in this way.

Written through the telling of stories and personal experiences, *Braiding Sweetgrass* is immersive, beautifully written and a must-read for all working in the field of STEMM.

> ***"We need acts of restoration, not only for polluted waters and degraded lands, but also for our relationship to the world. We need to restore honor to the way we live, so that when we walk through the world we don't have to avert our eyes with shame, so that we can hold our heads up high and receive the respectful acknowledgment of the rest of the earth's beings."***

Review by Sarah Hayward



Who Gets to be Smart: Privilege, Power and Knowledge

Bri Lee (Allen & Unwin)

The academic establishment, Bri Lee argues, couldn't exist without the colonial structures upon which it was built. In constructing our popular idea of intelligence, scientific institutions have done great damage to people excluded from the upper classes.

While this harm is clear in historical injustices like eugenics, it is less obvious but still pernicious in policy and funding decisions that persist today.

Who Gets to Be Smart explores how many of our educational institutions are set up for self-protection by systematically excluding people who are different. Elites have wrangled ways to 'measure' intelligence to satisfy their own interests, providing a cover of 'meritocracy' for deep-rooted systems of power.

The book covers several issues (schools, COVID-19, the Black Lives Matter protests), which are interesting, but not always cohesively connected to the broader argument.

Lee is vulnerable with her audience. Despite a relatively privileged upbringing, she admits to having deep insecurities and a longing to be considered 'smart' that continue even as she gathers evidence that the concept is flawed.

After taking a wide lens, Lee's personal conclusion is as satisfying as it could be – especially given that the events of the past two years are not going to be the catalyst many hoped for a course to a new kind of future.

> ***"We ascribe an intrinsic sense of worth and goodness to intelligence, yet the world would undoubtedly be a better place if we were all a little more giving and a little less 'smart'."***

Review by Dr Esa Chen

Printed on ecoStar+ 100% recycled.
Made with 100% recycled post-consumer waste.

ecoStar+ is an environmentally responsible carbon neutral paper, and the fibre source is FSC CoC (Forest Stewardship Council — Chain of Custody). ecoStar+ is manufactured in a process chlorine free environment under the ISO 14001 environmental management system.

Printed by Southern Impact
Printed using vegetable based low VOC (Volatile Organic Compounds) inks.

FSC logo here please

ATSE

Australian Academy of
Technology & Engineering

ANNOUNCING OUR 2021

New Fellows

Elected by their peers, ATSE's 2021 new Fellows represent an extraordinary breadth of expertise across engineering, applied science and technology in Australia.

26 November 2021

7.00pm AEDT

www.atse.org.au/2021-new-fellows