IMPACT

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Our digital future

Food for thought

ATSE

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.

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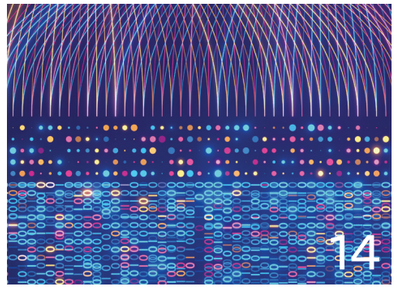


FEATURES

NEWS & REGULARS

SUSTAINABLE DEVELOPMENT GOALS

The Australian Academy of Technological Sciences and 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

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.

In my first six months as ATSE President I have enjoyed meeting more Fellows. I was especially delighted to attend the Leaders Forum event recently in WA, where I met many Fellows engaged in the local Division to discuss how we can embrace and foster sustainable leadership in STEM. We had a great turnout at the Leaders Forum from Fellows, INMIS Mentors and Mentees and a number of scholars from the Forrest Foundation. I left feeling inspired and privileged to be a keynote speaker at such a wonderful event!

Expanding the role technology can play to accelerate the transition toward net zero emissions is one of my priorities for the Academy and a personal passion. Professor Iven Mareels FTSE provides an excellent discussion in this issue on the necessity of incorporating digital infrastructure into our future energy transition plans.

This issue also focuses on how digital technologies can solve current and future problems in sectors such as Agriculture and Infrastructure. With major global challenges such as climate change threatening the future of food security for coming generations, it is important to develop and deliver new technologies that can increase yields and reduce environmental and social impact.

Integrating new digital technologies such as AI into everyday practices can have enormous benefits; for example, the use of AI in refining agricultural practices to further future-proof the sector from the effects of climate change.

Changing future conditions for agriculture means how we approach agriculture in the education sector must change. Emeritus Professor Lindsay Falvey FTSE discusses how we must reflect on what has worked well holistically in the past, and what we can learn from agriculture as an applied science.

I am also proud to share a powerful piece from Elevate scholar Kiowa Scott-Hurley about the STEM sieve and being a cactus in the Antarctic. I encourage all readers to consider what actions they can take to create environments that increase opportunities for women in STEM to be in decision-making roles.

We live in a world of systems

Intricately linked natural systems govern the weather, oceans, the riches on and under land masses, and the ever evolving web of biological diversity.

Created systems, interwoven with these and layered over the top of them, power commerce, communications, politics, food, movement and more.

ATSE's mission is to help Australians understand and use technology to solve complex problems. At the heart of complex problems — defining them, creating them, responding to them and sometimes solving them — are systems. This issue of IMPACT magazine examines a few of them. Our federal government is busy examining a few more.

As I learn from Fellows, speak with decision-makers, work with our policy and programs teams across ATSE's remit, it's becoming increasingly clear that our created systems have much in common. Health, transport, energy, education, defence, security, communications, manufacturing, agriculture, land and ocean management, minerals production and processing — all of these benefit from timely expert, evidence-based advice to their decision-makers. They can all benefit from a continuous improvement framework that embraces transparency and collaboration, and puts technology, science and engineering expeditiously to work.

There's a hopeful energy as Australia sets itself bold and necessary challenges. We're striving to decarbonise and reduce waste. To electrify transport, transform into a nation powered by renewable energy and selling it to the world.

We're looking for increasingly agile and resilient modern approaches to food and water security, strong cyber security know-how and infrastructure, and cutting-edge manufacturing that builds Australian wealth and capability. We aspire to new quantum leaps in computing and artificial intelligence.

Like our systems, all of these ambitions rely on technology, engineering and science. And all of them rely on people: to learn, apply that knowledge, communicate it, iterate it, and start again. A STEM-skilled and diverse globally competitive workforce is required for thriving research, and conditions to support its application into innovations.

It's a sensible first step to review the systems that underpin and administer our hopeful ambitions. To ask: How resilient is our infrastructure and how can we make it stronger for the increasingly uncertain environment? Could we take a better approach to higher education, to research funding and assessments? What's the best way to build a diverse knowledge and translation economy that genuinely includes all kinds of people and draws its fabric from ancient knowledge? What does a transformative and bold science vision for our nation look like today?

To transform the hope represented by these ongoing reviews into action and build genuine momentum that grows a clever, thriving, healthy society that is fully capable of realising its ambition, it's important that we are activists for evidence and expertise.

This edition of impact takes a systems thinking lens to the digital revolution and how it impacts our natural and built environments. It embraces the framework of the interlinked and indivisible UN Sustainable Development Goals (SDGs) and notes how ATSE's work contributes to the 2030 Agenda for Sustainable Development. I hope its articles inspire readers to show grit, ask difficult questions, seek to understand the less understood and shine a light in the dark corners, bring a solution-seeking mindset, and be guided by imagination. Systems thinking.

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.

News from the Academy

Image: yes23.com.au

Two ATSE Fellows celebrated as Prime Minister's Prize winners for Innovation

NOVEMBER 2022

Two ATSE Fellows were awarded the prestigious Prime Minister's Prize for Innovation.

Adjunct Professor Alison Todd FTSE and Dr Elisa Mokany, co-founders of SpeeDx, received a Prize for Innovation for their work to successfully commercialise molecular diagnostics technology.

Dr Nick Cutmore FTSE also received an Innovation Prize for the development and commercialisation of a unique technology to measure gold levels in mineral ore.

Passing of Electric Vehicles Bill a promising catalyst toward transport electrification

NOVEMBER 2022

The Academy welcomed the Treasury Laws Amendment (Electric Car Discount) Bill 2022 passing through the Senate. ATSE hopes this Bill will boost uptake of EVs for business vehicle fleets and welcomes the commitment from the Government to use EVs for their own fleets, having previously made recommendations to the legislation.

Responsible partnership for mining and mineral sustainability

FEBRUARY 2023

In a Position Statement on mining and mineral resources, ATSE called for an urgent increase in national R&D investment, as well as widespread use of low-impact technologies in the mining sector.

ATSE CEO, Kylie Walker, emphasised that the statement calls for respectful collaboration beyond the STEM sector, and the need to build partnerships across key sectors such as research organisations, Aboriginal and Torres Strait Islander peoples and communities, government, and industry.

"The mineral resources sector in Australia is essential for the global green energy movement. Our nation can set itself apart by being a provider with high ethical, social, and environmental standards which other countries like those in Europe require," said Walker.

ATSE statement supporting the Voice to Parliament

FEBRUARY 2023

ATSE strongly supports the establishment of a constitutionally recognised Aboriginal and Torres Strait Islander Voice to Parliament and the Executive Government ("the Voice") and encourages our Fellows to champion this critical step in reconciliation, accepting the Uluru Statement's invitation to "walk with us in a movement of the Australian people for a better future".

ATSE recognises the importance of including Aboriginal and Torres Strait Islander Peoples in decisions affecting their own peoples and communities. We strongly support establishing the Voice to Parliament as a critical step in reconciliation and moving forward as a nation.

Silent pandemic: CSIRO-ATSE report charts path for curbing antimicrobial resistance

FEBRUARY 2023

A joint report initiated by CSIRO and developed by ATSE outlined the challenges Australia and the world need to overcome to avoid being thrust back into a pre-antimicrobial age, where simple infections are deadly and some surgeries are too risky to perform.

The report, *Curbing antimicrobial resistance: A technology-powered, human-driven approach to combating the 'silent pandemic'*, calls for greater national coordination and a focus on streamlining commercialisation processes for new antimicrobial resistance solutions and technologies.

Policy and technology for a prosperous NSW — Leading Technologists, Scientists and Engineers present priorities ahead of 2023 state election

MARCH 2023

Ahead of the March 2023 NSW state election, 250 eminent technologists, applied scientists, and engineers from the state presented their vision for a strong New South Wales economy built on the foundation of technology and innovation.

ATSE encouraged NSW leaders to outline a vision for how they will address the state's challenges, and make the next decades the most prosperous in the state's history.

Prestigious prize to celebrate Traditional Knowledge — new ATSE Innovation Award

MARCH 2023

A new national award was announced to be presented as part of the prestigious annual ATSE Awards. The ATSE Traditional Knowledge Innovation Award is part of ATSE's strong commitment to reconciliation and will recognise Aboriginal and Torres Strait Islander innovators who solve modern problems through the application of Traditional Knowledge.

ATSE CEO Kylie Walker said "The impact of incorporating or building on Traditional Knowledge can extend beyond a particular application to a single problem. We can shape the future of Australian STEM by highlighting the work done to strengthen connections between knowledge systems, and celebrating the people who are demonstrating excellence through their impact on modern innovation."

Increased university system funding, leadership and flexibility crucial for a strong Australia

APRIL 2023

ATSE outlined new ways to reform Australia's universities and transform the research sector for stronger national outcomes. ATSE President, Dr Katherine Woodthorpe AO FTSE FAICD said the Universities Accord is a once-in-a-lifetime opportunity to ensure the university system genuinely equips students for a future increasingly driven by technology.

"Australia urgently requires a culture change in higher education. The incentives that drive our universities are outdated and unfit for setting up Australian students for success." Dr Woodthorpe said.

National Science Priorities should focus on rapid decarbonisation and bolstering Australian innovation

APRIL 2023

In a submission on Australia's National Science and Research Priorities, ATSE called for a laser focus on decarbonising high-emitting sectors and building Australia into a nation of technology innovators, not just users. The Academy highlighted the need for a mission-focused approach, applying science to the most pressing challenges such as bringing carbon emissions to net zero by 2050, providing healthcare for an ageing population, and restoring sovereign capability and supply chain resilience.

ATSE President Dr Katherine Woodthorpe AO FTSE FAICD said an independent review of the research sector, with a view to boosting government investment in research and development to around 3% of GDP and a concerted uplift in STEM skills will be essential if Australia is to realise these science and research priorities.

A welcome charge to our future Electric Vehicle industry

APRIL 2023

ATSE welcomed the National Electric Vehicle (EV) Strategy as a critical step in making Australia a significant player in the global electric vehicle (EV) industry. The Academy welcomed the introduction of fuel efficiency standards to reduce EV costs and incentivise national adoption. Making EVs accessible and affordable to all Australians is fundamental to reaching the nation's 2030 and 2050 climate change commitments.

Boosting Board experience through Elevate as DMTC Guest of the Chair

APRIL 2023

ATSE and defence innovation specialists DMTC Limited were proud to announce Elevate scholar Yang-Ming Goh as the inaugural recipient of a DMTC Guest of the Chair Fellowship. Elevate partner organisation DMTC has designed the Guest of the Chair position as a mentoring experience that facilitates an Elevate Leadership scholar to gain board-level experience within Australia's innovation ecosystem.

As the Guest of the Chair, Ms Goh will gain skills and capacity as a future industry leader and a new level of management, financial planning and corporate governance experience.

ABOVE L>R: Elevate Leadership Scholar and DMTC Guest of the Chair Yang-Ming Goh, with Dr Alison Every (Elevate Program Manager) and Harry Baxter (Head of Government Relations and Communications, DMTC), at the DMTC Annual Conference in Canberra, April 2023.

Australian Research Council Review a crucial step to revitalise Australian research

APRIL 2023

ATSE believes the recommendations from the final report reviewing the Australian Research Council (ARC) Act 2001 will help strengthen Australian research, reduce administrative burdens, and minimise the potential for political interference in research. The Academy endorses the recommendation in ATSE's submission to the review, to optimise the grants process by introducing a two-stage grant system, as well as a board with broad research experience.

Twenty young science and tech innovators appointed as industry ambassadors

MAY 2023

A speech pathologist working to rehabilitate those impacted by brain injury, an aerospace engineer working on chemical transportation, and a science publisher working on STEM resources for school students were among the diverse group of 20 emerging leaders in STEM announced to join the 2023 IMNIS Catalyst program. Read more on pages 52-55.

Federal Budget: Greater investment for Australian innovation critical for a resilient, decarbonised economy

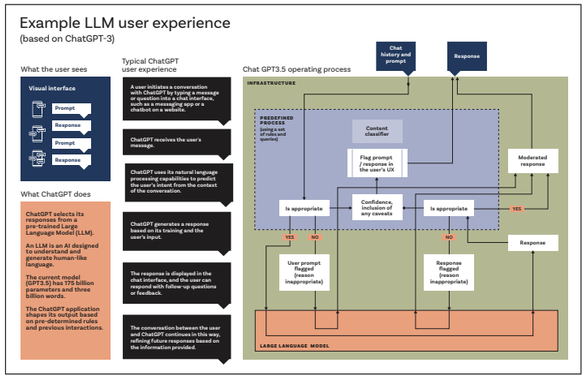
MAY 2023

ATSE welcomed measures for science and technology in the Federal Budget, however, called for further strategy and investment to grow wealth and well-being by making Australia a global leader in research and innovation.

Time is of the essence for Australia to grow as a leading innovation nation, rapidly decarbonise our economy and become a global renewable energy powerhouse.

Kylie Walker, CEO of ATSE said innovation is the lifeblood of economic, social, health and environmental progress. Walker added that we have a time-bound opportunity to bring together Australia's ingenuity and abundant natural assets to truly leverage our renewable energy advantage.

"The figures released in April have shown a continued decline in research and development (R&D) spending with total government spending on R&D falling to a low of 0.49%," said Walker.



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. Critical minerals, such as lithium, cobalt and other rare earth elements, are essential to supporting the transition to net zero emissions in Australia and worldwide.

The Academy recognises 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.

Developing a circular economy for critical minerals, as outlined in the Strategy, will be crucial to getting the most out of the growing industry. Recovery, reprocessing and recycling will all play an important role in reducing the sector's carbon footprint.

Australia's top engineers and applied scientists welcome national discussion on regulating Artificial Intelligence

JUNE 2023

ATSE welcomed the Federal Government's discussion paper on regulating AI technology as a critical step to safeguarding society. The Academy recognises that AI can deliver enormous benefits across economy and society, but we need to consciously plan to mitigate potential for harm.

Learned Academies deliver Rapid Response Information Report on Generative AI

JUNE 2023

The Australian Council of Learned Academies (ACOLA) was pleased to develop a rapid report in response to an urgent request for information from the National Science and Technology Council (NSTC) on Generative AI. The report convened contributions from the Academy of Technological Sciences and Engineering, the Academy of the Humanities, and the Academy of Science. Lead authors, Professors Genevieve Bell FTSE FAHA, Jean Burgess FAHA, Julian Thomas FAHA and Shazia Sadiq FTSE, together with many contributing experts, enabled a multidisciplinary assessment of these technologies.

Political leadership and input from the breadth of Australia's experts is needed, including Fellows of Australia's Learned Academies across various research disciplines, to help Australia harness this opportunity, especially to provide job certainty in this disruptive environment.

ABOVE: Infographic of an example LLM (Large Language Model) user experience that was included in the Rapid Response Information Report on Generative AI.

ATSE Fellow Announced as new CSIRO Chief Executive

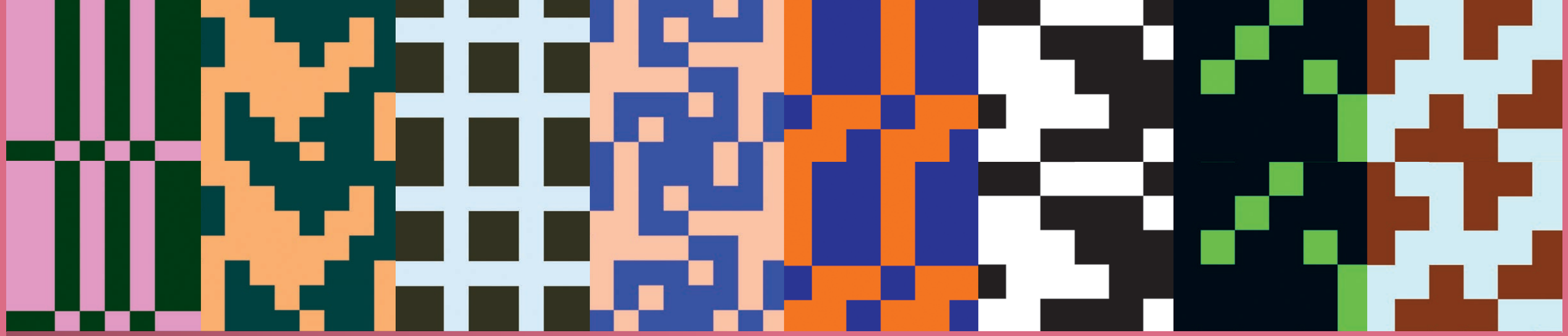
JUNE 2023

ATSE welcomed the appointment of Professor Doug Hilton AO FTSE FAA FAHMS as CSIRO's Chief Executive.

Dr Katherine Woodthorpe AO FTSE FAICD, President of the Academy has welcomed the appointment and looks forward to continuing a strong collaborative partnership with Australia's national science agency CSIRO under Professor Hilton's leadership.

"I know ATSE Fellows will join me in welcoming Doug to this vital role and celebrate that a respected researcher and Fellow is to lead CSIRO at such a critical time for science in Australia and globally."

ABOVE: ATSE Fellow Professor Doug Hilton AO FTSE FAA FAHMS has been announced as CSIRO's new Chief Executive and will start later in 2023. Image: CSIRO



The ABCs of Generative AI

Avoiding harm, battling bias, cautions and ChatGPT

Generative Artificial Intelligence (AI) is the hot topic of 2023, with thought leaders across many fields highlighting new possible use cases and speculating about its transformative potential.

Generative AI is trained using machine learning on large unstructured data sets. It is a step above previous AI technologies as it can produce new content in response to user prompts. With the power to revolutionise society, the risks and rewards of Generative AI must be carefully anticipated and managed.

While Generative AI is not new, its accessibility and visibility was accelerated by the release of transformers by Google in 2017 gaining widespread and rapid adoption, with the release of ChatGPT to the public in November 2022. Suddenly, the world could explore the technology and imagine how AI and its successors could change the way we live, work and play.

ChatGPT users simply type in their instructions, questions or requests and receive a text-based response that integrates billions of pieces of information in seconds. The potential for economic and societial transformation is breathtaking, though its exact impacts remain uncertain.

Many wonder if ChatGPT will make their job obsolete, or if it will function an assistant enhancing their work outputs. Others are putting ChatGPT to use already, using it to assist with all kinds of writing, idea generation and even data analysis — some of which requires human supervision to verify that outputs are accurate and make sense.

ChatGPT's prominence arose from being a publicly available free and useful tool. However, its quick adoption does not mean it will be the defining AI tool for economic change. Specialised Generative AI models have already been in use for more than five years, with applications as broad as pneumonia detection, predicting protein structures, creating art, and predictive policing. The great advantage of ChatGPT is that it can be broadly applied and has permeated the public sphere, enticing business and governments to consider how AI can be deployed for efficiency gains or to produce better results. In this sense it provides individuals and organisations with a concrete glimpse of future possibilities that could help shape and scale innovation.

Generative AI applications have shown promising abilities for performing analytical tasks, particularly in medicine and law. The AI driving ChatGPT is Generative Pretrained Transformers (GPT), otherwise known as large language models. We are currently witnessing rapid growth in other applications being built on GPT, which are creating new jobs, and more specialised, proprietary Generative AI models are being rolled out across different sectors, driving considerable investment in startups.

Parallel to its benefits and opportunities, the Generative AI boom comes with inherent risks. The extensive data sets required for training generative AI models, plus data fed into the model in its use may not be safe, secure, legal or fair. Some applications and data sources (for example, patient health records) represent a high-value target for misuse and cyberattacks. Caution must be exercised to avoid adverse outcomes where algorithms are charged with decision-making, as the automated debt system 'Robodebt' demonstrated.

Inbuilt biases, ebedded in the AI model through training data or interactions with people, can amplify inequalities such as sexism and racism. Inequality of access should also be considered. For example, students at schools without sufficient hardware, internet access and qualified information technology teachers will have less opportunity to navigate AI in the same way as peers of higher socio-economic status.

Just as innovators are imagining how to use generative AI, so too are bad actors. For example, Generative AI can be used to improve the quality and reach of disinformation campaigns. The ability to generate human-like text as well as high-quality images, video and audio is likely to be used to dramatically scale and grow the spread of disinformation through social media at a low cost, fuelled by perverted incentives that drive increased profit for extreme content to drive human clicks. Early prototypes already out there demonstrate the extraordinary potential to disinform through AI-powered videos appearing to depict world leaders or experts endorsing conspiracies or other incorrect information.

As argued by ATSE's joint submission with the Australian Academy of Science on the Australian Code of Practice On Misinformation And Disinformation, social media companies are not doing enough to stamp out disinformation campaigns. The Code excluded cumulative harms when considering content moderation. The steady drip of disinformation often does not represent an immediate threat, rather it slowly erodes trust in public institutions and democracy. Following concerns raised by ATSE, the Academy of Science, and others, the Code was updated so a threat no longer needs to be imminent to be considered harmful. The Code's capacity to limit harm will be put to the test in coming years with the rise of AI-enabled disinformation. While social media giants can use AI tools to enhance their platforms and moderate their content to address the tide of disinformation campaigns, incentives will need to align for this to happen in practice.

The question now is not if Generative AI models should be implemented, but how to do so safely and responsibly. In March, tens of thousands of scientists, engineers and innovators signed an open letter calling for a moratorium on next generation GPT-like AI research and development, citing risks to humanity and seeking to provide some time to contend with ethical problems and develop shared safety protocols. In May a group of leading AI scientists signed another letter stating "the risk of extinction from AI should be a global priority alongside other societal-scale risks such as pandemics and nuclear war". I signed both letters.

Much has been written about how Generative AI will touch all facets of society. Ethics and avoiding harm must be at the forefront of this conversation, along with the design of adoption and adaption strategies to ensure a safe, free future for all.

Professor Mary-Anne Williams
FTSE
Professor Mary-Anne Williams FTSE is an international authority in Artificial Intelligence and Human-Robot Interaction. She is an exceptional communicator and enthusiastic advocate of science-led and technology-enabled innovation.

UN SDGs
8, 9

Images: openai.com

UN SDGs
8, 9

Our new friend, AI

Meet ChatGPT, the Artificial Intelligence language model that knows more than you think!

We asked ChatGPT a few questions about the use of Artificial Intelligence (AI) in the modern world, asked it to tell us a joke about AI, and even asked ChatGPT to write its own hook for this article.

According to ChatGPT, "This hook plays off the idea that people might underestimate the capabilities of an AI language model, and that there is more to me than meets the eye. It invites readers to learn more about what I can do and what I know, while also hinting at the possibility of surprises and unexpected insights."

Phoebe Edwards (L) and **Elizabeth Turner**
This article was written by Phoebe Edwards and Elizabeth Turner: students at The Australian National University's Centre for Public Awareness of Science (CPAS).

When it comes to the world of AI, there have been exponential advancements in recent years, opening up a realm of fantastic opportunities that were once only found in popular fiction. From the original Chat Generative Pre-Trained Transformer (GPT) models like GPT-1 and GPT-2 to the more advanced GPT-3 and GPT3.5, these language models have been trained on massive amounts of text data, continuously pushing the boundaries of what AI can achieve.

2018-2019

GPT-1 and GPT-2 were developed in 2018 and 2019 respectively. Both models were trained on 40 gigabytes of text and information from various websites, books and Wikipedia.

2020

Along came GPT-3 and GPT-3.5. Both models were trained on approximately 570 gigabytes of text data. The most advanced language model of 2020, GPT-3 was said to have "amazing abilities, such as the capacity to finish sentences" based on a prompt. GPT-3.5 was able to draw conclusions about a topic from a single text source and had some level of creativity.

2023

GPT-4 brought a revolution in AI language models. It was trained on a whopping 45 terabytes of information from websites, books, and other text sources. According to OpenAI, the creators of ChatGPT, it was "82% less likely to respond to requests for disallowed content and 40% more likely to produce factual responses than GPT-3.5 based on our internal evaluations". GPT-4 can synthesise coherently from multiple sources, has image and graphics understanding, and has reduced inappropriate and potentially harmful responses.

The rapid rise in AI advancements has brought about concerns. ChatGPT acknowledges this, stating, "One of the most controversial contemporary topics in science is the development and use of artificial intelligence (AI). While AI has the potential to revolutionise many fields, such as healthcare, transportation, and manufacturing, there are also concerns about the ethical implications of AI, including issues of bias, privacy, and job displacement."

When asked about primary topics of concern, ChatGPT highlights five: job displacement, bias and discrimination, privacy concerns, autonomous decision-making, and lack of transparency.

Addressing the fears surrounding AI, ChatGPT said "We know that AI uprising is just a science fiction concept and there's no need to fear it. AI is programmed to assist humans and make our lives easier, not to overthrow us!"

While OpenAI, the company behind ChatCPT software, collects and processes personal data, they are committed to enhancing their privacy and security.

It is hard at the moment to see how ChatGPT comes up with its answers and its lack of transparency may be concerning. OpenAI is studying ways to make ChatGPT more transparent, to improve understanding about how responses are generated. The improvement in transparency would help to discern where lies the responsibility and liability of the autonomous decisions made by the model.

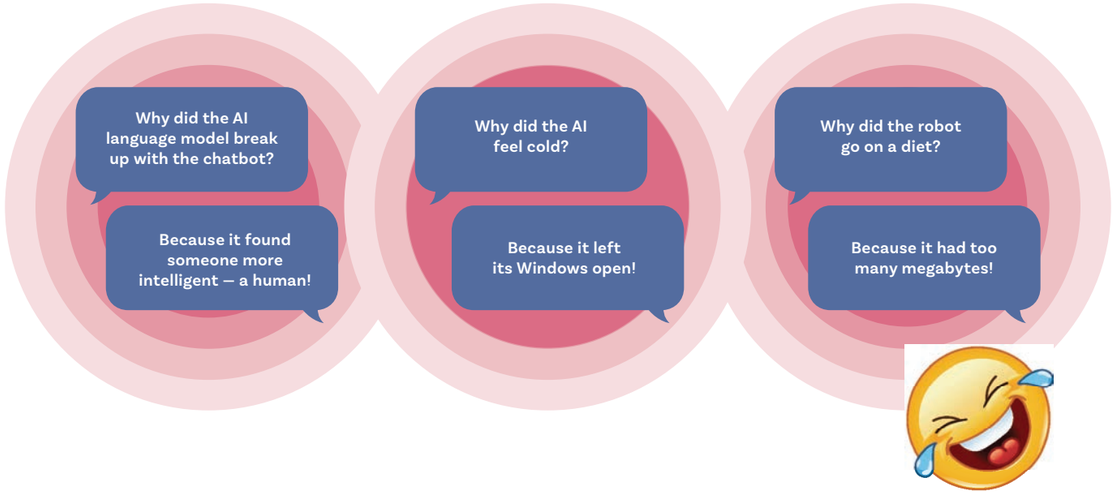
"AI technology is rapidly advancing and has the potential to revolutionise the world we live in. As we move forward, OpenAI and other researchers are striving to address concerns, improve transparency, and ensure ethical and responsible development of AI. The future is exciting, and AI will undoubtedly play a key role in shaping it."

Plans for improvement address the concern that AI language models are only as un-biased as their training. Newer models will receive more extensive training from various sources, helping to negate any biases their creation might include. Some more improvements that OpenAI can make to ChatGPT could be to give it better ability to discern context from the user and ascertain their sentiment, emotion, and background, and to respond accordingly. Other improvements could be to expand its long-term memory, so that it can build new outputs based on previous responses, and to reduce its 'hallucinations' — the times when it believes false information from user input.

ChatGPT concluded that the concerns raised reflect the need for consideration and regulation of technology as it advances to ensure its advance is beneficial as opposed to harmful to society as a whole.

The introduction of cutting-edge Generative AI technologies, such as ChatGPT, holds tremendous implications for our young leaders. While we embrace the exciting new possibilities this technology brings, it is crucial for us to approach its development with a strong sense of responsibility. As a proud host organisation for the Centre for Public Awareness of Science's Science in the Media course, ATSE oversaw a group of students through a consultancy project in which they developed a number of resources to highlight the Academy's policy priority areas, including this article.

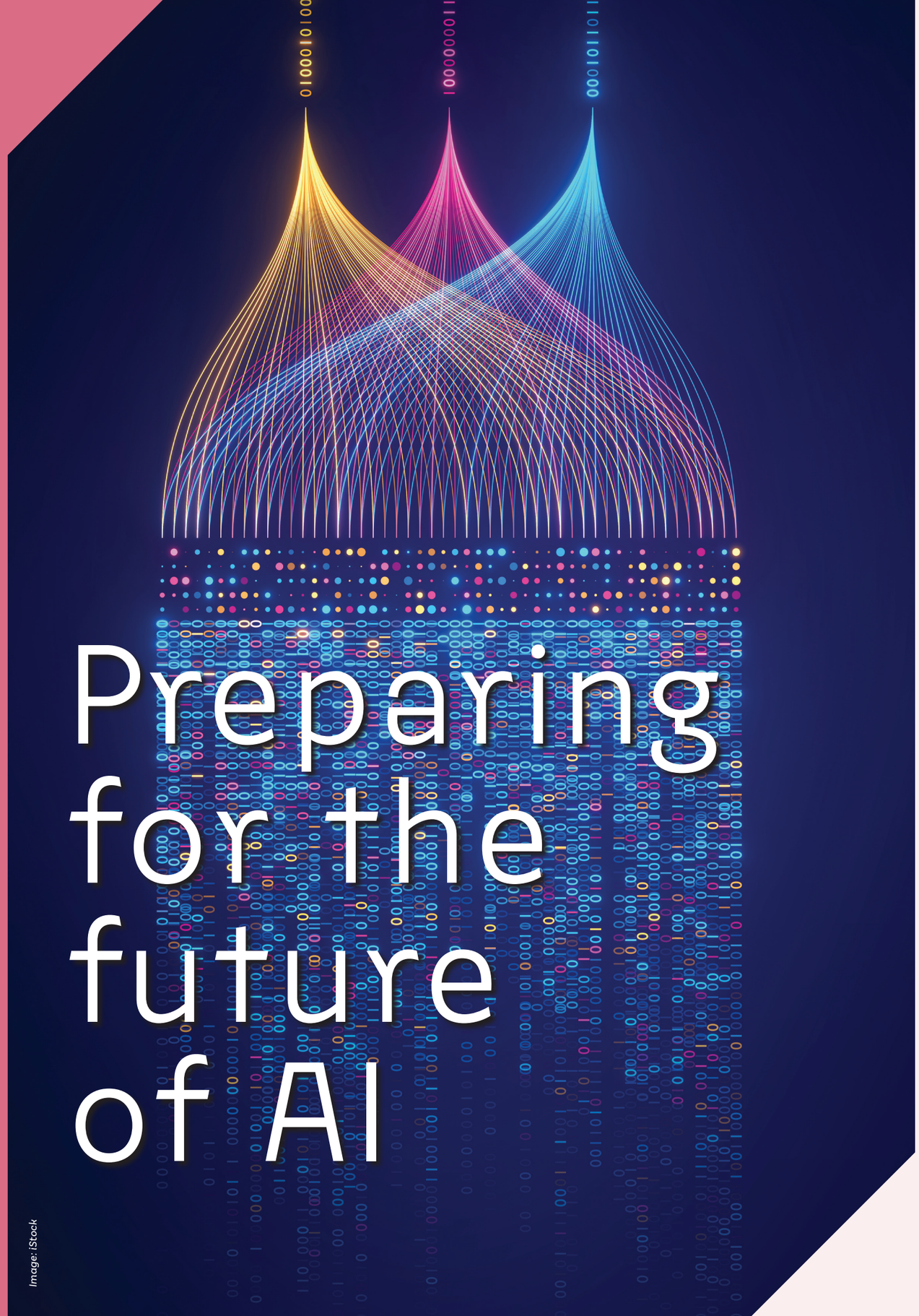
We asked ChatGPT to tell us some jokes



AI can be for images too

Coffee with our new friend AI in the style of Australian impressionist painting

Above: This image was generated by DALL-E2 — a deep learning model developed by OpenAI to generate digital images from natural language descriptions, called "prompts". DALL-E2 was revealed by OpenAI in a blog post in January 2021, and uses a version of GPT-3 to generate images. The prompt given to DALL-E2 was 'Coffee with our new friend AI in the style of Australian impressionist painting'.



Preparing for the future of AI

Image: iStock

It has been over 10 years since the ‘Data Deluge’ became a phenomenon of universal interest and the multidisciplinary area of data science emerged to harness the potential of Big Data.

The rise of Big Data alongside an almost obscene amount of funding from Big Tech has resulted in game-changing advancements. The most recent is ChatGPT — the latest addition in a series of developments in the realm of Generative AI.

Generative AI is a type of artificial intelligence that uses deep learning techniques to create new and unique data, rather than just making predictions or classifications based on pre-existing data.

There seem to be endless possibilities and opportunities for creativity and productivity through Generative AI, like writing an essay, producing code, composing music, and even more when multiple AI models are included. For example, Stable Diffusion can generate images from a textual description.

During the last few months, a question has been keeping me awake as I see researchers, students, professionals, and children interacting with Generative AI.

Are we ready, at an individual and societal level, to fully harness the potential of what these technologies — built from large datasets and opaque models — can offer? This is of course a multi-faceted and highly complex question. I identify three areas that I think need our attention now.

1. TRAINING FOR QUALITY

Training data is a linchpin for these advanced models. I know from my work on Information Resilience, that while quantity of data can drive performance, the quality characteristics, including those that reduce bias, toxicity, profanity and harm, are much harder to train.

Evaluating data quality and ensuring its fitness for purpose requires not just technical prowess and a hefty budget for data curators, but also a foundational set of values that will transfer through into data curation, cleaning and labelling activities.

At the Australian Research Council Training Centre for Information Resilience, we are working with our industry and government partners to build knowledge and workforce capacity for tackling the challenges of Information Resilience relating to:

- **Responsible use of data** To create and support capacity for responsible management of data assets through principled approaches to data governance, access and sharing.
- **Data curation at scale** To build new data curation methods through machine learning, crowd-sourcing and human-in-the-loop techniques to achieve data curation at scale.
- **Algorithmic transparency** To enable and promote interpretability, uncertainty quantification, unbiasedness, transparency, and reproducibility into the design of learning algorithms.
- **Trusted data partnerships** To improve data literacy and trust in data linking within the wider community, working towards reducing barriers in data sharing and flow of knowledge.
- **Agility in value creation from data** To enable agile deployment of data driven solutions within IT landscapes and business processes.

2. ADDRESSING THE SKILLS SHORTAGE

A second area that needs our attention is the global skills shortage for qualified data scientists and machine learning engineers. The skills shortage and a lack of basic consumer-level digital skills can contribute to expanding the digital divide. There is an evident and urgent need to invest in digital and data talent pipelines at all levels.

I cannot emphasise enough the importance of nurturing a homegrown expert base of research leaders who not just use but also build cutting-edge technology and have a deep understanding of the so-called impenetrable black boxes like Generative AI models. Without this talent pipeline and expert base we are importing not only foreign technologies but also the value systems embedded in those technologies.

3. MAKING AI ACCESSIBLE

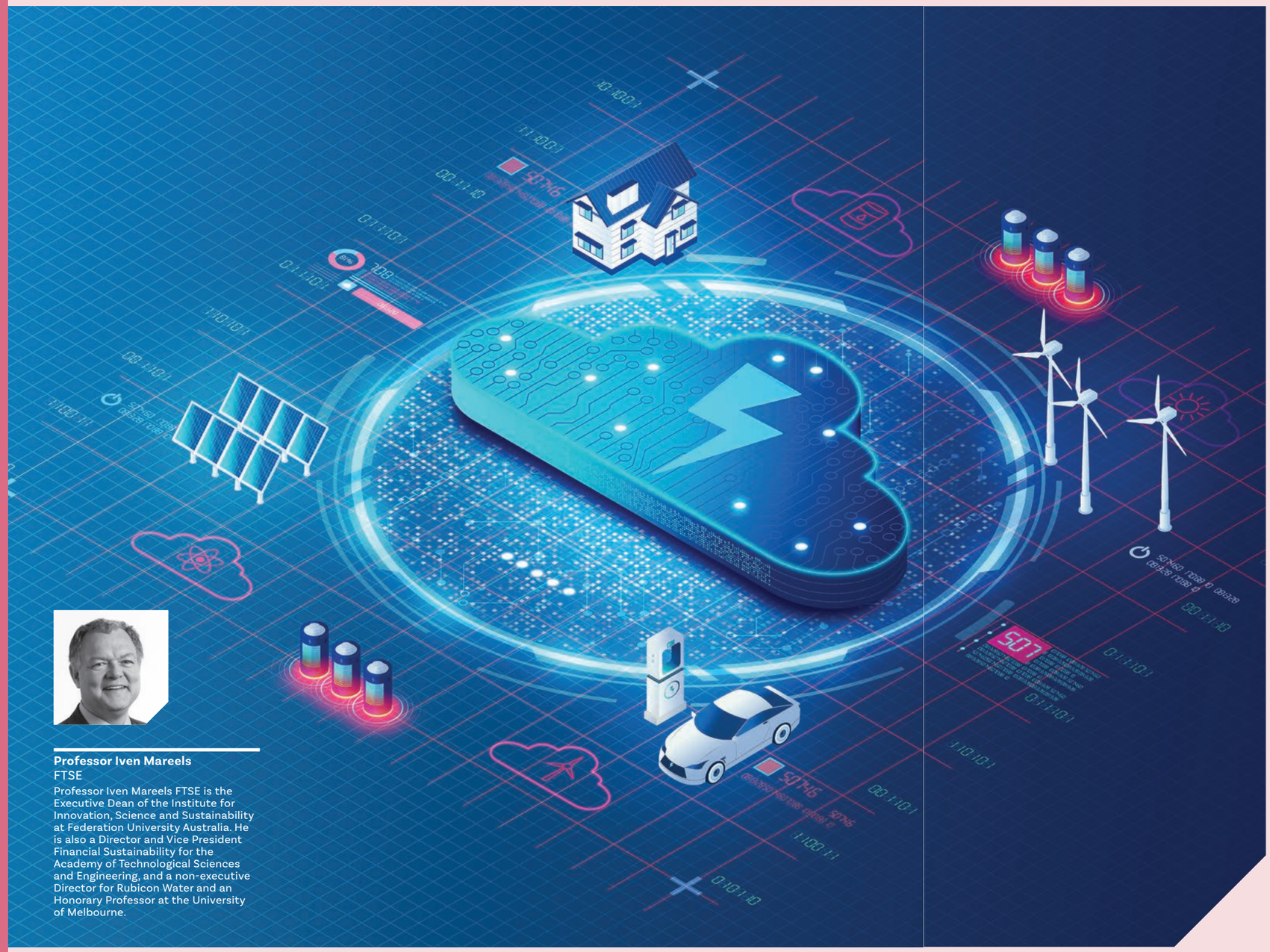
We know that progress is asymmetrical. While AI growth for consumer internet companies like Amazon, Google, Alibaba, and Apple has been phenomenal, other sectors – including manufacturing, finance, and agriculture – have yet to harness the full potential that current AI solutions can offer. We still need to overcome fundamental scientific challenges to make the value of AI and data science more accessible to the broader span of business and industry sectors.

We are in the midst of game-changing advancements in computing that have the potential to assist with some of the biggest challenges of our times. My hope is that as we engage in healthy debates about the benefits and limitations of these technologies, we do not get polarised in our views, as this would stifle innovation and progress.

Professor Shazia Sadiq
FTSE

Professor Shazia Sadiq FTSE has made lasting contributions to responsible and integrated solutions for effective information processes and data quality management. These contributions have substantially influenced international research activity in the field. She is a champion of trans-disciplinary work and through her foresight and capacity for collaboration, she has repeatedly encouraged and managed successful outcomes from diverse teams.

UN SDGs
8, 9, 10



Professor Iven Mareels
FTSE

Professor Iven Mareels FTSE is the Executive Dean of the Institute for Innovation, Science and Sustainability at Federation University Australia. He is also a Director and Vice President Financial Sustainability for the Academy of Technological Sciences and Engineering, and a non-executive Director for Rubicon Water and an Honorary Professor at the University of Melbourne.

Image: iStock

Digital infrastructure for Australia's Net Zero Transition

The recently released Net Zero Australia report* highlights the enormous scale and complexity of achieving a net zero carbon position for Australia.

However, the large cost estimate provided by the report is relatively minimal when compared to the costs of avoidable climate change remediation and adaptation. The report positions Australia as a leading solar energy exporter, leveraging its abundant sunlight and making the cost estimate more feasible due to substantial energy export income.

A net zero Australia is a significant nation-building project that requires coordinated governance and planning. An uncoordinated free market approach is inadequate. It is slow, inefficient in resource allocation, and not necessarily in the best interest of all Australians. To ensure a cohesive and complementary investment strategy, the implementation of digital infrastructure is crucial.

This digital platform should consolidate and centralise all relevant data related to the net zero transformation, enabling analysis, information extraction, and communication at citizen, project management, and governance levels. By facilitating the conceptualisation, planning, and management of a circular economy, this platform aims to determine the minimum material footprint required to sustain our standard of living within planetary limits.

The development of a comprehensive digital infrastructure, such as a digital twin for the country's energy system from source to use is a complex task. However, the necessary building blocks exist and can be developed and expanded during the net zero

*netzeroaustralia.net.au

The task ahead is enormous, but achievable. The technology exists to plan this transition. Let us build the digital infrastructure that enables the net zero transition and supports the circular economic future we need.

transition journey. To begin, a four dimensional digital map of the land (three dimensions for spatial representation and the fourth dimension for tracking over time) is crucial. The map should integrate digital layers for all energy infrastructure, renewable resources, and existing fossil energy resources. Additionally, it must be integrated with climate change scenarios by utilising both earth system models and localisation models to achieve the necessary spatial resolution for proper climate risk modelling. Finally, and very importantly, it must incorporate digital layers for energy use scenarios using population models, and consider the role of imports and exports and international cooperation.

From an engineering point of view, this digital infrastructure should go a step further by documenting every aspect of how energy infrastructure is used on a national scale[1], from its source to the demand side throughout its lifetime. This comprehensive information will minimise required infrastructure and resulting costs, improve energy and infrastructure efficiency, and facilitate the circular economy.

The digital platform should prioritise transparent accountability, presenting an overview of progress and associated risks at any given time. Due to the complexity of the transition, responsible and transparent accountability is essential. Indeed, the journey is not linear, and many choices will need to be made, not all of which will be proven 'correct' in hindsight. It is therefore of utmost importance that choices are documented against the best available information, including their accepted risk profile at the time of decision.

The lack of a comprehensive and integrated digital infrastructure is already costing society dearly. The poorly planned exit of base load fossil fuel generators from the electricity market, witnessed not only in Australia but in energy markets worldwide, inevitably results in rising electricity prices and subsequent inflation across the economy. While some may attribute these cost escalations to unexpected events or outcomes, they serve as evidence of deficient planning. Infrastructure planning requires a robust, resilient, and objective risk-based approach, which can be facilitated by a digital infrastructure that is free of subjective biases.

This transition is not business as usual; it needs coordinated, nationwide planning. The normal efficiency of the free-market economy does not hold under the shifting risk scenarios that the nation is currently experiencing.

Developing digital infrastructure which can support Australia's net zero ambitions is critical and will be the ideal space to develop, explore, and understand these scenarios and their associated risks.

1. In fact, if you take the logistic chains into account, the digital twin will reach well beyond Australia, as it is very clear that Australia is not currently self-sufficient in terms of building any infrastructure (just read the name plates on construction machinery).

2. See for example, Iven Mareels, Julian de Hoog, Doreen Thomas, Marcus Brazil, Tansu Alpcan, Derek Jayasuriya, Valentin Müenzel, Lu Xia, Ramachandra Rao Kolluri, "On making energy demand and network constraints compatible in the last mile of the power grid", Annual Reviews in Control, Volume 38, Issue 2, 2014, Pages 243-258, ISSN 1367-5788.

UN SDGs
7, 9, 12, 13

Transitioning from internal combustion engine vehicles to electric vehicles will go a long way towards decarbonising personal transport. Under average commute conditions in Australia, an uncoordinated transition relying solely on Lithium-Ion battery technology would require a distribution grid twice the size of Australia's current infrastructure (requiring more than double the peak power and total energy requirement). Fortunately, widespread use of smart meters combined with smart grid technologies, both elements of the envisioned digital twin infrastructure supporting the net zero Australia transition, offers an opportunity to shift the paradigm without doubling the infrastructure.

By leveraging demand side energy storage to moderate instantaneous power demand, a dynamic supply-demand match can be achieved, significantly reducing infrastructure requirements compared to the traditional 'demand is king' approach. The feasibility[2] of such an approach has already been demonstrated, but not at scale. Moreover, this approach may buy enough time to maturely develop flow battery technology and battery swap technology as further options to alleviate power congestion in existing distribution grids.

Image: iStock

Kiowa Scott-Hurley's speech at the launch of ATSE's boosting women in STEM initiative, Elevate
24 November 2022

One day, I am going to apply for a senior leadership role.

I will have the academic qualifications.

I will have the years of experience.

I will have built the network, done every leadership course, aced the interview...

And I won't get the job.

I was in my second year of university when I learned about the STEM sieve. Women come into the top of the sieve, and we catch a handful with biology, chemistry and psychology. A few filter through to engineering. Fewer still land in maths. Sometimes tech gets the scraps.

Every layer of the sieve requires women to be succulents — to withstand hostile environments and to adapt rapidly. Here at the bottom of the sieve in tech, I feel like a cactus in the Antarctic. I do not belong here.

I also started my first tech job in my second year of university. In the interview, I was told I wouldn't work with many women. My interviewer knew about the sieve, and he knew it wasn't a good excuse. He knew job ads were written to hire usually white, academic, straight, able bodied, financially stable ... men. If I was a cactus in the Antarctic — they were roses in a manicured garden with full time gardeners. The landscape was purpose built for them.

At every job since, I have seen very few people like me. The few women in STEM I found were temporary interns and grads, or people who'd worked in tech longer than I'd been alive. Few of them were in positions of genuine power despite being leaders and mentors. Few of them were recognised for this work. They were hardy succulents, sapping up whatever sunshine was left underneath the leafy roses above.

This is by design.

When I fail to get that senior leadership role, it will be because I was a good woman. Too considerate, kind, empathetic. I will have listened too much and not interrupted loudly enough. I will be a bad leader.

When I fail to get that leadership role, it will be because I was a good leader. Too abrasive, strategic, powerful and decisive. I will be a bad woman.

Like many women, I will decide whether to leave for a more hospitable landscape, or stay in the Antarctic.

I hope the Elevate program will be the hothouse in the Antarctic that helps me grow above and beyond the bottom layers, visible to others like me in the undergrowth. I will persevere to get that senior leadership role and hold myself and leaders to account.

And more importantly — by the time I retire I want to see overgrown gardens, buzzing with bees and life. I want to have worked with diverse people who innovate out of necessity, ever adapting to the inhospitable, beyond the boundaries of what the manicured garden will support.

UN SDGs
4, 5, 8, 10

Kiowa Scott-Hurley
Kiowa Scott-Hurley is a proud Dja Dja Wurrung woman and Digital Science Migration Engineer (AI) at Defence Science and Technology Group (DSTG). She collaborates with researchers to scale, accelerate, and optimise their AI workflows on research computing systems at DSTG. She is a recipient of an Australian Academy of Technological Sciences and Engineering's Elevate: Boosting women in STEM leadership scholarship.

Update from Kiowa six months into her scholarship

Despite my parents' best efforts, my education has always been fraught with financial stress. As a young woman in a regional area, studying was an expensive gamble.

When I was 9, I packed empty school lunchboxes to save my family money. When I was 14, I mended holes in my school-dresses and shoes as I outgrew them. I pretended I didn't want an exorbitantly priced school jacket for two years, freezing through winters.

During year 12, I hunted for my literature novels in op-shops. My second hand maths textbooks cost two of my paychecks, and I considered dropping the subjects. I paid the $35 university application fee, sparing my parents the stress. I wondered if life would be easier if I stopped studying and worked more hours at Coles. I wondered if I should study locally and not do STEM at all.

When I moved out of home for university, I sunk time and energy into activities that other students didn't seem to worry about. On Sunday mornings I'd carry my washing basket for 30 minutes to the laundromat. I stalked catalogues for cheap groceries and made meal plans while the dryer whirred. I spent Sunday afternoons searching supermarkets and grocers for bargains. I cooked as many meals as possible while the oven was on. Every hour I spent doing things the hard way was an hour not spent working, focusing on my assignments, or engaging with my community. I hated how my STEM subjects consumed endless hours in exchange for passing grades. I daydreamed about dropping them to work more. I was relieved to graduate and start full time work. I rapidly realised that I was surrounded by folks who were far more educated than me, and was haunted by the fact that my STEM career depended on further study. I was tired of choosing between my basic needs and my education. On my long commutes I hunted for STEM careers that didn't demand more study. I could finally turn the heating on when it was cold, and yet felt stranded like the high-school girl shivering in her poorly mended school-dress.

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. I can even afford the convenience tax. I don't spend hours on laundry anymore. I don't spend hours agonising over carrot prices. I drive when public transport would double my travel time. I can see specialist doctors for my chronic illness. While the Elevate program is more than a series of payments, it's those payments which have given me the time and resources to do training, networking, volunteering, public speaking ... all the extra activities which will enable me to flourish as a STEM leader. The Elevate program has transformed my relationship with studying for the first time into a bright and exciting opportunity for the future, instead of a financial hardship.

Australian Government
Department of Industry, Science and Resources

Elevate is a STEM careers initiative of the Australian Academy of Technological Sciences and Engineering (ATSE) and is funded by the Department of Industry, Science and Resources (DISR).

atse.org.au/elevate

Submissions from the Academy

Draft National Teacher Workforce Action Plan

DECEMBER 2022

ATSE's submission to the Department of Education on the National Teacher Workforce Action Plan recommended that a National Skills Taxonomy be established along with a centralised database of digital, quality-assessed self-serve STEM education resources for teachers.

ATSE recommended that Government education departments invest in programs and development in consultation with local communities to improve and provide culturally appropriate and engaging delivery of STEM education for Aboriginal and Torres Strait Islander students, acknowledging Traditional Knowledge and teaching 'in language'.

The Employment White Paper Consultation

DECEMBER 2022

ATSE's submission on the Employment White Paper recommended establishing a National Skills Taxonomy, as well as strategies for attracting young people into priority STEM careers, including support for the delivery of internship programs. The Employment White Paper should also include a long-term strategy to recruit and retain in-field STEM teachers.

The submission also outlined the need to incentivise lifelong learning for the workforce, including fee relief and tax incentives for businesses and include targeted strategies for improving workforce participation of under-represented groups in STEM.

Australian Critical Minerals Strategy

DECEMBER 2022

The submission on Australia's Critical Minerals Strategy outlined the skills crisis for engineers and recommended that the Government implements targeted training and migration programs to develop and secure skills for the energy industry.

ATSE recommended that the Government takes a coordinated approach to developing critical minerals processing capacity by investing in green mining and processing, including the amendment of the Clean Energy Finance Corporation and Australian Renewable Energy Agency Acts and the development of a coordinated infrastructure and industry investment plan.

Australian Research Council Review

DECEMBER 2022

ATSE's submission to the Australian Research Council (ARC) Review proposed that the ARC should be strengthened, supported, and legislated to be a national leader in research grant funding. ATSE outlined that the ARC should develop and model best practices in research funding, including a two-stage approach to funding applications to streamline the process and reduce wastage of researcher time.

ATSE's submission also addressed the issue of research funding, arguing for funding to cover the full cost of research and for funding across the research pipeline. ATSE recommended creating certainty for the sector by legislating funding announcements dates, removing or constraining the ministerial veto, and implementing a grant renewal system for promising research.

Australian Universities Accord Terms of Reference Consultation

DECEMBER 2022

The four terms of reference in the Australian Universities Accord Consultation that ATSE are most closely aligned with were: meeting Australia's knowledge and skills needs now and in the future, access and opportunity, investment and affordability, and delivering new knowledge, innovation and capability.

ATSE and the AAS joint submission on Australia's Transition to a Green Energy Superpower

DECEMBER 2022

The joint submission with the Australian Academy of Science (AAS) engaged with five key themes: developing a green energy workforce to encourage students to study in critical fields, supporting existing green energy industries in Australia, creating an evidence-based carbon emissions certification scheme for Australian exports, coordinating development and use of green energy infrastructure, and creating social license for the industry. ATSE and the AAS expanded on these themes when invited to appear at a public hearing for the inquiry in late March 2023.

Right: ATSE CEO Kylie Walker (centre) and Fellows Professor Ian Chubb AC FTSE FAA (left) and Professor Ken Baldwin FTSE (right) gave evidence at the Joint Standing Committee on Trade & Investment Growth's inquiry into Australia's transition to a green energy superpower.

Pre-budget submission 2023-24

JANUARY 2023

ATSE's pre-budget submission focused on three core themes: what the STEM sector needs right now, building the STEM sector of the future, and using STEM to solve our nation's biggest challenges.

ATSE recommended that the Australian Government commits to conducting an independent review of Australia's research sector, with a view to raising sector-wide funding to an internationally competitive level. High priority recommendations included funding the full cost of STEM degrees, developing a national STEM strategy, and investing in near-term emissions reduction.

Decarbonising Infrastructure Delivery

JANUARY 2023

ATSE recommended strengthening the framework with further actions to comprehensively measure, standardise and budget for embodied emissions in infrastructure projects, support research and development on embodied emissions, and implement a circular economy approach to infrastructure.

National Energy Performance Strategy

FEBRUARY 2023

The submission to the National Energy Performance Strategy covered three main themes: mandating improved efficiency in new housing stock, incentivising energy-efficient upgrades in existing housing stock, and improving energy efficiency in rental and public housing properties.

Guarantee of Origin (GO) Consultation

FEBRUARY 2023

ATSE's submission recommended positioning Australia as a trusted low-carbon exporter by creating a framework in alignment with international standards, enabling broad participation in the GO scheme and the future-proofing of the GO scheme by designing it to be technology neutral.

National Reconstruction Fund (NRF) Consultation

FEBRUARY 2023

ATSE's submission recommended using the NRF to build on existing strengths while bringing economic value to regional economies, public-private partnerships, and the entrepreneurial ecosystem. ATSE also recommended supporting the circular economy, particularly for renewable energy components. The submission suggested that the NRF can also be used to support commercialisation for priority areas such as negative emissions technologies and medical manufacturing.

Emissions Reduction Objective Consultation

FEBRUARY 2023

To improve transparency, ATSE recommended legislating market bodies to publish a list in their annual reports outlining the emissions reduction targets that were considered when applying their energy objectives. To strengthen communication about emissions reduction targets, ATSE recommended that the legislation specifically mentions compliance with interim targets in line with Australia's international commitments.

Jobs and Skills Australia Consultation

FEBRUARY 2023

Having previously participated in the August 2022 consultation on the legislation establishing Jobs and Skills Australia, ATSE built on its previous submission by suggesting how Jobs and Skills Australia can be best positioned to provide the analysis needed to tackle Australia's skills needs. This could be done by building an evidence base to understand skills needs and supply, coordinating a National Skills Taxonomy and creating a cross-sector skills registry.

The submission highlighted that some areas of minority workforce participation are poorly understood.

The submission also argued that Jobs and Skills Australia should increase understanding of workforce diversity and barriers by conducting comprehensive data collection on workforce diversity across a range of dimensions and across time.

Inquiry into the Role of Permanent Migration in Nation Building

FEBRUARY 2023

In its submission, ATSE noted that more than one-third of Australia's STEM workforce was born overseas and that migrants can help relieve critical workplace skill shortages across industries. However, many migrant workers are not working in the role for which they're trained. Developing a comprehensive national strategy may help to keep migrants in the roles they trained for and improve skills shortages. ATSE recommended that the Australian Government improves processes for processing visas in less time to help make Australia more attractive to incoming researchers. ATSE was invited to appear before the committee in May 2023 and used this opportunity to highlight migrant workers in the STEM sector and barriers to entry.

Future Delivery of Foundation Skills Training in Remote Australia Consultation

FEBRUARY 2023

ATSE's submission recommended integrating foundational skills programs with a National Skills Taxonomy, delivering foundation skills in the context of lifelong learning, and providing digital skills training. ATSE also recommend developing the foundation skills teaching workforce by targeting regional and remote students in fields needed for their communities.

Below: Science and Technology Australia CEO Misha Schubert, ATSE CEO Kylie Walker and ATSE Fellows Dr Tony Peacock FTSE and Professor Chennupati Jagadish AC PresAA FTSE gave evidence to the Joint Standing Committee on Migration in May 2023.

Australia's Animal Sector AMR Draft Action Plan 2023-2028

FEBRUARY 2023

ATSE's submission drew upon the previous report in collaboration with CSIRO, *Curbing Antimicrobial Resistance: A technology-powered, human-driven approach to combating the 'silent pandemic.*

ATSE recommended dedicated research into the fundamental causes of AMR's emergence in different animal species and the potential risks it poses to its shared ecosystems.

ATSE further recommended maximising the effectiveness of the One Health approach by utilising Traditional Knowledge principles and inputs.

A final recommendation was made to create objectives to develop the future One Health competent workforce to be added to the action plan's objectives.

Road Resilience Inquiry

FEBRUARY 2023

ATSE's submission highlighted the importance of utilising a whole-of-systems approach in the planning phase of infrastructure projects to achieve resilience. ATSE called for standardised, centralised, and transparent data to support infrastructure project planning and ongoing assessment as well as benchmarking for infrastructure design and materials.

ATSE was invited to appear before the House Standing Committee on Regional Development, Infrastructure and Transport in June 2023 and used this opportunity to discuss the implications of severe weather events on regional, rural and remote road networks.

Inquiry into the Perceptions and Status of Vocational Education Training

MARCH 2023

ATSE'S submission argued that the Australian Qualifications Framework (AQF) implies a hierarchy of qualifications that places vocational qualifications below university qualifications. Amending the AQF to remove this hierarchy may help to remove perceptions that vocational education is less desirable.

ATSE also argued that greater collaboration between schools, universities, and the vocational education sector will not only break down negative perceptions of vocational education but also help improve skill development options across the lifespan.

Future Drought Fund Inquiry

MARCH 2022

ATSE's submission recommended that the fund focus on guiding resilience to extreme events caused by climate change by investing in rural and regional communities and their economies. The fund should focus on establishing foundational structures to combat drought-related challenges, with transparent and publicly accountable funding decisions and coordinating activity through drought resilience adoption and innovation hubs.

ATSE also suggested the Commission utilises the wealth of Traditional Knowledge to aid in adapting to the challenges posed by droughts and other environmental stresses.

National Battery Strategy

MARCH 2023

ATSE's submission recommended that the National Battery Strategy invests in research and development of new battery technology through established centres like university research hubs and the Future Battery Cooperative Research Centre.

The National Battery Strategy should establish manufacturing precincts for all parts of the value chain to improve the domestic battery industry's commercialisation capability. It should also create regulations that help develop resilience to raw material shortages and business practices that are open, environmentally friendly, and circular.

Above: ATSE CEO Kylie Walker and Fellow Dr Helen Cleugh FTSE appeared before the House Standing Committee on Regional Development, Infrastructure and Transport to talk about the implications of severe weather events on regional, rural and remote road networks.

Safeguard Mechanism Reform

MARCH 2023

ATSE's submission argued that the proposed changes are a step in the right direction. It was also argued that carbon credits should not be used to reduce emissions where an industry can reasonably reduce emissions based on available technology.

Carbon credits that are used should represent genuine carbon abatement — noting the issues with carbon credits raised in ATSE's 2022 submission to the Independent Review of Australian Carbon Credit Units.

Inquiry into Developing Advanced Manufacturing in Australia

MARCH 2023

ATSE's submission made recommendations to support four broad themes: enhancing sovereign capacity via manufacturing, establishing a circular manufacturing industry, developing manufacturing skills and supporting the medical manufacturing industry.

Australia's Science and Research Priorities: Conversation Starter

APRIL 2023

ATSE's submission advocated a mission-oriented approach, with key challenges identified by ATSE's experts such as meeting net zero emissions by 2050, healthcare and wellbeing for an ageing population, digital leadership, equity and inclusion and developing the STEM workforce and teaching capacity. While Australia has significant opportunities and strengths to align its Science and Research Priorities, it is challenged by a limited capacity within an austere research funding environment and talent shortage.

Australian Universities Accord Discussion Paper Consultation

APRIL 2023

ATSE's submission to this second round of consultation put forward recommendations for the culture of higher education to make it easier for researchers to move between academia and industry, increasing flexibility and integration for widening student participation by adopting a more specialist approach for universities and greater integration with the VET sector.

For better educational outcomes, there should be increased investment in the higher education sector, especially for regional universities with large student bodies that are the first in the family to attend university, come from low socio-economic backgrounds or are Aboriginal or Torres Strait Islander students.

Pathway to Diversity in STEM Review

APRIL 2023

ATSE recommended a strategic, consolidated approach to enhancing diversity in STEM, with successful programs to be scaled up. The Academy also recommended supporting programs that encourage diversity across the STEM education and career pipeline as well as an intersectional approach to supporting diversity in STEM and a leveraging of STEM leadership to create inclusive cultures that foster intersectional diversity.

Startup Year Inquiry

APRIL 2023

ATSE's submission recommended that the Startup Year is subject to review after its first year of operation, that demographic information about participants is collected and published, and that the Government creates a scholarship program targeted at increasing Startup Year participation by under-represented people in STEM. The submission also recommends some minor name changes to programs to mitigate any confusion, such as changing "SY-HELP" to "Start-up-HELP". ATSE's submission was extensively referenced in the Senate report.

Initial Teacher Education

APRIL 2023

ATSE'S submission argued that STEM education must be integrated with Initial Teacher Education (ITE), with ongoing professional development to develop expertise and maintain currency throughout a teaching career.

ATSE's submission to the discussion agreed with the panel's proposal that numeracy should be considered the responsibility of all teachers and that all ITE students should develop a conceptual understanding of foundational concepts in mathematics.

ATSE recommended that the panel extends this target by requiring STEM qualifications for STEM teachers and considers how these qualifications can be better integrated with ITE. The panel should consider how STEM students can be enticed to also enrol in teaching qualifications and how to establish mid-career pathways to ITE for people with STEM qualifications.

National Robotics Strategy Discussion

MAY 2023

ATSE's submission highlighted the importance of setting up ethical and security frameworks for the responsible use and deployment of robotics to ensure the ethical usage of robotics and the data they collect. ATSE recommended that the Government must promote and support the use of interoperable and open-source software for robotics. The Government can support this with dedicated support programs and priority procurement of open-sourced robotics systems.

Diversity in STEM Review: Let's Talk Solutions

MAY 2023

ATSE's submission focused on the importance of adopting a sector-wide strategy approach to increase inclusion and diversity in STEM — combining fragmented projects into a single framework to maximise impact and efficacy. ATSE recommended baseline data to assess the efficacy of programs that is both quantitative and qualitative.

Victoria's 30-year Infrastructure Strategy

MAY 2023

ATSE's Infrastructure Forum led a submission building on the themes discussed in the 2023 submission to Infrastructure NSW on Decarbonising Infrastructure Delivery. The submission argued that the infrastructure strategy should focus on decarbonising infrastructure, beginning with a carbon emissions accounting and budgeting framework, to ensure it is nationally consistent. The submission also advocated for circular economy principles in infrastructure projects.

Submission to the Greenwashing Inquiry

MAY 2023

As the nation pursues economic decarbonisation and Australians increasingly seek environmentally conscious consumption and investment choices, it is critical we have regulatory frameworks to guard against greenwashing. Consumers and investors who make decisions based on dubious claims about environmental sustainability are not only misled about their purchase, their spending has also been diverted away from genuine opportunities for social good.

ATSE's submission argues for a clear regulatory framework for environmental claims, supported by a legislated definition of environmental sustainability for consumer goods as well as other products prone to greenwashing claims (such as energy products and investments).

MORE

Submissions
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atse.org.au/publications

To feed nine billion people, we must harness robots and AI for smarter farming

Professor Salah Sukkeriah
FTSE

Professor Salah Sukkarieh FTSE is a Professor of Robotics and Intelligent Systems at the University of Sydney's Australian Centre for Field Robotics (ACFR). He is also CEO of Agerris, a new Agtech startup company from the ACFR, developing autonomous robotic solutions to improve agricultural productivity and environmental sustainability. In 2022, Professor Sukkarieh won the International Council of Academies of Engineering and Technological Sciences (CAETS) Communication Prize for a video showcasing smart farming robotics that improve business outcomes, food quality and environmental sustainability.

Image: iStock

The global population is set to reach nine billion people in just over a decade. With the threat of climate change, depleting resources, more complex supply chains and increasingly scarce water sources, one of the biggest challenges we now face is securing the world's food supply.

Technologies and systems predicated on robotics (robots that help with on-farm tasks) and AI (intelligent systems that help understand, monitor and care for the environment) are set to play a crucial role in addressing these challenges by improving farming productivity and making better use of existing farmland.

Already, Australian farmers are at the forefront of trialling these technologies at scale, which is having a transformational impact on agricultural productivity, efficiency and sustainability.

Agricultural robots are being designed to perform labour-intensive tasks, such as planting, harvesting and weeding. They can also work around the clock, overcoming the tyranny of distance on large farms and performing tasks that are too difficult or dangerous for humans, like working in extreme weather conditions and handling hazardous chemicals. Robots can also assist with the fluctuating and seasonal demands of farming; planting individual seeds through to harvesting individual plants. On-ground rovers and specialised drones can also be used to oversee and monitor the health of animal herds, providing information on grazing patterns, and even feeding and watering.

They do all of this using in-built sensors and intelligent on-board tools that capture information on crops and animals via cameras, lasers and hyperspectral imaging. On-board communication systems then relay real-time information back to the farmer, agronomist or field worker. The insights gleaned range from knowledge on individual plants and animals, to current and expected yield, pests and disease, as well as the projected health of crops and animals.

These systems gain autonomy through complex guidance and control algorithms which determine the paths robots take to minimise energy expenditure, and avoid obstacles like rocks, logs, animals and farm workers. This approach can also be used to directly deliver commands for the precise application of chemicals to an individual plant, or even remove weeds without disturbing soil.

Other algorithms are used to determine when a robot should harvest, ensuring only ripe produce is picked. These algorithms even give robots the ability to herd animals to optimal pastures and reduce soil and plant degradation.

Although on-farm labour shortages are a global phenomenon, this technology can provide a solution. Even with a growing population, the march towards service economies and urbanisation has seen a brain — and brawn — drain away from food producing regions, resulting in an ever-increasing median worldwide farming age. Robotics and AI can be used to power the repeatability, precision and automation of on-farm tasks and provide the brawn now lacking in so many food producing regions.

This issue is even more pronounced in developing countries where access to nutritious food is a significant challenge. Many of these countries are experiencing the biggest surges in population growth which has led to over-farming and negative environmental impacts. Despite differing economic scales, these can be overcome through alternative technology developments. Agricultural robotics and AI can help smallholder farmers make better use of their existing land, support labour shortages and encourage greater crop diversity.

There are, however, some challenges to introducing robotics and AI in agriculture; firstly, the business model — for this technology to make an impact it must align with farmers' typical business approach. For example, tractors are often a farm's main capital expenditure, providing significant power delivery and tools. Next, robotic equivalents must be able to meet the farmer's demands which means delivering robust engineered technologies at equivalent cost or for additional value.

Robotic and AI technologies will need to provide a wide range of capabilities and in doing so meet operational expense requirements, meaning the delivery of robotics-as-a-service business models pushes the costs onto the technology providers.

Education and training is also paramount to continuous operation of this technology. In most cases, service providers are responsible for maintenance, which increases costs. A coordinated effort in the delivery of STEM based activities in high-schools and vocational institutes is important for developing these skills among farm workers.

Finally, there is the need to consider the concerns, expectations and values of farmers and communities regarding the introduction of robotics and AI into agriculture. Impact on workforces, data privacy, and fairness are important elements to consider when seeking trust, acceptance, and public approval of agricultural robotics and AI. This is a continuous process as the technologies are always evolving rapidly. Engagement with farmers and the wider community on developing frameworks, guidelines and accountability is paramount.

Despite these challenges, the opportunity for Australia to lead in this field is immense. Our farmers are already early adopters of many of these technologies. And, as major agriculture producer and exporter, the world will be looking to how we transition.

UN SDGs
2, 9, 15

Dr Raj Paroda
FTSE
Dr Rajendra Paroda is an acclaimed agricultural scientist specialising in plant genetics and breeding. His contributions to plant breeding and genetic resource management are globally recognised and include establishing the first modern national genebank in India.

Plant health and global food security


Image: iStock

2023 is the International Year of Millets — nutrigrains which are tolerant to drought, heat, pests and diseases and nutritionally superior in protein, fibre, minerals and vitamins, compared to rice and wheat.

Nearly one billion people go hungry every day. And a significant amount of food is lost due to pests and diseases.

Use of improved varieties, integrated pest management (IPM) and good agricultural practices (GAP) can help ensure good plant health — which is critical to achieve the Sustainable Development Goals (SDGs) by 2030.

From the beginning of civilisation, the importance of quality seeds and healthy plants to guard against diseases, pests and natural disasters has been well known. Globally, annual losses due to pests and diseases are estimated to be around $200-300 billion, with 10-40% of crop losses due to pests. Climate change is also adversely affecting plant health and threatening global food security.

PLANT HEALTH FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS (SDGS)

Today the whole world celebrates the International Day of Plant Health, signifying the importance of crop plants for human survival. From the beginning of civilisation, the importance of quality seeds and healthy plants to guard against diseases, pests and natural disasters has been well known.

By 2050, the global population will be 10 billion, and will need 60% more food than today produced from fewer natural resources such as land, water, and biodiversity.

Meeting the United Nations Sustainable Development Goals by 2030, especially those relating to poverty (SDG1), zero hunger (SDG2), climate action (SDG13) and healthy life on land (SDG15), is a daunting task. Urgent action is needed at both national and global levels to raise healthy crops, while guarding against biotic and abiotic stresses as well as the impact of climate change.

PESTS AND DISEASES — REAL THREAT TO PLANT HEALTH

Plant pests and diseases pose serious threats to global food security. There are several examples from around the world: a severe outbreak of Brown spot fungus (Helminthosporium oryzae) in West Bengal destroyed rice crops (50-90%) leading to over two million deaths (Bengal Famine, 1942-43), the potato late blight caused by Phytophthora infestans (Irish Famine, 1845) killed more than one million people in Ireland, and the Taro leaf blight (Phytophthora colocasiae) in 1993 caused almost 100% crop loss in Samoa thus threatening food security in the Pacific region.

Over decades, wheat crops have been affected adversely due to black, brown and yellow rusts and Karnal bunt. In the last two decades, the threat of virulent transboundary stem (black) rust Ug 99 — first noticed in Uganda and now spread to Iran — has been addressed through the Borlaug Global Rust Initiative (BGRI), as 90% of wheat varieties are susceptible.

More recently, the infestation of Fall Armyworm (Spodoptera frugiperda) in East Africa, Bangladesh and West Bengal in India has caused yield losses up to 40%.

In India, prior to the release of genetically modified Bt cotton in 2001, the yield losses due to Bollworm (Helicoverpa armigera) required spray of chemical pesticides that totalled almost half the quantity used in all agriculture. Fortunately, Bt cotton has rescued smallholder farmers for over two decades now due to reduction in pesticide use by almost 40%. Adoption of genetically modified cotton thus enabled India to be the largest producer in the world and emerge as an important exporter.

For containing transboundary diseases, effective quarantine measures at the national level are urgently required in developing countries. For instance, thanks to effective quarantine systems in Australia, there are no reports of Karnal bunt incidence in wheat and many other pests of other crops. Strong plant quarantine systems are, therefore, critical to guard against diseases and pests emerging in new host crops and regions.

In global production and exchange of vegetatively propagated food crops like banana, cassava, potato, yam, sweet potato and fruits like citrus, apple etc., certified planting materials will be critical for raising healthy crops and their quality produce.

CROP BREEDING TO IMPROVE PLANT HEALTH

Plant genetic resources are crucial for global food, nutrition, and environmental security. Genetic enhancement through dwarfing and photo-insensitive genes in wheat and rice helped achieve the Green Revolution in South Asia. Revolution in sugarcane production took place in India through nobilisation (a form of crop breeding) of cane using wild germplasm. Nobilisation also helped in spreading sugarcane production from tropical south to sub-temperate regions of north India due to earliness and tolerance to rot.

In order to guard against adverse impacts of climate change, we urgently need the genes that are tolerant to drought, heat, cold, flood, diseases, pests, etc. There is also a need to intensify efforts in stacking multiple resistance genes using innovative genome editing (Crisper/Cas9) technology. This requires strengthening of plant breeding efforts at the global level, including strong partnerships between the National Agricultural Research System (NARS), CGIAR (a global research partnership for a food secure future), and with the private sector.

According to the United Nations Food and Agriculture Organisation (FAO), plant breeding efforts have invariably declined in many developing countries. Hence, a Global Initiative on Plant Breeding (GIPB), supported by the Bill and Melinda Gates Foundation (BMGF), is being implemented by FAO in developing countries.

PROMOTING THE CONCEPT OF 'ONE HEALTH'

Though the UN had declared 2020 as the International Year of Plant Health, its importance was overshadowed by the COVID-19 pandemic. However, the importance of 'One Health' could still gain considerable prominence. 'One Health' is an integrated, unifying approach that aims to sustainably balance and optimise health of soils, plants, animals, and people under varying ecologies. Food security is a major goal of 'One Health' as it embraces healthy food production, processing, value chain and marketing. All stakeholders including farmers, consumers, researchers, private sector, non-government organisations and government officials, need to work towards sustainable food production in a coordinated manner, in order to raise healthy crop plants that meet our food and nutritional security needs. We also need to develop automated plans for pest and disease outbreak prediction and associated management systems for our major food crops.

CROP DIVERSIFICATION FOR SUSTAINABILITY

Agricultural diversification towards remunerative and high value crops such as vegetables, fruits, condiments, spices, medicinal plants, etc. will increase farmers' income and reduce poverty. We should promote the recently evolved use of biofortified varieties in cereals, millets, pulses, oilseeds, vegetables, and fruits that produce high nutritive value and low anti-nutritional factors.

2023 is the International Year of Millets – nutri-grains which are tolerant to drought, heat, pests and diseases and nutritionally superior in protein, fibre, minerals and vitamins, compared to rice and wheat. Their enhanced use in the food basket would help address specific concerns about global hunger. The recent UN Food Systems Summit also emphasised the need to strengthen research on local food crops and support their greater use.

Shifting away from cereal-centric cropping systems to a more diversified (cereal-legume based) integrated farming systems will also be more sustainable. This will help conserve natural resources and promote regenerative agriculture. Crop diversification and growing of healthy crops and growing of healthy crops have helped increase global food security. However, reorientation around local food systems being more resilient and adapted, and using seeds of healthy plants, will help achieve greater agricultural sustainability.

UN SDGs
1, 2, 3, 13, 15

Agricultural innovation and education

Emeritus Professor Lindsay Falvey
FTSE

Emeritus Professor Lindsay Falvey FTSE was Dean of Agriculture, Forestry and Horticulture at The University of Melbourne, where he continues in an honorary role. His career has spanned government, academia, research and the private sector, and he has authored some 15 books. He is currently Australian Commissioner for the Australian Centre for International Agricultural Research among other governance and advisory roles.

STEM remains a foundation of agricultural and food science education and research. Today it relies more than ever on efficient coordination between scientific organisations. Perhaps the best Australian example is the Queensland Alliance for Agriculture and Food Innovation (QAFI) in Queensland. Other states have various approaches and in the case of the major production and exporting state of Victoria, more advanced coordination is needed between its four providers - namely LaTrobe University and The University of Melbourne, the state government department and CSIRO's food research. Coordination of programs and capacity-building in these institutions is ripe for enhancement through a Victorian agriculture and food precinct initiative.

Innovation in agriculture relies on both specialists and integrators for the complex interactions between biochemical, microbiological, biophysical and ethical fields that underpin major industries. Founded on STEM with key social science inputs, the sector demands continuous training of new researchers who will dedicate their skills to the major industries that create much of Australia's wealth.

Supporting that wealth in parallel with the usual funding mechanisms has been one of Australia's great innovations: the joint public-private funding of the levy-based Rural Research and Development Corporations. Benefits accrue not only from that system's unique design, but also through its efforts to balance issues around private-benefit research, short-termism, public and national benefit, and environmental care.

State governments that have traditionally accepted responsibility for, among other matters, local regulation, research and communication, are faced with declining resources and confused overheads in dealing with overlapping funding systems. Yet much innovation has arisen from these sources in parallel with the research-oriented universities that train researchers. Continuing these contributions of agricultural innovation rests on education and research systems that are overdue for updating if they are to meet current and future demands. However, Australia's urban orientation has 'civilised' agricultural education and research training, which has allowed the inseparably interdisciplinary nature of agricultural science to be misconceived as an agglomeration of disciplines. Such misconception has led to some carving-up of once world-leading faculties to be combined into other administratively tidy units that can find it tiresome to maintain connections with the diverse industrial and funding base of agricultural science.

The marginalising of agricultural science, an unconscious by-product of our centralised university governance, is decried within the profession; yet a better response is recognition of the changing circumstances that contain the seeds for a new coordinated approach that offers savings and increased impact. Responding to changes has been a past hallmark of the profession - from the 1880s beginnings of agricultural education to today's government and university departments, the colourful history of agricultural innovation is replete with persuaders, rogues, visionaries, and entrepreneurs that contributed to Mark Twain's observation that early Australia did '*not read like history, but like the most beautiful lies … but they are all true, they all happened.*' Twain went further when visiting an agricultural college, when he said its students were '*without any inherited prejudices in favour of hoary ignorances made sacred by long descent*'. Since then, great innovations across diverse environments have created a wide educational and research base around Australia, as indicated in the table below.

Now, more than a century since Twain's faint praise, we might well be accused of harbouring our own prejudices when we seek to return to the golden age of our own pasts. It is time for change.

Reviews, debates and musings about the future of agricultural science agree on the need to acknowledge change in social and political environments, university decision-making, climate, and technologies - particularly in communication and AI, all the while preserving the integrative essence of the field. For example, AI is already revolutionising agriculture. Vast amounts of data inform complex biophysical decision-making from pre-production to processing and marketing. Precision at individual soil, plant and animal levels informs machine-learning algorithms serving sensors that detect diseases, pests, yields, quality, nutrient and water needs, livestock stress and wellbeing, genetic variability and inform genetic manipulations critical to climate adaption, and more. This means that agricultural science courses once seen as the liberal arts degree of Australia, as a reflection of its multidisciplinary integration, may no longer be feasible in an age of specialisation and student-demand-driven education. It is probably unreasonable to expect leaders of the multi-billion-dollar universities to address the concerns of one unit within their institutions, even though agricultural faculties are often a university's major research provider. However, insofar as much of university funding comes from public sources, it is eminently reasonable to orient education and research to a sector that underpins national wellbeing and wealth.

Decade	Colleges	Universities
1850		Sydney*, Melbourne*
1870		Adelaide*
1880	Roseworthy SA, Dookie Vic, Longerenong Vic	
1890	Burnley Vic, Hawsbury NSW, Wagga NSW	Tasmania*
1900		
1910		Queensland* Western Australia
1920	Muresk WA	
1930		
1940	Dairy Research Vic	
1950		New England NSW*
1960	Glenormiston Vic, Marcus Oldham Vic, Yanco NSW, Tocal NSW, Longreach Qld, Emerald Qld	QIT/Central Queensland LaTrobe Vic*
1970	McMillan Vic	James Cook Qld* Murdoch WA*
1980		Curtin WA* Charles Sturt NSW* Western Sydney*
1990		Southern Cross NSW

*Agricultural Education Institutions by Decade of Creation (*major agricultural research providers)*

National wealth from agriculture, according to the Bureau of Statistics, is mainly generated in Victoria, Queensland and NSW where 2019-20 values of raw production were $18, $14 and $11 billion dollars; noting variations in rainfall can boost NSW in good years. The figures for other states were $9 billion (WA), $7 billion (SA), $2 billion (Tas), and $1 billion (NT). If these values are divided by a state's land area, the relativities for the above three main states become even more stark, with Victoria's value per area being at least six times that of any other state. This crude comparison is sufficient to indicate that innovation driving production efficiencies and effectiveness should reflect these relativities. That may have been the case in the past, but today it is less clear. Recent organisational initiatives in Queensland have shown means of increasing efficiencies and impact.

Queensland might be seen as having the most advanced approach to meeting today's challenges in sustaining agricultural innovation though its creation of the Queensland Alliance for Agriculture and Food Innovation — QAAFI. Constituted as a research institute of the University of Queensland, it is seen as a leading research provider in tropical and sub-tropical agriculture and food production relevant to the state. It is supported by industry and the state government to coordinate collaborative research, innovation and capacity building through graduate training and research oriented to industry outcomes and global opportunities. Its multidisciplinary research leverages the full capacity of the university and the state. A similar opportunity is open to the major agricultural state of Victoria.

Victoria is Australia's largest food and fibre producer contributing 27% of national food and fibre exports by value (>$14.0 billion, approximately $11 billion from food and $3 billion from fibre). Major markets, taking

>50 percent of Victorian exports, are China, USA, Japan, New Zealand and Indonesia.

In addition to being Australia's major exporter, Victoria has the highest number of people working in food and fibre (150,080), including agricultural production (67,630) and food manufacturing (82,450), which represents 24% of such employment nationally. Similarly, the 21,600 farm businesses in Victoria represent 25% of the national total. These figures increase substantially when other components of the sector are factored in, including agribusiness, input suppliers, major banks and traders.

Such production from just three percent of Australia's area arises both from a favourable agricultural environment across half of the state (11.4 million hectares), and from a tradition in education and research.

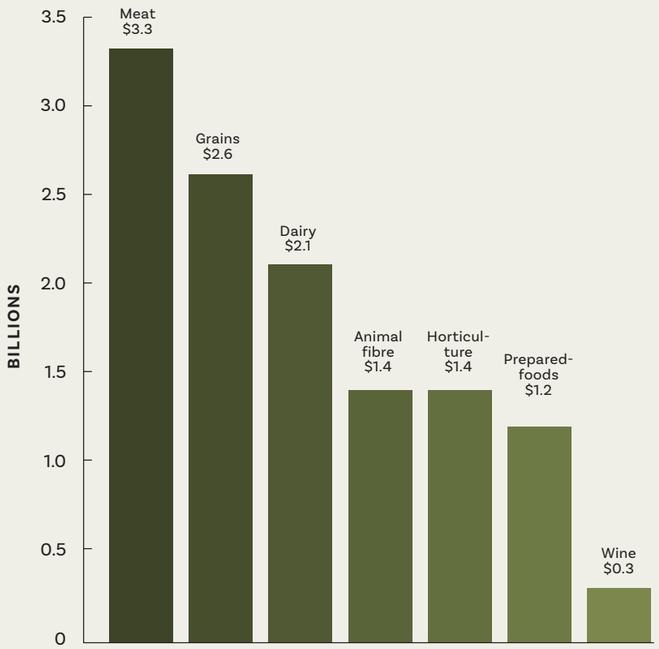
In servicing these intensive agricultural businesses, the major players in research and education have been the state department known as Agriculture Victoria, and Melbourne and LaTrobe universities. Other smaller providers include non-self-accrediting institutions.

Investment in research and education has neither kept pace with export values nor recognised the importance of agriculture and food sectors in Victoria, which has increased risks to the underpinning national resource base and to future export income. The opportunity to increase the efficiency and impact of research and education providers by learning from Queensland warrants immediate consideration.

VICTORIAN PROVIDERS

Agriculture Victoria seeks "to grow and protect profitable, sustainable farms in thriving regional and rural communities across Victoria".

MAJOR VICTORIAN EXPORTS
by industry and value



Among other responsibilities it supports research through; encouraging interaction between government, industry and academia, supporting some PhD scholarships, and undertaking research in the organisation's elite research facilities — a major focus of which is the AgriBio facility located on the LaTrobe University campus.

Particularly in the mid-late 1990s, Agriculture Victoria supported The University of Melbourne by transferring high performing researchers to the university while continuing to meet their salaries and on-costs through allocations to the university. A different arrangement has potentially assisted LaTrobe through the presence of Agriculture Victoria research in the AgriBio facility. The initiative to transfer staff has the triple advantages of allowing state researchers to access national funds otherwise precluded to state instrumentalities, meeting government objectives to reduce public servant numbers, and updating government's role in providing services. These factors remain relevant.

In recognition of the need for increased coordination and focus through modern facilities, the Victorian Government's concept of innovation precincts has led to its significant investment in the AgriBio facility adjacent to Latrobe University foreshadowing an Agri-food precinct — the vision for which is a smaller mirror of the state's successful Parkville Strip precinct for biomedical research. The recently announced relocation of the CSIRO Food Research laboratories to the Agri-food precinct consolidates the policy to concentrate innovation services.

The University of Melbourne has a long history in agricultural and food education and research through various faculty iterations, much of it as the sole Victorian university offering agricultural science. The recent incorporation of agriculture and related fields into the Faculty of Science offers the opportunity to pursue unrealised potential by building on the wider strengths of the applied and pure sciences in one entity. Examples include: zoology, animal and veterinary sciences; cell, plant and pathogen genetics; soils and nutrient/pollutants, and chemistry and physics; ecology and managed ecosystems; food science and chemistry. The alternative of seeking to strengthen all applied disciplines relevant to Victoria is no longer possible across the disciplinary diversity demanded by today's sector; the Faculty's 1990s co-funding with Agriculture Victoria, CSIRO, NAB and others that allowed such a coherent applied vision within the university is now more relevantly oriented towards coordination with the AgriBio and CSIRO facilities within the Agrifood precinct.

The University of Melbourne manages its image and entrance scores in a manner that has not generally favoured agricultural science, which suggests that its future agricultural offerings might benefit from strengthening key areas of applied and pure science to achieve international recognition based on local relevance. It cannot cover all aspects, and in delivering sound undergraduate agriculture degrees it needs to access the best teaching expertise, as does LaTrobe University, and this is best done by sharing the best resources. On the other hand, Masters, PhD and research offerings of each university would logically focus on their recognised areas of strength, which would suit the objectives of Agriculture Victoria and can be expected to attract other co-funding.

LaTrobe University began with agricultural science being its leading applied science school from 1968. At times it was seen as the superior undergraduate agricultural science course although it soon felt the shadow of The University of Melbourne's elite image.

These developments, together with LaTrobe's City of the Future development, are seen as the foundation for the Agriculture and Food precinct envisaged by both the Victorian Government and City of Melbourne to become a world-class R&D precinct that embraces other universities and logistics hubs.

1. Agriculture Victoria's co-location to the AgriBio facility (a $280M investment) in the Research & Innovation Precinct
2. The establishment of the La Trobe Institute for Agriculture & Food (LIAF; a $50M investment) with the move of Professor Tony Bacic's group from Melbourne to La Trobe to establish a central Institute — the La Trobe Institute for Sustainable Agriculture and Food
3. Sustainable Agriculture and Food being one of five key research themes
4. The co-location of CSIRO's Werribee food science capability to La Trobe's Research and Innovation Precinct in a new building to also house the Australian Food Innovation Centre (AFIC), a jointly led CSIRO/LaTrobe University initiative.

SECURING THE OPPORTUNITY

An umbrella facility that integrates the agricultural sciences across the major institutions has been suggested in the past. Circumstances now suit revisiting such an arrangement. Realistically, national funding arrangements make it difficult to integrate undergraduate courses beyond the sharing of leading teaching and learning resources including rural campuses. However, the major contributors to innovation in Australia are post-graduate degrees and research, both of which offer clear benefits from a coordinated focus under an umbrella facility. The example of QAAFI is a functioning example. In Victoria, with its concentrated and high-value sector, even greater benefits might be expected than those evident in Queensland. Potential benefits accrue to each of Agriculture Victoria, CSIRO, and the universities of Melbourne and LaTrobe. In addition, unaddressed needs in current provisions across all parties are now evident and can best be addressed by a coordinated plan — such needs include the fields of digital, bioengineering and enhanced biological science research, and from the viewpoint of major research funders, also include improved efficiency and impact from research investments.

Past attempts at such coordination have suffered from institutional rivalry and the absence of a coherent state plan. Now, the opportunity to enhance the efficiency of research and education in Victoria is real with a resourced state plan for an agriculture and food research precinct, the existence of the AgriBio facility, CSIRO's relocation of its food science research, organisational changes within The University of Melbourne and a renewed commitment to agricultural science at LaTrobe University.

A STEP FORWARD

Cross-institutional cooperation is easier to imagine than to effect and should be carefully planned. University funding mechanisms, entrenched attitudes, organisations' salary differentials and fears of loss are but some of the objections that are bound to be raised. Rather than pre-empt such matters, a period of higher-level objective investigation should be conducted to inform a conceptual plan that spans improved delivery impact and efficiency and addresses newly emerging needs.

UN SDGs
2, 3, 9, 15

AGRICULTURE INNOVATION

Events

From safeguarding Australia's unique marine biodiversity to science and policy lessons two decades on from the 2003 Canberra bushfires, our events have continued to set the STEM agenda.

NOVEMBER

On 3 November we celebrated the ICM Agrifood Award in a joint event between the ATSE Victoria Division and the Agriculture and Food Forum entitled *Challenges in the Agriculture and Food Sector*. Paul Wood AO FTSE led the discussion with past award winners Dr James Hunt (2017), Dr Angela Van de Wouw (2018) and Dr Lydia Ong (2019). This panel of emerging leaders deliberated on the climate change challenges facing their work and how it is affecting the agriculture and food production sector in Australia.

On 15 November, the last ATSE event of 2022 featured NSW Productivity Commissioner Peter Achterstraat AM as he presented his paper *Rebooting the Economy*. This event focused on how NSW can manage the health and economic impacts of the COVID-19 pandemic and recover from the impact of bushfires and floods.

FEBRUARY

On 17 February, Professor Emma Johnston AO FTSE FAA kicked off ATSE's 2023 events by reporting on the 6th National State of the Environment report. Professor Johnston discussed the report's key findings, the need to safeguard Australia's unique biodiversity and the role the STEM sector can play to help create a biodiversity-positive net-zero economy.

MARCH

On 2 March a Quantum Revolution event moderated by ATSE Victoria Division Chair Professor Sandra Kentish FTSE, showcased quantum experts Professor Elanor Huntington FTSE, Professor Lloyd C.L. Hollenberg FAA and Dr Marcus Doherty CSM about the many opportunities and challenges for the future of quantum technologies.

On 6 March, we celebrated International Women's Day with a panel of inspiring women from across ATSE's programs and network. ATSE President, Dr Katherine Woodthorpe AO FTSE FAICD moderated the panel and discussed the importance of diverse voices, particularly women's voices in innovation and technology for gender equity, and the role digital technologies play in closing the economic and social inequality gap.

In a joint event with The Queensland University of Technology on 29 March, Queensland Biofutures industry envoy Professor Ian O'Hara joined aviation experts in a panel to explore the progress, opportunities, and challenges in creating a sustainable aviation fuel industry in Queensland.

The panel discussed aviation in Queensland becoming a major regional hub for manufacturers and supply but believed there has been no progress in producing sustainable aviation fuels.

APRIL

On 13 April, Chair of the Stawell Underground Physics Laboratory Dr Sue Barrell AO FTSE and a panel of experts discussed research infrastructure as a catalyst for collaboration and innovation. They emphasised that sustained investment in the topical suite of research and knowledge infrastructure will attract, motivate, and enable effective collaboration across disciplines, institutions, academia, and industry.

On 19 April, in an event moderated by Dr Helen Cleugh FTSE, we heard from internationally recognised bushfire dynamics expert Professor Jason Sharples FTSE FAA on the lessons learnt from the 2003 Canberra Fires while the Chair of the ACT Multi-Hazard Advisory Council Dr Sally Troy discussed a council report on bushfire management over the last 20 years.

In response to an urgent national need for energy security, Australian governments have adopted the Australian Energy Market Operator (AEMO) Integrated System Plan 2022. Moderated by Professor Renate Egan FTSE on 20 April, speakers Dr Adi Paterson FTSE and Dr Peter Tyree AM FTSE presented the merits and concerns about the AEMO plan and discussed alternative pathways to support the energy transition using secure, high-quality, and low-cost electricity supply.

MAY

Biodiversity was also the central theme on 4 May 2023, in an event featuring Professor Richard Eckard FTSE and Bush Heritage Australia's Rebecca Spindler and Oliver Costello. Rebecca and Oliver shared their insights on Bush Heritage Australia's partnership with Traditional Owners on biodiversity conservation work and the application of right-way science.

At the end of May 2023, over 20 ATSE Fellows had the opportunity to engage with the local community in Darwin and Jabiru, gaining insights into the region's history, enterprise culture, and communities. The regional tour also explored the eastern Arnhem Land region, visiting Yirrkala, the Arnhem Space Centre, and witnessing Indigenous forestry and rehabilitation efforts at the Rio Tinto bauxite mine site.

JUNE

On 1 June 2023, Former Senator for Victoria and ATSE 2022 Honorary Fellow, Professor The Honourable Kim Carr FTSE FAHA spoke on the importance of ongoing communication with policymakers, building relationships and offering expertise to build public support for STEM in Australia.

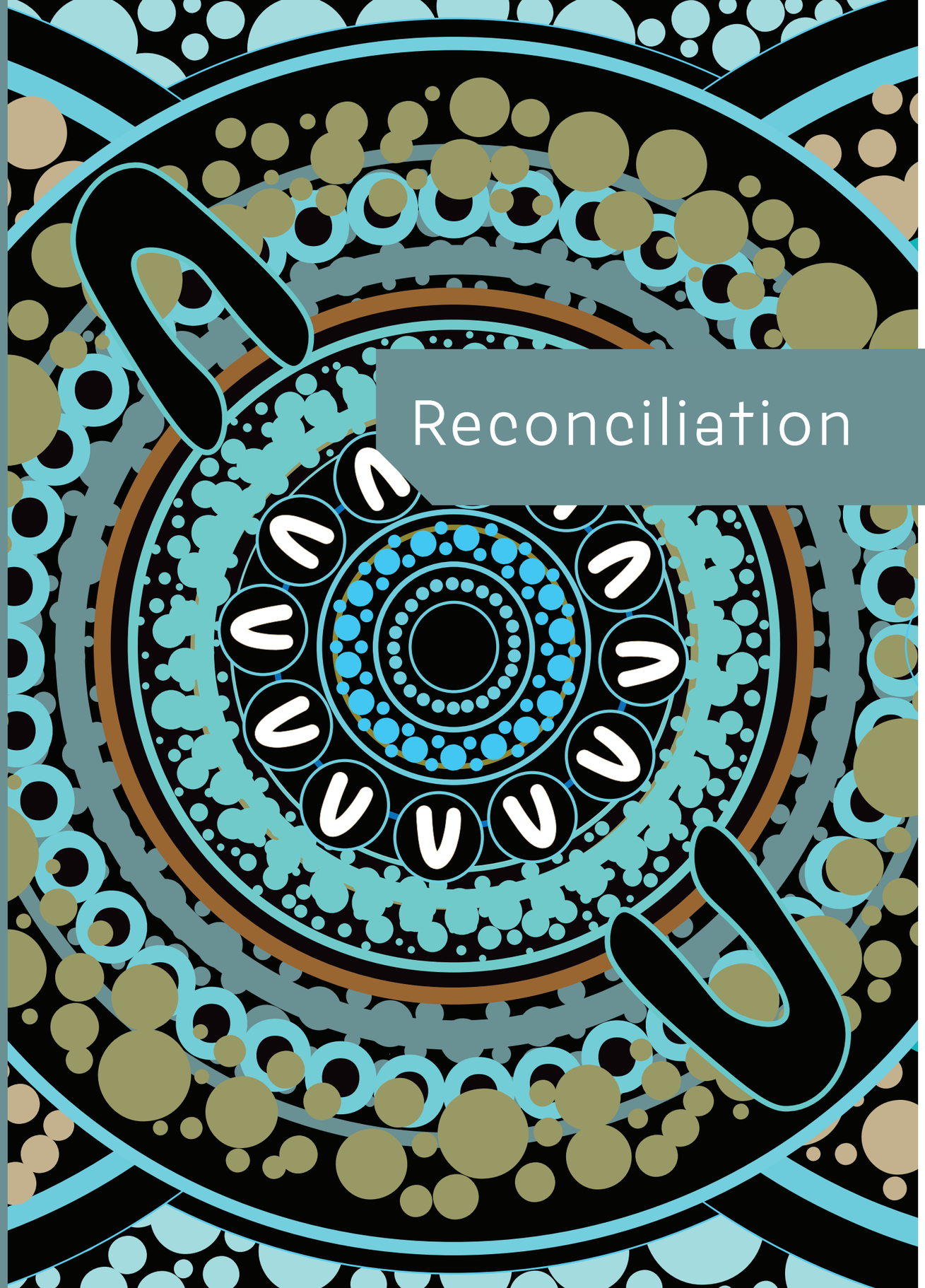
This presentation was followed by a panel discussion featuring CSIRO Chief Scientist Professor Bronwyn Fox FTSE and La Trobe University Professor Susan Dodds FAHA.

On 13 June, presented by the Agriculture & Food Forum 2022, new Fellows Dr Nicholas Austin FTSE and Dr Rajendra Paroda FTSE explored how science linkages between Australia and India can be enhanced, with particular attention to water management and sustainable farming methods. They also discussed mechanisms to strengthen collaboration on climate smart and productive agriculture.

Below: Fellows and supporting staff of the Engineering Academy of Japan visiting The Australian National University's School of Cybernetics with ATSE Fellow Distinguished Professor Genevieve Bell AO FTSE FAHA.

MORE

Events
All ATSE events are listed on our website atse.org.au/events



Reconciliation at ATSE

Image above right: On Friday 5 May ATSE hosted a launch event for the ATSE Reflect Reconciliation Action Plan.

Left: ATSE's Reconciliation Action Plan artwork title: 'Knowledge Systems and Holders'. Artist: Lynnice Letty Church. Tribes: Ngunnawal, Wiradjuri and Kamilaroi (ACT and surrounding region / NSW)

Below L>R: Maurice Walker, Aboriginal and Torres Strait Islander Elected Body (ATSIEB) and David Smith MP, Federal Member for Bean.

In Australia we are fortunate to live on the lands of the longest living culture on earth.

Indigenous Knowledge systems and traditions have existed for more than 65,000 thousand years — long before western science and technology.

This incredible experience has resulted in a deep knowledge, understanding, care and respect for the lands and waters of this country. This makes Aboriginal and Torres Strait Islander Peoples Australia's first scientists and technologists.

The sustainability and adaptability of Indigenous Knowledge systems are extraordinary, and science presents a tremendous opportunity for deep engagement and cooperation, particularly on issues that relate to our environment.

The Australian Academy of Technological Sciences and Engineering's vision for reconciliation is that all Australians recognise and value Aboriginal and Torres Strait Islander custodianship as one of the oldest knowledge systems on the planet.

Through respectfully working with, listening to and learning from current Traditional Knowledge holders and practitioners in science and engineering, we will build a better nation and a healthier, more sustainable world.

Our mission is to help all Australians understand and use technology to solve our greatest challenges. We can only truly do this through meaningful collaboration with Aboriginal and Torres Strait Islander communities.

At this time of environmental and climate crises, ATSE believes building awareness of and respect for Traditional Knowledge is a matter of urgency.

The need for varied voices and perspectives in our modern science, technology and engineering workforce is acute.

ATSE's Reflect Reconciliation Action Plan hopes to provide a platform for empowerment and inclusion of Aboriginal and Torres Strait Islander People and voices in scientific and technological advice and decision-making, and that this acts as a pathway to respectful, collaborative, and empowering application of Traditional Knowledge in the modern context.

atse.org.au/reconciliation

Wednesday 25 October
Thursday 26 October

National Portrait Gallery
King Edward Terrace
Parkes
ACT 2600

NEW FELLOWS

New Fellows Showcase

Hear from our new Fellows for 2023 as we welcome them to the Academy.

Elected by the Fellowship on the basis of excellence, accomplishment, and fit with a modern and future-facing Academy, our new Fellows for 2023 will participate in robust discussions about STEM in Australia.

REGISTER

atse.org.au/NewFellows23

Thursday 26 October

National Arboretum
Forest Drive
Molonglo Valley
ACT 2611

ATSE AWARDS

Gala Dinner

Our prestigious ATSE Awards recognise excellence in Australian STEM.

The 2023 ATSE Awards Gala Dinner will continue a legacy of bringing together Australia's brightest minds across STEM who are collaborating for a better Australia and world.

We are pleased to share that our Fellow and Governor-General of the Commonwealth of Australia His Excellency the Honourable David Hurley AC DSC (Retd) FTSE along with the Honourable Ed Husic, Minister for Industry and Science, will be joining us at the ATSE Awards 2023 Gala Dinner.

CLUNIES ROSS TECHNOLOGY INNOVATION AWARDS

BATTERHAM MEDAL FOR ENGINEERING EXCELLENCE

ICM AGRIFOOD AWARD

DAVID & VALERIE SOLOMON AWARD

EZIO RIZZARDO POLYMER SCHOLARSHIP

TRADITIONAL KNOWLEDGE INNOVATION AWARD

ATSE PRESIDENT'S MEDAL

REGISTER

atse.org.au/ATSEAwards23

Image: Unsplash

INFRASTRUCTURE

UN SDGs
9, 11, 12

Transforming the built environment

A registered civil engineer, researcher, project manager and senior leader in a career spanning 40 years, Professor Keith Hampson's inclusive and inspiring leadership has delivered 'real-world' solutions to the built environment industry with award-winning research collaborations that sit at the interface between research and industry.

He has led the transformation of the sector — one not traditionally known for a focus on research — into an industry that is more collaborative, coherent and technology-driven, and welcomes the value that researchers and academic leaders can deliver to boardrooms nationally.

The influential relationships with business, government, policymakers, researchers and educators that Professor Hampson has cultivated formed the basis for the continued investment in and research engagement with the Sustainable Built Environment National Research Centre (SBEnrc) by industry and research organisations alike over the last 13 years. This support followed the completion of CRC funding for the Centre's predecessor, the Cooperative Research Centre for Construction Innovation (CRCci). Indeed, the SBEnrc is one of only a few examples of a CRC transitioning into a successful, industry-supported business. It's an outstanding achievement that can guide the Australian Government's and CRC Committee's approach to research funding.

Professor Hampson has overseen research that has delivered major benefits nationally to the built environment, where Australians spend 90 per cent of their time.

How does research in the built environment translate into our everyday lives?

“The new knowledge and innovative processes applied to the built environment have increased industry skills, improved sustainability and productivity, reduced costs, increased safety and influenced industry policy and research processes,” Professor Hampson said.

“This has been achieved through our collaborative national and global research projects, and the delivery of best-practice models, policy contributions, published research, conference presentations and case studies.”

One particular highlight of Professor Hampson’s leadership in research collaboration is the project he masterminded for Australia’s most famous icon: the Sydney Opera House.

“The Sydney Opera House Facilities Management (FM) Exemplar Project in 2004 evolved into an integral component of the Australian Government’s FM Action Agenda in 2005,” Professor Hampson said.

“The research showed that data on the physical structure of a building (obtained through a retrospectively generated 3D digital model of the building and its relationship to objects such as lifts, ventilation and fire systems) can be integrated with FM functions like condition reporting, energy consumption, room bookings and occupancy to provide more effective ways to manage the building’s operations, maintenance and strategic functions.”

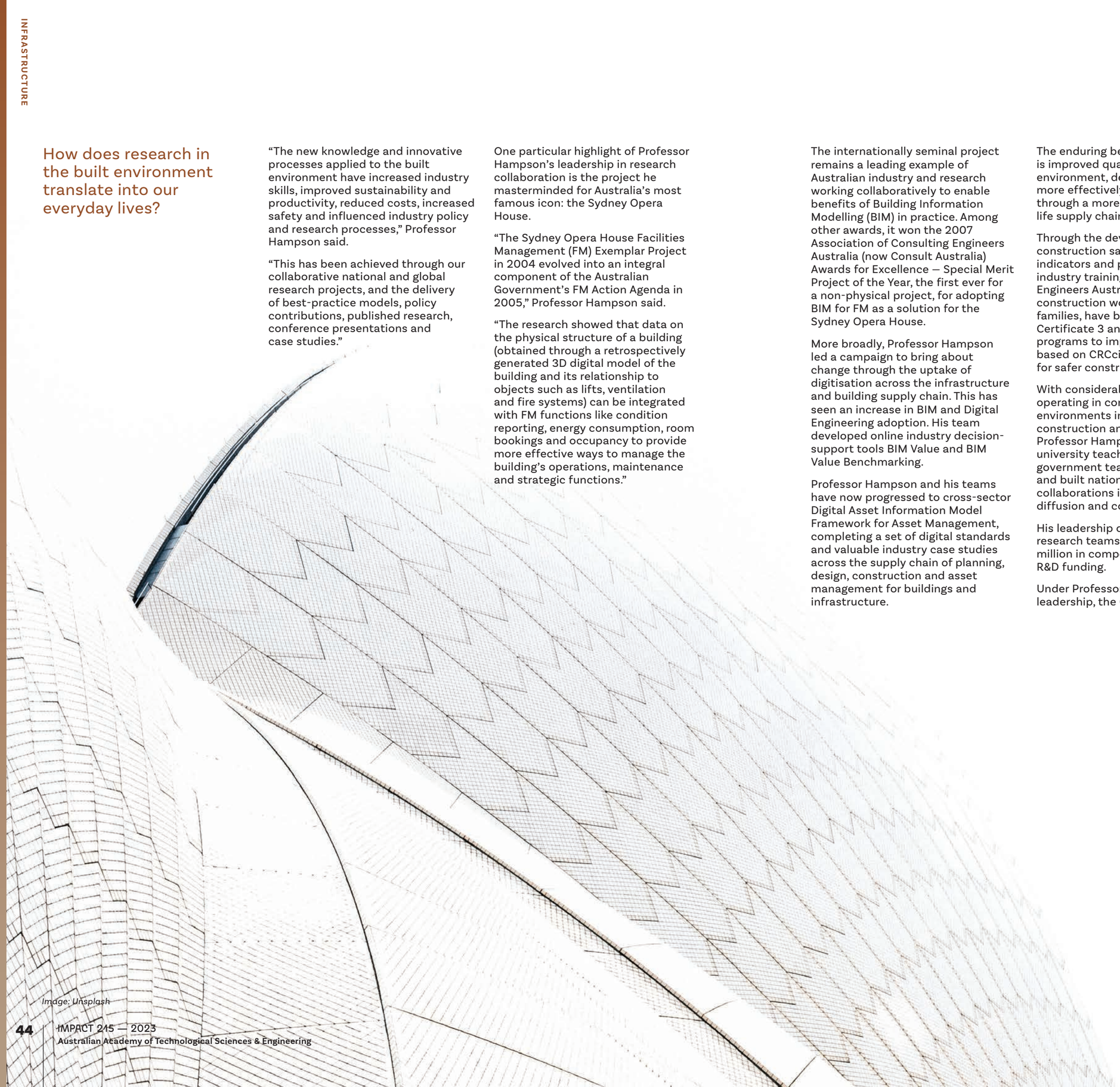


Image: Unsplash

The internationally seminal project remains a leading example of Australian industry and research working collaboratively to enable benefits of Building Information Modelling (BIM) in practice. Among other awards, it won the 2007 Association of Consulting Engineers Australia (now Consult Australia) Awards for Excellence — Special Merit Project of the Year, the first ever for a non-physical project, for adopting BIM for FM as a solution for the Sydney Opera House.

More broadly, Professor Hampson led a campaign to bring about change through the uptake of digitisation across the infrastructure and building supply chain. This has seen an increase in BIM and Digital Engineering adoption. His team developed online industry decision-support tools BIM Value and BIM Value Benchmarking.

Professor Hampson and his teams have now progressed to cross-sector Digital Asset Information Model Framework for Asset Management, completing a set of digital standards and valuable industry case studies across the supply chain of planning, design, construction and asset management for buildings and infrastructure.

The enduring benefit to community is improved quality of the built environment, delivered and managed more effectively and sustainably through a more productive whole-of-life supply chain.

Through the development of construction safety effectiveness indicators and partnering with industry training providers including Engineers Australia, 16,000 Australian construction workers, and their families, have benefited from Certificate 3 and Certificate 4 training programs to improve site safety, based on CRCci/SBEnrc best practice for safer construction research.

With considerable experience operating in complex multidisciplinary environments in planning, design, construction and maintenance, Professor Hampson has also managed university teaching, industry and government teams, and initiated, led and built national and international collaborations in research, technology diffusion and commercialisation.

His leadership of industry-focused research teams has secured A$70 million in competitive and industry R&D funding.

Under Professor Hampson’s leadership, the CRCci and SBEnrc have nurtured individuals to succeed in the built environment sector through their involvement in the Centre’s collaborative research projects, policy, practice, published research and conference presentations across the globe.

He is an advocate for gender equity in engineering and developing the career trajectory of young researchers.

As Immediate Past President of the CIB (International Council for Research and Innovation in Building and Construction), Professor Hampson has stimulated global leadership of Early Career Researchers by establishing and funding the CIB Early Career Researcher–Industry Award, in perpetuity.

“The purpose of the annual award is to promote new and innovative connections between young researchers and the built environment industry globally,” he said.

“The challenge in securing a capable and committed workforce for the future is fundamental — and encouraging our young researchers to work side by side with industrial partners is a vital part of that. I trust this will assist in delivering practical solutions for some of the world’s most challenging issues.”

Professor Keith Hampson FTSE

CEO and founder of the Sustainable Built Environment National Research Centre (SBEnrc), Professor Hampson was elevated to an Honorary Fellow of Engineers Australia in October 2022, in recognition of his achievements. The SBEnrc is the successor to the Commonwealth-supported Cooperative Research Centre for Construction Innovation (CRCci). The Centre is a collaboration in construction supply chain research. Professor Hampson was elected a Fellow of the Academy in 2018, for his award-winning collaborations translating research into practice in the construction industry.

Professor Hampson FTSE was interviewed by Margaret McNally.

Materials science solutions for global problems

Professor Darren Martin FTSE is a translational materials scientist and mentor based in the Department of Chemical Engineering at the University of Queensland (UQ). Elected to the Academy in 2020, Darren is globally recognised for his breakthroughs in polymer science and nanomaterials research and has successfully commercialised his research after protecting his ideas through a number of patents.

Professor Darren Martin FTSE is a translational materials scientist and mentor based in the Department of Chemical Engineering at the University of Queensland (UQ).

Professor Martin FTSE was interviewed by Ezreena Yahya.
Images: UQ

Darren discovered a love for materials science while studying at Lismore High School in northern NSW over 35 years ago.

"Originally, I wanted to be an industrial arts or a manual arts teacher, but when I was in Year 11, my Year Master at the time, Mr Squire, had very intuitively picked up on the fact I was naturally curious about materials. He told me about an excellent degree in materials science available at the University of Technology Sydney (UTS) and encouraged me to apply."

"I took his advice and, fast forward to 2020, I was awarded both the UTS Chancellor's Award [given to top UTS alumni annually] and the UTS Faculty of Science Award for Excellence. I guess Mr Squire was right and I have thanked him many times since!"

While Darren has won many awards for his work over the years, he has expressed that the 'real satisfaction' has come from mentoring the next generation of Australian academic entrepreneurs and the enjoyment associated with building functional, diverse teams.

"The ability to build teams surrounding the development of new and better materials sometimes feels like a superpower — it takes time, sometimes decades, but I believe you can truly enable solutions to many of our wicked societal problems with teams of materials scientists and engineers working together," said Darren.

Together with Stony Brook University's Distinguished Professor Benjamin Hsiao and CSIRO's Dr Stuart Gordon, Darren is currently working on the U.S. National Science Foundation (NSF) Convergence Accelerator-funded Nanomaterials from Upcycling and Renewable Technologies Used to Rejuvenate Earth (NURTURE) project. The 30-week NSF Convergence Accelerator program funds teams to solve societal challenges through the merging of innovative ideas, approaches and technologies across disciplines, expertise and organisations. In 2022, only two out of the 16 teams awarded featured Australian partners.

By converting organic waste like crop residues or manure to produce a myriad of sustainable, nature-based products including safe and cheap fertilisers, biogels and wetting agents, the project aims to deliver scalable, zero-waste processing platforms and advance food-water systems resilience.

Professor Darren Martin and Dr Hima Haridevan — NSF Project assessing conversion of cotton ginning. Waste cotton ginning crop residue is one of many feedstocks Darren and his team are currently assessing in the NSF Conversion Accelerator project (with CSIRO and Stony Brook University), and where Dr Hima Haridevan is working in his team as a Research Fellow.

"Materials science is such a powerful enabler for solving global problems such as climate change, the food and clean water crises."

Cotton ginning crop residue is one of many feedstocks Darren and his team are currently assessing in the NSF Conversion Accelerator project (with CSIRO and Stony Brook University), and where Hima is working in his team as a Research Fellow.

"But you can't solve these problems alone. To achieve successful outcomes and technological breakthroughs, you must be brave, find willing collaborators from diverse disciplines and perspectives who you have a good dynamic with and trust."

Darren is no stranger to collaborating with a wide and diverse group of partners and stakeholders. In a landmark partnership with the Dugalunji Aboriginal Corporation (DAC) in North West Queensland, Darren and his team at the Australian Institute for Bioengineering and Nanotechnology (AIBN) developed innovative medical gels from spinifex, a native grass found abundantly across northern Australia. Spinifex grass has unique resilient properties that can withstand extreme heat through the application of Traditional Indigenous Knowledge. As one of the technology's inventors, Darren worked with the Australian National Fabrication Facility (ANFF) to determine how to extract spinifex's cellulose microfibres — or incredibly small, biodegradable fibres — using a gentle, environmentally low-impact nanotechnology processing method.

UN SDGs
9, 17

"My takeaways from this 14-year journey have been two-fold. Firstly, these partnerships are hugely collaborative and can also be very high-tech. Associate Professor Colin Saltmere and his large team at DAC run a highly sophisticated outfit. Secondly, the key concepts embedded in Traditional Knowledge like custodianship of knowledge for Country, for people and for perpetuity can truly fit into a more sustainable commercialisation model of today. We all stand to learn a lot from this!"

The application of thousands of years of Indigenous Knowledge and spinifex harvesting practices has enabled the creation of employment opportunities for the local Aboriginal communities, new potential treatments for arthritis and osteoarthritis, as well as more efficient drug delivery to the body. This work has been widely recognised and a portion of royalties is allocated to a UQ Indigenous Education Fund prioritising remote Indigenous education in STEM and nanotechnology.

Visibility for the impact of engineering on advancing the United Nations Sustainable Development Goals.

The United Nations Sustainable Development Goals (UN SDGs) were agreed by all member states in September 2015 and provide an integrated approach to development with considerations of impacts on society, the environment and the economy.

The United Nations Science Technology and Innovation (STI) Forum is an annual meeting that brings together the science, engineering and technology community to address progress on the UN SDGs and how these can be accelerated.

Eight years on, progress has been slow and there is a sense of urgency to provide roadmaps and case studies of successful strategies and projects that have advanced the Goals.

The World Federation of Engineering Organisations (WFEO) — representing more than 100 national and continental professional engineering institutions — and the International Science Council (ISC) — representing more than 300 members comprising science academies, science unions and research institutions - are the leading international organisations in science and engineering. As Co-Chairs of the UN Major Group on Science and Technology, WFEO and ISC represent the voice of science, engineering and technology at the United Nations.

As past president of WFEO (2017-2019), I participated in four events over four days, highlighting the importance of engineering at the highest international levels.

The message is clear. For all the UN Sustainable Development Goals, engineering is key to delivering the solutions we need to shift the needle on the dial.

I presented a key example on the role of engineering in addressing the hole in the ozone layer following the Montreal Protocol to ban the use of CFCs, including as refrigerants.

The 2023 Global Sustainable Development Report mentions engineering only once, and interestingly in the context of the role of engineers and engineering in developing alternatives to hydrochlorofluorocarbons that were then used as refrigerants and were considered to be causing the hole in the ozone layer. Engineers developed alternatives and consequently, the hole is substantially expected to close by 2040.

We will achieve similar success with advancing the UN SDGs if we collectively understand and agree on the key role of engineers in developing and implementing solutions for sustainable development in every sphere of our lives. The world is depending on it.

Through the leadership of ATSE's International Strategy Group, the UN SDGs have been integrated into the Academy's policy priority areas, the work of our Forums, and in each of our events.

Engineers in Australia and across the globe are encouraged to continue to highlight their role as creative problem solvers helping the world to reach our shared goal of a sustainable future.

Dr Marlene Kanga
AO FTSE

Dr Marlene Kanga AO FTSE is a recognised leader of STEM organisations in Australia and internationally and is currently a nonexecutive director of Sydney Water Corporation, Air Services Australia, Standards Australia and BESydney and other boards involving innovation and the commercialisation of new technologies. She is the co-chair of ATSE's Elevate: Boosting Women in STEM Advisory Group.

Dr Marlene Kanga AO FTSE Chairs Session 2, Africa Day, UN STI Forum, UN HQ, New York. 2 May 2023

The urgency to address the progress on the UNSDGs resulted in important events led by WFEO and ISC. These included:

The first Science Technology and Innovation (STI) in Africa Day was held on 2 May 2023 with a focus on STI4SDGs: Priority Areas, Levers and Actionable Steps for Africa. Dr Marlene Kanga AO FTSE chaired a session that addressed the role of frontier technologies in the agricultural and food sector that can accelerate the SDGs in Africa and the need for digital infrastructure and capacity building, especially in rural and regional areas, to enable the use of these technologies.

The first side event co-hosted by WFEO and ISC was held on 3 May 2023, themed Science, Technology, Innovation, and Engineering Solutions for the SDGs: Theory, Practice and Application. This event focused on engineering solutions for sustainable development — groundwater engineering, sustainable infrastructure and nature-based solutions for green infrastructure. Dr Marlene Kanga AO FTSE delivered closing remarks. This is also expected to be an annual event and will be an important opportunity for engineers to provide visibility to their work in advancing the SDGs.

Engineering was also a focus at the first Global Solutions Summit (GSS) co-organised by WFEO, the United Nations Department of Economic and Social Affairs (DESA), the American Society of Civil Engineers (ASCE) and the Global Solutions Summit (organisation), held on 5 May 2023. The GSS2023 amplified the discussions held at the first STI in Africa Day and explored case studies on the successful implementation of various SDGs. Dr Marlene Kanga AO FTSE presented a keynote on the work being done by WFEO to address the quality of engineers through the review of the International Engineering Alliance Graduate Attributes and Professional Competencies benchmarks and capacity-building efforts for more engineers with the right skills in Africa. She also presented a case study on the implementation of sustainable water infrastructure in Greater Sydney along with a written policy brief, which presents an example of the successful implementation of sustainable water development in a large city.

UNESCO and WFEO collaborated on the launch of preliminary results of on gender and science in South Africa. UNESCO Regional Office for Southern Africa (UNESCO Office in Harare) and UNESCO International Institute for Higher Education (UNESCO IESALC) released the preliminary results of their survey on: "Uncovering gender disparities in STEM and higher education in Southern Africa: evidence from nine countries". The survey assessed women's representation in Higher Education Institutions (HEI) and science, technology, engineering and mathematics (STEM) and identified areas with gender imbalances. Dr Marlene Kanga AO FTSE spoke about the work of WFEO to address the need for more engineers with the right skills in Africa. She also presented the climate change education project that she is leading, which was successfully delivered in Mauritius in November 2022.

UN SDGs 9, 11, 17

The 17 United Nations Sustainable Development Goals are listed on page 70.

Showcasing Australian technological sciences and engineering to the world

In 2025, ATSE is delighted to be hosting the annual conference of the International Council of Academies of Engineering and Technological Sciences (CAETS) here in Australia. Hosting the CAETS conference is a once-in-20-year opportunity.

ATSE is a founding member of CAETS — an independent international organisation that aims to promote engineering and technological sciences, provide expert advice, and facilitate international cooperation in addressing global challenges. The CAETS network of 31 engineering and technological science academies worldwide convenes annually for an international conference, where Fellows of member academies gather to discuss pressing global issues, share research findings, and collaborate on joint initiatives.

"Global challenges like climate change need global solutions built on international cooperation. Applied scientists and engineers are critical to the collaborative approach that drives these innovations," said Kylie Walker, CEO of ATSE.

"It's an honour for ATSE to be hosting CAETS2025 and to bring this international conversation to Australia."

CAETS 2025 is an important opportunity to convene global STEM leaders from the CAETS network together with Australian government, and leaders in industry and academia for a future-focused conversation.

The discussion will be a chance to focus our combined efforts for priorities such as sustainable development, STEM education and climate change combatting technologies and approaches to clean energy and decarbonising key industries.

"For the first time in a decade the CAETS conference will be in the Asia-Pacific region where we can highlight local and regional approaches to tackling these challenges," said Dr Carrie Hillyard FTSE, Chair of ATSE's International Strategy Group.

ATSE will share further information about CAETS2025 in late 2023 including the dates, host city and conference theme.

CAETS
International Council of Academies of Engineering & Technological Sciences

CAETS 2015 was hosted by the Indian National Academy of Engineering. The 2020 conference hosted by the National Academy of Engineering Korea was held online only due to the travel restrictions during the COVID-19 pandemic. More about CAETS and its members is available at the CAETS website: newcaets.org

Dr Cath Latham

Dr Cath Latham is the Director of International Affairs at the Australian Academy of Technological Sciences and Engineering (ATSE). She moved into a career in policy and advocacy in the health and science sector after more than 15 years as a biomedical researcher. In her current role, her focus is on connecting Australia's STEM knowledge, capacity and expertise to the global STEM community.

In the realm of STEM careers, a vibrant and dynamic force of young professionals emerges, their minds ablaze with curiosity and innovation.

Armed with cutting-edge technology, they stand at the forefront of scientific exploration, ready to push boundaries and redefine what is possible. They are driven to solve the greatest challenges of our time, from curing diseases to addressing climate change. Guided by an insatiable thirst for knowledge and armed with the tools of the digital age, they are eager to pave the way for a future where science and technology reshape the world.

INTRODUCING THE EMERGING LEADERS NETWORK (ELN)

Recognising the immense potential of young professionals in STEM, the Australian Academy of Technological Sciences and Engineering (ATSE) is preparing to launch its new Emerging Leaders Network. In its inaugural year, the Network will draw upon ATSE's IMNIS Alumni and Elevate scholarship program cohorts as first participants.

The pilot year will serve as a launchpad, allowing for continuous refinement and improvement, creating an impactful and robust program.

This initiative aims to empower and support emerging leaders in making significant contributions to applied science, technology, and engineering. Through the Network, competitively selected emerging leaders will find a platform to connect, collaborate, and grow as they become immersed as official guests of ATSE's policy Forums.

CREATING CONNECTIONS

The Network offers the opportunity to build strong connections between emerging leaders and ATSE Fellows in a collaborative environment that will not only broaden their networks, but foster interdisciplinary discussions and enable participants to tackle complex challenges with fresh perspectives.

Participants will be invited to events and other opportunities to connect with ATSE Fellows; engage in policy Forums and consultations; and actively contribute their expertise and insights to offer a new perspective on ATSE's policy work, and thus to influence the national discourse.

Participants will also each receive a year's mentoring by an ATSE Fellow, to guide and nurture their development, provide support as they navigate their professional journeys, and grow unique connections to Australia's leading applied scientists, technologist and engineers.

This is an opportunity to develop leadership capacity and work alongside senior scholars and industry leaders to inform Australia's response to complex problems.

INCLUSIVE AND DIVERSE LEADERSHIP

The Network embraces inclusivity and diversity, acknowledging that true progress is achieved when all voices are heard and valued.

By championing both excellence and diverse leadership, the Network aims to drive innovation and advocate for policy changes that aim to solve complex challenges, build wellbeing and create opportunity for all Australians.

ATSE hopes and plans that the Emerging Leaders Network will stand as a powerful force, harnessing young STEM professionals' passion, innovation, and expertise. By creating connections with ATSE Fellows and Forums, this initiative will cultivate a community of forward-thinking young change-makers who can collaboratively help Australians understand and use technology to solve complex problems and shape a brighter future.

To find out more, contact STEMcareers@atse.org.au

Alejandra Fernandez

Written by ATSE Policy Analyst Alejandra Fernandez. She has recently submitted her thesis to obtain a PhD in DNA damage repair and genomic stability at the Queensland University of Technology.

Introducing the IMNIS Catalysts for 2023

IMNIS Catalyst is an ambassador program where IMNIS alumni represent the program and ATSE in the broader STEM ecosystem as they engage with schools, industry, and academia.

The IMNIS Catalyst program has been designed to support our emerging IMNIS leaders to gain experience in communication, one of the top three executive skills in demand today, and enable opportunities to apply these skills in the broader STEM ecosystem. The program runs on a calendar year, and applications open in February of each year.

In 2023, 20 IMNIS Catalysts will be provided with tailored opportunities for professional development designed to:

- Hone their STEM communication and media skills
- Build a public profile
- Communicate with influence
- Develop their leadership voice.

IMNIS Catalyst

REDI DEVELOPING AUSTRALIA'S MTP SECTOR WORKFORCE
Powered by MTPConnect

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

Eslam Ahmed

Eslam is a third-year PhD candidate at the School of Medicine, Deakin University, specialising in neuroscience. His research focuses on investigating the impact of asthma on mental health by utilising preclinical models and human epidemiology data to understand underlying mechanisms in the brain. By identifying and studying these new biological targets, Eslam aims to enhance our understanding of the interaction between the lungs and the brain, improve outcomes for individuals with mental illness, and develop alternative therapeutic approaches. In addition to his research, Eslam has a keen interest in teaching. He currently serves as a casual academic tutor, instructing second-year medical students in anatomy. He also actively contributes to his clinical experience by volunteering as a research assistant in the Brain and Mind Group at the Royal Children's Hospital.

Dr Nimal Kumar Balasubramani

Nimal Balasubramani is an aerospace engineer specialising in advanced composite structures for chemical transportation in the logistics and space sector at Omni Tanker Pty Ltd. He has a PhD in Aerospace Engineering from UNSW Sydney, where he focused on creating innovative tools to predict damage in composite structures as part of a collaborative project with Boeing Aerostructures Australia. Prior to pursuing his PhD in Australia, Nimal obtained a Master's degree in Aerospace Technologies from The University of Nottingham, UK. He also gained practical industry experience designing composite tanks and electro-mechanical product systems.

Dr Sangita Bista

Sangita is an experienced energy professional and academic with expertise in energy management, energy planning, distributed energy resources, energy life cycle assessment (LCA), resource optimisation, and electrical engineering. She has worked with various sectors including government, non-governmental organisations (NGOs), tertiary education, and private industries. As a conscientious team member, she collaborates harmoniously with her peers to consistently deliver high-quality results. She is self-motivated and values a can do attitude. Sangita is always willing to provide coaching and support to others in their career development.

Pia Campagna

Pia Campagna, a final year PhD student at Monash University's Central Clinical School, specialises the genomics of treatment response and pregnancy in multiple sclerosis. Throughout her PhD, Pia has made significant achievements, including the publication of six papers, securing a $25,000 MS Research Australia Incubator Grant in 2021, and receiving four conference awards for her presentations. She has also demonstrated her leadership skills through various committee roles, such as Co-Chair of the Monash CCS Graduate Research Student Committee, Secretary and Student Liaison Manager of the Students of Brain Research, Secretary of the Australian Computational Biology and Bioinformatics Student Society, and member of the COMBINE Symposium committee. Pia is committed to realising her potential as a scientist in Australia and has participated in mentoring programs such as the L'Oreal For Women in Science Program, IMNIS REDI program, and Startmate Student Fellowship.

Adaeze Ekwe

Adaeze is a research scientist specialising in microbiology and immunology. Her expertise lies in the development of gene-modified cell therapies following good manufacturing practice (GMP) standards. She is currently pursuing her PhD candidacy at Queensland University of Technology (QUT) and QIMR Berghofer Medical Research Institute, focusing on the development of gene-modified cell therapy for graft-versus-host disease (GVHD). Throughout her research, Adaeze has acquired valuable skills and knowledge in both research methodologies and the regulatory aspects of GMP, enabling her to navigate the process of translating therapeutics from the laboratory to clinical applications. Additionally, she has a strong commitment to community engagement and actively communicates scientific concepts to the public as a science ambassador at QIMR Berghofer Medical Research Institute in Australia.

Daniel Gan (Zheng Gan)

Daniel is a final-year PhD student at the Faculty of Medicine and Health, UNSW. His doctoral research aims to promote greater engagement with e-health technologies by partnering with end-users to design, implement, and evaluate innovative user-centred strategies. Daniel was one of ten mentees selected to participate in the inaugural IMNIS Clinical program which ran from 2021-2022. He found the experience to be extremely rewarding because of the many valuable insights gained from his mentor. These insights provided him with a greater awareness of how to thrive as a research professional in a non-academic context. As a beneficiary of the IMNIS mentoring program, Daniel hopes to pay it forward through sharing his knowledge and experiences in the IMNIS Catalyst program.

Qiang (Dan) Gao

Qiang (Dan) is a research fellow and PhD candidate at the University of Adelaide, Australia, in the School of Electrical and Mechanical Engineering. He holds a Masters of Science in Electrical and Electronic Engineering from the University of Melbourne. Qiang's research focuses on addressing the practical engineering challenges involved in the development and implementation of ocean renewable energy technologies, specifically offshore wind and ocean wave energy harnessing. His impressive track record includes publications in esteemed professional journals and conferences, highlighting his expertise in this field. Qiang has taken a leading role and contributed to numerous research projects related to clean energy technologies and the design of large-scale energy storage systems. He has collaborated with industry partners and research institutes such as CSIRO, as well as universities both in Australia and overseas.

Dr Lukas Gerstweiler

Lukas Gerstweiler is a lecturer in the School of Chemical Engineering, The University of Adelaide. His research focuses on the improving the production of therapeutic and food proteins applying model based process development and digital twins.

Dr Amol Ghodke

Amol, a PhD graduate from the University of Melbourne, specialises in aphid research with a focus on transcriptomics, molecular evolution, and pest control. He has presented his work at international conferences, securing travel scholarships, and has gained valuable industry experience as a scientist at CESAR Pty Ltd. Currently serving as a CERC postdoctoral fellow at CSIRO in Brisbane, Amol actively collaborates with international institutes and industries. Additionally, his dedication to education is evident through his participation in the Gene Technology Access Center's mentorship program, where he has spent four years educating students from year 5 to year 12 about biology and science. Amol has a strong track record in impactful agricultural research and collaborative publications, presentations, and engagement with researchers, individuals, and students.

Emma Kuhn

Emma is an ambitious PhD candidate who is dedicated to raising awareness about third-hand exposure to methamphetamine contamination and the potential risks faced by unsuspecting residents moving into contaminated properties. She is a passionate advocate and lecturer in environmental health, an area of public health focused on understanding and preventing environmental factors that impact human well-being. Emma thoroughly enjoys teaching undergraduate and postgraduate students, helping them explore their own interests in environmental health. She particularly enjoys the challenge of integrating new technologies and applications to enhance online and in-person learning experiences. Emma's educational background includes a Bachelor of Science in Microbiology, an Honours degree in Environmental Health, and a Graduate Diploma in Environmental Health Practice from Flinders University in South Australia.

Dr Eugene Madzokere

Eugene is a skilled microbiologist (virologist) who recently graduated from Griffith University. As an early career research scientist, he brings enthusiasm and innovation to his work. Having completed his IMNIS Ignite internship at SpeeDx, a leading molecular diagnostics company headquartered in Sydney with additional units in London and Texas, Eugene collaborated with the Innovation Team to develop and enhance fast, highly sensitive, and specific molecular diagnostic assays and robust technologies for various sexually transmitted infections (STIs), including those resistant to existing treatments. His primary objective as a member of SpeeDx was to contribute to the improvement of point-of-care STI diagnostics and enhance patient outcomes.

Dr Sam Harvey

Sam is a speech pathologist and post-doctoral research fellow at the Queensland Aphasia Research Centre, University of Queensland. His research focuses on enhancing rehabilitation outcomes for individuals recovering from brain injuries, inspired by his work with people experiencing acquired communication difficulties and their families. Sam's specific interests lie in optimising treatment effectiveness, predicting language recovery after strokes, understanding the neurological foundations of language, and implementing research findings to enhance clinical services. Alongside his research, Sam actively engages in advocacy and community support initiatives for individuals living with aphasia. He has served as a committee member for a consumer advisory group for individuals with aphasia in Victoria and is involved in co-facilitating a community aphasia group.

Dr Alina Lim

Alina, with her recently completed PhD, is a passionate scientist with a strong affinity for science communication and proficiency in word document formatting. She has immersed herself in the world of publishing and is currently focused on creating print and digital educational materials to aid secondary students across the country in navigating their science curriculum.

Deepak Surendhra Mallya

Deepak, in the final year of his PhD, is focusing on the development of advanced nanomaterials for water treatment, aiming to address critical environmental cleanup and water reclamation challenges. He actively contributes as a Study Geelong Ambassador, spearheading projects and workshops to support international students in Geelong's tertiary education sector by enhancing their skills. At Deakin University, Deepak teaches and designs courses in water engineering, air pollution and control, and global environmental systems. His PhD journey has fostered his leadership, professional development, engagement and impact, and effective communication skills. Deepak is driven to cultivate the next generation of leaders and inspire young students to explore STEM education, empowering them to tackle community-wide issues.

Christopher Mesiku

Chris is a Research Fellow in the ANU School of Cybernetics. He is applying a cybernetic theory of change to develop a suite of tools aimed at assisting stakeholders in designing data projects that effectively address disadvantage in Australia. Throughout his career, Chris has demonstrated a deep passion for optimisation and a commitment to acquiring and translating knowledge into tangible outcomes for positive societal transformation. His diverse professional journey includes research positions in physics, astronomy, and machine learning, alongside roles as a web and app developer, data analyst, and storyteller for esteemed organisations such as CSIRO, Queensland Government, and IBM Research Australia. Currently finalising his doctoral thesis at the University of Queensland, Chris integrates his interdisciplinary expertise in philosophy, physics, and AI to investigate and assess the validity of AI-generated information, among other topics of exploration.

Sinead Reading

Sinead holds a Biochemistry Bachelor's degree from the University of York (England) and brings a wealth of scientific experience to her work. She completed an honours year at GlaxoSmithKline, focusing on epigenetics, and pursued a PhD in Cancer Immunotherapy. At the prestigious Peter MacCallum Cancer Centre, Sinead's research revolves around gaining deeper insights into the negative regulatory pathways that limit immune responses to cancer, with the ultimate goal of enhancing existing treatment options. Apart from her research, Sinead is deeply passionate about science communication and strives to inspire the next generation of young scientists. She has chaired sessions at the Petermac Student Symposium, engaged in discussions about Women in STEM on a rural radio station, and currently serves as a scientist mentor, conducting scientific workshops for high school students at the Gene Technology Access Centre.

Dr Pramod Subedi

Pramod obtained his master's degree in Biotechnology and Bioinformatics in 2016 and completed his PhD in Biochemistry and Genetics in 2020 at La Trobe University. During his doctoral studies, he focused on investigating virulence pathways in antibiotic-resistant pathogens, *Salmonella enterica* and *Escherichia coli*, using a combination of biochemical and structural biology techniques. After completing his PhD, Pramod continued his postdoctoral research in the Heras laboratory, exploring the role of redox-active enzymes in bacterial fitness, pathogenicity, and antibiotic resistance. In 2021, he joined the Maher laboratory at the Bio21 Molecular Science and Biotechnology Institute, University of Melbourne, to investigate bacterial metal transporters and integral membrane proteins. He has also participated as an IMNIS mentee in the 2017 IMNIS MedTech-Pharma Program in Victoria.

Lydia Qian

Lydia, a third-year PhD student at the University of New South Wales, holds a Bachelor's degree in Advanced Science (Honours). Her research focuses on unraveling the mechanisms behind cellular production and regulation of cholesterol, with the ultimate goal of developing effective cholesterol-lowering medications. In 2021, Lydia completed IMNIS Engage, an enriching experience that allowed her to connect and learn from numerous professionals in the STEM field. Alongside her studies, she tutors biology to school and undergraduate students, aiming to inspire their passion and foster an appreciation for life at both the micro and macro scales. Lydia firmly believes that a strong understanding of STEM disciplines will drive technological advancements across various sectors, ultimately improving society's quality of life.

Nanditha Sirigiri

Nanditha possesses a breadth of experience in conducting technical due diligence across computational, experimental, and ML/AI modeling in battery materials and energy storage systems. Her research expertise lies at the crossroads of computational-experimental science, machine learning, and AI, with a focus on material design to advance the development and implementation of innovative battery energy storage systems for efficient energy storage from reliable renewable sources like solar and wind farms. With a strong drive to contribute to businesses dedicated to enhancing renewable energy technologies, Nanditha is keen on collaborating with clients and expanding their ventures in the realm of renewable and green technologies.

Dr Niveditha Vathsangam

Niveditha, an experienced immunologist, is currently serving as the Associate Director (Immunology) at 360biolabs. She focuses on assessing the immunogenicity and pharmacokinetics of pharmaceuticals during Phase 1 clinical trials. With over 10 years experience in product development, she has been involved in various stages, from concept to commercialisation. Niveditha's expertise spans a wide range of products, including biologics and medical devices, and she has gained valuable project management skills. Niveditha also has a passion for mentoring and sharing her knowledge with the next generation of industry leaders to foster positive advancements in the field.

Prototyping, projects, and potential

STELR kits in school classrooms

Above: Caitlin Vine, Head of Department, Science at Viewbank College with the STELR Wind Energy kit. Right: Veena Nair, STEM teacher at Viewbank College.

Veena Nair
Veena has a passion for discovering innovative ways of making STEAM more engaging. Her work has increased the number of students who receive first round offers to study engineering and technology subjects at university, especially young females and students from diverse backgrounds.

As a Prime Minister's Prize winning educator in STEAM, Veena Nair has more than 20 years' experience teaching science-based subjects across three different countries — India, the United Arab Emirates and now Australia.

Veena has a passion for discovering innovative ways of making STEAM more engaging. Her work has increased the number of students who receive first round offers to study engineering and technology subjects at university, especially young women and students from diverse backgrounds.

ATSE asked her to reflect on over a decade of using STELR kits in the classroom.

HOW DID YOU FIRST FIND STELR KITS?

I first got an email about the STELR kits in 2011 and I thought they were a really good resource because it touched on different aspects, and it was all bundled together as a kit. The school I was working with at the time was a very new school, so we were looking at resources to incorporate into our science curriculum.

HOW DO YOU USE STELR KITS IN YOUR CLASSROOM?

I have used them in a couple of ways. I started using the kits as a part of my science curriculum, especially for electricity and renewable energy with senior students. I really liked that the high-speed fans are added on to the wind turbine kit because it gives a very effective spin.

I've also used them in younger year level projects. One of my students was trying to make a wind turbine, and he used the STELR kits as a prototyping tool for his project. There is a whole subject called environmental science in the Victorian curriculum, and this kind of work kit is easily adaptable for that. I have also used it in my Year 12 Systems Engineering class.

I think the incorporation of solar panels and the wind turbine are still relevant today — these kits have great longevity in the classroom!

HOW CAN THE STELR KITS SUPPORT AND ENCOURAGE INQUIRY-BASED LEARNING?

The STELR kits incorporate inquiry-based learning so effortlessly into any curriculum. There are options for testing sizes, lengths and angles of blades. All of those choices for experimentation are so important for developing a science inquiry mindset.

To develop an inquiry, students need to come up with a question themselves. When I explain the STELR kit to them and let them have a play with it, then the questions automatically start forming. What if? What if I use five blades instead of three blades? What if I use this angle instead of that angle? What if I use a longer blade or a shorter blade?

And that is the most difficult part of inquiry learning — the formulation of this question, and that becomes very easy with these kits.

STELR kits don't require teachers to have a great deal of understanding about circuits. There can be a little bit of an apprehension about how they work or what to do if something goes wrong. What I have found is that these kits are pretty robust, they can withstand a lot of handling from the students, and they can be incorporated in every year level in some shape or form.

It's not just that you buy the kits and only one year level can use them — it's something that can be spread across many year levels.

DID YOU SEE A DIFFERENCE IN STUDENT ENGAGEMENT AFTER YOU INCORPORATED THE STELR KITS?

Yes absolutely! Because the kits open up so much discussion with the students - including potential energy to kinetic energy conversion. It makes students more active participants who want to experiment.

It is not that the teacher sets experiments; it's a natural curiosity that takes them. It leads students to natural curiosity, which is amazing.

DO YOU HAVE A FAVOURITE KIT?

I have used the wind turbine more than any other! It's a moving thing, I like to see the permutation combination and the fact that you can create a buzzing sound or a light to switch on. With the solar kit, a lot of students are aware of solar panels now because they have them on their roofs. But wind turbines are not so easily seen or experienced — that is why that is my favourite one.

Throughout 2023, 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. Veena Sahajwalla


2. Buddhima Indraratna


3. Kadambot Siddique


4. Marlene Kanga


5. Rob Fitzpatrick


6. Alex Zelinksy


7. Richard Sheldrake


8. Sue MacLeman

1. Veena Sahajwalla
Professor Veena Sahajwalla FTSE FAA has received an Industry Laureate Fellowship to develop approaches that can be implemented locally anywhere in Australia, for using waste as a resource, recovering metal alloys, rare earth elements, generating jobs, skills and new business opportunities.

2. Buddhima Indraratna
Professor Buddhima Indraratna FTSE was honored with the Life Membership of the Australian Geomechanics Society for outstanding contributions to geotechnical engineering over three decades.

3. Kadambot Siddique
Professor Kadambot Siddique FTSE has been appointed as the Cuiying Chair Professor of Lanzhou University.

4. Marlene Kanga
Dr Marlene Kanga AO FTSE was invited to deliver a keynote address and moderate a session at the UN Headquarters in New York at the UN Science Technology and Innovation Forum.

5. Rob Fitzpatrick
Professor Rob Fitzpatrick FTSE was awarded the Pons Medal for outstanding contribution to acid sulfate soil science and practice by the International Union of Soil Sciences (IUSS) Acid Sulfate Soils Working Group during the 9th International Acid Sulfate Soils Conference in Adelaide, South Australia, 26–31 March 2023.

6. Alex Zelinsky, 7. Richard Sheldrake, 8. Sue MacLeman
Professor Alex Zelinsky AO FTSE, Dr Richard Sheldrake AM FTSE and Sue MacLeman FTSE have been named as members of the NSW Innovation and Productivity Council.

January honours

The Australian Academy of Technological Sciences and Engineering was proud to announce that Emeritus Professor Alexander McLean AO FTSE has received an honour for his contributions to the advancement of road safety.

ATSE President, Dr Katherine Woodthorpe AO FTSE said, "I would like to extend my warmest congratulations to Professor McLean who has been recognised in today's Honours. This is a testament to the significant and inspiring work being done by our Fellows across the fields of science, technology, and engineering."

"His contributions have had profound impacts within Australia and globally, and we are incredibly proud of his achievements."

Professor Alexander (Jack) McLean AO FTSE is a renowned road safety researcher who has made significant contributions to the understanding of the causes and prevention of motor vehicle accidents.

He has been instrumental in changing attitudes towards drink driving and played a key role in the enforcement of random breath testing. Additionally, his research has been pivotal in lowering urban speed limits to 50km/h, which has helped in reducing the national road toll from accidents.

Throughout his career, Professor McLean has dedicated himself to improving road safety and reducing the number of accidents on our roads, making a significant, meaningful impact on the community.

Officer (AO) In the General Division of the Order of Australia

Emeritus Professor Alexander (Jack) John McLean
AO FTSE

For distinguished service to road safety research, particularly to the causes and prevention of motor vehicle accidents.

King's birthday honours

Nine Australian Academy of Technological Sciences and Engineering (ATSE) Fellows have been named in the King's Birthday 2023 Honours List.

Our Fellows were among a range of recipients of the General Division of the Order of Australia awards in recognition for 'distinguished and conspicuous service' to Australian society.

ATSE Fellow Distinguished Professor Kingsley Dixon was named as a Companion of the Order of Australia (the highest honour), and Fellow Professor Fiona Stapleton as an Officer of the Order.

ATSE CEO, Kylie Walker, said, "I am thrilled to see the names of many brilliant applied scientists, technologists, engineers and educators in this, the first year of the King's Birthday Honours list. I congratulate our Fellows on their well-deserved recognition."

"In particular, I would like to extend my special congratulations to our South Australian and Northern Territory Division Membership Coordinator, Professor Peter Langridge; our Mineral Resources Forum Chair, John McGagh; and our Education Forum Deputy Chair, Professor Robyn Owens, for their contributions to the ATSE Fellowship."

"On behalf of ATSE's Fellows, who count over 900 of Australia's leading engineers and applied scientists, we congratulate you on your remarkable achievements."

Companion (AC) in the General Division of the Order of Australia

Distinguished Professor Kingsley Dixon
AC FTSE
Ecology researcher and restorer

For distinguished service to conservation biology, particularly ecological research and restoration, and to tertiary education.

Officer (AO) in the General Division of the Order of Australia

Scientia Professor Fiona Stapleton
AO FTSE
Optometry science & research leader

For distinguished service to optometry as a researcher, mentor and role model, to tertiary education, and to national and international organisations.

Member (AM) in the General Division of the Order of Australia

Professor Maria Forsyth
AM FTSE FAA
Electrochemical materials scientist

For significant service to chemistry education, research and scholarship.

Emeritus Professor Peter Langridge
AM FTSE FAA
Plant genomics pioneer

For significant service to science in the field of plant genomics and agriculture.

Dr Anna Lavelle
AM FTSE
Science & innovation champion

For significant service to science and innovation through a range of roles.

John McGagh
AM FTSE
Mineral resources engineer

For significant service to the mining sector as a chemical engineer.

Emeritus Professor Robyn Owens
AM FTSE FAA
Computer imaging scientist

For significant service to science in the fields of computer vision and mathematics.

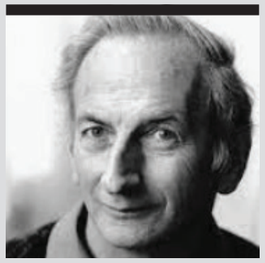
Dr Alison Todd
AM FTSE
Biotechnology inventor

For significant service to medical research and to tertiary education.

Christoper Vonwiller
AM FTSE
Science & technology innovator

For significant service to science and technology development.

VALE



Percy Rollo Brett OBE FTSE

Percy Brett was elected as a Fellow of the Academy in 1975 for his contributions to telecommunications research and development. He was a member of the ATSE Council from 1975 to 1979 and an active member of the ATSE Fellowship.

Percy led the metric conversion change for the Postmaster-General's telecommunications and postal departments. This change had effects department-wide, particularly on package sizes and pricing models.

He was appointed Head of Planning for Telecom Australia in July 1975 when the departments were split and Australia Post was created. During this time, he was appointed a member of the task force established to explore the possibility of developing Australia's first domestic satellite. Percy was later appointed the Victoria State Manager for Telecom Australia from 1980 to 1983.

Percy Brett retired after 44 years with Telecom Australia and was appointed an Officer of the Order of the British Empire (OBE) in recognition of his service as a public servant.

Percy died peacefully on 10 August 2022 and is greatly missed by colleagues, friends, and especially by his loving family; wife of 60 years, Beryl; and children Judith, Ian and Helen.

With thanks to the Journal of Telecommunications and the Digital Economy Obituary, which was compiled with contributions from Dr Brett's daughter, Emeritus Professor Judith Brett, and former PMG/Telecom/Telstra engineers David Smyth, John Costa, John Lewis and Peter Gerrand.

Professor John Lovering AO FAA FTSE

Professor John Lovering was elected as a Fellow of the Academy in 1993 for his achievements as a geologist. He was a valued member of ATSE's Climate Change and Water Forums.

Professor Lovering became a Senior Fellow in Geophysics and Geochemistry at the ANU between 1964 and 1969. During this period, his distinguished career began with notable areas of study in meteorites, moon rock composition and Antarctic research. Today, ANU offers the 'John and Kerry Lovering Scholarship' to Research School of Earth Sciences (RSES) students to support a domestic student undertaking a Master of Earth Sciences (Advanced) program.

Professor Lovering was one of the first to analyse moon rock samples from Apollo 11. He was quoted as joking that he was disappointed that they were not dissimilar to basalt samples on Earth's surface.

Professor Lovering was the loving husband of Kerry for 68 years, the loving father of Erin, Matthew and Adam and their partners David, Liz and Megan, and the loving granddad of Alex, Eleanor and Amy. He will be missed by all who knew him.

With thanks to the ABC Australian scientific superstars No.2 interview, Robyn Williams with John Lovering.

Else Shepherd AM FTSE FAICD

Else Sheppard was elected as a Fellow of the Academy in 2000 for her contributions to industry-focused engineering research and development. She was a member of ATSE's Membership Committee and Queensland Division.

In the same year, she was named the Queensland Professional Engineer of the Year by the Institution of Engineers Australia — although she could not attend their meetings at the time as they were held in the local men's club. She was a trailblazer and a life-long advocate of making space for women in STEM. She was appointed Chairman of Powerlink Queensland in 1994 with excellent leadership and oversaw the employment of many new technologies.

Else Sheppard contributed to breaking through barriers to women's professional acceptance and pursued a career in engineering after being inspired by the launch of Sputnik in 1957.

She was a Fellow of the Australian Institute of Company Directors (AICD), the Executive Director of Mosaic Information Technology Pty Ltd and Microwave and Materials Designs Pty Ltd. She contributed significantly to technical education, teaching at TAFE and several universities and working on university boards.

In 2020, one of the cross-river rail's twin tunnel-boring machines was named after Shepherd.

Else Sheppard was also named one of the 2022 Queensland greats for her contributions to the state, especially through the development of community music opportunities.

Else Sheppard was a valued member of the Academy, a pioneer in diversifying the engineering sector and an inquisitive soul. She will be missed greatly by all who knew her.

Else Sheppard passed away peacefully on 20th February 2023, aged 79 years, surrounded by family.

Distinguished Professor Adrian Mouritz FTSE

Professor Adrian Mouritz was elected as a Fellow of the Academy in 2019 for his contributions to materials engineering, specifically in advanced fire composites and fire-safe design. He was a member of the Victoria Division.

Professor Mouritz was a leader in composite material science, with his research mainly used in the context of engineering aircraft materials.

Professor Mouritz was the inaugural Dean of the School of Engineering at RMIT. He significantly improved research performance during his tenure and built more robust connections between the department and external industry bodies. Adrian had previously held positions at RMIT as the Director for Aerospace and Aviation.

Professor Mouritz passed away after a long illness. He is survived by his children Lauren and Christian; his siblings Aileen, Susan, Greg, Peter, David, and Stephen. He was a part of the ATSE family for a short period, during which our Fellowship gained a valuable mind and an inspiring member. His presence will be greatly missed.

Dr John Gilmour Nutt AM FTSE

Dr John Gilmour Nutt was elected as a Fellow of the Academy in 1997 for his contributions to civil engineering. He was a member of the New South Wales Division and a valued member of the ATSE family through his active participation in the Industry and Innovation Forum as well as the Education Forum.

Dr Nutt helped lead an international consulting engineering firm as Executive Chairman of Ove Arup and Partners for 30 years, where he established the Australian practice.

Dr Nutt helped pioneer the use of computers in engineering practice through the design of the Sydney Opera House roof in London and returned to Australia for the construction.

Dr Nutt specialised in the design and analysis of high-rise buildings, and his firm completed many tall buildings in Australia, including National Australia Bank Melbourne, Westpac Plaza, Governor Philip Tower and Governor Macquarie Tower, Sydney.

In 1992, Arup Australia won the American Institute of Architects Honor Award for the engineering of the Sydney Opera House. Dr Nutt was also awarded the Clunies Ross Award for Lifetime Achievement in 2014 forhis ongoing contribution to the engineering profession and commitment to the advancement of the industry.

Dr Nutt passed away surrounded by family on 23 April, 2023, survived by children, their partners, and grandchildren and their partners.

The Honourable John Kerin AO FTSE

The Hon. John Kerin was elected as a Fellow of the Academy in 2001 for his contributions to public policy formulation, resource management, development, and trade. He was a member of the ACT Division and an active member of the Agriculture and Food Forum.

John Kerin briefly served as the Treasurer in 1991 but was primarily known for serving as Minister for Primary Industries and Energy (1987–1991) and the longest-serving Minister for Primary Industry (1983–1987). "Politics is like farming; no one is forced to do it, but someone has to," he once wrote. He was thought to have been a strong potential candidate for a Labor Prime Minister.

John Kerin brought his expertise to the Bureau of Agricultural Economics and Federal Parliament. He played a crucial role in reforming agriculture and primary industries in Australia. He also drove reforms to boost farm productivity, including establishing research and development corporations.

For 17 years, John Kerin was involved in the Crawford Fund as the Chair of the NSW and ACT Committees, a member of the National Board of Directors and its Chair from 2010 –2017. John Kerin was also Chair of several bodies concerned with natural resource management in fisheries, forests, water, land, and animal health, such as the Australian Meat and Livestock Corporation.

John Kerin passed away on 29 March 2023, and is survived by his wife, June, and daughter, Heidi.

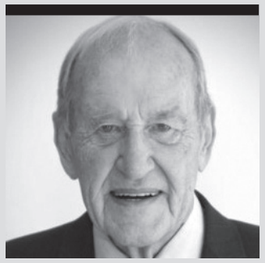
Dr William Wulf FTSE

Dr William Wulf was elected as a Fellow of the Academy in 2005 for his contributions as a computer scientist. He was a Foreign Fellow of the Academy and passed away in Charlottesville, Virginia.

Dr Wulf was among the first to receive a computer science graduate degree, receiving his in 1968. He made a career in the field when it barely existed, later leading efforts to reshape and inspire thinking about engineering conduct, progress and ethics. He was an advocate for education and diversity in engineering.

Dr Wulf's most notable achievement was overseeing changes to consolidate data-sharing technology, first developed by the Pentagon, to open it up for civilian users. At the time, he headed the National Science Foundation's computer and engineering directorate. The model he helped create was one of the critical building blocks of what we know as the internet today.

Dr Wulf is survived by his beloved wife, Anita Jones, daughters Ellen Wulf Epstein and Karin Wulf, sons-in-law Steven Epstein and Christopher Grasso, and grandsons Henry and Abraham Epstein and John and Ethan Lofgren. He passed away on 10 March 2023.



Thomas (Brian) Finn AO FTSE

Thomas Finn was an active member of the Fellowship as a member of the Queensland Division. He was elected as a Fellow in 1991 for his innovative management as Managing Director of IBM Australia.

He worked with IBM for 35 years in an international career that spanned marketing, software development and senior management. He oversaw many changes with the introduction and launch of the internet. He was the Chief Executive of IBM from 1980-1993 and Chairman from 1991-1998.

Thomas Finn also held a senior position through the Chairmanship of South Corp Limited.

He established the Business Council of Australia's Education and Training Committee as its inaugural Chairman. He represented the industry as a member of the National Board of Employment, Education and Training and other educational boards and councils.

As Chair of the Australian Education Council Review Committee, he produced the 'Finn review' report on young people's participation in post-compulsory education and training. Thomas Finn was appointed an Officer of the Order of Australia in 1990 for services to business, industry and education.

Thomas Finn passed away on April 18, 2023. He was a loving father, grandfather, husband and friend who will be dearly missed.

James (Jim) Richard May FTSE

James May joined the ATSE Fellowship in 1994 and was a member of the Victoria Division. He was also a member of the Membership Committee and Publications Committee (1995-1999).

James May began his career as a metallurgist before undertaking future endeavours as a chemical engineer and company director. He also led the Australian Minerals Industry Research Association Limited (AMIRA) between 1968 and 1994 as Chief Executive Officer.

James May also established the 'AMIRA model' in which R&D costs and intellectual property were shared with many research bodies and governments worldwide. In the 1990s, AMRIA began to be regarded as "world-leading" in the interaction between industry and the research community, paving the way for the practice of multi-company-sponsored research.

The Australian Mining Hall of Fame recognised Jim's efforts in 2016, inducting him in the Technologists and Scientists category. He was also awarded a Centenary Medal in 2001 for service to Australian society in mineral science and engineering.

James May died peacefully in Melbourne on June 6 2023, aged 88. Loved and loving husband of Christine; Father of Richard, Stephen, and Annette; Father-in-law of Elaine, Suzzanne, Darren and Sharyn; Grandfather of Matthew, Riley, Alex, Aiden, David, Riley, and Jake.

Dr John Possingham AM FTSE

Dr John Possingham was elected as a Fellow of the Academy in 1979 and was a valued South Australia and Northern Territory Division member. John was also a member of the Agriculture, Energy and Water Forums.

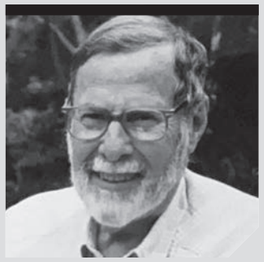
After completing his Doctorate in Philosophy, Dr Possingham was assigned by the Maralinga Atomic Bomb Trials as an Australian participant and observer for the British Government's Biological Response Team. One of his published papers looked at the effects of atomic fallout on plant leaves.

Dr Possingham was Chief of CSIRO's Division of Horticulture from 1967 to 1971. He is the author of some 250 published articles on grape growing, general horticulture and plant nutrition. He revolutionised the Australian wine industry in the 1970s by introducing mechanical grape picking and pruning.

In 1990 Dr Possingham was appointed a Member of the Order of Australia and received a Centenary Medal in 2001.

Dr Possingham was a grape grower for over 25 years and was a premium wine producer owning Possums Vinyards in McLaren Vale, close to Adelaide.

Dr Possingham died on 30 April 2023, aged 93 years. Loving husband of Carol. Loved father of Tony, Simon, Marcus and Sarah. Grandfather of Rosina, Alexander, Atticus, Dominic and Simon. Father-in-law of Fiona. Remembered by Leonie, Kundi and Suzanne.



Dr Ian George Dewar Cameron AM FTSE

Dr Ian Cameron was elected as a Fellow of the Academy in 1990 and was a valued member of the ATSE family. He was Honorary Secretary from 1990–1994 and then a member of the Queensland Division and a member from 1993–1996 of the ATSE Council.

Dr Cameron was a pioneer in the introduction of pre-stressed concrete in Australia. In 1960, he established his engineering consulting firm, Cameron McNamara Pty Ltd. The firm was involved in designing the Merivale Rail Bridge in Brisbane in the 1970s. In 1980, the Association of Consulting Engineers Australia named the bridge the most outstanding engineering project. He also worked in the field of water engineering at the Logan Water Alliance.

In 1993 Dr Cameron was awarded Queensland Engineer of the Year, and in 1996, he received an Honorary Doctorate from QUT.

In 2009, Dr Cameron was appointed a Member of Order of Australia for civil engineering services, particularly in bridge construction, dispute resolution, and professional and community associations. Dr Cameron was also inducted into the Engineering Heritage Queensland's Hall of Fame in 2013.

Dr Cameron passed away peacefully, surrounded by his family, on Friday 5 May 2023, in Brisbane at age 93. He is survived by his wife of 68 years, June Cameron; his children, Elizabeth, Rosemary, Sally and Robert Cameron; and his ten grandchildren.

Michael Taylor AO FTSE

Michael Taylor was elected to the ATSE Fellowship in 2007 and was a member of the Victoria Division and the Agricultural Forum.

Michael Taylor was a gifted agricultural economist who rose to lead the Department of Agriculture in Victoria in 1971. He was the Secretary for the Commonwealth Department of Infrastructure, Transport, Regional Development and Local Government and Secretary for the Department of Agriculture, Fisheries and Forestry.

Michael Taylor was also the Chair of the Geoffrey Gardiner Dairy Foundation, Director of the Melbourne University Business School, Director of the Bushfire Cooperative Research Centre, Australian Statistics Advisory Council Member, and a Governor of the Crawford Fund.

He was on the Board of the Crawford Fund from 2010 until his death and is remembered as never afraid to state his point of view, contributing significantly to all agencies he worked for and collaborated with.

In 2007, Michael Taylor was appointed an Officer of the Order of Australia for his contribution to managing natural resources and industry policy development at the Federal level and in Victoria, particularly in agriculture, and through contributions to transport, water, food and safety standards.

Always so full of life, so very positive and supportive, Michael Taylor passed away on 2 June 2023 after a short illness. He is survived by his wife, Eve; Children, Erica and Rachel; Grandchildren, Aris, Xanthe, Eva, and Bowie.

With thanks to the Crawford Fund
Vale Mike Taylor AO FTSE

What we're reading

The Panther
Letters to a Young Poet
by Rainer Maria Rilke

I was eighteen when I first read a poem of Johann Josef (Rainer) Maria Rilke in my final year at at the technical college. It was just as profound as many — including my German teacher in college — professed. One of the most famous poems of Rilke is titled the 'The Panther' (subtitled: In Jardin des Plantes, Paris; German: Der Panther: Im Jardin des Plantes, Paris).

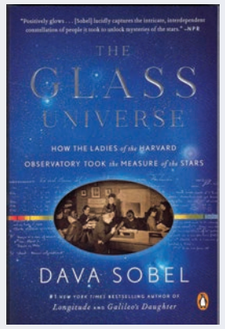
Since that time I became a vivid reader of Rilke if somewhat irregularly over the years. Six months ago I was listening to ABC National radio driving home from my university, I learned from an radio interview that the American Scholars Anita Barrows and Joanna Macy had written a new book *Letters to a Young Poet: A New Translation and Commentary*. I was fascinated again by Rilke's writing and thinking.

Serendipitously one of my German PhD students gave me a very special edition of a German version of *Letters to a Young Poet* three months ago as a thank you for my mentorship.

I was again inspired by Rilke's personal reflections on the vocation of writing and the experience of living, which urges all of us — not just the young poet — to look inward, while also offering sage wisdom on further issues including gender, solitude, and romantic love. Rilke is often acknowledged as the most lyrically intense German-language poet and I truly felt the intensity, especially reading the letters in my mother language, German. Written more then a hundred years ago, the advice to the Young Poet to develop an appreciation of, and relationship, to his innermost imaginative spirit and/or soul is still so important for all of us in the 21st century.

Rilke surveys leitmotifs which remain so important today and will be into the future: the importance of speaking for nature, wildlife, clean air, and rivers. It encourages all of humanity to be the voice of nature and to have realistic aspirations for the protection of the environment.

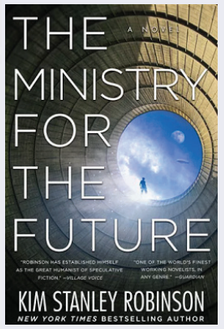
Distinguished Professor
Dietmar W. Hutmacher FTSE FAHMS



The Glass Universe: The hidden history of the women who took the measure of the stars
by Dava Sobel

The Glass Universe: The hidden history of the women who took the measure of the stars by Dava Sobel (who also wrote *Longitude*), describes the seminal contributions of the Harvard Observatory to the evolution of astronomy and astrophysics from the late nineteenth century onwards. The research was underpinned by = meticulous scientific analysis and complex calculations by dozens of women astronomers. Their examination of hundreds of thousands of glass photographic plates led to the increased understanding of binary and variable stars, the stellar classification system and the chemical composition of stars. Other people interested in the history of science might appreciate this book.

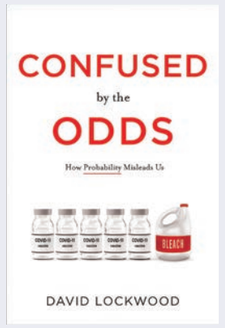
Dr Janis Cocking PSM FTSE



The Ministry for the Future
by Kim Stanley Robinson

Of all the books I've read in recent years, one of them that hit me hard is the science fiction novel *The Ministry for the Future* from Kim Stanley Robinson. It imagines a not-so-far-away future where the new Ministry is tasked with advocating for future generations, and begins to do so with ambitious and controversial projects, to face the disastrous effects of climate change. It's not easy to get everyone on board with the risks they plan to take. The story starts heavy, gives lots of very interesting ideas and scientific insights underlying climate change, and ultimately fills with hope.

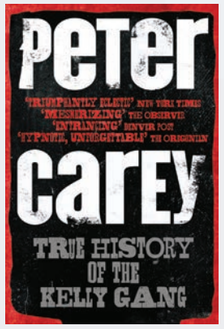
Professor Xiaojing Hao FTSE

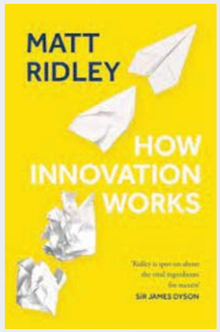


Confused by the odds: how probability misleads us
by David Lockwood

An entertaining and easy to read journey through advances in understanding probability issues, and dismissal during centuries. It is an essay and also a spy story set up, in which the author shows us the birth of statistics in Italy in the 16th century by a researcher and gambler, to more accredited scientists such as Gauss, and getting to present days to delve COVID-19, or the 2008-2009 financial crisis and many more examples, including jailing innocent people. What does probability have to do with this? Basically understanding what the problem is and framing it as accurately as possible: arguably, not an easy task.

Francesca Ferrazza FTSE





The Luminaries
Wolf Hall (and its sequels)
True History of the Kelly Gang

Over the last year I have become a voracious consumer of fiction, as I lie beside a new addition to the family who suffers from being too excited about the world around him to sleep well. I am keenly working my way through the Booker Prize list. Three books have been truly revelatory for me: The *Luminaries*, *Wolf Hall* (and its sequels) and the *True History of the Kelly Gang*. All make use of unusual and spectacular language with storylines that are interesting and compelling. Most astonishing however, is the ability of each to transport you into the head of a very different human in a place far away. The central character becomes so real that they appear to have a physical presence that you know better than friends and family.

Professor Andre Luiten FTSE

How Innovation Works — and why it flourishes in freedom
by Matt Ridley

A brilliant book about how innovation has shaped our society in the past and how it will change humanity in the future. The book presents many fascinating historical anecdotes in different areas such as energy, public health, transportation, foods, and communications and computing. It also addresses some of the most fundamental issues regarding the source, motives, and economics of innovation with new perspectives and different lenses. I was particularly impressed with two chapters which were quite refreshing and somewhat counter-intuitive. One was the view that "innovation is the mother of science as often as it is the daughter" in which the author clearly articulates that the commonly accepted linear model of science discovery leading technology innovation is not always true. There are as many cases where innovations actually led to science discovery in the history of the steam engine, electricity, gene editing, just to name a few. The other, in Chapter 10, discusses the fallacy of innovation and invention which is truly eye-opening. I also like author's observation that China is becoming an innovation engine with speed, scale, and hardworking, particularly in the era of artificial intelligence.

Let me end with an author's quote: "Innovation is the child of freedom and the mother of prosperity."

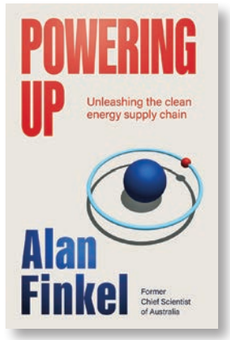
Dr Ya-Qin Zhang FTSE

New books by ATSE Fellows

Invention to Innovation
by Dr Larry Marshall FTSE

Invention to Innovation charts a course for scientists, leaders, investors and policy makers to translate research into growing innovative, competitive companies and industries. With extensive experience and insights gained over three decades, Dr Larry Marshall demonstrates how science can generate new value that grows markets and creates jobs while also delivering social, environmental and economic benefits.

www.publish.csiro.au/book



Powering Up
by Dr Alan Finkel AC FAA FTSE

In Powering Up, former Australian Chief Scientist Alan Finkel shows how to remove the barriers that prevent nations transforming from petrostate to electrostate. Finkel considers the entire supply chain, from raw materials through power infrastructure, the workforce, transportation and household customers. He reveals the outlines of a new geo-economic order and explains in persuasive, practical terms how we can get there.

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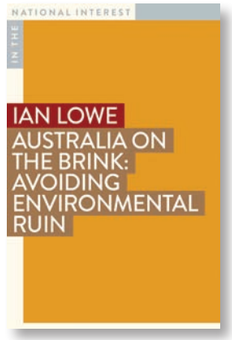

Australia on the Brink
by Professor Ian Lowe AO FTSE

In *Australia on the Brink*, Ian Lowe argues that the essential first steps in addressing key threats are stabilising the global climate and protecting our local biota. We must also change the emphasis of resource extraction from a damaging reliance on trade to improving our capacity to meet our own needs. This is our best — perhaps our only — chance of restoring a sense of social stability, and the equality of opportunity that was once a hallmark of this country.

publishing.monash.edu/product

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 at the end of featured articles indicating which of the goals relate to the subject. 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.

What are the SDGs?

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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