IMPACT

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Australia's competitive advantage

Becoming an innovation nation

BOOSTING AUSTRALIA'S COMPUTATIONAL CAPACITY IN AGRICULTURE, HEALTH & BEYOND

The Academy acknowledges the Traditional Owners of the lands on which we meet and work and we pay our respects to Elders past and present. We recognise the deep knowledge and practices embedded in the oldest continuous culture on the planet. Australia's history of engineering, technology and applied science spans more than 60,000 years.

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Australian Academy of Technological Sciences & 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
PO Box 4776
Kingston ACT 2604

TELEPHONE
+61 2 6185 3240

EMAIL
communications@atse.org.au

CEO
Kylie Walker

EDITORIAL TEAM
Alexandra Horvat
Adam Huttner-Koros
Edwyn Shiell

DESIGN
Elizabeth Geddes

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Cover image: Close up detail of a quantum computer. Peter Hansen on iStock

FEATURES

NEWS & REGULARS

SUSTAINABLE DEVELOPMENT GOALS

The Australian Academy of Technological Sciences & Engineering supports the United Nations' Sustainable Development Goals (SDGs). The wheel symbol (right) is shown when an article relates to one or more SDG. The SDGs are explained on page 70.

President's introduction

As I enter into my second year as ATSE President, I have been reflecting on the incredible impact that our Academy continues to have.

Dr Katherine Woodthorpe
AO FTSE FAICD

Dr Woodthorpe is President of the Australian Academy of Technological Sciences and Engineering and a Fellow of the Australian Institute of Company Directors. She holds a PhD in Chemistry (Manchester) and an Honorary Doctorate from the University of Technology Sydney. In 2017, she received an Order of Australia for her ongoing service to research and technology innovation in Australia. Dr Woodthorpe has a strong track record of achieving outcomes in a range of technology-oriented industries, including medical devices and health services, and a deep knowledge of governance, leadership and the private equity and financial sectors.

Elected 2015

In this issue, with a focus on Australian innovation, we highlight all the ways that our technological science and engineering leadership is shaping a better path for our future. From solar panels to weather warnings, and from integrated healthcare approaches to climate-resilient railways, it's inspiring to see concrete progress happening right across our society.

There is no better example of Australian innovation than our 33 new Fellows, who I was delighted to welcome into the Academy in October for the first time as President. The New Fellows Showcase was a wonderful celebration of the expertise and innovation present all around us. I'm certain that there are big things to come from this latest cohort to join the Fellowship, enhancing the diversity and reach of our network.

Presenting the ATSE Awards at the annual Gala Dinner was also a remarkable occasion. The evening was a reminder of the excellence that exists in our STEM community. I was particularly thrilled to see the inaugural Traditional Knowledge Innovation Award presented to John Watson and Professor Ronald Quinn AM FTSE for their work to apply Traditional Knowledge through modern innovation. I hope to see this Award flourish over the coming years.

ATSE's push for net zero emissions featured strongly in our last 6 months of advocacy work, most notably ATSE's call for net zero emissions by 2035. You'll find a number of pieces in this edition around that theme, including a joint piece from Engineers Australia's Romilly Madew FTSE, Tony Barry FTSE from the International Federation of Consulting Engineers and ATSE CEO Kylie Walker about the need to adapt our built infrastructure to meet our ambitious emissions reduction targets.

A number of critical reviews of the science and higher education sector are currently underway through the Federal Government. Chair of the Australian Universities Accord Professor Mary O'Kane AC FTSE writes in this issue about the potential of higher education to better deliver on national need. 2023 new Fellow and Chair of the Pathways to Diversity in STEM Review, Dr Sally-Ann Williams FTSE outlines the imperative for us to ensure that all Australians have the opportunity to fully participate in STEM careers.

We have now reached the end of the first year of studies for the initial cohort of 48 Elevate scholars, recipients of grants and professional support over the length of their undergraduate or postgraduate degrees. I'm touched by the reflections they offer about what the scholarships have enabled them to do. Thank you to Nova, Anastasiia and Claretta for sharing their experiences. With 116 new scholars joining their ranks in 2024, I can't wait to see our next generation of STEM leaders thrive.

To end on a light note, I'm delighted to see that this issue of IMPACT features — I'm sure for the first time — two sets of sisters as authors in our magazine. A big thank you to Cathy and Mary Foley, and Sue and Andra Keay for bringing their wide-ranging expertise to our pages. I hope you enjoy this issue of IMPACT and take its spirit of Australian innovation with you into 2024.

Headline

Whether they're life-saving medicines or everyday conveniences, our technological innovations are the result of a relentless pursuit and application of knowledge.

Kylie Walker
Chief Executive Officer

Kylie Walker is the CEO of the Australian Academy of Technological Sciences & Engineering. She works with Australia's leaders in applied science, technology and engineering to advise decision makers, lead crucial national conversations to solve complex challenges, and support Australia's technology-powered, human-driven future.

ATSE's work not only highlights and encourages responsible application of the fruits of this labour – it also seeks to shape an enduring, thriving, exciting and impactful culture and system of discovery and innovation.

The past year has reinforced the deep significance of R&D to our way of life, and to the way forward. National attention has turned to the development of responsible AI, forging towards a target of net zero emissions by 2035, and the critical need for STEM literacy: and we've been catalysing and shaping these crucial conversations.

ATSE Fellows and staff daily engage with academia, industry and government in pursuit of our mission to help all Australians understand and use technology to solve complex problems.

We have renewed our urgent call for increased investment in technology, research and development on a national scale, an investment that fosters emerging talent and harnesses Australia's innovation potential.

We continue to highlight the urgency of building a robust, diversified economy – and the skilled diverse workforce to put it to best effect. With Australia's economic complexity ranking alarmingly below our potential and leaving us open to economic shock, it is time to recalibrate our approach. Our peers invest upwards of 3% of their GDP in R&D, reaping stability, growth, wellbeing and resilience. In contrast, Australia's investment has faltered to 1.68% of GDP. This decline isn't just a statistic; it signifies a diminishing of our national capacity for innovation over the last 30 years, and a strident warning bell against a less capable future.

Much like the many and deeply varied conversations I enjoy with our excellent Fellows forging new paths in a huge range of sectors, this issue of IMPACT makes it abundantly clear that there is no shortage of Australian ingenuity, drive, and potential. Our applied science, engineering and technology leaders both tap into Australia's competitive advantage, and are themselves some of our greatest national assets. Imagine what we could achieve if we properly resourced this extraordinary potential.

If Australia fails to make a significant and strategic approach to R&D investment now and into the future, we risk losing this unique capacity. Already, we know that entrepreneurial innovators are more likely to seek investment – and build brilliant businesses – offshore. Already, we know that some of our most promising researchers are leaving for better prospects in other countries.

As we strive as a nation to build our green economic strength, lead an exciting new era in unimaginably powerful computing, build resilient civil infrastructure and food production systems that will see us through climate change, and maintain our well-earned position amongst the world's most admired medical technology innovators – a strategic infusion of resources is vital. This is not just an economic imperative but a multiplier for societal advancement, with the potential for billions injected into our economy each year.

With a collaborative, strategic approach to R&D investment, Australia can reclaim its position on the world stage of innovation. We cannot afford to wait. Investing in R&D is not just investing in the future of science and technology – it's investing in the future of Australia.

I hope you enjoy the incredible examples of Australian innovation captured in the following pages, and are reminded of just how much potential Australia holds.

News from the Academy

Image: Ore hauling trucks, Telfer, Western Australia. Credit: iStock

Government's Critical Minerals Strategy a welcome step for Australia's net zero ambitions

JUNE 2023

ATSE welcomed the Australian Government's Critical Minerals Strategy 2023-30. We recognise the vital role that critical minerals already play in the world's transition to a net zero future and the importance of supporting Australia's critical minerals industries.

ATSE is pleased to see a focus on developing a circular economy through recovery, reprocessing and recycling, as well as developing and growing a skilled workforce to build Australia's critical minerals industry.

STEM Equity Monitor highlights urgent need to close the gender pay gap

JULY 2023

The 2023 STEM Equity Monitor demonstrates the deep need for Australia to scale up and accelerate initiatives to achieve genuine diversity in STEM; the report shows that women are still underrepresented in STEM education and STEM jobs, with adequate growth needed for drastic change.

At the current rate, it will take a century to achieve gender parity — and training more engineers, applied scientists, and technologists is urgent if we are to build the STEM-skilled workforce Australia needs to meet its clean energy, modern manufacturing, electric transport and next-generation computing ambitions in coming decades.

Australian innovators lead the way with Global Connections

AUGUST 2023

ATSE announced four new research-industry collaborative projects funded through the Australian Government's Global Connections Fund — Bridging Grants program (providing initial funding to promote international collaboration between researchers and small to medium enterprises).

These grants are awarded to projects in line with the National Manufacturing priorities; critical minerals processing and resources technology, food and beverage, recycling and clean energy, and medical products.

Diversity in STEM Review offers tangible actions for smashing barriers to education and careers

AUGUST 2023

Despite significant government investment and impactful targeted programs to increase diversity in STEM, national progress has been woefully inadequate; girls and women remain desperately underrepresented, from early school years through to tertiary education and into careers. Scale and systemic work are urgently needed. The Academy and Fellows congratulate the Review panel, led by Sally-Ann Williams FTSE, and look forward to advising on a robust set of final recommendations.

ATSE welcomes moves to strengthen Australian research

AUGUST 2023

A stronger Australian research funding architecture, support for Australia's world-leading research, and certainty for the research sector are all supported by the review recommendations made by the expert ARC Review panel, led by Professor Margaret Sheil AO FTSE. While these changes are welcomed, ATSE continues to call for a wider review of research and development funding in Australia to bring Australia's R&D investment up to 3%, in line with our global competitors.

Technology critical for a greener and more prosperous Australia — Intergenerational Report

AUGUST 2023

ATSE welcomed the sharp focus on investing in technology and digital transformation for a strong and resilient economy, outlined in the 2023 Intergenerational Report.

The Report also highlighted Australia's strong position to become a leader in green energy technologies and the minerals needed to create these.

Experts outline urgent options for energy system decarbonisation

SEPTEMBER 2023

ATSE experts presented options for driving Australia's progress towards a zero-emissions electricity system. "Powering the Net Zero Transition: Electricity Security Explained" recognises electricity as a critical lynchpin of decarbonisation. These options were outlined for Federal MPs in a briefing in Parliament House.

Accountability crucial for Diversity in STEM outcomes, say Australia's top engineers and applied scientists

SEPTEMBER 2023

ATSE called for formal accountability and oversight as part of a proposed office to coordinate national initiatives for greater diversity throughout STEM-powered sectors.

ATSE welcomed the draft recommendations of the Diversity in STEM Review for providing a national strategic approach.

L-R: Tony Wood FTSE, Professor Ken Baldwin FTSE, Dr John Söderbaum FTSE, Alex Wonhas FTSE, Kylie Walker, Kylea Tink MP, Dr Helen Haines MP, Kate Chaney MP, Professor Kylie Catchpole FTSE, Professor Mark Howden FTSE, Dr Sophie Scamps MP.

ATSE Fellow announced as next Vice-Chancellor of ANU

SEPTEMBER 2023

ATSE welcomed the appointment of Distinguished Professor Genevieve Bell AO FTSE FAHA, as the Vice-Chancellor of The Australian National University (ANU).

Professor Bell is a leader at the intersection of cultural practice and technology development and is an important voice in global debates around AI and human society.

Globally-recognised engineering, applied science and tech leaders appointed Fellows of the Australian Academy of Technological Sciences and Engineering

OCTOBER 2023

ATSE welcomed the 2023 new Fellows to the Academy.

The 2023 new ATSE Fellows have been chosen for their game-changing contributions in fields spanning artificial intelligence, marine biology, photonics, cancer therapy, battery and energy innovation, and more.

Find out more on page 18.

ATSE Fellow wins Prime Minister's Prize for Science

OCTOBER 2023

ATSE is thrilled to congratulate ATSE Fellow Professor Michelle Simmons AO FTSE FAA FRS for receiving the Prime Minister's Prize for Science.

Professor Simmons is a world-renowned quantum scientist who has pioneered new methods of quantum computer fabrication and design over decades. Her novel discipline of atomic electronics enables precise control of individual atoms, bringing powerful quantum computers one step closer to reality.

Ten trailblazers honoured with Australia's prestigious prizes for tech and engineering.

OCTOBER 2023

Weaving Traditional Knowledge with western science for a new approach to pain relief, tapping into green energy using recycling byproducts, and a revolutionary new approach to sustainability for the beef and lamb industry, were all celebrated at the Australian Academy of Technological Sciences and Engineering's Annual national Awards.

The winning engineers and technologists were recognised for their groundbreaking work on Australia's toughest issues, spanning climate change, mining, plastic waste, battery tech and food security among others, during a ceremony at the National Arboretum in Canberra.

L-R: ATSE Fellow Professor Mark Howden FTSE, ATSE President Dr Katherine Woodthorpe AO FTSE FAICD, ATSE CEO Kylie Walker at the Net Zero Position Statement press conference.

Net Zero by 2035: ATSE Position Statement

In a new Position Statement launched in September 2023 at Parliament House, ATSE called on the Federal Government to commit to an ambitious target of net zero greenhouse gas emissions by 2035.

In the face of increasing catastrophic weather, the Academy stated that Australia and the world are at a crossroads. Scientific evidence must be heeded, and more ambitious targets are needed to drive technological innovation, catalyse regulatory change, upskill the workforce, roll out the necessary infrastructure and spur a massive boost to investment across the economy to support decarbonisation.

The Academy is calling for a national effort across all Australian sectors, governments, and industries to set an ambitious benchmark for innovation which will equip the nation to become the renewable energy superpower it aspires to be.

The Position Statement calls for a national net zero emissions policy and implementation framework that prioritises the challenge and addresses the opportunity to transform Australia's economy; a zero-waste approach to supply chains; and reducing the impacts of human activity on biodiversity.

ATSE commits to working across government and industry leadership to advise on best practice policy settings and supports urgently reducing Australia's greenhouse gas emissions.

Science is critical to Australia's future...

And so is the way we discuss it.

UN SDGs
8, 9

Dr Cathy Foley
AO PSM FTSE FAA
Australia's Chief Scientist

Dr Cathy 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 from ATSE, and is committed to tackling gender equality and diversity in the science sector.

Elected 2008

As a physicist, doing research is very straightforward. Working in superconducting electronics, I made devices, measured lots of properties and developed the physics theory to explain what I saw. So it was an eye-opener to work with a team considering the impact of nanoparticles in sunscreen, where the way the research is performed is very different.

The team was working in what was a contested research field, so it was crucial to get every part of the research design and methodology right. It involved all the challenging variables of a life science project: mouse models, ethics approvals and experimental design — including choosing the correct statistical approach and correct sample sizes. It was complex work and with so many variables it was easy for things to go wrong, but we were absolutely transparent in communicating how we conducted the research, the results we realised, and the application, as well as the limitations, of our findings.

When scientific research is publicly contested, it is easy for the work of researchers and their reputations to be impugned by those unfamiliar with the scientific process, as well as those who like to cherry-pick research that reinforces their opinions or supports their own interests.

Science is a critical input to evidence-based policy making, so when the integrity of research and researchers is questioned unfairly it rankles. Uninformed commentary bothers me; deliberate misrepresentation and obfuscation of science is repugnant. They undermine science, dampen innovation, and slow the development of solutions to humanity's most pressing challenges.

As Australia's Chief Scientist, I have seen the dichotomy at play when it comes to how science and scientists are regarded in Australia. On the one hand, science is one of the few highly regarded professions in our society and the work of exceptional scientists is rightly recognised and celebrated. On the other hand, exceptional scientists can also be subjected to personal attacks and find themselves at the centre of divisive debates dominated by opinion, not fact.

There has been a lot of talk about the need for a research integrity body in Australia. From the evidence I've seen, I think Australian science and research are overwhelmingly robust and of high integrity. I'm yet to be convinced of the need for such a body, but if the evidence is there I'm happy to stand corrected. My main concern is that it is taking oxygen from what I see as the real issue — and our most pressing need — which is to improve the quality of Australian research.

We need to ask ourselves: 'How can we improve research quality so our work can always be trusted?'. And we need to be very aware that our research will be scrutinised and our findings challenged, especially when we work in a contested field.

We know that science and research are iterative. Findings build on work that has come before. Scientists test each other's conclusions and refine their approaches and processes to the point where a consensus is reached. Importantly, scientific consensus does not mean the weight of popular opinion; it represents the weight of evidence.

The science sector has always had a responsibility to earn and retain trust through transparent systems of accountability and through producing work of quality — demonstrating integrity in our actions.

By being inconsistent in our use of language when we debate the merits of a piece of research — such as, for example, questions about the accuracy or completeness of a particular dataset — we can give the wrong impression that we are questioning the integrity of the science, not its quality. This erodes trust, is unhelpful to legitimate scientific debate and muddies perceptions of scientific consensus. Classic examples are climate science and water quality in the Great Barrier Reef; research in response to the COVID-19 pandemic is another.

The urgency of the pandemic demanded the rapid publication and sharing of COVID-19 information. It necessitated extremely fast peer-reviews. As a result, some papers accepted for publication during the first year of the pandemic were subsequently retracted, including some very high-profile examples. These retractions were largely the result of the authors' scientific misconduct. However, despite the retraction rate being higher than normal, *99.926% of the published research was rigorous.* That body of research helped us navigate the pandemic and allowed us to come out the other side within years, not decades. The worst thing that could have happened was for all the published research to have been brought into disrepute simply because 0.074% of it was found to have been bogus.

In my *Trust in Science* paper, I have sought to clarify the definitions of research quality, integrity, excellence and impact as a means to improve scientific dialogue in Australia.

Research quality relates to the way research is planned, performed and published, and the methodology, rigour and judgement applied to all aspects of the process. This includes judgements about the match between the method and research question, the selection of subjects, measurement of outcomes, protection against error and appropriateness of data analysis and interpretation. Quality research is rigorous, transparent and in principle, reproducible.

Research integrity is behaviour-based. I like the definition used by Stanley G. Korenman: that integrity is the 'active adherence to the ethical principles and professional standards essential for the responsible practice of research'. Integrity covers everything from minor inadvertent breaches to more serious breaches and misconduct such as plagiarism, falsification, image manipulation and fabrication.

Research is excellent when it demonstrates new knowledge, new thinking, complexity of thinking, and breakthroughs in understanding difficult or new concepts, and may transcend discipline boundaries.

It is an important consideration when reviewing funding proposals and research outputs. And as part of the publication peer review process, reviewers assess how innovative and important the research is and the contribution it makes to advancing the field of knowledge.

We invest in research primarily for its beneficial impacts. Research has impact when it goes beyond the walls of academia and contributes to new knowledge, the economy, society, environment or culture.

Science and research are at the heart of the search for solutions to many global challenges, as well as many everyday policy developments. But they operate in a climate where distrust of public institutions is growing and misinformation and disinformation in public discourse are increasing.

If the science and research community are to maintain public confidence, we need to be mindful that the way we practice science and the way we discuss and debate science matters.

Good science is and should be celebrated. Yes, we must call out instances of poor research integrity. But when we discuss and debate scientific research — and scientific process — let's be clear that our questions, more often than not, actually relate to quality.

Conflating issues of quality with those of integrity just gets us bogged down in wrongheaded debates.

Dr Foley's Trust in Science paper is available for download from chiefscientist.gov.au

UN SDGs
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A system that does

Higher education does a lot for Australia.

It delivers advanced skills for the professions which drive our economy. Through practical use of new knowledge and high quality research, it helps to solve wicked problems, including climate extremes, population ageing, food security, automation and the changing geopolitical environment.

It promotes equity and a strong civil society, and advances creativity, inquiry, and intellectual, cultural and political development.

It has over 200 providers that educate more than 1.6 million students a year, including almost a half-million overseas fee-paying students.

Yet Australia has deep skills needs. Critical professions like engineering, nursing, medicine and teaching are in acute shortage. Many of these professions are where more jobs are needed in future, with Jobs and Skills Australia anticipating that more than 90% of new jobs generated by 2026 will require a post-school qualification.

Intractable and multigenerational challenges deter many Australians from accessing and participating in higher education; particularly First Nations people, people with disability, people from lower socio-economic groups and those from rural, remote and outer suburban communities. Higher rates of participation from these groups are essential to address national skills needs.

And despite strong Australian university research performance, there is a disconnect between knowledge production and use. Industry and governments do not draw on university research capacity and capability to its full potential. Too often, world-class Australian university research is commercialised overseas.

It is clear there is more the system could — and should — be doing.

The Australian Universities Accord Review addresses this point. Established in November 2022, by the Minister for Education, the Hon Jason Clare MP, it was tasked with making recommendations to deliver a higher education system that meets current and future needs of the nation, including targets to achieve this.

It is an ambitious task.

The Review's terms of reference were broad. Three go to major outputs: skills, equity, and new knowledge.

The remaining four terms of reference go to supporting structures and mechanisms and include quality, funding, international students, and the connections between higher education and Vocational Education and Training (VET).

The Review consulted widely, commissioned work from experts and held three rounds of submissions. It worked to capture the abilities and achievements of the sector, understand the challenges it faces and to reimagine it for the future over a 10, 20 and 30-year horizons.

But the Review is only the precursor to the real work.

An Accord will bring together all sector stakeholders — universities and higher education institutions, VET, staff, unions, students, industry and governments — to join in ongoing conversation about what we want from higher education and how it can continue to deliver on national needs.

An enduring and dynamic Accord will help our higher education system do more.

The Final Report of the Australian Universities Accord was delivered to Government in December 2023.

Professor Mary O'Kane
AC FTSE
Professor Mary O'Kane AC is Chair of the Australian Universities Accord and the NSW Independent Planning Commission. She is a company director, and Executive Chairman of O'Kane Associates, a Sydney-based consulting practice specialising in government reviews. Mary was NSW Chief Scientist & Engineer from 2008-2018; Vice-Chancellor of the University of Adelaide from 1996-2001; and Deputy Vice-Chancellor (Research) at Adelaide from 1994-1996; and Dean of the Faculty of Information Sciences & Engineering at the University of Canberra from 1990-94.
Elected 1994

UN SDGs
5, 10

Australia's future depends on us all

Over 10 million patients worldwide have benefitted from diagnostic tests for cancer and infectious diseases created by Cicada Innovations incubatee, SpeeDx. During COVID-19, SpeeDx manufactured COVID-19 tests and supplied them to the US and in Australia.

SpeeDx founders, Adjunct Professor Alison Todd FTSE and Dr Elisa Mokany received the 2022 Prime Minister's Prize for Innovation, placing them amongst a growing cohort of women overcoming the odds in STEM. If we are to achieve Australia's ambitious science and engineering agenda, we must ensure that we are providing opportunities for ALL Australians to fully participate. Alison and Elisa's stories should be the norm, rather than the exception.

While science, technology, engineering and mathematics (STEM) jobs are predicted to grow by 14.2% by 2026, only 20% of STEM-qualified people are women. Gender disparities extend to leadership roles, where 23% of senior management and 8% of CEOs in STEM-qualified industries are women. On average, women still earn 18% less than men across all STEM industries.

Additionally, other underrepresented groups such as Aboriginal and Torres Strait Islander Peoples, new migrants, individuals from regional areas, LGBTQIA+ people and people with disabilities require better representation in STEM. This is essential if we wish to see the emergence of technologies that address the significant challenges we are facing globally.

Addressing underrepresentation involves discussing both historical and structural barriers. We need to address the structural impediments to people participating in STEM at every stage of the journey — from kindergarten to employment — and the systems embedded in our institutions and organisations that perpetuate this. The Pathway to Diversity in STEM recommendations emphasise the role of leadership and governance in making this change.

Leadership and governance in promoting diversity and inclusion in STEM must go beyond surface-level commitment to adopt accountability and governance measures. Right now in Australia there's a conversation around every boardroom about mandatory environmental reporting. The decisions executives make and the role of the board in governance is under a spotlight that is driving change in everyday business decisions to avoid the serious consequences of greenwashing. If we are serious about diversity and inclusion in STEM, we need to follow a similar path.

This means setting clear goals and targets, and holding people accountable for achieving them. Investing in long-term initiatives. It means putting performance metrics and measurements in place for board members and executives, and putting bonuses at risk for non-achievement. We must use the governance tools available to us to continually drive both structural and behavioural change in our organisations. We must all take personal responsibility for making changes to dismantle systems and processes that don't drive inclusive outcomes by examining our own biases, behaviour and policies and processes that might prevent inclusion and access in education, employment, community leadership, and representation.

The role the Australian Academy of Technological Sciences and Engineering (ATSE) plays in championing the application of science and technology for our future economy is critical. It's one of the reasons I'm delighted to be joining the ATSE Fellowship to lend my support for a more inclusive workforce and pathway, for better outcomes for us all.

Dr Sally-Ann Williams
FTSE
CEO Cicada Innovations and Chair Pathways to Diversity in STEM Review
Under Sally-Ann Williams' leadership, Cicada has become Australia's most active and effective deep tech incubator, boasting a fivefold increase in STEM professionals engaged in developing ventures. Sally-Ann possesses a powerful combination of deep technical capability, business acumen, and an entrepreneurial spirit.
Elected 2023

Why we need a more diverse science and technology workforce

Australia's strategic environment is complex, increasingly contested and changing rapidly.

Kylie Walker
Chief Executive Officer
Kylie Walker is the CEO of ATSE. She works with Australia's leaders in applied science, technology and engineering to advise decisionmakers, lead crucial national conversations to solve complex challenges, and support Australia's technology-powered, human-driven future.

Professor Tanya Monro
AC FTSE FAA
Tanya Monro AC FTSE FAA is Australia's Chief Defence Scientist. Prior to that, she was the Deputy Vice Chancellor, Research and Innovation at the University of South Australia. Tanya was awarded the ARC Georgina Sweet Australian Laureate Fellowship in 2013 and was the the inaugural Director of the ARC Centre of Excellence for Nanoscale Biophotonics and the inaugural Director of the Institute for Photonics & Advanced at the University of Adelaide. Her research is in the field of photonics, with a focus on sensing, lasers and new classes of optical fibers.

Elected 2009

Growing geopolitical insecurity and climate risks, cyber threats and disruptive technological change are among a long list of challenges which demand innovative science and technology solutions to solve them.

But without a creative and motivated STEM — Science, Technology, Engineering and Mathematics — skilled workforce, Australia will be ill-equipped to bridge its current capability divide.

Put simply, we need to urgently grow our STEM workforce to create a safe, secure and prosperous Australia. STEM occupations will increase by 13% over the next five years, but the number of domestically trained engineers is dropping. Australia needs 100,000 more digitally skilled workers and 40,000 more engineers in the next two years alone. We have the potential to power a thriving science and technology sector that secures Australia's national interests — it is up to us to flick the switch. So what is holding us back?

We urgently need to tap into the innovative potential that a diverse workforce underpins.

Right now, STEM fields are missing out on the contributions of some of Australia's brightest students. Australia's emerging engineering and technology cohort is highly trained, but compared to other countries around the world, counts few women. We know that diverse viewpoints, from people with different experiences, backgrounds and training, help produce better outcomes and more innovation. If Australia is to rise to the challenge of the rapidly changing global technological landscape, we must embrace the full spectrum of our potential. It is up to us to deliberately break the barriers and support women to enter and thrive in this critical space. The best people — of all kinds — are required if we want to reach our potential and play a leadership role in our region and globally.

In a rapidly changing and complex security environment, innovative science and technology solutions are what will allow Australians to be safer at home and abroad.

Over the years, the Defence Science and Technology Group (DSTG) has developed world-leading innovations

like the Jindalee Over-The-Horizon Radar, the Black Box Flight recorder and the Nulka active missile decoy, among others, but the scope of challenges has never been bigger. Defence science and technology is an exciting place, working to advance capabilities that will help Australia successfully navigate challenges ahead.

That's why the Australian Academy of Technological Sciences and Engineering (ATSE) and DSTG are coming together. In 2024, through ATSE's program, DSTG will provide additional scholarships for undergraduate women and diverse people, including people from regional and remote areas, Aboriginal and Torres Strait Islander people, non-binary people, and more. This will be supported through ATSE's program funded by the federal Department of Industry, Science and Resources.

Recipients will receive more than just funding — they will also be supported with networks, skills and mentoring to thrive in their studies and shape Australia's future through scientific and technological innovation. These undergraduate students will, at the very start of their journeys, be exposed to the limitless jobs and inspiring potential of a defence science career.

The first round of Elevate scholarships, delivered in 2023, allowed recipients to devote time to their studies without financial stress.

"The ATSE Elevate scholarship has changed everything for me. I can spend time away from work to study without jeopardising my financial security. I can afford the study resources I need — textbooks, a functional computer, the internet bill," said a member of the 2023 Elevate cohort.

The program is in huge demand, with thousands of applications in its first two years emphasising the huge interest in STEM jobs. While supporting more women to enter STEM, ATSE and DSTG are also working on the structural and cultural barriers which stop women and diverse people from advancing, and providing them with genuine options for career support.

Elevate's aim is to increase the diversity of the STEM sector, not only through training more women but also by considering scholars' different life experiences and backgrounds. The program supports people from regional and remote areas, Aboriginal and Torres Strait Islander people, non-binary people, women returning to work after having children, and more.

We know that — in addition to financial support — new STEM entrants benefit most from access to science and technology leaders, industry mentors and networking opportunities to open doors and make new careers possible. Those connections and relationships grow into research collaborations and industry engagement opportunities over time, and equip more women with the expertise to contribute to important projects of national significance.

Supporting more women and diverse people to enter and thrive in a STEM-fuelled career will supercharge Australia's ability to respond to the critical challenges we know now and anticipate in the future — and create a safer, secure and more prosperous Australia.

This opinion piece originally appeared in The Australian *on Thursday 30 November 2023.*

UN SDGs
5, 10

Events

From exploring the future of technology to addressing critical issues in agriculture, education, and healthcare, ATSE events showcased cutting-edge innovation and knowledge across Australia.

July

On **25 July**, we had the opportunity to learn how STEM-empowered innovations can lead to emerging and disruptive technologies. Moderated by Professor Saeid Nahavandi FTSE and Dr Dimity Dornan AO FTSE, three expert speakers presented a path toward a more innovative future.

August

On **3 August**, we showcased two 2022 ATSE Fellows: Dr Beth Ebert FTSE and Professor Thas Nirmalathas FTSE. They taught us about the phenomenon of epidemic thunderstorm asthma as well as the technology behind optical wireless communications.
On **16 August**, our exploration of precompetitive geoscience and its role in building a low-carbon economy, with Dr James Johnston FTSE and Dr Sarlae McAlpine, showcased the vital connection between informed decision-making and responsible resource development.

Jumping into the future of engineers in Australia, on **30 August** our Engineering Education symposium analysed insights from the recent ATSE STEM Skilled Future roadmap and Engineers Australia's discussion paper. The event brought together an impressive array of speakers including:

- Mary O'Kane AC FTSE — Chair, Australian Universities Accord Review Panel
- Jane MacMaster — Chief Engineer, Engineers Australia
- Mark Scott AO — Vice-Chancellor and President, University of Sydney
- Professor Barney Glover AO FTSE — Vice-Chancellor and President, Western Sydney University
- Professor Vicki Chen FTSE — Acting Vice-Chancellor, University of Technology Professor
- Hugh Durrant-Whyte FAA — NSW Chief Scientist and Engineer
- Adam Copp — Chief Executive Officer, Infrastructure Australia
- Dr Marlene Kanga AM FTSE — Former President, World Federation of Engineering Organisations.

The event brought fresh perspectives to the field of engineering education, fostering collaboration among professionals, academics, researchers and industry representatives.

September

On **6 September**, energy storage was the focus of an international event with the ASEAN Academy of Engineering and Technology (AAET). ATSE President, Dr Katherine Woodthorpe AO FTSE FAICD and AAET President, Ir. Professor Dato' Dr. Ewe Hong Tat, along with expert Fellows, discussed regional collaboration, transformative battery technologies, and their impact on renewable energy, transportation and industry.

On **11 September** we hosted a briefing event with parliamentary cross-benchers on the state of electricity , hosted by the independent Member for North Sydney, Kylea Tink MP.

Nobel Prize Laureate Professor Brian Schmidt AC FRS FAA FTSE provided an oration on **13 September** about the evolution of higher education globally. His insights into developing trends, threats, and opportunities set the stage for planning the future of university-level education.

On **27 September**, in collaboration with the University of Queensland, a major symposium addressed the role of hydrogen in the nation's energy transition and brought together experts from research, industry, and government. The event boasted a lineup of impressive speakers including:

- Dr Fiona Simon — Chief Executive Officer, Australian Hydrogen Council
- Professor Peta Ashworth OA — Director, Curtin Institute for Energy Transition
- Dr Chris Shaw — Deputy Director-General for Hydrogen, Department of Energy and Public Works

Collaboration was at the forefront as participants explored how Queensland could contribute to the national energy agenda.

October

On **5 October**, an evening filled with excitement and inspiration, three 2022 ATSE Award winners shared their research and engaged in a dynamic panel discussion. The event questioned existing policies and explored strategies to support the next generation of Australian scientists and engineers.

Professor Stuart Khan FTSE led a historic walking tour of Sydney in November.

On **11 October**, Dr Arnagretta Hunter and Dr Steve Crimp delved into the impacts of the climate crisis on health, food, and agriculture. Their talk about future implications highlighted the need to address these complex challenges.

Commercialisation was at the forefront in an event on **12 October** featuring Dr Khoh Soo Beng as he spoke about Artificial Intelligence and Machine Learning software as a medical device (SaMD). The discussion centred on reducing commercialisation risks and fostering collaboration through platforms like Digital Health Malaysia.

On **23 October** we hosted a briefing for journalists in collaboration with the Australian Science Media Centre (AUSSMC) to launch a new report Responsible AI: Your Questions Answered.

On **31 October**, we celebrated Dr Katherine Woodthorpe AO FTSE FAICD as the 2023 Chaikin Orator. Her oration provided insights into her distinguished career, journey to becoming ATSE President, and vision for the future of STEM in Australia.

November

On **2 November**, with help from the Royal Society of Victoria, we highlighted the urgent need for action in science education. This event titled 'Aiming Higher: improving science education in Victorian schools' explored challenges faced by science teachers and opportunities to improve student outcomes. The discussion centred on supporting teachers and inspiring students to engage with the science curriculum.

On **11 November**, Professor Stuart Khan FTSE led an historic walking tour of Sydney, offering participants a unique perspective on the city's water infrastructure. Covering engineered water supplies to reservoirs and sewer vents, the tour was well received by the attendees and unveiled the rich history of water management in Sydney.

The exploration of Australia's role in global agriculture continued with a discussion on the challenges of feeding a growing population. In an event on **14 November** Professor Kadambot Siddique AM FTSE highlighted the importance of exporting knowledge, technology, and education to create a sustainable and fair food system.

On **27 November**, in collaboration with the Australian Academy of Science, we held an event featuring early career researchers who sparked discussions using electronic posters, providing a glimpse into their impactful work. The highlight of the evening was a keynote presentation by Professor Peta Ashworth OAM. The theme, 'Energy Transition: Challenges and Opportunities for Western Australia' set the stage for open conversations exploring pressing issues and exciting possibilities in the energy sector.

On **29 November**, Professor Matthew Morrell and Dr Kelly Pearce provided valuable insights into the evolution of collaborations. Professor Morrell reflected on the longstanding partnership between the University of Queensland and the Queensland Department of Primary Industries, while Dr Pearce shared the unique design and trajectory of the WA Agricultural Research Collaboration (WAARC) in Western Australia.

December

On **7 December**, we hosted an end-of-year event for Queensland ATSE Fellows featuring a keynote address by ATSE President, Dr Katherine Woodthorpe AO FTSE FAICD, a performance by Jacaranda Flute Collective and presentations from two 2023 ATSE New Fellows, Adjunct Professor Daniel Lambert FTSE and Professor Chamindie Punyadeera FTSE.

New Fellows 2023

A Nobel Prize laureate, leaders tackling the Aussie engineering shortage, climate change innovators, research translation superstars, and Aboriginal and Torres Strait Islander STEM education champions are among the distinguished cohort of Fellows elected to the Australian Academy of Technological Sciences and Engineering.

GROUP IMAGE Standing left > right: Dr Therese Flapper FTSE, Professor Chamindie Punyadeera FTSE, Professor Tuan Ngo FTSE, Distinguished Professor Vivian Tam FTSE, Professor Susanne Hermesch FTSE, Professor David Grayden FTSE, Lara Olsen FTSE, Professor Guillaume Lessene FTSE, Sally-Ann Williams FTSE, Professor David Taubman FTSE, Dr Susannah Eliott FTSE, Professor Graham Nathan FTSE, Professor Yun Liu FTSE, Professor Yue Gao FTSE, Professor Anna Giacomini FTSE, Professor Baohua Jia FTSE.

Seated left > right: Adjunct Professor Daniel Lambert FTSE, Jane MacMaster FTSE, Professor Joanna Batstone FTSE, Professor Zaiping Guo FTSE FAA, Professor Bronwyn Gillanders FTSE, Professor Christopher Matthews FTSE, Dr Alistair Hobday FTSE.

Absent from photo: Professor Stephen Foster FTSE , Mikaela Jade FTSE, Su McCluskey FTSE, Professor Anna Moore FTSE, Dr Glenn Platt FTSE, Professor Brian Schmidt AC FTSE FAA FRS, Dr Penny Stewart FTSE, Daniel Westerman FTSE, Professor Sandra Eades AO FTSE FASSA FAHMS, Dr Sangeeta Bhatia FTSE

SMALL IMAGES: Attendees at the ATSE New Fellows 2023 cocktail reception at the National Portrait Gallery in Canberra.

Photography: Salty Dingo

Globally-recognised engineering, applied science and tech leaders appointed Fellows of ATSE.

The 2023 new ATSE Fellows have been chosen for their game-changing contributions in fields spanning artificial intelligence, marine biology, photonics, cancer therapy, battery and energy innovation, and more.

Noongar woman Professor Sandra Eades AO FTSE FASSA FAHMS, Australia's first Aboriginal medical doctor to be awarded a PhD, has been named as an Honorary Fellow for her contributions to epidemiology research and education in Aboriginal child health.

Dr Sangeeta Bhatia FTSE is a nano tissue technologist who develops miniature technologies which mimic those found in the body. Her world-leading technology includes human micro-livers, to test new drugs and study liver disease.

Distinguished Professor Brian Schmidt AC FTSE FAA FRS, outgoing ANU Vice-Chancellor, has been elected for his world transforming career as an innovator, educator, and communicator. In 2011, Professor Schmidt jointly won the Nobel Prize for Physics for discovering the accelerated expansion of our universe.

Laser technology has been transformed by innovations from Professor Yue Gao FTSE. He is the creator of the artificial star (known as a laser guide star) — which helps astronomers to calibrate their telescopes, and has designed a fully automated laser system for accurately tracking tiny space debris smaller than 10cm, safeguarding Australian satellites used for environmental monitoring and bushfire tracking.

CEO and Managing Director of the Australian Energy Market Operator (AEMO), Daniel Westerman FTSE, is a national leader in Australia's transition to net zero emissions. Daniel advises Australian governments and is a trusted communicator, guiding the public through this crucial time of energy crisis and low-emissions transition.

Cabrogal woman Mikaela Jade FTSE is a passionate advocate for using emerging tech to amplify connection to Traditional Knowledge and culture. Mikaela founded Australia's first Indigenous edu-tech company, Indigital, which uses technologies — like AI — as a pathway to learning Indigenous heritage and teaching digital skills.

ATSE President Dr Katherine Woodthorpe AO FTSE FAICD said the new Fellows are creating a better Australia through their work.

"As we face global challenges such as climate change, the digitisation of our economy and the massive challenge of building a diverse and skilled STEM workforce, technological innovation is the lynchpin for shaping our future. It's looking bright thanks to the extraordinary contributions of our 33 newest Fellows."

"It is a proud moment to be elected by your peers and acknowledged for your lifelong achievements. ATSE Fellows are truly exceptional at what they do, and Australia is all the better for them."

Professor Joanna Batstone FTSE

Responsible AI champion

A global expert in artificial intelligence (AI), technology and data science, Professor Joanna Batstone is the inaugural Director of the Monash Data Futures Institute. She forges partnerships between academia, government and industry to harness the power of AI and data science for social good.

Dr Susannah Eliott FTSE

Science communicator and evidence advocate

As CEO of the Australian Science Media Centre (AusSMC), Dr Susannah Eliott has been a driving force in improving Australian's access to trusted information about science and technology.

Dr Therese Flapper FTSE

Water sustainability superpower

Dr Therese Flapper is a global leader in water management. She has worked on more than 80 water-related projects around the world, helping to secure safe drinking water and sanitation for more than 100 million people.

Professor Stephen Foster FTSE

Structural engineering specialist

Stephen (Steve) Foster is an internationally renowned authority in structural engineering. He has played a major role in advancing the quality and sustainability of concrete structures in Australia and around the world, with research focused on new materials.

Professor Yue Gao FTSE

Space and defence laser innovator

Professor Yue Gao has developed and commercialised cutting-edge laser technologies for space and defence applications, boosting Australia's space science and defence capabilities and facilitating a multi-billion-dollar industry on Australian shores.

Professor Anna Giacomini FTSE

Rockfall mechanics maestro

Professor Anna Giacomini is Australia's leading expert on rockfall mechanics and protection design. Extreme weather events are set to spark more rockfall instabilities, requiring big investment to assess and reduce risk to both people and infrastructure.

Professor Bronwyn Gillanders FTSE

Oceans advocate

Professor Bronwyn Gillanders is a globally recognised oceans scientist whose research is critical to sustainable management of commercial fisheries and protection of coastal environments.

Professor David Grayden FTSE

Brain decoder and entrepreneurial mentor

Professor David Grayden's research focuses on understanding how the brain processes information, and applying this knowledge to design and develop medical bionics and brain-machine interfaces.

Professor Zaiping Guo FTSE FAA

Cutting-edge battery innovator

Professor Zaiping Guo has made significant breakthroughs in engineering safe, long-life, and high energy batteries — an essential technology for powering the shift to renewable energy.

Professor Susanne Hermesch FTSE

Livestock genetics expert

Professor Susanne Hermesch is a leader in animal genetics research and a pioneer in using genetics to improve animal welfare.

Dr Alistair Hobday FTSE

Marine sustainability steward

Overseeing a diverse research portfolio as the research director for Sustainable Marine Futures, Dr Alistair Hobday is a multi-disciplinary 'big thinker'. He is a world-renowned marine scientist whose research focuses on building ocean resilience under climate change.

Mikaela Jade FTSE

Trailblazing edutech entrepreneur

A proud Cabrogal woman of the Dharug-speaking nation, Mikaela Jade is a passionate advocate for using new and emerging technologies to amplify knowledge and culture from remote and ancient cultures.

Professor Baohua Jia FTSE

Photonics game-changer

Professor Baohua Jia is at the forefront of photonics, manipulating light for innovative applications in sustainability.

Adjunct Professor Daniel Lambert FTSE

World water engineer

Adjunct Professor Daniel Lambert is an award-winning civil engineer and influential leader in the water industry.

Professor Guillaume Lessene FTSE

Cancer therapy designer

Professor Guillaume Lessene is a leader in small molecule drug discovery with a passion for enabling the translation of Australia's science into world class therapeutics.

Professor Yun Liu FTSE

Advanced materials chemist

Professor Yun Liu is an internationally recognised materials chemist and ARC Georgina Sweet Laureate Fellow.

Jane MacMaster FTSE

National engineering influencer

Over her 30-year career, Jane has helped to advance Australia's engineering capability on complex technological engineering projects, has influenced policies and ways of working, has raised the profile of the engineering profession and has represented the engineering perspective in conversations of national importance.

Professor Christopher Matthews FTSE

Indigenous education champion

Professor Christopher (Chris) Matthews has made exceptional contributions to Indigenous education in mathematics, drawing on his applied mathematics background and his lived experiences as a Quandamooka man.

Su McCluskey FTSE

Agriculture advocate

Su McCluskey is a widely respected and sought-after advisor in the agriculture sector, known for her unique mix of technical, practical and policy skills stemming from her many roles — including director, advisor, accountant, and beef farmer.

Professor Anna Moore FTSE

Astronomer, inventor and pioneer

As the founding Director of the multi-disciplinary ANU Institute for Space (InSpace), Professor Anna Moore is at the forefront of Australia's renaissance in space exploration.

Professor Graham Nathan FTSE

Decarbonisation developer

Professor Graham (Gus) Nathan is an internationally recognised researcher leading decarbonisation transformation in heavy industry.

Professor Tuan Ngo FTSE

Sustainable building specialist

Professor Tuan Ngo is a global leader in composite materials and an expert in safe and sustainable buildings and infrastructure.

Lara Olsen FTSE

Sustainable technology leader

Lara Olsen has a track record of delivering climate change solutions with global impact across the energy and climate sectors. An innovative and inclusive technology leader, Lara has been a key part of multiple sustainability initiatives around the world, including industrial-scale applications of new technologies, such as the Big Battery in Hornsdale in 2017.

Dr Glenn Platt FTSE

Renewable energy changemaker

Dr Glenn Platt's visionary insights, new technologies, and innovative start-ups are helping to drive the world's renewable energy transition.

Professor Chamindie Punyadeera FTSE

Biomedical innovator

Professor Chamindie Punyadeera is a translational scientist at the interface of biomedicine and engineering. Her cutting-edge research and transformative applications have real-world impact.

Distinguished Professor Brian Schmidt AC FTSE FAA FRS

STEM research and education advocate

Distinguished Professor Brian Schmidt is a leading educator, communicator, innovator and astronomer. He is a leader of immense community standing.

Dr Penny Stewart FTSE

Industrial data science entrepreneur

Dr Penny Stewart is an accomplished researcher, innovator and business leader. She founded PETRA Data Science to commercialise her research findings and is now pushing the boundaries of what is possible with data.

Distinguished Professor Vivian Tam FTSE

Green construction innovator

Distinguished Professor Vivian Tam's research and inventions are contributing to a future low-carbon, circular economy. She is an award-winning researcher making substantial contributions towards the world's Sustainable Development Goals.

Professor David Taubman FTSE

Digital media expert

Professor David Taubman is an outstanding inventor and entrepreneur whose pioneering work has greatly advanced the field of media compression technology.

Daniel Westerman FTSE

Energy transition expert

Daniel Westerman plays a national leadership role in Australia's transition to net zero emissions.

Sally-Ann Williams FTSE

Innovation leader

As CEO of Cicada Innovations, Sally-Ann Williams has enabled extraordinary growth in deep tech commercialisation. Under her leadership, Cicada has become Australia's most active and effective deep tech incubator, boasting a fivefold increase in STEM professionals engaged in developing ventures addressing the world's most pressing problems.

HONORARY FELLOW

Professor Sandra Eades AO FTSE FASSA FAHMS

Indigenous health trailblazer

Sandra Eades is a leading Indigenous health leader and Noongar woman with family from the Minang and Goreng mobs from Western Australia. Through Sandra's research and appointments, she has greatly contributed to the epidemiology of Aboriginal and Torres Strait Islander children's health in Australia.

FOREIGN FELLOW

Dr Sangeeta Bhatia FTSE

Tissue technologistand entrepreneur

Dr Sangeeta Bhatia's work is small in scale, but big in impact. She develops and deploys nanotechnologies for medical innovation.

The ATSE New Fellows Showcase was held at the National Portrait Gallery in Canberra

Showcasing our new Fellows to the world

One of ATSE's highlights of the year is the New Fellows Showcase, an opportunity for newly elected Fellows to meet for the first time and publicly take their place among ATSE's prestigious Fellowship.

The 2023 New Fellows Showcase took place in Canberra on the 26th of October in the National Portrait Gallery's picturesque Terrace Room, with a full schedule of panels giving each of the new Fellows an opportunity to discuss Australia's greatest challenges.

Alongside the Fellows were sponsors, scholarship recipients and invited guests and scientists. A Welcome to Country from Mary Mudford located the event on Ngunnawal Country, giving the scientific and technical discussions to come a basis in the original science and technical expertise of the many generations of Aboriginal people who are the traditional custodians of the region.

It's clear from the conversations at our 2023 New Fellows Showcase 'Breaking Barriers — realising Australia's technological advantage' that it's never been more important for research, government, society and industry to come together.

Learning from each other — across disciplines, across knowledge systems — is key to a bright future, as is inspiring, educating, and supporting a more diverse and connected STEM-skilled workforce.

Our 33 new Fellows hail from a wide range of applied sciences, engineering and technological innovation. Over the course of the day, the six panels discussed: how to decarbonise the hardest-to-abate sectors on the road to net zero emissions, building resilience in times of crisis, manufacturing for the 21st century, using green technologies to drive innovation, creating advanced technology for a better world, and how artificial intelligence is reshaping industries and our lives.

Moderated by leaders of Australian science including CSIRO Chief Scientist Professor Bronwyn Fox FTSE and incoming Vice-Chancellor of The Australian National University Distinguished Professor Genevieve Bell AO FTSE FAHA, the panels featured wide ranging discussions allowing the Fellows to introduce themselves and their work in the context of some of the biggest opportunities and challenges they are trying to address.

The day offered a space for learning, sharing and meeting, placing the new Fellows in the context of efforts to solve current global challenges. The increasing disciplinary diversity of the Fellowship is a timely signal that leadership on national issues requires interdisciplinary, multidisciplinary and cross organisational thinking.

Photography: Salty Dingo

Infrastructure will define our climate

Image: Luke White on Unsplash

Globally, physical infrastructure and its services are responsible for approximately 80% of all greenhouse gas emissions, and 88% of all adaptation costs. This sector will make or break our capacity to tackle climate change: We must urgently update and adapt how we plan, build and use infrastructure.

Reporting on carbon emissions has focused on industrial sectors, but an enormous proportion are generated by the construction and use of infrastructure. To move the climate change dial, we must urgently act through effective infrastructure planning, and management of carbon emissions associated with its construction and use. Most large-scale infrastructure projects can take up to 10 years. That's a decade-long lag before current projects are completed and any new, less emissions intensive projects, are built.

In the building sector, growth in population and floorspace is out-pacing efforts to reduce operational carbon emissions: in 2021 these were up by 2% over pre-pandemic 2019 levels (UNEP 2022 Global Status Report for Buildings and Construction). While energy intensity and emissions decreased marginally between 2015 and 2021, global floorspace growth in the same period was the equivalent of the land area of Germany, France, Italy and the Netherlands combined.

But right now, we are making major infrastructure decisions in an evidence vacuum; without an assessment of the carbon emissions associated with infrastructure. Engineers and applied scientists have an ethical, moral and professional responsibility to assist society to decarbonise the built environment and its use.

It is encouraging to see the new Infrastructure Net Zero initiative and the emerging collaboration by governments and industry to re-shape our approach to infrastructure development. It is made more urgent with forecast population growth and the transition to clean electricity technologies driving power generation demand.

Against this backdrop, Australia (and the world) must plan, design and construct our built environments within a dedicated carbon emissions budget. Standardising emissions calculation, measurement and reporting methods would lay the foundations for an efficient and accurate carbon market. However, even in the absence of a nationally standardised approach, we still need to include limits on carbon emissions. For example, within the bounds of a project-determined carbon budget, carbon limits can be identified during both procurement and contract development phases.

We need to focus on where the greatest opportunities to influence carbon emissions reduction occurs. This thinking needs to be integrated right at the start of the planning and design stages of the infrastructure asset lifecycle. We are committed to working towards this, and call on government and infrastructure planners to assess all new infra-structure projects through this lens.

Analysing whole-of-life emissions via standardised methods will be increasingly critical so that emissions intensity for infrastructure projects can be objectively understood and compared. We hope such an approach will spur innovation to reduce carbon emissions, and to monitor and manage operations in support of Australia's climate ambitions.

Using carbon balance sheets will facilitate effective assessment of the merits of different infrastructure projects scope, designs, and concepts. It will enable infrastructure owners, operators, designers, and constructors to monitor carbon emissions over a project's lifecycle. Measuring, accounting for and budgeting carbon emissions will help drive the change we desperately need to address the climate crisis.

Infrastructure decision-making must be based on the cost of the impact of carbon emissions (known as carbon cost), drawn from our knowledge of the cost of protection, damage, repair and reconstruction of infrastructure impacted by climate change events.

The veracity of and access to data and models used to compile carbon balance sheets needs to be transparent, supported by research, certifiable and accessible to all parties. This can absolutely be done — but will require commitment and work by academia, engineers, scientists and government.

Scoping infrastructure projects consistent with achieving net zero targets, and aligning responsibility for emissions and sequestration on a project or portfolio basis, will drive innovation across the supply chain.

Net zero infrastructure in Australia is possible, and it will define our ability to tackle climate change — but we urgently need to commit to it, measure it, and model it. Even with immediate action, impact from decisions made today won't be felt until 2030 or beyond. There is no time to waste — the planet depends on it.

UN SDGs
9, 11, 13

Romilly Madew FTSE
CEO Engineers Australia

Romilly Madew is a driving force for the development of sustainable buildings and communities globally. As the former CEO of the Green Building Council Australia she has used deep knowledge of sustainable practices, with her personal and professional leadership, to influence the way we design, construct and manage built assets.

Elected 2019

Kylie Walker
Chief Executive Officer

Kylie Walker is the CEO of ATSE. She works with Australia's leaders in applied science, technology and engineering to advise decision makers, lead crucial national conversations to solve complex challenges, and support Australia's technology-powered, human-driven future.

Tony Barry FTSE
President International Federation of Consulting engineers (FIDIC)

Tony Barry is a civil engineer with 35 years' experience in design, project management and construction of infrastructure. He was a Director of Aurecon from 2000-2016 and elected to the Board of FIDIC in 2015. He served as National President of the Association of Consulting Engineers of Australia from 2004-2006.

Elected 2009

UN SDGs
9, 11, 12

Effective & eco-friendly solutions for Australia's railways

According to Oxford Economics Australia, there has been a substantial rise in the construction and maintenance of railways in Australia, reaching an all-time high of $12.9 billion in 2021-22. Source: Buddhima Indraratna

Distinguished Professor Buddhima Indraratna FTSE
Distinguished Professor of Civil Engineering and Director of the Transport Research Centre at University of Technology Sydney

Buddhima Indraratna is a world authority on the application of fundamental and applied geotechnical research to the development of railway infrastructure. He has led numerous research projects worth millions of dollars and founded the Australian Research Council's Industrial Transformation Training Centre, ITTC-Rail as its inaugural Director in 2018. A consultant to various geotechnical and rail organisations around the world, he is also among the most highly cited researchers internationally.

Elected 2011

RAILWAY BOOM DOWN UNDER

The surge in rail demand in Australia can be attributed to several key factors, including ongoing urban and regional population growth, expanding trade activities and the recognition of the environmental advantages of rail over road transport.

To meet this growing demand and ensure efficient operation of railways, it is crucial to prioritise timely upgrades to the materials and techniques used in railway construction. These upgrades should not only accommodate rising demand but also reduce the frequency of maintenance cycles.

A primary focus of these upgrades should be the incorporation of sustainable materials and environmental practices.

THE WEIGHT OF RAILWAY DEMAND

The layer of crushed stones beneath train tracks, known as the ballast layer, ranges from 200 to 300 mm and is designed to withstand the maximum impact caused by train loads.

However, these stones can break over time as a result of impact, creating a frequent need to replenish ballast with freshly quarried materials. Rail authorities have identified this as one of the most expensive items in their track maintenance schemes.

RECYCLED RUBBER TO THE RESCUE

To optimise track maintenance costs and while enhancing passenger comfort and safety, the construction of rail tracks requires the use of appropriate materials and improved techniques for ballast and its layer formation. Extensive research conducted by the Transport Research Centre at the University of Technology Sydney (TRC-UTS) has demonstrated that incorporating recycled rubber conveyor belts, waste tyre segments, or their derivatives in track substructures can enhance track performance and prolong its lifespan.

Implementing these research and development outcomes from theory to practice was conceptualised through a close collaboration between the Australian Research Council Industrial Transformation Training Centre for Railway Infrastructure (ITTC-Rail) and Sydney Trains, with Bridgestone and EcoFlex as industry partners. This collaboration, which commenced in 2018, led a world first implementation of three innovative approaches to track sections at the Chullora Technology Precinct. These approaches were tested according to the specifications outlined by Transport for New South Wales (TfNSW).

This field trial allowed the performance and feasibility of these innovations to be evaluated on a larger scale and delivered valuable insights into the adoption across future railway infrastructure projects.

Below I highlight the three-fold solution used in this collaboration that will revolutionise our railways.

ENERGY ABSORBING RUBBER SEAM

Recycled conveyor belts are transformed into 11mm thick rubber seam grids using the waterjet cutting method.

These grids are strategically positioned beneath the ballast layer to interlock the stones and also act as shock-absorbing dampers.

By effectively resisting lateral movement and maintaining the stability of the track formation, the rubber seams ensure long lasting track integrity.

Additionally, the rubber material acts as a cushion, absorbing and dissipating impact energy from rail corrugations, track imperfections, and wheel wear.

RUBBER INTERMIXED BALLAST

Large-scale laboratory tests demonstrated that rubber granules derived from waste tyres can replace a portion of the high-quality and increasingly scarce crushed stones used in the load bearing ballast layer.

The composition of rubber granules is carefully determined to minimise particle breakage during train operations, surpassing the performance of conventional tracks. The inclusion of rubber particles reduces friction and wear between rock particles, extending the ballast layer's lifespan.

The track construction process is similar to conventional methods, utilising readily available volumetric mixers to blend natural rock aggregates and rubber granules to the desired proportion.

This approach offers technical effectiveness, extended ballast lifespan, and compatibility with existing construction equipment, making it a promising avenue for sustainable and efficient railway track construction and maintenance.

INFILLED TYRE CELL FOUNDATION

The infilled tyre cell approach involves repurposing used car tyres by removing one side rim and filling the tyres with granular waste materials like used ballast or coal wash.

The filled tyres are then arranged in a grid pattern beneath the ballast layer. The innovative structure serves two purposes: reducing lateral movement of the track formation and minimising the load transfer into the untreated ground beneath the track. By dispersing the load and ensuring an even distribution of forces, this approach reduces the risk of track settlement and associated maintenance issues.

CIRCULAR ECONOMY ON TRACK

Fundamental and applied research efforts like the Chullora field tests have shown that the blending and placement of these new materials in the track substructure can be technologically superior to the current minimum technical standards prescribed for conventional tracks.

The combined implementation of rubber seam grids, rubber intermixed ballast, and infilled tyre cell foundations offers a comprehensive solution to improve railway tracks. It enhances track stability, extends the lifespan of the ballast layer, reduces maintenance requirements and promotes sustainable and efficient railway infrastructure.

These innovations are an attractive way to reduce Australia's carbon footprint while embracing the circular economic perspectives strongly encouraged by the state and commonwealth governments in Australia.

It is projected that these expenditures will continue to remain significant, with an average of $14.4 billion expected over the next five years.

UN SDGs
3, 6, 11

One Health explained

WHAT IS ONE HEALTH?

"One Health is an integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals, and ecosystems. It recognises the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent. The approach mobilises multiple sectors, disciplines, and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for healthy food, water, energy, and air, taking action on climate change and contributing to sustainable development."
One Health High-Level Expert Panel

The consensus definition of One Health was developed by the One Health High Level Expert Panel (OHHLEP), an international advisory committee to the Food and Agriculture Organisation, the United Nations Environment Programme, the World Health Organisation and the World Organisation of Animal Health, collectively known as the 'Quadripartite'. OHHLEP was established by the Quadripartite to provide evidence-based scientific and policy advice to address the challenges raised at the animal-human-environment interface using the One Health approach. This is an acknowledgement that no one sector can solve these challenges alone.

In the late 19th century, the physician Rudolf Virchow stated that "*between animal and human medicine there are no dividing lines–nor should there be.*" The concept has previously been referred to as 'One Medicine', or 'One World — One Health', and has extended beyond the human-animal health interface to encompass the health and sustainability of the world's ecosystems. This includes issues like biodiversity loss, clean air and energy, the impact of climate change, food and water security, and antimicrobial resistance.

ONE HEALTH APPLIED

Tackling zoonotic diseases
Virchow was the first person use the term 'zoonosis', which are infectious diseases transmitted from animals to humans. About 60% of emerging infectious diseases are zoonotic, with around 75% of these originating from wildlife. This spillover of diseases from animals to humans has created a real need for integrated and collaborative approaches to understanding the role of wildlife and wildlife ecology in spillover events and in developing risk assessments and designing response and control measures that cut across disciplinary and jurisdictional barriers.

Environmental ecosystems
Since the advent of the industrial revolution, rapid population growth and the over-exploitation of natural resources has led to the degradation of soil, water, biodiversity and environmental health. Climate change is also fuelling the increased incidence of pests and diseases, accelerating a decline in soil health and the spread of transmissible diseases. The long-term sustainability of ecosystems and planetary boundaries is currently drawing attention worldwide, necessitating an integrated, transdisciplinary approach to solving these deeply interconnected problems.

THE EMERGENCE OF ONE HEALTH

The emergence of the SARS coronavirus in 2003 and the H5N1 avian influenza in 2004-2005, clearly demonstrated the importance of zoonotic diseases and the possibility for the future emergence of novel diseases with pandemic potential from an animal reservoir.

Indeed, these viruses demonstrated that a previously unknown pathogen could threaten the health, well-being, and economies of all societies — concerns validated by the emergence of SARS-CoV-2 (the virus that causes COVID-19).

Driving the early momentum were a series of strategic goals known as the 'Manhattan Principles', developed by the Wildlife Conservation Society. The principles recognised the link between human and animal health, and the threats that diseases pose to food supplies and economies. They were a vital step in recognising the importance of collaborative, cross-disciplinary, and cross-jurisdictional approaches essential to a comprehensive One Health response. In response to international requests for pandemic prevention and the promotion of sustainable health outcomes through a One Health approach, the Quadripartite has recently developed the One Health Joint Plan of Action (2022–2026).

This plan outlines the commitment of the four organisations to collectively advocate and support the implementation of One Health into policy action in all countries.

IMPLICATIONS OF ONE HEALTH FOR OUR HEALTH SYSTEMS

Consideration of the connections between human health and our environment, including other animals, is not new to health systems. In 1900, a major function of the NSW Department of Health was rat catching in the slums of The Rocks area of Sydney to contain an outbreak of bubonic plague, spread by fleas carried by rodents. These days, State Health Departments routinely address environmental health issues such as chemical spills polluting waterways, tick-borne diseases, Hendra virus in horses, air pollution advisories, mosquito control and fluoridation of water supplies, to name but a few.

In the last decade, there has been increasing global focus on researching the social determinants of health, including environmental factors, especially in relation to poverty and disadvantage, and health systems are designing health solutions which extend well beyond the confines of the hospital or clinic.

ONE HEALTH FOCUSED POLICY PRIORITIES

Coordination and collaboration will be key. Australia's emerging national Centre for Disease Control (CDC) will need to consider a broader set of relationships beyond medical science, ensuring cross-jurisdictional and cross-disciplinary collaboration through interfaces with commonwealth and state services for detecting and responding to human, animal and wildlife diseases, and including the consideration of environmental and meteorological factors.

Some considerations for future policy priorities include:

- Transdisciplinary approaches. Implementing One Health requires a systemic, multidisciplinary focus on the health of animals, humans, and ecosystems worldwide, and potential solutions that are equitable, inclusive, and sustainable.
- Connected data. Digital health solutions which connect disparate data across human, animal and environmental domains will be required to monitor and manage the spread of diseases. Such systems will require investment, and will need to be underpinned by both national and international data standards that support interoperability and data matching, while protecting individual privacy and ensuring cyber security.
- Collaborative research. Cross-jurisdictional and multi-disciplinary research initiatives and open-source data sharing will become even more important both within and across all One Health domains.
- Evolved service models. Population health service models will need to evolve from traditional public health approaches to harness digital technologies, AI, big data, and personalised data (precision medicine).
- Environmental health restoration. There will be a continued need for regenerative agriculture, and policies and incentives to improve our global food, nutrition and environmental security.
- Climate change. Many of the issues implicated in One Health processes are likely to be significantly affected by climate change, and it is essential that planning is initiated for mitigation and adaptation.

Want to know more about One Health and its implications for antimicrobial resistance? Read our 'Curbing antimicrobial resistance' *report, released 2023 and delivered in partnership by ATSE and the CSIRO.*

See the publications page on the ATSE website to download this joint report.

Emeritus Professor John Mackenzie AO FTSE
Emeritus Professor of Faculty of Health Sciences at Curtin University

John Mackenzie is co-founder and Vice-Chair of the One Health Platform, a non-profit foundation based in Belgium, and Editor-in-Chief of the journal, One Health. He has been a consultant to the World Health Organization since 1982, and has been closely involved with establishing the Global Outbreak Alert and Response Network and the Asia Pacific Strategy for Emerging Diseases. He serves on the Roster of Experts of the WHO's International Health Regulations, and in 2009-2010 was the Chair of the first IHR Emergency Committee for Pandemic H1N1 influenza.

Elected 2015

Professor Mary Foley AM FTSE
Adjunct Professor of School of Health Sciences, Western Sydney University

Mary Foley has made an extensive contribution to health systems leadership and policy development. She was Director General and Secretary of NSW Health overseeing a period of substantial reform. Previously, she was National Health Industry Leader for PwC Australia, and Chief Executive of St Vincent's and Mater Health in Sydney. As Managing Director of Telstra Health, Mary led a major digital transformation in healthcare such as the National Cancer Screening Register.

Elected 2022

Image below left: Murray River in flood at Mildura. Source: iStock

CASE STUDY
Mosquito-borne diseases

Mosquito-borne diseases are excellent examples of One Health in action. Australia has a number of important mosquito-borne diseases including Ross River virus, Murray Valley encephalitis, West Nile fever, and most recently, Japanese encephalitis. Each of these diseases is normally transmitted between wildlife and/or domestic animal hosts — including marsupials, wading birds and pigs — by mosquitoes. Humans can become opportunistic hosts when bitten by a mosquito carrying one of these viruses, further spreading the diseases. Surveillance strategies for identifying the presence of these diseases, and in responding to the risks they pose, require knowledge and understanding of the ecology of each host, vector, and the environmental factors that impact transmission. When a wildlife host has been infected with one of these viruses, it is immune to further infections, so young naïve animals are essential in maintaining the transmission cycles. Integrated One Health approaches are therefore essential for understanding, monitoring and breaking the transmission cycles to ensure human, animal and environmental health and wellbeing.

Dr Beth Ebert FTSE
Senior Principle Research Scientist,
Bureau of Meteorology

Elizabeth Ebert is a meteorologist with extensive experience working in governments. She holds a science leadership role in the World Meteorological Organization and has had considerable influence on international research in high impact weather.

Elected 2022

Advancing Australia's weather warnings

UN SDGs
3, 9

As the Bureau of Meteorology's Senior Principal Research Scientist, I work at the forefront of improving forecasts and warnings for high impact weather, helping to keep all Australians safe.

For me, professional success means doing something useful, and throughout my career, I have strived to achieve just that.

Early in my career, I had envisioned myself delving into pure research. However, my first project at the Bureau of Meteorology was just the opposite. I was tasked with developing an algorithm to detect fog and low cloud from geostationary satellite data. One of the operational meteorologists called me to tell me how useful that work was for forecasting weather at airports, providing essential information for flight safety. Hearing that feedback was extremely rewarding for me, and it changed my perspective. Since then, I have tended to work on applying weather science for practical solutions.

Over the course of more than 30 years, I am proud of the pioneering contributions I have made to improving forecast services from the Bureau and other national weather services and agencies.

As global warming exacerbates the frequency of high impact weather events, there are growing opportunities to apply weather science to improve public health, aided by improving technologies for collecting and exchanging data. I have co-led multidisciplinary science teams in Australia to develop forecasting systems for smoke exposure, high pollen concentrations, and epidemic thunderstorm asthma.

A project I am particularly proud of, was the development of a pilot epidemic thunderstorm asthma (ETSA) forecasting system in response to the devastating event in the greater Melbourne and Geelong area in November 2016. These areas experienced an unprecedented epidemic of thunderstorm asthma when a thunderstorm squall line coincided with high concentrations of airborne grass pollen. The ambulance system was overwhelmed. Over 9,000 people sought emergency medical assistance within a period of 30 hours, and 10 people died.

Commissioned by the Victorian Department of Health and Human Services (DHHS), my team at the Bureau of Meteorology and university partners began the development of an integrated early warning system to mitigate future epidemic thunderstorm asthma events.

It was a crazy time. The DHHS urgently needed ETSA early warnings to be available in October 2017, the start of the next grass pollen season, so we had to work quickly.

Through intense efforts and close collaboration with health professionals, botanists, statisticians, and thunderstorm experts, six new pollen monitors were deployed to locations around Victoria and statistical pollen forecasts were developed. A new system was designed and implemented to combine the pollen forecasts with the Bureau's thunderstorm forecasts to predict the occurrence of epidemic thunderstorm asthma and inform the community and emergency and health services.

I am immensely proud of the work we did in partnership to get the world's first thunderstorm asthma warning service up and running in less than a year. Normally, creating a new warning service takes several years. It is exciting to have contributed to reducing the health impacts of thunderstorm asthma events that occurred in subsequent years.

Soon afterwards, from 2017-2020, I led a multidisciplinary research team to improve the forecasting of ryegrass pollen, one of the main ingredients in thunderstorm asthma in Victoria. I also instigated a series of workshops on thunderstorm asthma and pollen prediction, which has helped to coalesce a community of scientists, engineers, and health professionals who are continuing to make inroads on understanding and mitigating the impacts of thunderstorm asthma.

I am now leading a project for the World Meteorological Organization. The project aims to improve warnings for high impact weather events by using value chain approaches to evaluate the flows of data and information between relevant partners and capabilities in the end-to-end warning chain. This project emphasises the importance of integrating natural and social science to improve warning outcomes. After all, the most accurate warning in the world won't have its intended effect if it is poorly communicated and not understood by the people who need to take action.

My journey as a Senior Principal Research Scientist at the Bureau of Meteorology has been incredibly fulfilling. I have dedicated my career to making meaningful contributions to weather forecasting and warning systems, with the ultimate goal of making it easier for Australians to stay safe. Through innovative approaches and collaborations with diverse experts, I have had the privilege of improving forecasts, reducing health impacts, and advancing the field of meteorology on a global scale.

Image (left): Sea Bridge at Clifton by Silas Baisch on Unsplash.

Celebrating Australian technology and engineering trailblazers at the ATSE Awards 2023

Weaving Traditional Knowledge with western science for a new approach to pain relief, tapping into green energy using recycling byproducts, and a revolutionary new approach to sustainability for the beef and lamb industry, were all celebrated at the ATSE Annual Awards.

The winning engineers and technologists were recognised for their groundbreaking work on Australia's toughest issues, spanning climate change, mining, plastic waste, battery tech and food security among others, during a ceremony at the National Arboretum in Canberra.

ATSE President, Dr Katherine Woodthorpe AO FTSE FAICD, said the winners' innovation, drive, and impact were exemplars for the game-changing application of Australian research.

"The winners of the 2023 ATSE Awards are exemplary engineers, applied scientists, and leaders in technology; their shining example is an inspiration as we reflect on and celebrate the novel science and engineering endeavours that are bettering our world," Dr Woodthorpe said.

"Australian innovators are changing the world for the better. I am thrilled to see our national award winners' game-changing work forging new territory in medical technology, climate solutions, critical minerals, food technology, and waste reduction."

Nominations for the ATSE Awards 2024 open in February 2024.

The ATSE Awards 2024 Gala Dinner will be held in Melbourne on Thursday 17 October.

Above left > right: Dr James Tickner, Professor Ronald Quinn AM FTSE, Bailey Richardson, John Watson, Dr Conrad Wasko, Laila Amanda Halim, Dr Natalie Morgan, Dr Marzi Barghamadi, Dr Benjamin Holman. Missing: Peter Laver AM FTSE. Photo: Salty Dingo

CLUNIES ROSS TECHNOLOGY INNOVATION AWARD

Dr James Tickner
Chrysos Corporation Ltd

Dr James Tickner's invention, PhotonAssay™, uses X-ray technology to detect gold, silver, copper and other elements in mineral ores.

In the mining industry, quantifying the concentration of a target element in a sample is crucial. In developing PhotonAssay™, James overcame many of the safety, environmental and efficiency problems of older, more harmful and hazardous detection methods.

PhotonAssay™ technology counts atoms inside rocky samples in a matter of minutes, whereas previous assaying processes could take weeks. Furthermore, the innovative approach minimises health risks for operators, and eliminates toxic waste, while also halving energy consumption and carbon emissions compared to existing methods - making it safer for workers, and better for the planet.

James developed PhotonAssay™ while working at CSIRO, and left his research role to commercialise the technology. He co-founded the mining technology start-up Chrysos Corporation Ltd, where he continues to lead the science, engineering and product development teams. In just six years, as Chrysos' Chief Technology Officer, James has overseen the growth of PhotonAssay™ from its first functional unit to a fleet of commercially operating units across three continents running approximately 300,000 samples per month.

BATTERHAM MEDAL FOR ENGINEERING EXCELLENCE

Dr Conrad Wasko
University of Melbourne

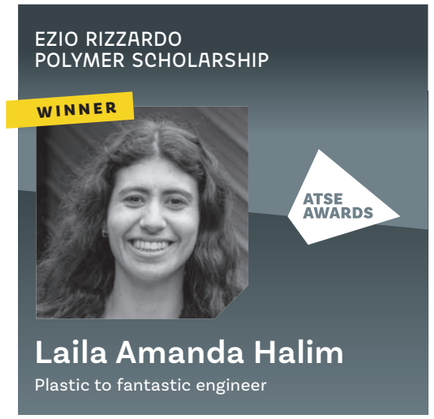
As a hydrological engineer, Dr Conrad Wasko has transformed our understanding of how climate change will affect floods.

Ten years ago, the scientific community knew little about the relationship between climate change and flooding. Conrad's world-leading research has filled this global knowledge gap, discovering that we won't see universal increases in flood events with the changing climate. Conrad has found that small floods—those that fill up water supplies—are decreasing and in contrast, larger damaging flood events are becoming more frequent.

Conrad was also the first to conclusively show that storms intensify as temperatures increase. This has implications for urban flooding as intense rainfall in concreted urban areas can result in flash floods.

A senior lecturer at the University of Melbourne and Australian Research Council Fellow, Conrad's discoveries are helping us adapt to and mitigate changing flood and water patterns. His clear communication of complex uncertainty informs engineering recommendations and updated flood guidance across Australia.

ATSE AWARDS



DAVID & VALERIE SOLOMON AWARD

Dr Marzi Barghamadi
CSIRO

Dr Marzi Barghamadi is a Research Scientist at CSIRO Manufacturing leading the Battery Materials and Design team. She works across a variety of different energy storage devices and tackles some of the biggest challenges in battery research by improving the cycle life and safety of lithium batteries.

Lithium-ion batteries are found in everyday life — powering our phones, laptops and electric vehicles. While they are fast and easy to charge, lithium-ion batteries have limited energy density. Marzi is collaborating across multiple leading industries to enhance the energy density of batteries, which will have the potential to store more energy and deliver increased power. She is the co-inventor of a power optimised lithium-ion energy storage device.

Through her research on lithium-sulfur batteries, she has made significant progress towards improving the safety of this emerging energy storage technology using alternative electrolyte additives and solvents.

An advocate for women in STEM, Marzi has won multiple awards including the prestigious L'Oréal-UNESCO For Women in Science Fellowship in 2020, and a Clean Energy Council's Chloe Munro Scholarship for emerging female leaders in 2021.

ICM AGRIFOOD AWARD

Dr Natalie Morgan
Curtin University

Dr Natalie Morgan has shaped how the poultry industry formulates diets for both egg-laying and meat chickens. Her research revealed the importance of fibre — a nutrient historically overlooked in poultry diets. Natalie developed a database of accurate fibre values to help poultry nutritionists improve accuracy when formulating feed that boosts birds' health and productivity.

Natalie has also investigated prebiotics, carbohydrates that fuel beneficial bacteria in the gut. Fueling these good gut bacteria can enhance nutrient absorption, and Natalie has shown that prebiotics can actually reduce nutrient waste in poultry feed. Her innovative efforts have focused on making and measuring prebiotics — including from human food waste products — and how best to supplement them into poultry diets.

A leader in both academia and industry, Natalie's portfolio extends into community engagement. She developed a training program in NSW to help unemployed young people find opportunities in the poultry industry and is a mentor to young women in STEM.

ICM AGRIFOOD AWARD

Dr Benjamin Holman
NSW Department of Primary Industries

Dr Benjamin Holman's award-winning work on Australian beef and lamb has cemented his place as an international leader in meat science.

Benjamin's rigorous research has enhanced the sustainability of the beef and lamb industry. He has analysed packaging options to improve shelf life, investigated how to speed up the resource-intensive meat ageing process, and identified refrigeration and freezing storage conditions with reduced environmental footprints that still deliver quality meat.

Benjamin's research feeds seamlessly into best-practice recommendations for farmers. For example, Benjamin's analysis of novel livestock feed ensures that any resulting meat is safe, high quality, and rich in the nutrients needed for a balanced human diet.

Recently, Benjamin undertook a ground-breaking review of meat freshness standards, and defined a new, lower spoilage threshold for beef — the point at which beef crosses from fresh to not ideal for human consumption. The study also demonstrated that Australian beef stays fresher for longer — a finding that improves market access and boosts the international reputation of Australian meat products.

EZIO RIZZARDO POLYMER SCHOLARSHIP

Laila Halim
Monash University

Laila Halim is passionate about sustainable engineering and creating a healthier planet for future generations. As a first-year PhD candidate at Monash University, she is putting her engineering expertise to work on the plastic waste problem.

When advanced recycling techniques are applied to plastic waste, a complex mixture of smaller chemical components is obtained. Laila's PhD project investigates how to filter out the useful components using polymeric membrane materials, in place of traditional high energy means of separation. Once isolated, the useful chemical constituents of plastic waste can be valorised into new products across various industries. She is particularly interested in finding ways to upcycle plastic waste for use in the green energy industry.

Laila's research treats plastic waste as an opportunity rather than a burden and contributes to Australia's circular economy aspirations. She holds a Bachelor of Engineering and a Bachelor of Science and has a stellar academic record with numerous Dean's List commendations and scholarships. Laila is strongly community minded, evidenced through her work with the Tech Girls Movement Foundation and Engineers Without Borders.

EZIO RIZZARDO POLYMER SCHOLARSHIP

Bailey Richardson
Queensland University of Technology

Bailey Richardson is a PhD student at Queensland University of Technology.

Inspired by the relationship between light and biology which affords processes such as photosynthesis, Bailey aims to understand the natural designs that allow certain biopolymers to use light efficiently.

By taking inspiration from these designs, he creates novel polymers that can interact with light in similarly specific ways. These materials hold potential to advance our understanding of cellular processes and lead to new ways to diagnose and treat diseases.

With an exceptional academic record and several awards earned during his undergraduate career at Queensland University of Technology, PhD candidate Bailey is well-equipped to take on this polymer challenge. He's also passionate about science community building, co-founding the QUT chemistry club.

PRESIDENT'S MEDAL

Peter Laver AM FTSE

Peter Laver AM FTSE has been an integral part of ATSE's progress as a modern Academy. A previous Vice President, Peter played a leading role in developing the agile and future-focused Board and Assembly structure that exist today, which pays respect to the Academy's origins and traditions. After his tenure as Vice President, he became a Senior Advisor to the Academy and has contributed to several Strategic Plans, policy documents, submissions and Government Inquiries.

Peter was elected in 1992 in recognition of his dedication to fostering industry and academic collaboration through his various managerial roles at BHP over 40 years. He has held many positions as chair and advisor. In 2005, he received a Member of the Order of Australia for service to industry, tertiary education and training, and science and technology.

As a lifelong learner, he is an advocate for investment in training and education.

Below L>R: Anthony Watson, Professor Ron Quinn AM FTSE and John Watson. Anthony travelled with his father John from the Kimberley region of Western Australia to attend the ATSE Awards.

TRADITIONAL KNOWLEDGE INNOVATION AWARD

John Watson, Nyikina Mangala Community and Professor Ron Quinn AM FTSE, Griffith University

Partners in traditional pain treatment

In 1986, John Watson's finger was bitten off by a crocodile. A Nyikina Mangala man from the Jarlmadangah Burru Aboriginal Community of the Kimberley, John turned to the bark of the Mudjala mangrove tree seeking pain relief. He chewed on a strip of bark and applied it as a dressing to his wound.

When Professor Ron Quinn from Griffith University heard of John's ordeal, and his use of the Mudjala bark, he was intrigued. An enduring partnership eventuated between the Nyikina Mangala people and Griffith University under the leadership of John and Ron, seeking to identify what active compounds could be present in the bark.

Combining thousands of years of Traditional Knowledge with western science has revealed a novel, natural remedy for the treatment of severe pain. The bark contains two classes of compound: one is effective for inflammatory pain and the other mitigates sciatic nerve injury. The resulting product — a possible topical gel— will be based on the complex mixtures present within the bark paste. John and Ron hope that this gel could be supplied to athletes at the 2032 Brisbane Olympics.

The project is powerful not only for its outcomes, but also its approach in retaining Traditional ownership and respect for the integrity of Traditional Knowledge.

Governor General's address

Address by His Excellency General the Honourable David Hurley AC DSC (Retd) FTSE, Governor-General of the Commonwealth of Australia to the ATSE Awards 2023 Gala Dinner

Photography: Salty Dingo

His Excellency General the Honourable David Hurley AC DSC (Retd) FTSE, Governor-General of the Commonwealth of Australia

His Excellency General the Honourable David John Hurley AC DSC (Retd) was sworn in as the Governor-General of the Commonwealth of Australia on 1 July 2019. David Hurley joined the Australian Army in January 1972, graduating from the Royal Military College, Duntroon into the Royal Australian Infantry Corps. In a long and distinguished 42-year military career, his service culminated with his appointment as Chief of the Defence Force. Prior to being sworn in as Governor-General, David Hurley served as the 38th Governor of New South Wales from October 2014–May 2019.

Elected 2016

Caroline [Aunty Caroline Hughes], thank you very much for your welcome. If you're not aware, I had the privilege in September of investing Caroline as a member of the Order of Australia for her work in reconciliation and working with the local communities here. So Caroline, thank you and congratulations again.

Joining with your acknowledgement, Canberrans here know how beautiful a part of the country this is with Namadgi down South, the Brindabellas, the Murrumbidgee, the Molonglo; we're really blessed by nature and we thank the Ngunnawal for looking after it for generation after generation. I pay respects, and my constant message over the last 12 months has been be mindful of our enormous responsibility to the younger generation of Indigenous children today because their future is absolutely critical to the future of this country. In our hands, their future.

Could I acknowledge our distinguished guests, Minister Ed Husic, Professor Katherine Woodthorpe , Kylie Walker, Cathy Foley and all who have joined us this evening. I've got a speech here that says a lot of nice things about you, but I'm going to just leave it for a moment.

Every time I visit the Northern Rivers, to Lismore, Coraki, Woodburn, Cabbage Tree Island, ravaged by terrible floods, heart rending floods earlier this year, and listen to the stories, talk to the boaties, talk to the little kids who were taken out of the roof as the water came up to their ceilings, held up by their parents, I come away from those visits and I've got three words in my head: technology, science, and engineering.

Because out of that tragic circumstance up there, I believe, we have been given a golden opportunity to show how good this country is. And the solution is in those three fields. How we as Australians, through our ingenuity, through our innovation, through our intellect, through our leadership, can demonstrate to the world as one of your aims of ATSE says, 'climate change mitigation and adaptation', how to demonstrate to the world how we can build a community that is adapted to climate change in the future. We have a golden opportunity in that rural community to demonstrate not only just building back, not only building better, but building for a future that will be different. That's why I'm inspired by what you do here at ATSE.

Now I'll come back to the good bits for you. I want to say congratulations to the new Fellows who were installed this week. And thank you for what you have contributed to date and what you will do in the future: you join a very distinguished cohort and deserve your recognition. I enjoyed reading about you and the exciting endeavours you're into, for example, harnessing AI for social good, developing new sources of renewable energy, securing safe water and sanitation in remote communities, diagnosing illnesses earlier and more accurately, the list goes on. And what I read in that and what I see in this particular Academy makes me optimistic about the future of Australia. Now it's not trendy to say that at the moment, but seeing it 365 days a year 24/7 every week, I'm optimistic for this country, for the quality of the people it has and the quality that you exhibit in this Academy.

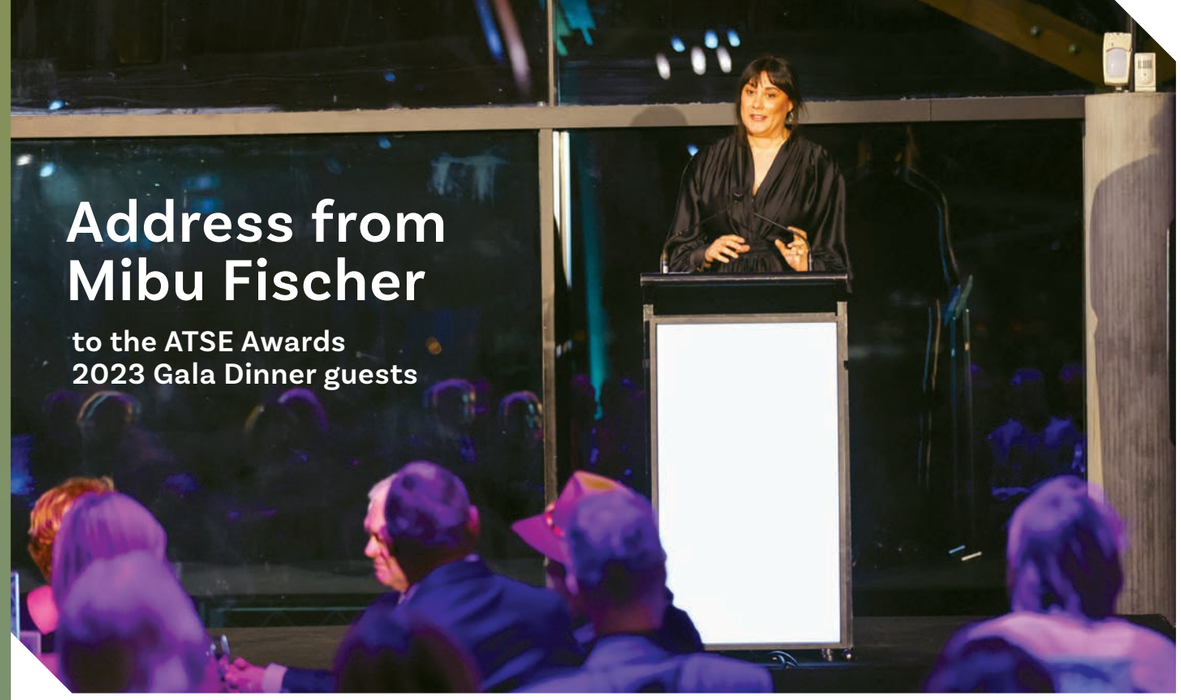
When I was sworn in, I quoted the Australian author David Malouf, he said, "Australia is still revealing itself to us. We oughtn't to close off possibilities by declaring too early what we've already become." i.e. we're not a finished product. So sometimes we are disappointed. Sometimes we are upset. Sometimes we are challenged, but we're not a finished product. And the ingenuity, the engine, the drive, the leadership to develop that product rests in a learned Academy, such as yours, in concert of course with the others.

I want to thank you for what you're doing in relation to STEM education. In your recent past Paper on STEM skills, I took out two major recommendations from it: the need to promote and support a culture of lifelong STEM learning and the workforce to ensure Australia has the skills it needs now and into the future, and the need to raise the profile of STEM careers in Australia to showcase their accessibility and their attractiveness.

Now, it's not for me to comment on the merits of individual policies, but let me bring out two themes for that. First of all, I think we are a nation of problem solvers. We're suited to lifelong learning, to adapting, to innovating. And I keep embarrassing Professor Michelle Simmons by quoting her back to herself. I'm not sure if she's here tonight. But I share her view. When she was asked "why did she come to Australia to take up quantum computing tasks here in Australia?", she said, "Because Australians will take on the big challenges." That's our track record. That's who we are. And that's what we should be doing. And Michelle, of course, won this year's Prime Minister's Prize for Science and became the Australian of the Year.

But the right skills are here. And really, there's no end to what we can do as a country, and certainly through my office, being able to raise the profile of STEM, particularly through the Order of Australia. I'm very pleased that this year, we finally achieved gender parity, in our honours list, and across the three highest levels in the Order. That was a significant achievement. But we've got more work to do. We need to represent the quality of the work that comes out of the Academy like this. So we can shout to the Australian community: This is important. And this is a future for you. Our job is not to open doors for young kids and make life easy for them. Our job is to show them how many doors are out there to knock on and what's the pathway to them. And if the pathways (mean) keep with maths, keep with science, then that's our job. It's the key to our future.

So I want to congratulate again the new Fellows, I want to congratulate those who are going to be award recipients tonight. Thank you for your contribution to Australia. Thank you for your contribution to our growth. But more than that, thank you for your potential and what you will do for us into the future. This is an important institution in the life of Australia. It has been, history tells us that, but more than that now, it is important as we take on some big challenges that face us into the future. Lismore, Cabbage Tree Island, Coraki, Woodburn, West Ballina, Casino — all those little country towns depend on us, showing the leadership to do it. Thank you.



Address from Mibu Fischer

to the ATSE Awards 2023 Gala Dinner guests

Photography: Salty Dingo

I want to thank ATSE and Bronwyn Fox from CSIRO for the opportunity to address you all this evening.

I was a judge this year for the inaugural Traditional Knowledge Innovation Award and want to congratulate the team and all nominees for the wonderful work they are doing and I can't wait to see more of it in the future.

Today it was a real privilege to listen to the new Fellows during their showcase panels, congratulations to you all. The breadth of work and thinking being undertaken is immense. And it's encouraging to hear that there is openness to widen ways of thinking to approach our shared challenges.

With that in mind, I was hoping to share some of my STEM journey with you and highlight aspects that speak to the theme of breaking barriers.

I started as a cadet in 2009 and have had numerous positions since, including lab tech and RA in aquaculture. During this time I tried to avoid being pigeonholed into Indigenous science/activities. But being proud of my ancestry I succumbed and became one of a few 'go to' Aboriginal people at work.

Being one of a few meant the cultural burden fell heavily on a small number of people. And working as a researcher who happens to be Indigenous with the cultural load on top has meant effort focused on cultural activities and engagement has taken away time from science. And this has been at the cost of career progression, (as) the work is not valued in our promotion systems.

CSIRO has been addressing these barriers, committing to cultural advisory officers who are taking on tasks like ensuring our organisation is on track with meeting our RAP deliverables. But as a collective body of STEM professionals and changemakers there is still a long walk ahead for all of us.

For myself that walk so far, has been an incredibly taxing one, ensuring I am walking in both worlds effectively and creating space for the young ones coming up behind me. For me the opportunity for my voice to be heard is a conflict for myself between feeling privileged to having my voice heard and feeling like a fine line to being a box ticker — as I have for many years as a young Aboriginal woman in science — it takes a lot of energy to feel like I belong in spaces like this because of my accomplishments and not my identity.

Academia or bureaucratic processes in STEM are often challenged about how to allow multiple worldviews, for alternate kinds of knowledge production and this can often come down to the old notion that western society is the pinnacle of human achievement (Luke Pearson, IndigenousX). Viewing knowledge production from this lens has resulted in the othering, devaluing and under appreciation for what other cultures do differently. I think it'd be important for STEM to consider diversity beyond its workforce but also in projects, problems and questions we are asking.

That the ways in which we need to view a problem in order to find a solution can be different and that it's okay to include alternate ways of thinking like our Indigenous Knowledge systems, because they are respected by people like you in this room.

Thank you.

Mibu Fischer

Mibu is an early career marine ethnoecologist within the multi-use ecosystems tropical coastal group, in CSIROs Oceans and Atmosphere, in Brisbane. She is an Aboriginal scientist with engagement skills for strengthening partnerships between First Nations communities and the research sector. Her specific interests are around Traditional Knowledge (science) and management practices being considered within modern day fisheries, coastal and conservation management. She joins with other Indigenous and Traditional practitioners to strengthen the global Indigenous voice and leadership in areas of marine research and coastal Indigenous livelihoods. Her goal is to bridge a gap that draws attention to the Indigenous communities facing the frontline of impacts and changes to coastlines, ecosystems and livelihoods from climate change impacts.

This speech was given to the ATSE Awards 2023 Gala Dinner at the National Arboretum in Canberra on 26 October 2023.

ATSE Fellow and newly-appointed Director of the Australian Centre for Advanced Photovoltaics, Renate Egan, has a bold plan for the next ten years of solar power in Australia and beyond.

Photovoltaic innovation

Professor Renate Egan
FTSE
Renate Egan was appointed Centre Director of the Australian Centre for Advanced Photovoltaics (ACAP) in July 2023, having led UNSW's activities in ACAP since 2015, including leading the bid to extend ACAP to 2030. She is also co-founder of Solar Analytics Pty Ltd, and an ATSE Fellow.

Elected 2020

UN SDGs
7, 9, 13

It's been an incredibly dynamic time in the solar industry in Australia over the last decade. At the Australian Centre for Advanced Photovoltaics (ACAP), a nation-wide research collaboration headquartered at UNSW Sydney, I've been fortunate to work with leading-edge researchers in the field of solar power; not only leaders in Australia, but in the world.

ACAP was established in 2013 by Martin Green, Scientia Professor at UNSW, and as a partnership with ANU, Monash University, CSIRO-Manufacturing and the Universities of Queensland and Melbourne. Over the last ten years, ACAP has delivered an astounding number of technical breakthroughs in solar and is developing talent and ideas with the next generation of engineers and technologists. New benchmarks have been set in how effectively solar cells can convert sunlight into electricity, new research and industry collaborations have been established, and innovative new technologies have been developed and commercialised.

More recently, I've been working with the ACAP team, ARENA and our industry partners to plan the solar technology roadmap to 2030, to continue to improve performance and to deliver the ultra low cost solar we need to become a renewable energy superpower. I'm thrilled to be able to take up the role of Director with the Centre and lead ACAP into its next phase. I look forward to continuing to work with Martin, who will stay involved as a technical advisor, where his decades of experience and success in the field will continue to inspire and guide the new generation of solar engineers.

Through the Australian Renewable Energy Agency, we have been funded to continue our research until 2030, with $45 million in grant funds that are more than matched by an additional $80 million from our university and industry partners. We can see, through this investment, and the record funding by ARENA of new renewable energy projects over the last 12 months, that the federal government is confident in backing the renewable energy technologies and projects that will ensure a robust Australian energy sector into the next decade and beyond.

I see ACAP's role as continuing to push the potential of solar power even further, and in engaging all parts of the sector to reach the ambitious goals required to bring our economic and energy systems to next zero by 2050.

I look forward with optimism, as we've seen the incredible speed with which these technologies can be improved and deployed at scale. On a household level, Australia has led the world in embracing rooftop solar. At a state level, we are already seeing days when renewable energy, backed by storage, can produce more than 100% of the electricity needs of South Australia. Nationally, we have more solar installed on a per-capita basis, than anywhere else in the world. And globally, Australian research and education continues to attract international attention.

We have seen what solar can do; now is the time to bring it to its full-scale potential.

The solar technology of today provides the lowest cost of energy where it is produced, say, on your rooftop, and is competitive for 24/7 supply, even when battery storage is included. With a view to even lower costs for industrial scale processing, we continue to work on improving performance and driving down the price of solar technologies. This will be achieved through new development in materials, devices and deployment, and answering questions like: How can Australia participate in the solar supply chain? How can we best deploy and integrate vast amounts of solar, considering community, cost of energy and sustainability? And how will we manage recycling of solar technologies at the end of their lifecycle?

Having worked in this field for my entire professional life, I have never felt more optimistic about Australia's solar future. With over 90% of the world's solar panels relying on technologies invented in Australia and with strong industry partnerships meaning the advances developed within the ACAP team are quickly taken up in large scale manufacturing, the research at ACAP remains at the leading edge internationally. We are training the engineers who will deliver on this ultra-low-cost solar future. We have the commitment and we have the vision.

ACAP is a national collaboration, recently extended to include University of Sydney and CSIRO-Energy. With ARENA and our industry partners, we are working to make a net-zero economy in Australia the most economically and environmentally sound path forward. And we welcome collaborators at all levels, whether industry, government, or at the forefront of research, to be in touch to find out how to become a part of it with us.

Image: iStock

Australian innovators lead the way with global connections

In August 2023, ATSE announced four new research-industry collaborative projects funded through the Australian Government's Global Connections Fund — Bridging Grants program.

The Global Connections Fund provides initial funding to promote international collaboration between researchers and small to medium enterprises (SMEs), with the aim of fostering lasting research-industry partnerships. These grants are awarded to projects in line with national manufacturing priorities; critical minerals processing and resources technology, food and beverage, recycling and clean energy, and medical products.

ATSE CEO, Kylie Walker, said "By increasing links between Australia's STEM leaders and global partners, we have a unique opportunity to unlock access to international networks that can boost our sovereign capabilities, grow our economy and build our international science and technology reputation."

Enhancing the Food Supply Chain with a Dragon Fruit Quality Control System

Associate Professor Duy Ngo of the University of Newcastle has been awarded a Global Connections Fund grant for his project A Smart System for Monitoring and Quality Control of Dragon Fruit in Vietnam's Cold Freight Trucks.

Professor Ngo is a senior Electrical and Computing Engineering academic, whose expertise is helping to reduce food waste in Vietnam. Along with local industry partner, Think Alpha Co Ltd, Professor Ngo is developing an on-board automated system for monitoring and quality control of Dragon Fruit.

Dragon Fruit represents 30% of Vietnam's fruit and vegetable exports, of which approximately 56,000 tonnes are wasted in transit. Vietnam's climate and long road freight distances are a significant factor. Professor Ngo's smart system aims to provide accurate detection of fruit quality anomalies, allowing for corrective actions to be taken to prolong the fruit's shelf life.

Accelerating Wound Healing with a New Topical Gel

Iain Ralph, Executive Director of Melbourne based Biotechnology company Cannenta Pty Ltd, has been awarded a Global Connections Fund — Bridging Grants program for his project Wound Care Gel promoting Vascularisation and Pain Relief.

Cannenta aims to bring affordable, effective advanced wound care products to markets worldwide, leveraging patented technology that stimulates vascularisation in wound beds. The company's initial patch product incorporating 2dDR, targeted at the treatment of chronic wounds such as diabetic foot ulcers, is currently in preparation for clinical trials. In parallel, the company is looking to develop additional products using the 2dDR Technology for a wider range of indications. Cannenta is partnering with researchers from the University of Sheffield (UK) and COMSATS University (Pakistan) to develop a proof-of-concept topical gel, incorporating Cannenta's technology for accelerating healing in conjunction with a fast-acting analgesic for effective pain relief.

Advanced Recycling Solution with Wastewater Treatment Innovation

Professor Ivan Cole of RMIT has been awarded a research grant for his project recycling galvanised zinc ash into high-value additives to treat wastewater.

Professor Cole is a renowned researcher with expertise in the discovery of new materials and processes. His work combines computational materials modelling and experimental research to develop innovative methods. With over 30 years of experience in academia, industry, and CSIRO, Professor Cole is a world leader in corrosion science and multiscale modelling of corrosion and inhibition.

Along with Indian-based industry partner, Deep Construction, Professor Cole's project aims to convert galvanised zinc waste into high-value zinc oxide to treat wastewater produced by local galvanising plants. This novel wastewater treatment, implementing circular economy principles will be used to alleviate the problems of water scarcity in India.

Advancing Medical Science with a Buruli Ulcer Treatment

Dr Tony Peacock FTSE, Chairman of Australian-American pharmaceutical company Wintermute Biomedical Pty Ltd, has been awarded a research grant for his project A feasibility study for a Buruli ulcer topical treatment.

A reproductive scientist by training, Dr Peacock is a highly accomplished research leader. He and his colleagues at Wintermute Biomedical are an experienced team of healthcare innovators, infectious disease experts and entrepreneurs.

Wintermute's focus is fighting infections which are drug-resistant by using the natural antimicrobial power of the fatty acids found in everyday foods. Wintermute is developing a new medicine called to treat shingles. In partnerships with a research team from John's Hopkins University in the U.S., Wintermute will be conducting experiments to determine if their shingles treatment can also be used to fight Buruli ulcer disease.

UN SDGs
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What are the limits of current AI, and what opportunities does this create for Australian research?

This last year has seen incredible growth in public awareness of artificial intelligence, but perhaps not as much public understanding. Despite ChatGPT and a raft of other consumer AI software releases, the public perception of AI still hovers excitedly around visions of sentient physical beings: loyal and attentive robots at our side, diligently doing the jobs we humans find so annoying. The truth is far less Hollywood.

While related, AI and robots are not the same thing. The vast majority of what people call 'AI' today is machine learning. It's math and computer code. It's software that's able to analyse and interpret vast amounts of information, and make accurate predictions, far more efficiently than any human. And while AI is now driving a technological revolution and powering the world's largest companies, it's not about to cook you dinner and do the dishes.

The capabilities of even the most advanced contemporary robots are far more modest than the public imagines. The truth is the robot vacuum cleaner in your home is one of the smartest pieces of robotic technology you can buy. Most robots deployed in the industry today lack any form of true AI, rendering them essentially elaborate machines for the basic automation of repetitive tasks. They can't deal with complexity, and they stop working if they encounter even the slightest unexpected change in their surrounding environment. They're not intelligent, by the broadest of possible definitions.

This prevailing public misconception tells us a lot about the kinds of opportunities Australian AI research could be well positioned to pursue.

Right now, AI has trouble operating in the real world and interacting with the environment. Embodied AI tries to solve that problem.

Embodied AI operates inside smart devices like robots and drones and allows them to perceive, navigate and understand the real world in all its rich complexity. Perhaps the most publicly well-known example of robots with some basic attributes of embodied AI are iRobot's Roomba range of vacuum cleaners; and they can trace part of their origins to Australian robotics and AI research.

Alongside two of his MIT students, Australian roboticist Professor Rodney Brooks founded the iRobot company in 1990. Thirty years and 30 million robot vacuum cleaners later, he's internationally lauded for challenging the traditional AI approaches of the time and pioneering the commercially successful development of behavior-based robots. Modern Roombas are equipped with advanced visual navigation systems so they don't get lost in your living room; and that is a downstream result of landmark research by the University of Adelaide's Professor Ian Reid, who co-invented the computer vision AI technology that effectively transforms an inexpensive digital camera into a powerful geometric sensing and mapping tool.

Embodied AI holds the potential to radically change our economy. Consider Australia's vast landscape: we have plentiful land to cultivate and resources to manage, but manual labor at scale is both inefficient and expensive. Robots guided by advanced machine learning algorithms could potentially be deployed to perform some of these tasks autonomously, capturing significant economic value while doing the jobs Australians don't want to do themselves. This technology could open the door to advanced manufacturing industries previously unviable in Australia due to our high labour costs. Future robots will not be restricted to controlled factory conditions but will operate in open, dynamic environments, executing complex tasks.

The public dream of what AI technology should be—robots that listen to us and carry out our natural-language instructions—has been with us long before The Jetsons first appeared on TV screens sixty years ago; and while it's still a way off, recent AI advances are encouraging.

ChatGPT's great mainstream adoption is prompting people to now ask why they can't have similar interactive experiences with other machines. Enter vision-and-language AI, a burgeoning field at the intersection of computer vision and natural language processing techniques. It's an area where Australia has a very strong research talent, and an opportunity we should pursue.

The next generation of robots will possess natural language capabilities, allowing for more seamless human-machine interactions, while also interpreting and navigating the physical world in real time. Imagine asking your robot to "clean up that mess in the kitchen," and it not only understands you, but is able to effortlessly avoid obstacles, find the mess in the kitchen and maybe even empty the bin when it's done.

So, what's the broader implication? Australia is well positioned to be at the forefront of AI research in these emerging fields, but it requires investment. While the rest of the world is also accelerating in AI capabilities, Australia has a unique set of assets that make it viable for leadership in AI research.

The gap between current AI capabilities and the public's expectation isn't a drawback, it's an opportunity for Australia to invest in building technology that will significantly alter our economic landscape and daily lives. The question remains: will Australia capitalise on this fertile ground for AI research, or will we let another opportunity slip through our fingers?

This essay was first published in Responsible AI: Your Questions Answered, a collection of short papers from some of Australia's leading technologists published in November 2023 by ATSE and the Australian Institute for Machine Learning. The full collection is available to read on the ATSE website at atse.org.au/responsible-ai.

ATSE Australian Academy of Technological Sciences & Engineering

The University of Adelaide — Australian Institute for Machine Learning

Professor Anton van den Hengel FTSE
Director, Centre for Augmented Reasoning, Australian Institute for Machine Learning

Professor Anton van den Hengel FTSE is a leading researcher in computer vision, the founding director of the Australian Institute for Machine Learning (AIML) and currently director of its Centre for Augmented Reasoning. His research expertise is in the complex way that information is encoded, especially in images, and methods for recovering it. He is a powerful advocate for the importance of machine learning as a critical technology for Australia's future economic growth and social success.

Elected 2020

Image (left): An artist's illustration of artificial intelligence (AI). This image represents the boundaries set in place to secure safe, accountable biotechnology. It was created by artist Khyati Trehan as part of the Visualising AI project launched by Google DeepMind. Source: Unsplash

How robots are already helping improve our lives

Dr Sue Keay
FTSE
Chair Robotics Australia Group

Sue is a recognised leader in robotics, AI and automation and is passionate about helping emerging technology businesses, the companies adopting new technologies and their workforces.

Elected 2021

Andra Keay
Managing Director Silicon Valley Robotics

Andra is the Managing Director of Silicon Valley Robotics, an industry group supporting innovation and commercialisation of robotics technologies. The Silicon Valley area is home to the world's largest robotics and AI cluster, with over 600 robotics companies, and more than 50 robotics/AI research labs.

Robots have an image problem. Many people fear robots, supported by media articles that talk about robots taking over our jobs or even taking over the world. Very few people realise the role robots already play in our lives, which is perhaps why misconceptions about them flourish: Think 60 million vacuum cleaner robots in our homes and the fact most cars are now manufactured with the aid of robots.

UN SDGs
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Just as ChatGPT has enabled people to gain a better appreciation of artificial intelligence by letting them use it, so too, robotics would benefit from people being able to work with robots and learn more about their capabilities and, importantly, their limitations. For example, few people appreciate the opportunities robots present in helping to solve many of the world's most pressing challenges, as defined by the United Nations (UN) Sustainable Development Goals.

As supporters of the development of sustainable robotics industries in both Australia and the US, my sister and I are uniquely placed to see some of the remarkable developments in robotics and related technologies that people are turning into businesses. Increasingly we are seeing the democratisation of robotics.

Where once accessing an industrial robot arm to work in a factory would cost over $2 million, now smaller manufacturers can access the components, computational power and new manufacturing techniques to 3D print their own highly precise robot arms much more easily. Robots are becoming more affordable and more widely available. This trend is going to continue as they become more numerous and useful across all domains.

Robots are starting to become more common in factories and warehouses. These robots are built to operate safely side-by-side with humans, unlike early industrial robots that need to be caged off from humans as they cannot respond to changes in their environment. This new breed of robots can increasingly work safely in the highly unstructured and unpredictable environments in which humans live. They herald a new era in which robots will more commonly be seen outside of factories and robotics laboratories.

Agricultural robots are helping end hunger and fill worker shortages by spraying weeds and pests, picking fruit, and sorting and packing produce.

Medical robots are supporting surgeons and nursing staff during operations and recovery in hospitals, as well as providing the back-end logistics in both hospitals and aged care facilities. In the future, robots may take on caring roles in our own homes, keeping people company, ensuring they are safe and well, and looking after people's mental health.

Logistics robotics is one of the most vibrant areas in robotics at the moment with robots deployed to tedious, labour-intensive tasks (picking and packing), freeing up people for more creative and fulfilling jobs. Rather than leading to a decrease in employment, the rise in the robot population correlates with increased investment in training opportunities for workers and the creation of new roles that did not exist before. Amazon has created 700 new roles for people to support and manage robots.

Robots are a vital component of the energy transition. To decarbonise you must also automate. Electric vehicles are easier to automate than those relying on liquid fuels and making these self-driving allows the optimisation of transport routes and charging schedules that would be impossible with human-crewed vehicles, reducing traffic congestion and energy expenditure. In mining, robots play an important role in keeping people away from dangerous, often unstable, environments and Emergency Responders now call for robots to provide situational awareness in disaster situations where it's not safe for humans to act.

The environment is an area where most people do not expect to see robots, but it is also an area where robots can have a positive impact towards addressing climate change on the land, in the ocean, in the atmosphere and even in space. We see robots that can help rehabilitate coral reefs, robots that can fight bushfires, robots that can de-foul boats, robots that clean solar panels, robots that service satellites and, increasingly, robots that help to inspect and even construct the critical infrastructure that underpins our renewable energy requirements. Robots are also an important mobile platform for sensors that can catalogue our biodiversity and help to re-establish fragile ecosystems after natural disasters.

The true power of robotics is not just in providing a helping hand to humans to complete a variety of useful tasks, or to operate in areas where it is unsafe for humans. The power lies in robots' ability to scale and expand human potential.

Humans have to individually learn new skills, but once one robot learns how to do a particular task, all robots can know how to do it too. This opens the possibility for robots to provide multiple sets of extra helping hands to support human endeavours.

Reaching the UN's Sustainable Development Goals will be difficult to achieve with humans alone. But working with robotics technologies give us the ability to develop and scale up solutions that would otherwise be impossible. As we see robots making a difference to the problems that matter to us, inevitably people will fear robots less and understand them more.

Submissions from the Academy

Submission to the consultation on Delivering the Murray-Darling Basin Plan

JULY 2023

Active management of the Murray-Darling Basin is needed to protect the Basin's ecosystem and ensure water is available across the Basin for future generations. ATSE recommended a science and technology-based approach for the Plan and water buybacks as the primary short-term mechanism to deliver the water recovery target.

Submission on setting, tracking and achieving Australia's emissions reduction targets

JULY 2023

ATSE's submission recommended that Australia must focus on research and development, regulate greenhouse gas emissions, adopt a sectoral approach to reduce emissions, and harness digital technology solutions like artificial intelligence to help in reducing emissions.

Submission on improving alignment and coordination between the Medical Research Future Fund and Medical Research Endowment Account

JULY 2023

ATSE's submission recommended maintaining two separate funds with a coordination mechanism. More coordination between the MRFF and MREA would assist in shepherding basic research into translatable outcomes. Strategic investment in translational research would help foster researcher-industry engagement and economic benefits and keep globally competitive health technology companies in Australia.

Submission to the National Health and Climate Strategy

JULY 2023

ATSE's submission to the National Health and Climate Strategy put forward recommendations for measuring and reducing carbon emissions from the healthcare sector. The submission recommends a 'triple bottom line' approach of considering profit, people and the planet, along with procurement strategies such as local procurement and circular economy principles.

Submission to the Murray-Darling Basin Plan: Implementation Review 2023

JULY 2023

ATSE's submission to the Productivity Commission's consultation on the Murray-Darling Basin advocated an evidence-informed, long-term approach to Basin planning. It also recommended standardising monitoring data and modernising associated infrastructure, and utilising buybacks as a strategy to meet recovery targets.

Submission to TEQSA Good Practice Note on preventing and responding to sexual harm

JULY 2023

ATSE's submission urged that the Good Practice Note should capture recent research developments and changes to educational institutions to showcase best practices. The submission considered how sexual harm is a barrier to diversity in STEM, being one of many factors contributing to low participation from women and the LGBTQIA+ community.

Submission to the Industry Growth Program consultation

AUGUST 2023

ATSE's submission welcomed the Industry Growth Program, which provides a pathway for small and medium enterprises (SMEs) to access expert advice and guidance for navigating regulation and other aspects of research commercialisation. It made recommendations for targeting the program, assessing applications, building diversity into the program and evaluating the program.

Submission to the Inquiry into generative artificial intelligence (AI) in the Australian education system

AUGUST 2023

ATSE's submission considered the impacts of generative AI on student wellbeing, teaching, learning, assessment and administrative practices. It argued for allowing students to embrace generative AI and supporting AI literacy for public school students.

Submission to the Supporting safe and responsible AI in Australia Discussion Paper

AUGUST 2023

ATSE also made a submission on AI regulation, following on from the Rapid Response Information Report on Generative AI (of which ATSE was a co-author). ATSE's submission provided recommendations for strengthening the proposed regulatory framework.

Submission to the AI in Schools Framework consultation

AUGUST 2023

ATSE's submission agreed with the core elements and principles prescribed by the Framework. However, a key gap is the lack of national infrastructure to support AI development. ATSE also recommended that the Framework provides guidance on managing risks to student safety from engaging with AI technologies and embedding an understanding of rights in AI literacy.

Submission to the Critical Minerals List consultation

AUGUST 2023

The 2023 update to the Critical Minerals List provided an opportunity to recognise elements of increasing importance for decarbonising the economy, and to align with global as well as domestic aspirations. ATSE's submission recommended modernising the list by adding elements that are increasingly important to the global energy transition, and meet all criteria for inclusion, and monitoring important elements that do not currently meet all criteria.

Submission to the National Hydrogen Strategy Review consultation

AUGUST 2023

ATSE recommended that the government invest in hydrogen transport infrastructure and storage, scale existing hydrogen projects, create markets for hydrogen and hydrogen-embedded products, establish engineering standards, develop regulations and standards, invest in skills development, and work with other countries to develop common standards.

Submission to the Developing a national framework for recycled content traceability consultation

AUGUST 2023

ATSE's submission recommended that the Department utilise the recommendations and the findings of ATSE's 'Towards a Waste Free Future' report in the development of the framework. The report recommended a paradigm shift in design principles to avoid waste altogether and to improve information quality, quantity, timeliness and transparency.

Submission to the Communications Legislation Amendment (Combatting Misinformation and Disinformation) Bill Exposure Draft

AUGUST 2023

ATSE's submission focused on the importance of trust in the government's efforts to tackle misinformation. The submission highlighted the controls private messaging services can apply without impacting user privacy and advocated for media literacy training in schools.

Submission to the South Australian Select Committee on Artificial Intelligence

AUGUST 2023

ATSE's submission focused on the benefits AI can bring to South Australian industries and government services, while also recognising the need to build a strong, capable and ethical AI-enabled workforce. It argues for investments in AI development related to South Australia's major industries, ensuring the next generation is trained to use and develop AI systems.

Submission to the Australian Universities Accord Interim Report

AUGUST 2023

ATSE's submission highlighted its support of several proposals in the Interim Report including a needs-based funding model, better VET integration and improved prior learning recognition. ATSE argued that the proposed Tertiary Education Commission needs to reduce regulatory and administrative burdens to allow universities to focus on teaching and research.

Submission to TEQSA's Academic and Research Integrity Guidance Note Consultation

AUGUST 2023

ATSE provided a submission to the Tertiary Education Quality and Standards Agency's (TEQSA) recommended strengthening TEQSA's guidance on open science principles, interdisciplinary research, citizen science, and Traditional Knowledge.

Submission to the Residential Electrification Inquiry

SEPTEMBER 2023

ATSE's submission to the Senate's inquiry into Residential Electrification recommended expediting residential electrification efforts and the uptake of renewable energy. Combining rooftop solar generation and battery storage with electric appliances would allow for a more significant integration of renewable energy into the residential sector.

Diversity in STEM Review Draft Recommendations

SEPTEMBER 2023

ATSE has called for formal accountability and oversight in implementing the draft recommendations as part of a proposed office to coordinate national initiatives for greater diversity throughout STEM-powered sectors. ATSE also called for the expansion of ATSE's Elevate: Boosting Women in STEM program which is providing up to 500 undergraduate and postgraduate scholarships.

Draft National Science and Research Priorities

SEPTEMBER 2023

ATSE's submission broadly endorsed the draft National Science and Research Priorities and their mission-oriented approach. ATSE recommended that the structure could be strengthened by outlining a vision statement and adding a new priority to highlight Traditional Knowledge.

Submission to the Understanding Our RNA Potential consultation

OCTOBER 2023

ATSE recommended that a national RNA strategy, backed by stable funding and resources, should focus on collaboration, research excellence, infrastructure development, and manufacturing.

Decommissioning offshore gas infrastructure

OCTOBER 2023

ATSE's submission emphasised the need for sustainable decommissioning of offshore oil and gas facilities in Australia as the country transitions to renewable energy.

ACCU Review Discussion Paper

OCTOBER 2023

ATSE's submission advocated for the alignment of ACCU issuance with international best practices to meet Australia's net-zero commitments and stressed the importance of transparency, calling for an independent and politically unbiased Carbon Abatement Integrity Committee.

AI in NSW

OCTOBER 2023

ATSE's submission highlighted the potential benefits of AI for NSW industries and government services, emphasising the need for a capable and ethical AI workforce. It suggested investing in AI-powered industries like finance, manufacturing, health, and creative sectors to boost the state's economy.

Assessment reform for the age of AI

OCTOBER 2023

ATSE's submission suggested including the role of informal assessment and feedback practices to enhance adaptability as AI usage grows. The submission drew attention to ATSE's submission to a parliamentary inquiry on generative AI in education, emphasising the importance of fostering AI literacy in students.

Submission to the Climate Change Amendment (Duty of Care and Intergenerational Climate Equity) Bill 2023

NOVEMBER 2023

ATSE's submission called for the implementation of the United Nations guidance on upholding children's rights through climate change reduction actions. It proposed amendment to encourage sustainable decisions, including by covering other sectors in the carbon dioxide threshold for 'significant decisions'.

Submission to the Future Gas Strategy 2023

NOVEMBER 2023

The submission called for an ambitious Future Gas Strategy addressing residential and industrial aspects, investing in technological development to reduce the role of gas, utilisation of existing gas infrastructure, emissions monitoring, and ensuring equitable transition.

Submission to the consultation on NSW's Critical Minerals and High-Tech Metals Strategy

NOVEMBER 2023

ATSE encouraged interfacing with the national strategy, incentivising technology development, maximising collaboration between states, fostering a circular economy approach, and building a skilled workforce.

Submission on the Defence Trade Controls Amendment Bill 2023 exposure draft

NOVEMBER 2023

ATSE's joint submission with the Australian Academy of Science proposed that the Bill be amended to exempt fundamental research. The submission also highlighted the need to undertake co-design with the STEM sector and provide resources to improve awareness and compliance.

Submission to the Consultation on the Murray-Darling Basin Plan: Implementation Review interim report

NOVEMBER 2023

ATSE's submission welcomed the interim report's focus on many of the issues raised in ATSE's prior submission, including undertaking water buybacks, taking climate change into account, coordinating across the various authorities, and consolidating community engagement.

Image above: Murray River and Darling River Junction, were the Darling meets the Murray at Wentworth Victoria, near lock 10. Source: iStock

MORE

Submissions
All our submissions can be read in full on our website
atse.org.au/publications

Elevate
Boosting women in STEM

ATSE's Elevate: Boosting Women in STEM program will award 500 undergraduate and postgraduate scholarships to women and non-binary people in STEM through the generous support of the Department of Industry, Science and Resources.

Reflections from scholars

The first cohort of Elevate scholars started their studies in 2023, studying all around the country and across a huge range of science and engineering disciplines. A few scholars have shared their thoughts on the program, one year into their degree. The Elevate program aims to address gender inequities in STEM through fostering more women and non-binary people to study STEM and access mentoring, networking and career development opportunities.

Nova Leo
Undergraduate Scholar
Bachelor of Biotechnology
University of Queensland

I am so proud to be part of the first ATSE Elevate Scholar cohort.

Financially, the scholarships' assistance has allowed my focus to be directed toward studies during the first year of my Biotechnology degree, amidst the stresses of relocating to Brisbane. More importantly, the many events I have been privileged to access through being an Elevate scholar have broadened my perspectives on the various roles I could step into within the STEM ecosystem one day. Some of my highlights include the online workshop Overcoming Imposter Syndrome, delivered by Science & Technology Australia, which allowed for honest reflections about ways imposter syndrome was limiting my confidence and studies, and provided valuable tools for self-improvement (and the improvement of my grades!).

Additionally, the Innovation and Entrepreneurship panel and the opportunity to engage with experienced industry leaders, and learn about the variety of paths that led to their STEM careers gave me confidence in my skills and my choice of degree. Alongside the content of these events, meeting so many inspiring women, including my fellow Elevate scholars has been a highlight, allowing me to build support systems underpinned by kind, intelligent, and ambitious women.

Anastasiia Kudriashova
Postgraduate Research Scholar
University of Melbourne

Enrolling in PhD study with the Molecular Genetics Department in Agriculture Victoria Research (AgriBio) and accepting the Elevate scholarship marked the beginning of a new era for me. The resources and support provided go beyond the financial sphere, creating an environment where diversity and inclusion are embraced.

I wish to express my deep appreciation for the Elevate scholarship's commitment to support women from various backgrounds. It was a massive decision for me to radically change my life and resume my education after a long break. After a decade in dairy farming and putting aside my veterinary science degree, I started to fear I am repeating my mother's life. She spent 42 years working as a labourer in the same oil processing factory, where she initially started at 18. Despite obtaining an engineering diploma at the age of 45 through university study, she faced barriers to career progression.

These experiences can be disheartening and have a profound impact on self-esteem. However, conducting my research project at AgriBio and being an Elevate scholar has changed my worldviews. Witnessing women in leadership positions and experiencing the non-judgmental environment of support and encouragement they cultivate has been transformative. Because of them I feel excited to see what lies ahead.

Claretta Dsouza
Leadership Scholar
Master of Business Administration
Melbourne Business School

The year 2023 has gone by in a whirlwind of four 12-week bursts for me, that is the length of each term of study at the Melbourne Business School (MBS) where I am currently doing an MBA. It has been a year of varied experiences, from adjusting to classes in the evening after a day of work, to living by my calendar juggling work, life, study, assignments, classes, tutorials, AND making the most of the extracurricular events MBS has to offer. Whether it is case competitions, student consulting, leadership workshops and volunteering at pitch events, I have tried (where time permits) to make the most of the MBS experience. As a life-long learner, new knowledge excites me, but since all of my education in the past has been strictly scientific, this novel business schooling has been particularly fascinating. Determining the quality of management practices of a business by looking solely at its financial statements is nothing short of sorcery.

But perhaps the most enriching outcome of the journey so far has been the people. Firmly in my late-thirties, I thought I was done with 'college life' and end-of-semester parties but I have had the privilege of getting to know an amazing bunch of individuals from diverse backgrounds and have formed what I am sure will be lifelong friendships. I look forward to the rollercoaster that 2024 is sure to be and I wish the new Elevate Scholars of 2024 all the very best for their studies.

IMNIS Engage
Mentoring

IMNIS (Industry Mentoring Network in STEM) is our award-winning industry engagement initiative, which annually pairs motivated PhD students and early career researchers (mentees) in STEM with influential industry leaders (mentors) in a one-year mentoring and professional development program. The program proactively builds a cross-sector collaboration culture. ATSE is extremely grateful to the IMNIS mentors who have donated their time and expertise equalling close to $1 million this year.

Reflections from an industry Mentor

MENTOR A NEXT GENERATION LEADER IN 2024

The Industry Mentoring Network in STEM (IMNIS) is an award-winning industry-led initiative of the Australian Academy of Technological Sciences and Engineering. IMNIS connects motivated PhD students and postdoctoral fellows with industry leaders in a one-year mentoring and professional development program.

This is the second year that my employer Aurecon has supported me to volunteer my time as a mentor in this program. Part of my role as National Capability Lead for Sustainable Water involves developing talent, and my contribution strongly aligns with Aurecon's commitment to encouraging more engineers and scientists into STEM to solve complex future challenges, which we do through active pursuit of our diversity, equity and inclusion strategy and initiatives. People are at the heart of everything we do. We all belong. Specifically, Aurecon's commitment to this important issue includes our membership of the Champions of Change STEM group and our 2022-2024 Reconciliation Action Plan which includes creating meaningful career pathways for Aboriginal and Torres Strait Islander peoples as one of its core aims.

SO WHY DO I SUPPORT THE IMNIS MENTORING PROGRAM?

It's really important to me personally to help PhD students bridge the gap between their pursuit of academic excellence and the big world of employment. This can feel like a lonely, daunting, and scary experience. I know — I was in this position myself more than 20 years ago and I felt really lost. IMNIS provides a platform for me to share the experiences and knowledge I've picked up along the way and pay it forward to the STEM community.

In August 2022, my mentee Billy FitzGerald-Lowry and I met over Zoom for the first time. Billy is a scientific researcher supervised by Associate Professor Katherina Petrou in the School of Life Sciences, University of Technology Sydney. Billy's PhD aims to observe and quantify the impacts of climate change (specifically ocean acidification) on marine microalgae. These organisms underpin some of the largest food webs on Earth and drive global biogeochemical cycles.

What struck me from the very first conversation with Billy was how purposeful, disciplined, and mature he was — I wish I was half as organised at that stage in my professional career!

With the last of our monthly sessions on the horizon, I am reflecting on what we've both learned about one another, and what Billy has gained from being involved in the IMNIS program. By having this opportunity to engage with someone with decades of experience advising global organisations on water quality issues, I hope he has been able to strengthen his interpersonal skills and business acumen, supplement his professional skills and gain a better insight into how this fascinating industry works. More than that, I hope it has given Billy access to an independent sounding board as he navigates his way through finishing his PhD — a tough journey for even the most accomplished researchers, and rightly so.

Along the way, I have shared some ways that I might handle technical issues, relationships with stakeholders and colleagues, and the management of a research project.

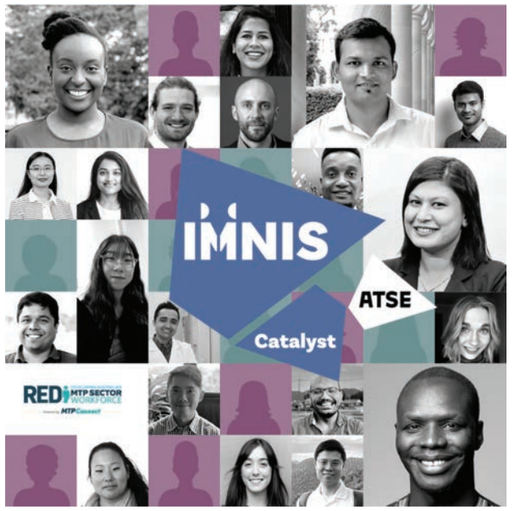
What I'm convinced of is that Billy won't be as lost as a young me when he completes his PhD and that he'll have gone on some amazing adventures along the way to deciding what pathway he takes next in his career journey. The next round of IMNIS Engage will officially launch in July 2024. I would encourage all PhD students and high-level industry leaders to consider signing up for the IMNIS program to invest in Australia's STEM workforce.

Dr Dan Evans
Director Environment and Planning at Aurecon and IMNIS Mentor

Billy FitzGeral-Lowry (above) sailed in the Southern Ocean with a multinational crew of fellow researchers onboard the RV Investigator, a 94-metre ocean research vessel owned and operated by CSIRO. The purpose of this trip was to sample diatoms as part of his PhD studies.

IMNIS Catalyst
Professional development

Bridging the commercialisation gap for the future STEM workforce



KCA partnered with ATSE to make this support available for the IMNIS Catalysts as they are an organisation committed to transforming the sector by boosting innovation and supporting the next generation of STEM industry leaders.

Four of the participants of ATSE's Industry Mentoring Network in STEM (IMNIS) Catalyst program were supported by Knowledge Commercialisation Australasia to attend the 2023 KCA Annual Conference.

During the conference, which took place on the Gold Coast from 11-12 October 2023, Dr Sinead Reading, Dr Alina Lam, Lydia Qian, and Dr Dan Gao had the opportunity to explore how commercialisation and industry pathways can enhance their careers in STEM.

The conference's theme centred around 'Innovation to Adoption: Delivering Real Impact', emphasising the various avenues available to STEM researchers and professionals for engaging in commercialisation and driving a more innovative sector.

atse.org.au/career-pathways/imnis/

ATSE's IMNIS Catalyst program is powered by MTPConnect as part of the REDI initiative.

Dr Sinead Reading

I had the privilege of attending the Knowledge Commercialisation Australia (KCA) 2023 conference on the Gold Coast alongside my fellow IMNIS Catalysts Alina Lam, Lydia Qian and Qiang (Dan) Gao. It was an incredible experience where we delved into the world of tech transfer and commercialisation, learning how to bridge the gap between ground-breaking discoveries and their real-world applications.

My key takeaways from this experience were:

- It takes a village: Emphasising the importance of bringing together a diverse range of skills to successfully transfer discoveries into tangible products.
- Too many people are saying, 'Look what my product can do' and not 'Look what people can do with my product: The ultimate focus in commercialisation is on customers and patients, highlighting the significance of meeting their needs and solving their problems.

Networking with a myriad of inspiring professionals in the commercialisation realm, spanning various industries and exploring the transformative power of AI in driving innovation and reshaping industries, providing a glimpse into the future were some of the highlights from this experience.

Attending KCA 2023 expanded my professional network and opened my eyes to the plethora of career opportunities within the tech transfer and commercialisation field, which I hadn't fully grasped during my academic journey. This experience has reinforced my aspiration to pursue a career in industry with a strong focus on commercialisation.

I extend my heartfelt gratitude to the Industry Mentoring Network in STEM and the Australian Academy of Technological Sciences & Engineering for making this opportunity possible. Special thanks to John Grace, Quin Chang, and Kate Taylor at Knowledge Commercialisation Australasia Ltd for their generous sponsorship. Your support has been instrumental in shaping my career path and broadening my horizons.

Lydia Qian

KCA conference was an eye-opening and rewarding experience. I learnt what it takes for an academic to launch their idea to the commercial space. I was able to network with industry professionals and saw how a PhD can lead to myriad career paths in STEM.

My key takeaways from this experience were:

- Teamwork makes the dream work — commercialisation of research requires a whole team of experts. Better for academics to engage with clinicians, IP, business development office early in the process.
- Successfully pitch your million-dollar idea to investors — people are less interested in how great the tech is, but more interested in how great your tech will be in solving the problem.

Meeting fellow IMNIS Catalysts, sharing our IMNIS and PhD journeys with a view at SkyPoint Gold Coast and celebrating the Australasian Research Commercialisation Awards were some of the highlights from this experience.

Dr Alina Lam

In my career, I have been to a number of scientific and education conferences, but KCA 2023 felt like stepping into a different world. KCA2023 was all about the business of science, innovation and technology.

The panel session on Indigenous IP and protocols supporting and elevating First Nations innovations was insightful, and a reminder that we, on Australian soil, have a long way to go. I also took home some tips for what makes a compelling speaker.

The conference made me reflect on times during my PhD when I often found myself lost in the weeds of tiny experimental details, momentarily losing sight of the bigger picture and forgetting to take the end-user perspective. Much of the research that goes on in Australia is so fundamental, and I remember seeing a lot of students get caught up in the same thinking. I'm fortunate to have had mentors, past lab members at Monash University and colleagues at Oxford University Press who helped me take perspective. They planted the seed of translational thinking in my mind and KCA 2023 provided it with a fresh drink of water.

I am thankful to ATSE, the IMNIS Catalyst program and John Grace, Quin Chang and Kate Taylor at KCA for facilitating our attendance. Altogether, it was a unique opportunity and I feel very privileged to have been able to participate.

Dr Qiang (Dan) Gao

This conference is an exceptional platform to connect with professionals in the technology transfer and innovation space, including researchers, entrepreneurs, investors, and industry representatives. This conference offered me an outstanding opportunity to enhance my comprehension of the commercialisation process.

As an early career researcher and professional in technical consultancy, the KCA conference held immense value for me, offering insights and knowledge crucial to my career development.

Engaging in discussions and receiving feedback from peers will help me to fine-tune my research strategies as necessary, and my approach to potentially navigate the complex process of commercialisation of my research outcome. More importantly, this conference facilitated invaluable connections with like-minded individuals (such as our IMNIS Catalysts), potential investors, and industry experts.

Finally, I would like to express my appreciation again to all ATSE colleagues who made this happen and I look forward to participating in and supporting ATSE's future events.

STELR
STEM education in schools

Paula Taylor
Academy of Future Skills
Specialist STEM teacher
ACT Education Directorate

Caroline Shultz
Academy of Future Skills
Specialist STEM teacher
ACT Education Directorate

STELR (Science and Technology Education Leveraging Relevance) is ATSE's hands-on secondary school science education program. It's a national initiative which aims to boost student participation and achievement in STEM, in which teachers and students apply engineering principles to put the science curriculum into hands-on action, with a focus on environmental sustainability.

Innovative science kits drive childhood inspiration and education

STELR, ATSE's national school education initiative, seeks to support Australia's STEM skilled future by exciting and engaging our next generation of scientists and technologists.

Since its inception nearly 15 years ago, STELR has been providing science teachers across the country with resources to improve engagement in the curriculum and the retention of students studying STEM. Through a combination of relevance and project-based learning, STELR kits challenge students with real-world topics, like sustainability and climate change, enabling deep learning through issues young Australians are passionate about.

STELR also provides regular webinars to raise the profile of STEM career pathways in Australia, and teacher professional development to enhance classroom practice.

To date, STELR has supported more than 900 secondary schools, almost a third of all secondary schools in Australia, as well as a number of schools around the world. As one of Australia's longest running STEM Education Programs, STELR's suite of educational equipment and resources have been proven to stand the test of time and the rigours of the classroom.

Our colleagues at the ACT Academy of Future Skills shared some of their experiences with the STELR kit resources and how they have been able to extend them to primary school students to build skills in experimentation, data analysis and scientific literacy.

WHY ARE YOU EXCITED ABOUT THE STELR KITS?

STELR kits are very popular items that are booked and used by many of our schools across the ACT because they cover so many curriculum areas across many year levels. What makes them exciting is that they allow for students to be creative and explore their own driving questions, as there are so many variations and possibilities within the kits. The data collection systems keep students engaged as they continually strive for better results during the design testing phases.

WHAT ARE YOU CURRENTLY USING THE KITS FOR?

Our primary and high schools use the STELR Sustainable Housing Kits to look at insulation materials and their properties with respect to chemistry, design and modern technologies. This allows them to perform experiments on the materials and go further by designing and testing their own homes based on the results. Our students also use the electricity generation kits including wind turbines and solar panels.

The Australian Curriculum includes sustainability as a cross-curriculum priority and the STELR kits are ideal for demonstrating our commitment to green energy alternatives. Our college students are also using the kits to conduct inquiries in both Earth and Environmental Science and Senior Science courses.

WHAT DO YOU SEE AS THE POTENTIAL FOR THIS PROGRAM FOR YOUR STUDENTS?

The STELR homes are a great starting point for students to begin integrating technology so they can see how sustainability practices can also include smart home technologies. We use the STELR homes to teach coding to solve authentic problems such as turning lights on or off and opening windows as a response to the external environment.

HOW DO YOU THINK THIS CAN HELP AUSTRALIAN SCHOOL STUDENTS WITH STEM SKILLS, AND WHY DO YOU THINK THAT IS IMPORTANT?

The STELR kits provide the foundation for excellent scientific thinking and reasoning skills as students are able to develop their own investigations. This allows them to practice the dispositions of being a scientist while learning very relevant science concepts such as heat transfer, properties of materials and electric circuits. Students use mathematics to analyse their results, to evaluate their designs and to make improvements. Throughout the process, students are using their soft skills as they work within collaborative teams to design their experiments and to discuss their thinking. The kits have proven themselves to be very engaging to learners of all ages who are learning so many skills and concepts to solve real problems.

***Paula Taylor** Academy of Future Skills specialist STEM teacher, ACT Education Directorate*

WHY ARE YOU EXCITED ABOUT THE STELR KITS?

I like using the kits because I only have to spend the first session introducing the students to the kits and after that they can be self-sufficient in setting up their investigations. Having access to all the equipment in one box allows them to explore the materials and decide for themselves what the next factor they want to investigate is.

WHAT ARE YOU CURRENTLY USING THE KITS FOR?

I am currently using the kits on a sustainable housing unit with Year 4 students in a primary school. They have been investigating all the different factors that might affect their build.

I modelled the inquiry to start with by scaffolding the initial investigation: for us this was about what wall material was best suited for our sustainable houses. We were looking at natural and processed materials in chemistry, so I also made some additional walls with different insulating materials for the students to test. Following this, the students could design their own inquiries and test the houses as they wished. They investigated using the materials provided in the kit e.g. pitched or flat roof, flooring type from the teacher kit, effectiveness of a fan etc. They also designed their own materials to test e.g. students made window coverings— curtains from old fabric, a venetian blind using pop sticks, they made different coloured walls to see what to paint their house, they looked at the effect of landscaping and position of the house on the block. They then shared their data with the class so everyone could see the different investigations that were carried out.

WHAT DO YOU SEE AS THE POTENTIAL FOR THIS PROGRAM FOR YOUR STUDENTS?

I think it has helped the students with independent inquiry as well as with responsibility— it was their job to pack away the kits properly and ensure all the materials were there and in the right place. They definitely had a sense of achievement being able to use the sensors independently of the teacher too. I think future improvements could include adding more materials to the kits (or teacher kits) such as those we designed above, and wireless sensors would be great because when they build their own houses (which may not be a 10x10 box!), they would be able to use the same sensors as used for testing.

HOW DO YOU THINK THIS CAN HELP AUSTRALIAN SCHOOL STUDENTS WITH STEM SKILLS, AND WHY DO YOU THINK THAT IS IMPORTANT?

One of the students' family is currently building a sustainable home and so he was able to show us photographs of his house in progress. His house used straw bales for insulation and previously we had tested insulation of the homes using straw too. The students could see how their investigations and house designs link to someone's actual home— a great real-life link to learning.

***Caroline Shultz** Academy of Future Skills specialist STEM teacher, ACT Education Directorate*

Throughout 2024, STELR is presenting a series of webinars for secondary school students — Shape Your Future.

STELR gives students across Australia the chance to hear from Australian scientists, engineers and technologists who are shaping the future through STEM. The series will showcase the diverse and dynamic journeys that these inspiring individuals have taken through their career.

atse.org.au/SYF23

Movers & shakers


1. Sally-Ann Williams


2. Veena Sahajwalla


3. Rose Amal


4. Tony Wood


4. Daniel Westerman


6. David Thodey


7. Larry Marshall


8. Katherine Woodthorpe


9. Kadambot Siddique


10. Emma Johnston

1. Sally-Ann Williams
Dr Sally-Ann Williams FTSE has been awarded a Doctor of the University from Griffith University.

2. Veena Sahajwalla
3. Rose Amal
4. Tony Wood
5. Daniel Westerman
6. David Thodey
7. Larry Marshall
8. Katherine Woodthorpe
All these Fellows were named in *The Australian*'s Top 100 Green Energy Players 2023.

9. Kadambot Siddique
Professor Kadambot Siddique FTSE has been elected a Fellow of the World Academy of Sciences and also named Western Australia Scientist of the Year for 2023.

10. Emma Johnston
Professor Emma Johnston AO FTSE FAA has been appointed to the Board of CSIRO for four years.

11. Doug Hilton
Professor Doug Hilton FTSE has been appointed as Chief Executive of CSIRO.

12. Chien Ming Wang
Professor Chien Ming Wang CM has been elected as a Fellow of the European Academy of Science and Arts.

13. Genevieve Bell
Distinguished Professor Genevieve Bell AO FTSE FAHA has been named the new Vice-Chancellor of the Australian National University.

14. Marlene Kanga
Dr Marlene Kanga AO FTSE has been made an International Fellow of the Royal Academy of Engineering.

Dr Kanga urged engineers to keep solving important global problems after being awarded the 2023 UNSW Women in Engineering Ada Lovelace Medal for Outstanding Engineer.

15. Chennupati Jagadish

The Indian Government has recognised Australian Academy of Science President Professor Chennupati Jagadish AC PresAA FTSE with the Pravasi Bharatiya Samman Award.

16. Dennis Liotta
Dennis Liotta FTSE has been named as one of five inaugural recipients of the Faces of American Innovation Award.

17. Simon Poole
Dr Simon Poole AO FTSE has been chosen as the 2023 recipient of the IEEE Industry Achievement Award.

18. Harry Poulos
Professor Harry Poulos FTSE was awarded the International Society for Soil Mechanics and Geotechnical Engineering Lifetime Achievement Medal.

19. Michelle Simmons
Professor Michelle Simmons AO FTSE FAA FRS has received the Prime Minister's Prize for Science.

20. Ronald Quinn
Professor Ronald Quinn AM FTSE is a co-recipient of ATSE's inaugural Traditional Knowledge Innovation Award.

21. Martin Green
22. Andrew Blakers
Professor Martin Green AM FTSE FAA FRS and Professor Andrew Blakers FTSE have received the 2023 Queen Elizabeth Prize for the invention and development of Passivated Emitter and Rear Cell (PERC) solar photovoltaic technology.


11. Doug Hilton


12. Chien Ming Wang


13. Genevieve Bell


14. Marlene Kanga


15. Chennupati Jagadish


16. Dennis Liotta


17. Simon Poole


18. Harry Poulos


19. Michelle Simmons


20. Ronald Quinn


21. Martin Green


22. Andrew Blakers

Professor Martin Green AM FTSE FAA FRS (left) and Professor Andrew Blakers FTSE (right) receiving their award at Buckingham Palace. Professor Green and Professor Blakers (along with Dr Aihua Wang and Dr Jianhua Zhao) received the Queen Elizabeth Prize from His Majesty Charles III. Photographer: Jason Alden

Vale

The Hon Michael (Mike) Ahern
AO FTSE

The Hon Michael Ahern was elected to the Academy in 1997 for his role in establishing highly innovative technology policy for Queensland. He remained a Queensland Division member and active member of our Water, Health, Education, and Energy forums.

Michael was Queensland's first Technology Minister after being the Primary Industries Minister and completing a degree in agricultural science in 1964 (at the time, he was the only minister with a tertiary education). He then went on to become the Premier in 1987 while continuing his mission of transforming the state into a "technology-based community better equipped to handle the challenges of the future."

After his retirement from politics in 1990, Michael became directly involved in technology advancement for Australia as the Chair of several technology companies in fields ranging from space and satellite communications to bagasse processing for livestock feeds.

Michael had incredible knowledge of the development and commercialisation of technology both nationally and internationally. He was a successful consultant to construction companies, manufacturers and investment groups.

Michael is remembered as a pinnacle figure of Queensland politics, a good-humoured and loving family member to which he is survived by his wife, Andrea, and children, Louise, Claire, John, Christine, and Sharon, and 10 grandchildren.

Harry Wragge
AM FTSE

Harry Stewart Wragge AM FTSE was elected to the Academy in 1987 for his service to telecommunications.

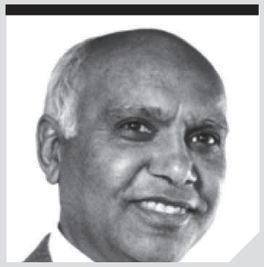
Harry was the Director of the Telecom (later Telstra) Research Laboratories (TRL). He led the transition from analogue switchboards to computer-controlled circuits in the 80s and 90s.

During Secondary schooling at Scotch College in Melbourne, Harry lost sight in his left eye due to an explosion in a Chemistry class. He was absent from school for some time; however, he was successful in Mathematics and Engineering, working his way to a PMG scholarship.

He was made a Member of the Order of Australia in 1989 for his services to telecommunications technology and research in Australian Universities. He played key roles in supporting Telecommunications at the University of Adelaide, the University of Melbourne, and Curtin University.

Harry was a member of the Frankston Yacht Club with an annual Open Harry Wragge Trophy Handicap race named in his honour. He was inducted into the City of Frankston's Hall of Fame as a local hero.

Harry retired from Telstra at the age of 63. He was a loving father to daughters Sue, Jennie and Kate, and husband of Shirley.



Dr Hari Narayan Sinha
AM FTSE

Dr Hari Narayan Sinha was elected to the Academy in 1986 for his achievements in the field of innovative metallurgy. Hari graduated from Banaras Hindu University in 1950 and was a lecturer there from 1950-1953.

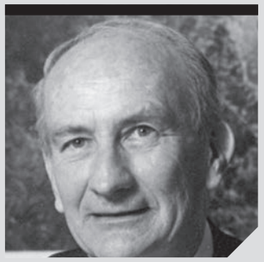
Hari Sinha was a metallurgical engineer who led the CSIRO team that developed the production process of high-grade zirconia for engineering ceramics in the late 1970s. This led to the construction of the world's largest zirconia plant in Rockingham, Western Australia (with a 700 tonnes per annum output).

From 1968-1977, Hari was a consultant to Mitsubishi Chemical Industries, which built a pilot plant in Japan to test the Murso Process — a process of producing synthetic rutile from ilmenite that Hari pioneered.

Hari was a Member of the Council of ATSE from 1997-1999, member of our International Relations Committee from 1993-1999, as well as Chairman of the Victorian Division.

He was appointed a Professorial Associate (Honorary) in the Department of Chemical Engineering at the University of Melbourne after his retirement.

Hari received both a Federation Centenary Medal, and a Member of the Order of Australia in 1990. He is dearly missed by all who knew him.



Alan Gordon John Brown
AM FTSE

Alan Brown was elected a Fellow in 1993 for his plant production and processing contributions. He was a former member of our Agriculture and Forestry Forums.

For just over two decades (1975-1996), Alan held various positions in the CSIRO Forestry Divisions, including Assistant Chief, Deputy Chief and Chief, after which he was appointed as an Honorary Research Fellow.

Alan was deeply involved in Forestry within the ACT, especially with research around the arboreta established in the ACT before the National Arboretum. He compiled arboreta maps with detailed plot information in 1960 and conducted trials on drought-tolerant pines such as *P. attenuate*.

Alan became a Member of the Order of Australia in 1998 for his service to the forestry industry, particularly through research into tree breeding and the development of plantation forestry in Australia.

For nearly twenty years, Alan contributed to the International Union of Forest Research Organizations (IUFRO), embracing and supporting forestry development internationally.

Alan was dearly loved by his wife Erika and extended family of children, daughter-in-law, stepsons and grandchildren. He was respected by many for his dedication and care for his family.

Vale

Professor William (Greg) John McGregor Tegart
AM FTSE

Having worked closely with Greg for five productive and rewarding years in the Hawke Government Science Portfolio from 1983 to 1987, we offer this reflection on the Department of Science at the time, and Greg's contribution to it..

Greg joined the Public Service from the CSIRO Executive in January 1982.

Dr Greg Tegart around the time of his appointment as Secretary of the Department of Science and Technology in January 1982.

The new Secretary quickly built a strong sense of cohesion and camaraderie in his diverse department which included the Antarctic Division, the Bureau of Meteorology, the Patents, Trade Marks and Designs Office, the Australian Government Analytical Laboratories, the Ionospheric Prediction Service, Space projects and Research Grants along with the Department's core responsibilities for science policy and technology development. He supported a strong forward-looking agenda for Australian science and, in March 1983, he presided over the Ministerial transition to incoming Hawke Government Minister for Science and Technology, Barry Jones.

A TRIBUTE FROM BARRY JONES

As Minister for Science 1983-90 I was grateful to have Greg Tegart at my right hand, or possibly my left, until the demise of the Department of Science as a separate entity on Bastille Day 1987, and its incorporation into the Department of Industry and Commerce. I had been very ambitious, not so much for myself, but for science and scientific method, looking towards the long term, especially the emerging reality of a post-industrial society, the prospect of global climate change, the implications of the genetic and information revolutions, the importance of preserving Antarctica from mining, and population ageing. But I had a rare gift for irritating Prime Minister Bob Hawke, a man of extraordinary capacity whose emphasis was on the short to medium term, while, in the 1980s I was always banging on about the long or very long term, more than a dozen elections ahead: that is, now. Greg Tegart had wide experience, knowledge, a strong philosophical grasp, wisdom and tact. He worked very well with colleagues across the Department, the Public Service and CSIRO, among others. He was an excellent negotiator and won some battles with Treasury and Finance. He was one of the world's great travellers, not far behind Marco Polo and David Attenborough. I enjoyed travelling with Greg and his wife Robyn in Britain, France, Germany, Canada, the United States, Japan and China.

In 1987, Greg became Secretary of the Australian Science and Technology Council (ASTEC). Greg retired from ASTEC in 1993, but then took on new challenges, including ageing and climate change.

GREG TEGART AS REMEMBERED BY ROY GREEN.

When I joined the Department of Science as Deputy Secretary after some years as Secretary of the Australian Science and Technology Council, there was the possibility of conflict of interest. But with Greg's wisdom and diplomacy to guide us, it was never an issue. Greg's experience and confidence provided assurance to all of his senior staff in carrying out their roles, with guidance always available if sought, but never overbearing. The consequence was a harmonious department, progressing the science and technology policies of the Minister and Government effectively and efficiently. Greg earned the confidence and respect of his colleagues in the Department of Science and Technology and in the many other departments and agencies with technological responsibilities.

A PORTFOLIO AGENCY PERSPECTIVE FROM JOHN ZILLMAN.

The Bureau of Meteorology had been one of the statutory agencies of the Science Portfolio since the election of the Whitlam Government in 1972 but, unlike the much larger and more independent CSIRO, it was also part of the Public Service and thus part of the Department of Science, an arrangement that had caused some tensions in the 1970s. On taking up the position of Secretary (in those days still often referred to as 'Permanent Head') of the Department of Science and Technology in January 1982, Greg immediately set the Bureau and other operational parts of the Department at ease. From the perspective of a departmental outrider, he was the kind of Permanent Head that most Public Service agencies could only dream of. He took a real professional interest in all their activities and provided wise advice and support when needed, but trusted them to carry out their specialist roles and intervened only in exceptional circumstances. Even after the demise of the Department, Greg remained a valued adviser to the Bureau of Meteorology and a close friend and mentor of several of its staff for the rest of their careers.

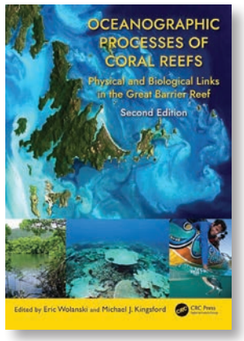
The portfolio-wide sadness at the 14 July 1987 demise of a separate Science Portfolio and the disbandment of Greg's close-knit Department of Science affected its staff deeply, with a number of Departmental officers gathering over the years to look back with fondness and pride on what had been achieved in the 'Science' years.

On looking back on the 'Department of Science' years 1983-87, there was general agreement among all those who had gone on to long careers in government and science that those had been the happiest and most satisfying years of their professional lives. They agreed that much of the credit for the good times was due to Greg's wise and sensitive leadership of the Department and the warm, friendly and constructive Departmental working relations he maintained with the Minister's Office. For we three, he was a very special professional colleague and friend.

Greg Tegart enriched our experience. We will never forget him.

Dr Barry O Jones AC FTSE FAA FAHA FASSA
Dr Roy M Green AO FTSE
Dr John W Zillman AO FTSE FAA

Publications by ATSE Fellows



Oceanographic Processes of Coral Reefs: Physical and Biological Links in the Great Barrier Reef

by Dr Eric Wolansky FTSE and Distinguished Professor Michael Kingsford

taylorfrancis.com

20 years after the publication of the first edition, Dr Eric Wolanski FTSE and Distinguished Professor Michael J Kingsford explore the advancements made in linking the sciences of physics and ecology in a transdisciplinary approach to coral reef protection. They explore the successes and failures of new engineering, going beyond identifying foundational information and current problems to pinpoint science-based solutions for managers, stakeholders and policy makers in protecting one of the seven natural wonders of the world.

Harmful Australian Marine Microalgae

by Emeritus Professor Gustaaf Hallegraeff FTSE

publish.csiro.au

Algal blooms have the potential to wipe out fish farms virtually overnight, with increasing global effects on economy and human health. Emeritus Professor Gustaaf Hallegraeff FTSE offers fish and shellfish farmers information on how to effectively identify and monitor for the presence of algal species and take the appropriate species-specific countermeasures.

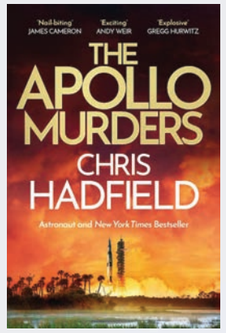
The engineering profession: a statistical overview, 15th edition from Engineers Australia

by CEO Romilly Madew AO FTSE and Chief Engineer Jane MacMaster FTSE

engineersaustralia.com.au

This report provides high-level insights about the engineering profession for the period 2016–2021. It contains the empirical data required to make decisions to develop an engineering workforce that will be the backbone of a sustainable, safe and energy efficient future.

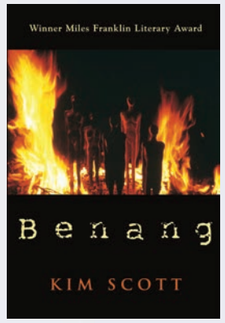
What we're reading



The Apollo Murders
by Chris Hadfield
hachette.com.au

A fun summer read is The Apollo Murders written by Chris Hadfield (the Astronaut). It's a thriller based around a flight to the moon. Technical details are on the mark (as the guy writing has been in space and had a bunch of experience of the astronaut program from Earth-side too) and the book is a fun ride. Can't say more without giving stuff away, but an enjoyable read.

Dr Beth Fulton FTSE



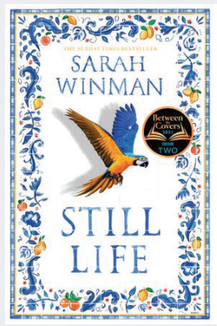
Benang: From the heart
by Kim Scott
fremantlepress.com.au

This year, I read Kim Scott's Benang: From the Heart (1999), a winner of the Miles Franklin Literary Award and the Western Australian Premier's Book Award. With the Referendum on an Aboriginal and Torres Strait Islander Voice happening this year, it seemed appropriate to read a book by an Aboriginal author.

In Benang, we read about the forced separation of Aboriginal children from family and community in Western Australia during the twentieth century with an aim to "breed out the colour" from Aboriginal people by means of cruel assimilation policies.

Scott connects the reader with Country through a story that tells of savagery but contains humour. Ultimately, Benang is a tale of survival and a journey of resolution, which the reader is invited to join. It is truly a great book.

Professor Emeritus Doreen Thomas AM FTSE



Still Life
by Sarah Winman
harpercollins.com.au

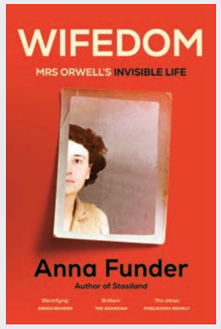
Published in 2021, this book found me while we were all deep in lockdown, feeling the strain of our wings being unexpectedly clipped. One day I will reread it with an Aperol spritz overlooking the Italian lakes, but in 2021 it did what historical fiction does best: it transported me to another time and place, and taught me things along the way.

The book moves from 1940's Tuscany, to a bleak post-war London East End, and back to an expected future in the Tuscan Hills. It centres on Ulysses Temper, former soldier and second-generation globe-maker, who treasures the people around him, and his craft and heritage.

Winman creates a cast of beautiful, funny, flawed characters in scenery so vividly described that reading the book was like watching an arthouse film, complete with tears and laughter.

A slow and gentle summer read to inspire and relax.

Kylie Sproston FTSE



Wifedom
by Anna Funder
penguin.com.au

In recent months I have read a few books worth recommending: The Lost Pianos of Siberia by Sophy Roberts, Chai Time at Cinnamon Gardens by Shankari Chandran and Medici Money by Tim Parks, all definitely worth your time. However, I have selected Wifedom— Mrs Orwell's Invisible Life by Anna Funder, who you may recall wrote the well-received Stasiland some years ago.

Wifedom is a story centered around George Orwell's (Eric Blair's) first wife, Eileen O'Shaughnessy, and hinges around six letters Eileen wrote to a friend in the 1930-40s and only discovered in 2005.

Funder focuses the book around Orwell's Spanish Civil War novel, Homage to Catalonia, published in 1938 in which there is only a passing reference to Eileen's presence. In fact, as Funder portrays Eileen, she had a far more significant role to play in Barcelona than Orwell had in the Republican trenches.

The book highlights how Orwell gave little recognition to Eileen. Although not quite misogynistic, Orwell certainly portrayed a very 1930s male view towards women, and took far more from the relationship with Eileen than he gave back. Funder links this story to the role of the wife more generally, and in a contemporary setting.

It's a great book and Anna Funder has done an excellent job in creating a very readable story. It should be immediately followed up by reading (or re-reading) Homage to Catalonia.

Dr Richard Sheldrake AM FTSE

ATSE supports the United Nations Sustainable Development Goals.

As a national Academy with many connections to international researchers and with our Fellows working towards global solutions for issues such as climate change, pandemics, and food security, ATSE has strong alignment with the 17 United Nations Sustainable Development Goals (SDGs). In order to make the 2030 Agenda a reality, broad ownership of the SDGs must translate into a strong commitment by all stakeholders to implement the global goals.

In this issue of IMPACT, you will find icons alongside featured articles indicating which Goals the article relates to. We hope this new feature will help shape discussions about how Australian applied scientists, engineers, and technologists are driving change to create peace and prosperity for people and the planet, now and into the future.

The UN SDGs provide a framework we can use to logically organise Academy efforts against an increasingly ubiquitous taxonomy, and as a logical, useful, mapping tool for our reports and studies.

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The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries – developed and developing – in a global partnership. Interconnected, they recognise that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth, all while tackling climate change and working to preserve our oceans and forests.

1 End poverty in all its forms everywhere.

2 End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

3 Ensure healthy lives and promote well-being for all at all ages.

4 Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

5 Achieve gender equality and empower all women and girls.

6 Ensure availability and sustainable management of water and sanitation for all.

7 Ensure access to affordable, reliable, sustainable and modern energy for all.

8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

9 Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation.

10 Reduce income inequality within and among countries.

11 Make cities and human settlements inclusive, safe, resilient, and sustainable.

12 Ensure sustainable consumption and production patterns.

13 Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.

14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss.

16 Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

17 Strengthen the means of implementation and revitalise the global partnership for sustainable development.

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