

**FUTURES
EXPO
SERIES
2024**



UNSW
SYDNEY



Future Climate

Discover UNSW research and innovation
that's powering a more sustainable future.



Future Climate – UNSW innovation for a resilient tomorrow

The Future Climate Expo 2024 is a testament to ingenuity in the face of adversity.

As we move towards a climate-resilient future, our focus is clear. Waste reduction and recycling, biodiversity conservation, resilience to natural disasters, and decarbonisation are not mere aspirations, they are guiding pillars in our research programs, collaborations, startups and commercialisation priorities.

The threat of extreme weather looms large, especially in Australia's bushfire-prone areas. UNSW research groups, in collaboration with government and industry partners, have designed artificially intelligent (AI) immersive environments that can be used to predict and respond to wildfires. They have also engineered fire prevention and suppression technologies such as FSI FIRECOAT, a paint that expands during heat exposure to form an insulating barrier. It is the first paint to receive a BAL-40 rating and is now available in Bunnings.

The safeguarding of our oceans is another focus for UNSW researchers. Projects that investigate the causes and impacts of marine heatwaves, build resilience amongst coastal communities across the Indo-Pacific, and explore the potential for carbon dioxide removal in Australian waters, all recognise the fundamental need to preserve marine environments.

A green future will not be possible without a circular economy. UNSW works with partners such as State Asphalts NSW, Novoco Group and Jamestrong to turn waste into valuable commercial products. This booklet includes a range of ingenious recycling solutions that convert coffee cups into road base, turn waste glass and textiles into engineered stone benchtops, and produce aerosol cans from recycled plastics.

Join us as we pave the way to a more sustainable tomorrow.

Professor Stephen Rodda
Pro Vice-Chancellor Industry & Innovation
UNSW Sydney



Discuss your
project or idea
with UNSW



Future Climate Overview

Future Climate showcases the breadth and depth of translational research and technology at UNSW addressing climate change. It includes research projects, groups, programs, institutes, and facilities. It also highlights pioneering companies, including spinouts, startups, and colocating enterprises, commercialising research within the UNSW innovation ecosystem.

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Extreme weather

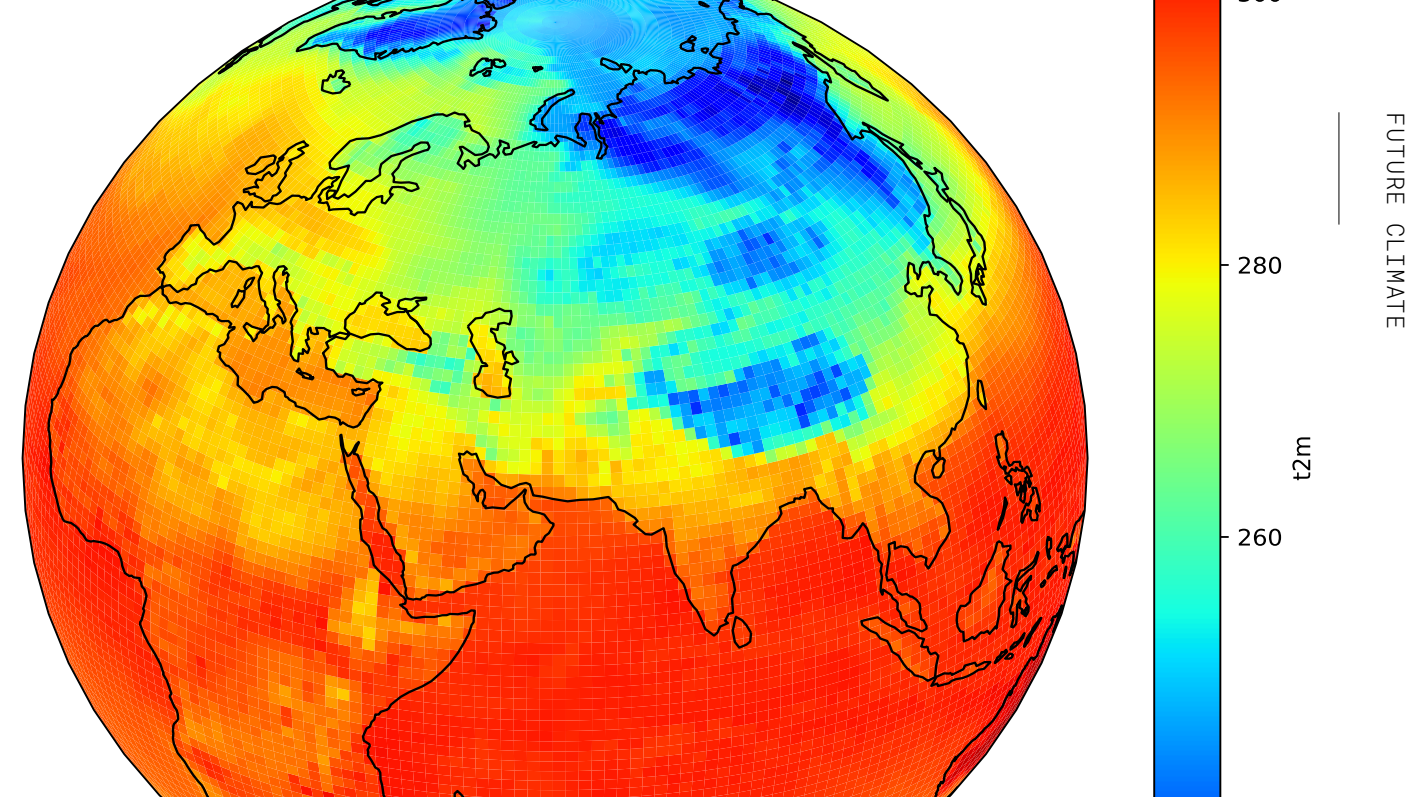
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Climate Climate Resilience & Biodiversity



> AI research for climate

• Data-driven sustainability research to advance climate resilience

Research group

It is pivotal for disaster management sectors to have accurate, localised weather information. This research project aims to enhance the precision of weather forecasting and climate downscaling. The team is also pioneering the use of AI to downscale lower resolution weather datasets into fine-grained, region-specific forecasts.

Practical steps include the development of machine learning algorithms that produce accurate global weather forecasts and achieve comparable results to operational Numerical Weather Prediction models without the computational complexities.

The project also focuses on leveraging analytics and AI to enhance carbon performance across the infrastructure lifecycle.

The project is currently in the early phases of national scale-up.

> ARC Industrial Transformation Research Program (ITRP) on whole-life design of carbon neutral infrastructure.

> Global weather forecasting model performs competitively with state-of-the-art forecasting models.

> Clean air schools

• **Creating healthier schools for our children and cleaner communities for all Australians**

Research project

Air quality in schools was identified as a public health priority in a report requested by the European Commission over 20 years ago. Despite this concern, little action was taken in the following two decades. Over the last few years, when classrooms were increasingly recognised as hotspots for the transmission of SARS-CoV-2, renewed interest and resources have been made available in response to the issue. However, questions remain as to the best way to achieve safer classroom air.

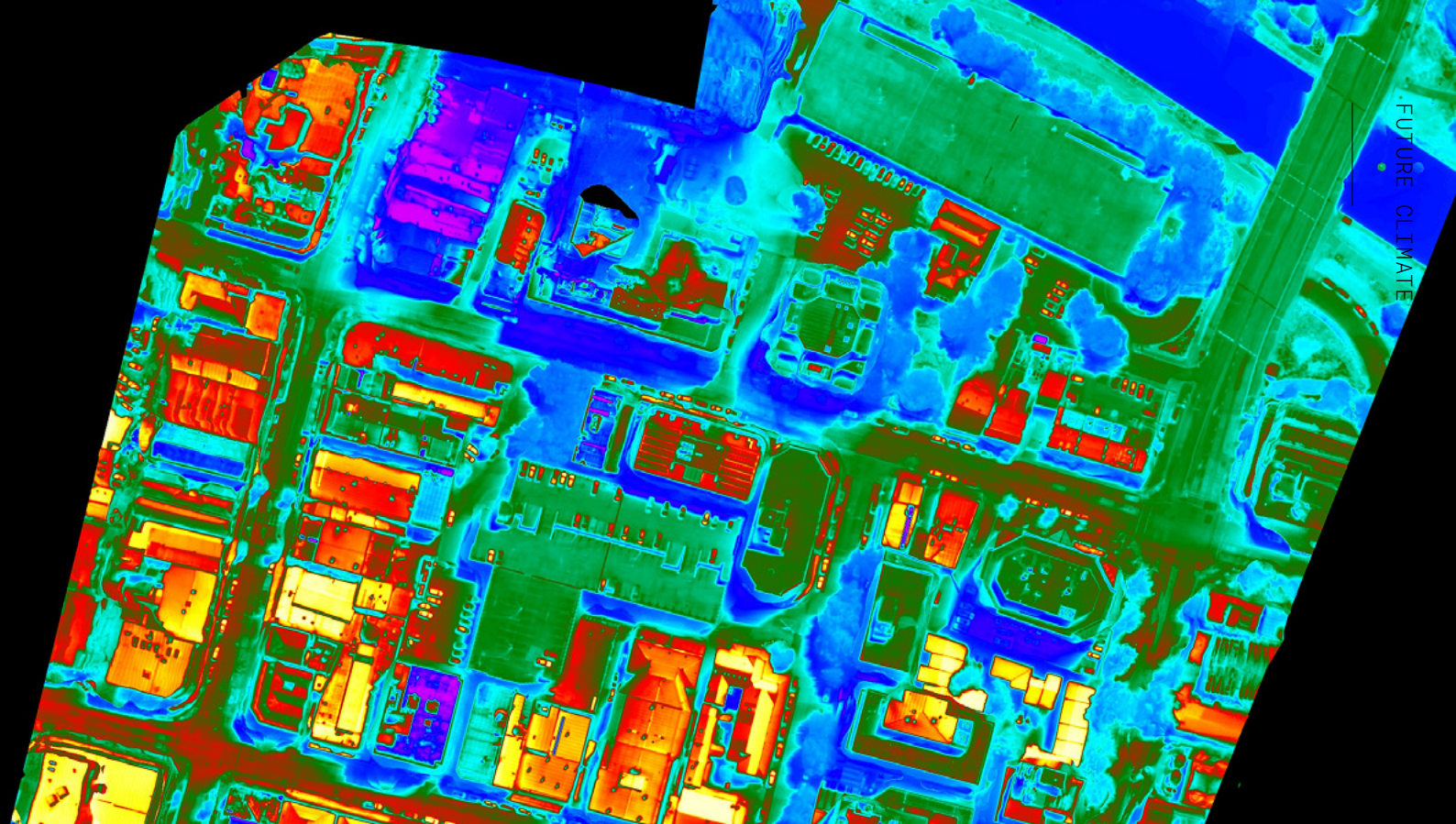
Clean Air Schools is the largest network of paired indoor/outdoor sensors in Australia with 100 schools engaged. The portable sensors are either powered by solar panels for outdoor use or plugged into existing electricity outlets for indoor use. The air quality sensors and associated weather stations use calibrated sensors to provide data at 5-minute intervals that measure particulate matter 2.5 (PM2.5), nitrogen dioxide (NO2), carbon dioxide (CO2), temperature and relative humidity.

Clean Air Schools provides vital research data about how to improve indoor air quality for health and learning benefits.

> **International recognition via an award from Clean Air Society Australia and New Zealand for Innovation 2022.**

> **Project scale-up plans include deploying HEPA filtration more widely across the NSW school system and integrating live indoor air quality tracking for real-time feedback and action.**





> Climatepods

- > ClimatePods capitalise on existing relationships and resources to 'meet people where they are' in boosting climate preparedness.
- > The 'kitchen table conversations' resource pack empowers pods to collaboratively plan and resource their preparedness efforts, elevating resilience beyond the individual level.

Empower your social network to respond to extreme events

Research project

The Anthropocene's changing climate heightens the risk of natural disasters, emphasising the need for innovative, adaptive, and empowered local responses.

Climate-resilient communities require resources, knowledge, and autonomy to confront these threats. The UNSW Bushfire Research Group (Dr. Katie Moon) in collaboration with colleagues from Australian National University (Dr. Sophie Yates) and University of Canberra (Dr. Elise Remling) are leading this cross-jurisdictional project to foster climate empowerment at the community-of-interest (or 'pod') level.

Existing disaster prevention resources in Australia target individual households or communities-of-place. However, there's a gap in preparation at the community-of-interest scale, pre-existing social networks where individuals share a common interest, passion, or goal and who connect regularly to exchange knowledge and resources. Leveraging these relationships, characterised by trust and support, is crucial for effective disaster planning and recovery.

By empowering communities-of-interest, this project enhances long-term resilience through tailored resources, including talking prompts, principles, and adaptable tools, catering to each pod's specific needs.

> Coloured supercool materials

Lowering surface temperatures through fluorescent-coloured daytime radiative cooling materials

Research project

The ARC Discovery Project DP220100318, "Fluorescent Daytime Radiative Cooling for Urban Heat Mitigation", has pioneered a technology designed to combat urban overheating in the built environment and decrease future cooling energy demands in buildings.

The innovative technology enables the application of new cooling techniques on coloured surfaces, creating a paradigm shift from the traditional white coatings used for heat mitigation. The coloured materials created through the project maintain lower surface temperatures than their white counterparts and offer a significant advancement in material science and urban planning.

Furthermore, the technology can modulate performance, catering to specific environmental conditions and architectural requirements. This adaptability enhances the functionality of urban surfaces and opens up new avenues for aesthetic design in building exteriors, providing the dual benefit of efficiency and visual appeal.

- > Creation of coloured materials that maintain lower surface temperatures than their white counterparts.
- > Technology can modulate performance, catering to specific environmental conditions and architectural requirements.



> Evolution & ecology research centre

- > Quantified real-world shifts in Australian species' distributions. Discovered many are shifting in the opposite direction to what the models predict.

- > Working with NSW Government to inform biodiversity conservation for the future.

Understanding how Australia's biodiversity responds to climate change

Research project

The Evolution and Ecology Research Centre provides vital insights into the responses of Australian biodiversity to climate change. Species are already changing the way they grow, reproducing at different times, and shifting their distributions. Different species respond in different ways and at different rates, resulting in the rapid reshaping of ecological communities. This has substantial implications for conservation and biodiversity markets.

> Indigenous knowledge futures

Protecting and promoting Indigenous knowledge through benefit-sharing agreements, biocultural protocols, and access

Research project

Indigenous biodiversity-related knowledge is subject to misappropriation, theft and biopiracy by non-Indigenous peoples and companies through commercial processes and dubious intellectual property rights claims.

This project implements The Nagoya Protocol to the Convention on Biodiversity (CBD), which encourages the creation of biocultural community protocols and the use of 'access and benefit sharing' (ABS) agreements.

This project works with communities in Australia, Vanuatu, and the Cook Islands to understand and codify customary law and practices into protocols. The team also provides expertise on ABS (including template agreements) and advises governments on policy and legislation reforms.

The team has worked with more than 50 Indigenous and non-Indigenous organisations, businesses and communities, academics, and governments across Australia, the Pacific and internationally. It delivers support and advice on biodiversity policies and legislation, establishing community protocols, access and benefit arrangements, and policies and procedures related to intellectual property rights and permits.

- > Knowledge from this project contributed to supporting the redrafting of Queensland's Biodiscovery Legislation.

- > Communities in Vanuatu and the Cook Islands are finalising biocultural protocols with future legal standing under national laws and policies.

- > Indigenous organisations and businesses in Australia are receiving forward-thinking technical and policy advice on ensuring Indigenous knowledge protection.

> Rapid climate action through new global agreements

Demonstrating the promise of new climate agreements to break international deadlock and accelerate progress towards net-zero

Research project

The weakness of the Paris Agreement on Climate Change is holding back global decarbonisation. States volunteer their targets without mechanisms to enforce them, meaning efforts to hold global heating at 1.5°C will fail. There are no agreements to tackle major emissions sectors, like forests, fossil fuels, transport, and energy. Existing voluntary initiatives on coal and forests lack enforcement mechanisms and resources.

This project builds on widely discussed proposals for a global Coal Elimination Treaty and a full-scale Architecture for a Net Zero World that will include a global ban on deforestation and agreements to phase out all fossil fuels. It will also develop a proposal for a stand-alone ecocide convention to prevent large-scale ecological harm and protect the biodiversity that is so crucial to the world's climate and food security.

Working across the fields of international relations, international environmental law, and earth system governance, the project will identify political and legal pathways to new agreements, set out their design principles, and build international research groups to draft model agreements.

It will also demonstrate to governments and civil society organisations the promise of new agreements to break through international deadlock and accelerate progress towards a safer climate future.

- > Architecture for a net-zero world endorsed by George Monbiot in The Guardian.
- > Coal elimination treaty proposal has wide international awareness and press coverage.
- > Forests treaty partnership established with Brazilian NGO Platform CIP0.





> Rapid urbanisation & population health (ruph) research group

- > NSW Government successfully planted >1 million trees across low-canopy areas of Sydney by 2022, citing RUPH-based research on the mental health benefits of urban tree canopy.
- > City of Sydney leveraged RUPH research, which indicates that a 30%+ local tree canopy cover reduces risks of mental ill-health, to plant >7000 trees in low canopy areas.

Working with communities, government and industry to shape healthier, more liveable cities for all

Research group

Urban health and environmental challenges are context-specific and cannot be fully understood or addressed by any one research discipline. The RUPH Research Group, led by Professor Xiaoqi Feng, harnesses scientific, clinical, and industry expertise, and the lived experience of community members, to shape healthier, more liveable cities for all. It embraces diversity to generate evidence-based solutions and builds transdisciplinary research capacity among UNSW academics, students, and collaborators worldwide.

RUPH has delivered game-changing research for city planners and urban foresters, both in Australia and around the world, by identifying the mental and cardiometabolic health benefits and healthcare cost savings of restoring tree canopies in cities. This evidence has been used to inform a range of policies designed to expand tree canopy cover, especially in lower-income communities, to help make places cooler, more walkable, and more climate resilient.

> UNSW Canberra coastal resilience group

Building resilience of coastal communities to climate change and human-induced impacts

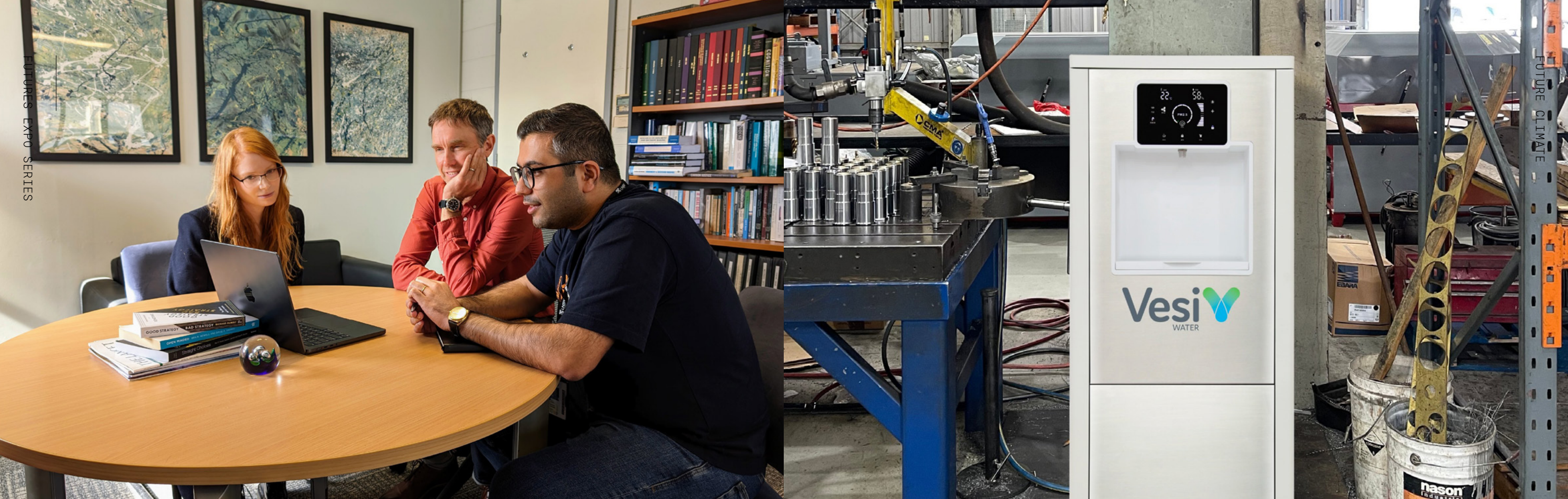
Research group

The UNSW Canberra Coastal Resilience Group brings academics and stakeholders together to exchange knowledge and ideas that will strengthen coastal resilience across the Indo-Pacific region.

The group conduct multidisciplinary research on community disaster relief and resilience against coastal hazards and climate change, including sea level rise, land subsidence, coastal erosion, flooding, and livelihood losses.

- > Developed a professional education course that can be delivered to DFAT Marine and Coastal Resilience Hub

- > Submitted an ARC Industrial Transformation Research Program (ITRP) bid – Transformation of Ports (TOP) for Enhanced Blue Economy and/or an Ocean Decade Programme under United Nations Decade of Ocean Science for Sustainable Development 2021-2030 – Marine Ecosystem Restoration and Management



> UNSW institute for climate risk & response

- > Appointment of a co-funded UNSW Industry Scientia Academic who will work with partners in the insurance industry to model the impacts of extreme weather events.
- > Successful integration of behavioural science principles to drive increased climate action in the financial sector.
- > Convened industry, government, and academia to co-develop workshops and roundtables on the application of new knowledge on climate risk and response.

• Empowering businesses, governments, and society to address climate change

Research group

The Institute draws on climate, behavioural, economic sciences, business, and law research to formulate comprehensive strategies for climate action. It refines its methodologies and strategies through partnership and collaborates closely with industry to integrate climate risk assessments into organisational practices.

The Institute's behavioural science team won recognition at a Commonwealth Bank hackathon for a solution to increase climate action among customers through innovative communication techniques. The solution will soon be tested among a sample of the Australian population.

The research group also investigates climate risks across governments and industries. This includes identifying and measuring risks, such as extreme weather events and how they will play out, as well as developing advice on how to approach, manage and disclose these risks.

> Vesi water

• Harvesting pure water from the air using renewable energy

Spin-out

Advancements in nanomaterials, renewable energy, advanced manufacturing and Internet of Things devices are at an inflection point and set to disrupt the traditional water utility model in a similar way to how solar panels have revolutionised the electricity industry.

Vesi Water uses the latest technologies to re-imagine how we access water, creating revolutionary, sustainable water resource solutions.

The team harvests water from airborne humidity, creating fresh water without the need for chemical treatment or carbon-intensive water-treatment plants. Through data integration, it can remotely monitor/control its units, thereby optimising performance.

- > Patented new graphene-based nanomaterial in partnership with UNSW. This nanomaterial, called Air Sponge, is optimised for Atmospheric Water Generation.
- > Deployed Air Sponge into test rigs and MVP units to achieve Technology Readiness Level (TRL) 6.

Climate Decarbonisation



> ADA innovation hub

Working collaboratively to find creative solutions to our time's diverse and complex issues

Research hub

The ADA Innovation Hub at UNSW's Faculty of Arts, Design & Architecture (ADA) is a vibrant, interdisciplinary initiative established in 2021. Positioned at the core of UNSW's most diverse faculty, it harnesses expert knowledge from its six schools, six research centres, and various labs, studios, and galleries. The Hub's mission aligns with ADA2051's vision of fostering creativity, collaboration, and inclusion to address challenges, seize opportunities, and drive positive change. Every year, it tackles projects proposed by students, staff, industry, or community partners.

Under the leadership of Dr. Carly Vickers, the ADA Innovation Hub employs a methodology that assembles interdisciplinary teams of ADA staff and students. These teams work inclusively and collaboratively, crafting creative solutions to various complex issues.

> In partnership with Massive Action, the Hub has catalysed transformative changes in power, health, and climate sectors.

> Facilitated connections for five Massive Action Sydney projects with external collaborators, fostering knowledge exchange and new partnerships.

> Various research translation projects have been successfully launched, including Making Good Media.

> Arch_manu: ARC centre for next-gen architectural manufacturing

**Digital transformation
towards sustainability:
rethinking design
and delivery for the
architecture, engineering,
and construction industries**

Research group

Persistent productivity challenges plague the AEC sector (architecture, engineering, and construction). Projects often exceed budgets and timelines, which undermines community benefits. On top of this, the environmental impact is substantial, with unacceptable rates of material consumption, carbon emissions, and waste production.

Arch_Manu develops solutions to these problems through data-driven design, digital workflows and processes, novel production techniques, and digital sustainability strategies.

Arch_Manu is a post-disciplinary research group working with local and international industry partners to tackle current industry challenges from various perspectives. Its program of industry-embedded PhDs, national and international placements, sector-focused short courses, postdoctoral projects, and applied demonstrator projects is the basis for growing knowledge, skills, and capacity within the AEC workforce, while delivering novel digital tools and frameworks to help drive the digital transformation of the sector.

> ARC Industrial Transformation Training Centre for Next-Gen Architectural Manufacturing, funded to AUD \$15.3M.

> CRC-P for 3D printing houses in remote environments using local materials, funded to AUD \$6M.

> Focused on delivering real projects to demonstrate and validate Arch_Manu research outputs.





> Centre for infrastructure engineering & safety (CIES)

- > CIES Innovation Decarbonised Infrastructure initiative pioneers solutions for emissions reduction in key industries, facilitating the transition to a low-carbon economy.
- > Backed by substantial funding and a commitment to environmental resilience, CIES research integrates sustainable materials and circular-economy principles to reshape the construction industry.

Decarbonising construction with sustainable design and circular economy solutions

Research group

The CIES Innovative Decarbonised Infrastructure (IDI) initiative develops and commercialises innovative solutions to reduce emissions in infrastructure and primary industries. It aims to decarbonise construction by integrating sustainable materials, innovative design, and circular economy principles.

The team comprises internationally-recognised engineers and researchers in sustainability, decarbonisation, circular economy, and climate-resilient infrastructure. Together, they are guiding the industry towards a regenerative model that minimises waste and maximises resource efficiency and paving the way for an environmentally-resilient future.

Ongoing projects have received substantial backing from government entities and industry stakeholders, amounting to multi-million-dollar research funding.

> High performance architecture

Developing strategies to radically reduce embodied carbon in buildings

RESEARCH GROUP

Global construction levels are equivalent to building a 'new' New York City every month, with an estimated 96,000 new homes needed daily. Each square metre of this construction emits around half a tonne of greenhouse gases due to the materials used –called 'embodied carbon'.

Embodied carbon is responsible for around 11% of all human-induced greenhouse gas emissions and there's an urgent need to reduce this.

The High-Performance Architecture Research Group has partnered with federal and state government and industry organisations to develop better methods to measure embodied carbon in buildings and create strategies for its reduction. This includes approaches to reduce material usage, innovative structural systems, the adaptive reuse and extension of existing buildings (instead of demolition and rebuild), material reuse and recycling, and the use of bio-materials such as timber, straw and cork.

- > Developed tools for industry partners, including architects and builders, to measure and reduce their embodied carbon in practice.
- > Created national guidance for the Australian Institute of Architects (AIA) and contributed to the National Australian Built Environment Rating System (NABERS) policy on embodied carbon.
- > Documented how Australian buildings can reduce embodied carbon by up to 40% today, and charted pathways to net zero embodied carbon by 2050.





> Institute for industrial decarbonisation

- > **Transition pathways:** decarbonising essential materials like ammonia, cement, plastics, and steel is a whole-of-system challenge. The IID builds initiatives that link industry, government and finance stakeholders in sectors including built environment, transport, critical minerals, and green manufacturing.
- > **Engaging with geopolitical and economic processes:** the IID seeks to align clean technology initiatives with broader government and industry drivers. For example, adoption by Australia of a Carbon Border Adjustment Mechanism - import tariffs on high carbon products - would facilitate investment in green metal foundries and refineries for green industrial chemicals and power fuels, thus increasing sovereign value creation and reducing supply chain risk.

Deep-decarbonisation initiative bringing together expertise from 30+ centres and hundreds of researchers across all faculties

Research institute

The Institute for Industrial Decarbonisation (IID) was established in late 2023 to consolidate UNSW's transdisciplinary decarbonisation and cleantech capability. It provides a pan-UNSW interface with industry and government and acts internally to build community-of-practice and shared strategy across teams. The academic leadership group comprises experts from relevant disciplines across engineering, science, arts, economics, business, and law.

The Industry Advisory Committee of the Institute provides insight into the needs of hard-to-decarbonise sectors. Comprising senior representatives from major companies and peak industry bodies, it plays a pivotal role in driving the formation of major transdisciplinary R&D projects and initiatives.

Scope includes:

- Clean tech acceleration for critical products (e.g. ammonia, plastics, steel, cement).
- Pathways for hard-to-decarbonise sectors (e.g. mining, construction, transport, industrial chemicals, manufacturing).
- Integrated modelling and data-driven solutions (e.g. systems simulation, AI, Scope 3 accounting, macroeconomic perspectives).
- Policy, codes, and standards (e.g. incentives and building codes to support adoption of low-carbon materials and design).
- Supporting UNSW interaction with governments (national and international) regarding cleantech investment strategy, alliances, and climate response.
- Skills pathway (input to UNSW undergraduate, higher degree research and work integrated learning curriculum design).

> Landfutures

Creating AI-driven sustainability systems for large-scale carbon stock estimation and decision optimisation

Research project

AI can play a critical role in mitigating climate change and promoting decarbonisation by autonomously processing large datasets and estimating key indicators for decision-making. This project employs deep learning for image processing to provide AI-powered solutions to the decarbonisation challenge. It creates sustainability systems for navigating, managing, and estimating carbon stock in real-time, end-to-end, and globally. Based on the carbon stock information, the systems can enable decision optimisation and plan for forest carbon projects, facilitating the development of carbon trading markets.

An interdisciplinary collaboration between UNSW and University College Cork (Ireland), the project offers useful toolkits for sustainability researchers, policymakers, investors, and landowners to gain visual estimation and experience in carbon stock management.

The first proof-of-concept system has been built, and second-round system development is ongoing to expand decision optimisation capabilities.

- > Built a prototypical system that can perform carbon stock estimation at scale.
- > Supported multiple PhD students in computer science and information systems research projects.



> Marine carbon dioxide removal in australia

- Maximising marine carbon dioxide removal potential in Australian waters

Research project

Due to anthropogenic carbon emissions, the atmospheric CO2 concentration has increased from 280 ppm in 1850 to 420 ppm in 2023 and is currently on track to reach 550 ppm by 2050. With current commitments, future projections suggest that the global mean temperature anomaly compared to pre-industrial will be ~2°C by 2050, with consequences for global climate and ecosystems (IPCC, 2023).

It is now clear that along with a drastic and rapid reduction in anthropogenic carbon emissions, we also need to implement gigatonne-scale CO2 removal from the atmosphere to hold global warming under the temperature thresholds set by the Paris Agreement (Smith et al., 2023; UNFCCC, 2015).

This initiative aims to evaluate the capacity for carbon dioxide removal (CDR) within Australia's exclusive economic zone (EEZ) using the leading marine CDR strategy, ocean alkalinity enhancement (OAE). Through detailed numerical experiments utilising advanced ocean and biogeochemical models with ultra-high resolution, the project seeks to determine the effectiveness of OAE in Australia and identify the ideal conditions for maximising CO2 capture while minimising adverse effects on Australian ecosystems. for industry partners and the general public.

- > The team comprises Australian experts specialising in biogeochemical and physical oceanography modelling and proficient in carbon dioxide removal techniques.
- > The project will include a specialist focused on advanced high-resolution biochemical modelling.



> Netnada

- Helping to decarbonise supply chains and democratise sustainability data across businesses and governments

Founders start-up

Up to 90% of the carbon footprint of Australian businesses originate in their supply chains (scope 3). Accessing accurate information on suppliers and their activities is key. While net-zero goals have been set by governments and large organisations, the availability of sustainability data from suppliers is astonishingly low and proves to be a big barrier to driving an economy-wide strategy.

NetNada technology combines business automation and AI in an all-in-one platform that calculates business emissions to increase transparency, assure compliance disclosures and avoid greenwashing.

NetNada has helped 100+ businesses of all shapes and sizes, and 1000+ suppliers, efficiently get a grip on their emissions without in-house technical expertise or a big budget.

The company is a scale-up funded by UNSW Founders, NSW Government, and other institutional investors.



> Nsw decarbonisation innovation hub

- > Commenced capability mapping across the networks and partner universities to better define the scope of decarbonisation-based research in NSW.
- > Delivered funding to 11 seed projects in the Land and Primary Industries Network and three in Powerfuels including Hydrogen Network, with Electrification and Energy Systems Network seed funding to commence in 2024.
- > Developed an NSW-wide online decarbonisation researcher community.

Supporting, accelerating, and attracting investment into decarbonisation tech and services

Research hub

The NSW Decarbonisation Innovation Hub supports three networks that bring together research, industry, and government to attract investment into decarbonisation tech and services.

The Hub supports the development and commercialisation of green powerfuel technologies, including hydrogen, and enhances the delivery of innovative electrification and energy systems. It also embeds decarbonisation in the next wave of sustainable land practices in NSW, accelerating the transition to net zero with benefits for people and nature.

The Hub is co-hosted by UNSW and the University of Newcastle and supported by leading universities across NSW. Funded by the NSW Government and member universities, it contributes to the state's goal of net zero emissions by 2050 and a 50% reduction on 2005 levels by 2030.

The team is currently distributing funding for its first round of seed projects across two of its networks, with the third to commence callouts in 2024.

> Powour - movement that matters

A platform to get more people to use healthier, sustainable forms of transport and feel good about it

Founders start-up

The Powour platform leverages the principles of nudge economics to encourage individuals to adopt healthier and more sustainable transportation methods and promote a positive emotional connection to these choices.

Powour provides corporations and institutions with a means to actively engage their staff in reducing their environmental impact. This not only helps reduce emissions but also enhances corporate social responsibility initiatives and fosters a stronger sense of community and shared purpose within the workplace.

The technology generates measurable and reportable data that substantiates the efforts made to lower emissions, aligning with Scope 3 emission targets. This functionality is essential for organisations committed to transparent sustainability reporting.

Powour is now implementing a series of corporate and institutional pilot programs designed to test and refine the platform's capabilities in real-world settings.

- > Completed Beta testing phase.
- > Agreed pilots with major national/international brands.



> RECITE: Reduced embodied carbon of infrastructure through transformational engineering

- > Pioneering design techniques that significantly reduce embodied carbon in new infrastructure and unlock the potential of existing infrastructure through retrofitting and repurposing.
- > Pushing the boundaries of construction materials, developing high-performance alternatives, and creating low-embodied carbon solutions.
- > Laying the foundation for comprehensive carbon accounting in infrastructure development.

Reducing embodied carbon in infrastructure to pave the way for a sustainable and resilient future

Research group

The RECITE Centre of Excellence's vision is to spearhead a global paradigm shift in infrastructure development and significantly diminish the embodied carbon footprint of the built environment through innovative engineering solutions.

RECITE envisions a future where advanced design, geomechanics, construction materials, retrofitting, and carbon accounting converge to revolutionise the way infrastructure is conceived, constructed, and maintained.

By harnessing cutting-edge technologies and methodologies, RECITE aims to not only mitigate environmental impact, but also set new standards of sustainability, resilience, and efficiency that will foster a greener future for generations to come. production processes.



> Research centre for integrated transport innovation (RCITI)

Rethinking transport infrastructure as sustainable, ethical, accessible, and equitable

Research group

The purpose of rCITI's interdisciplinary research is to enable people to have diverse and accessible mobility options, including public transport, affordable options, and non-motorised modes. The research targets methods, tools, techniques, and theories that contribute to developing a responsible transport system where emissions, equity, and ethics are taken seriously.

rCITI integrates transport policy, planning, technology, economics, and operations to inform ethical and equitable infrastructure, and liaise extensively with industry and government.

The team apply artificial intelligence, machine learning and statistical approaches to take advantage of new concepts such as shared mobility and non-traditional data sources. This accounts for emerging mobility systems, such as e-bikes and electric vehicles, and emphasises active transport modes, like walking and cycling in urban environments.

- > Quantifying ethics-related metrics for transport network systems to augment the social benefits of transport systems to relevant user groups.
- > Estimating large-scale walking and cycling volumes using an advanced, emerging, data-driven methodology to inform active transportation infrastructure planning and policies.



> Sonia Green technology

- > Reduced 90% of energy consumption during PMB production.
- > Secured \$600K of capital investment.
- > Received letters of intent from major asphalt companies in Australia.

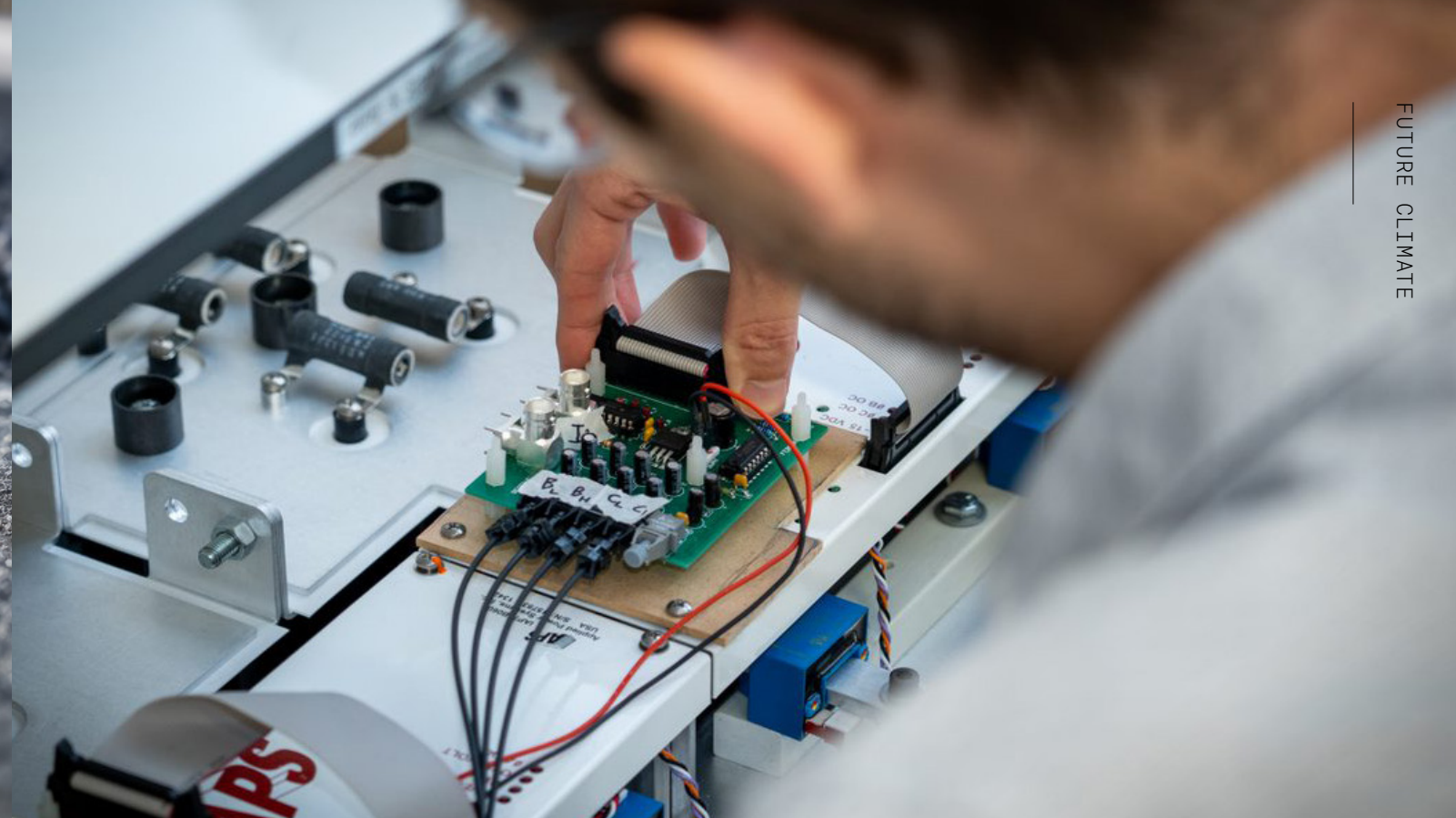
Reinventing road base through 90% energy reduction and the incorporation of waste materials into bitumen production

Founders start-up

SONIA has revolutionised the asphalt industry by implementing an innovative technology that reduces costs and minimises energy consumption. The primary focus of SONIA is on Polymer Modified Bitumens (PMBs), a crucial component within asphalt mixture. PMBs are conventionally manufactured, transported, and stored at extremely high temperatures and are susceptible to phase separation, negatively impacting their performance.

SONIA addresses these challenges, leading to a 90% reduction in energy consumption during production while enabling storage and transportation at ambient temperatures and eliminating the issue of phase separation.

SONIA further contributes to environmental sustainability by substituting virgin polymers with waste plastics.



> Trailblazer | recycling & clean energy (TRaCE)

Fast-tracking net zero - from research to global markets

Trailblazer universities program

Delivered by UNSW and the University of Newcastle, the Trailblazer for Recycling and Clean Energy (TRaCE) is moving circular economy and clean energy technologies out of the lab and into global manufacturing.

TRaCE offers:

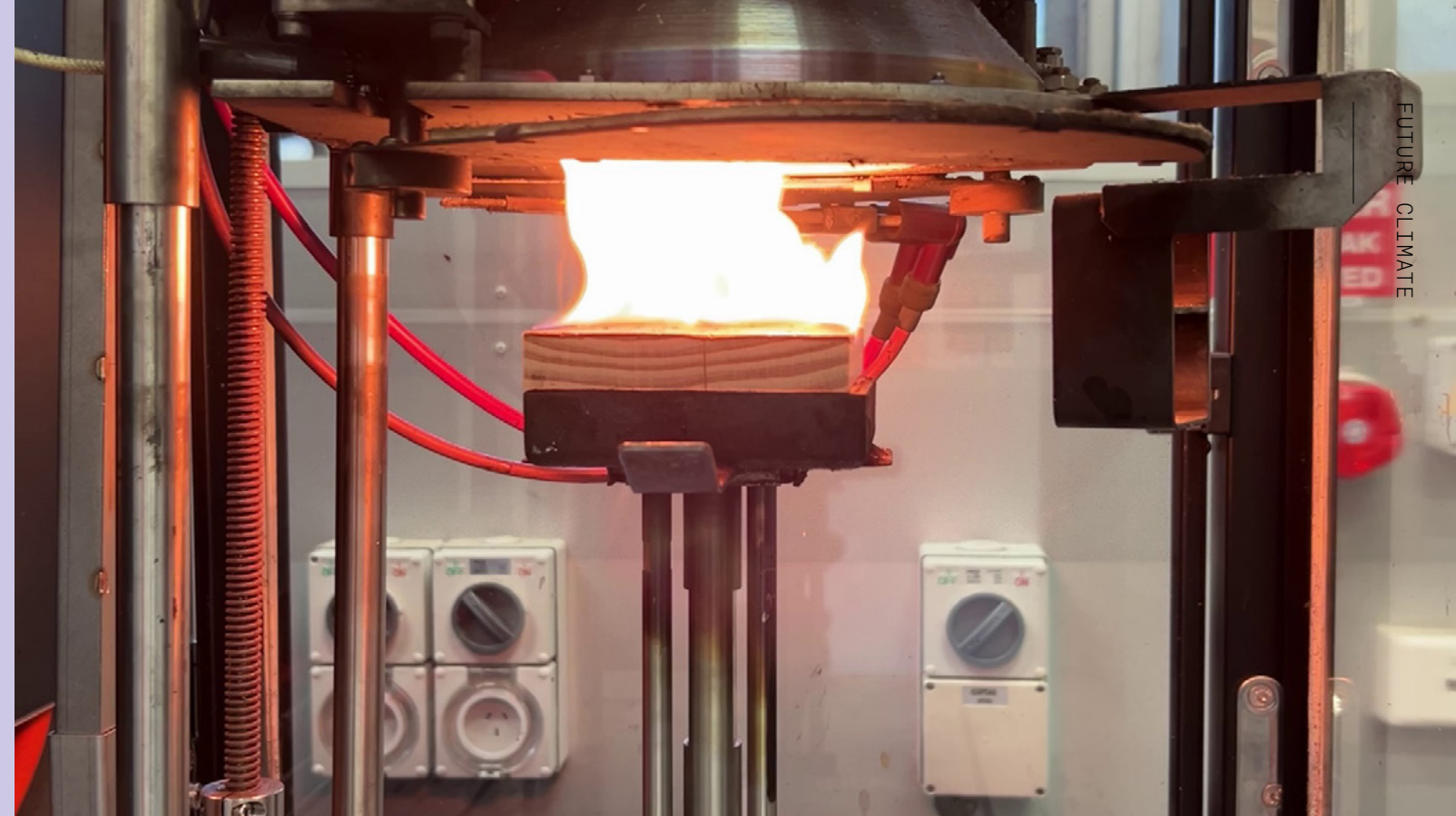
- World-leading researchers who are actively tackling the most significant challenges of the global net-zero transformation.
- Combined infrastructure, knowledge, and resources to mitigate risks in research commercialisation.
- Education pathways for industry co-design to address skills shortages effectively.
- A commercialisation ecosystem designed to accelerate the development and application of R&D solutions.

> Working with its industry partners, TRaCE is co-funding and fast-tracking \$117 million in R&D projects.

> Established \$67 million in transformative programs to support Australian SMEs and startups to commercialise climate technologies and address skills shortages.

> For more information please visit trace.org.au

Climate Extreme weather



> ARC training centre for fire safety

Protecting critical assets and infrastructure using bushfire resilience technologies

Research group

Australia's vulnerability to extreme weather conditions and the frequency of devastating natural and man-made fires are major risks to new and existing assets and infrastructure in bushfire-prone areas. The research group, in partnership with government entities and companies, has developed innovative fire protection and suppression technologies that will safeguard and minimise exposure to fire threats.

The team has developed an intumescent paint that expands due to heat exposure, providing insulation and preventing heat penetration. The paint produces a thick layer of char, which offers an insulating barrier and effectively deflects the fire's heat.

This new paint technology is commercially branded FSA FIRECOAT. It is manufactured locally by Flame Security International (FSI) and on sale at select Bunnings stores. It can be applied to a variety of surfaces, including existing render, timber, aluminium, steel, concrete, plasterboard, and brick.

> First paint to receive a BAL-40 rating. The paint can withstand severe exposure to radiant heat and ember attack and provides high protection in areas prone to bushfires.

> The commercial success of FSA FIRECOAT underscores the effectiveness of transforming academic research into practical, market-ready products that meet crucial societal demands.



> Climate change impacts on severe convective storms

• **Understanding changing severe thunderstorm hazards in a warming world**

Research project

Severe thunderstorms produce hazards that threaten lives and property, in the form of flooding rain, large hailstones, or extreme winds. While it is expected that severe storms will be affected by climate change, the exact nature of the changes remains difficult to quantify. Changes depend on the type of hazard and the location, while expected changes to the atmospheric 'ingredients' that influence severe storm hazards can offset each other. There are, therefore, a range of possible outcomes and high uncertainty around the evolution of severe storm hazards.

Dr Tim Raupach and the UNSW team work to increase our understanding of severe storms and reduce the uncertainty around climate change effects on these dangerous and costly phenomena. The research is relevant to the insurance, government, and weather forecasting sectors.

- > Received industry support from two insurance-sector companies to advance understanding of current and possible future storm hazards and support early-career researcher training.
- > Research outputs used by the insurance industry to assess current relative hailstorm risk.
- > Successfully ran the first Industry-Science Workshop on Severe Convective Storms at UNSW in 2023 to foster industry-academia collaborations in the severe storm space.

> Collective action & collaborative governance during climate-driven disasters

• **Investigating the novel organisational challenges posed by the increased occurrence, overlay, complexity, and impact of climate-driven disasters and crises**

Research project

Bushfires, floods, and tropical storms have rapidly evolved in scale, impact, and frequency. This constitutes a pressing challenge to our capacities for effective crisis planning, preparation, response, and recovery. This project brings together leading Australian and international scholars of management and governance to investigate the organisational challenges posed by the increasing complexity of these events.

Taking the Australian 'Black Summer' Bushfires 2019-2020 as a case study, the project seeks to inform societal resilience strategies in a climate-changed future. It focuses specifically on the implications of the evolving nature of climate-driven disasters for the design of crisis governance arrangements, the ability of actors to develop a level of coherence in decision-making and action, community capacities to recover, and our capacity to learn collectively. The project is at a mid-point with stakeholder forums, based on the findings to be held in 2025 and 2026.

- > Research insights bring together the perspectives of stakeholders across Federal and State emergency response services, public sector agencies, the not-for-profit sector, and community organisations involved in disaster recovery.
- > The Institute for Climate Risk & Response (ICRR) is using insights from this project to inform climate resilience education offerings for industry and government.



> Evil reflections from glazed facades

> Outcomes shared with Parramatta City Council to revise Development Control Plans.

> Different building designs have been tested.

Investigating how commercial building facades intensify street-level solar and UV exposure

Research project

Commercial buildings in Australia and abroad often employ glazing and other materials that reflect specularly (i.e. mirror-like) the direct radiation from the sun. This concentrates solar and UV radiation at street level. Famous cases include the egg-cooking Walkie-Talkie building in London, but it was not widely understood that 'normal' buildings also present this issue.

In Parramatta, UNSW research measured that solar radiation and total ultraviolet radiation were 20-25% higher at pedestrian levels in front of reflective buildings than in an open (unobstructed) location.

This unnatural level of solar and UV radiation increases thermal discomfort and skin cancer risk for people who work in the CBD and don't take the countermeasures (slip, slop, slap) they would when going to the beach.

> Flame security international

Protecting lives and assets from disastrous bushfires

Co-located company

Fires are an increasing threat to life and property due to climate change and Australia is one of the most fire-prone countries on the planet.

Flame Security International (FSI) develops game-changing products and technologies to help combat the impact of bushfire and structural fire. It recently launched two fire protection coating products under the trademark FIRECOAT.

The exterior coating allows treated structures to withstand flame intensity equivalent to BAL-40, which would significantly increase the chance of survival of assets in the event of bushfire.

The interior coating can substantially increase the time for occupants to escape the fire by delaying the spread of flame and subsequent collapse of internal walls. Several new products will be launched in 2024 that specifically target bushfire management and protection.

> Launch of FIRECOAT Exterior and Interior in collaboration with Bunnings in November 2023.

> FIRECOAT won the People's Choice Award through participation of Professor Guan Heng Yeoh in the 2024 Shaping Australia Awards.



> Future rainfall & its extremes

Advancing Australia's capacity to adapt to future rainfall with AI

Research project

This project will increase Australia's resilience to climate change by quantifying the nature, and associated risks, of changes in rainfall patterns and extremes.

Existing approaches are unable to interpret the change in rainfall over many regions in Australia due to the prohibitively high computational cost required to produce adequate information. This project uses AI to cut those costs and leverage a broader range of data.

The team works with government departments and the reinsurance sector to inform strategies worth billions of dollars in risk mitigation and adaptation, ensuring funds are directed towards initiatives that maximise resilience and minimise economic loss. The knowledge produced will benefit the government, businesses, and key sectors that include agriculture, energy, water, transport, and insurance.

> The innovative framework, combining AI and regional modelling, was highlighted at several National Partnership for Climate Projection gatherings, laying potential groundwork for a coordinated regional projection roadmap.

> The project received a Google Research grant for cloud computing, which contributed to the development of its AI framework.



> iFIRE

Intelligently and interactively reimagining extreme wildfire scenarios

Research project

The iFire system connects global researchers and 3D systems in the world's first artificially intelligent (AI) immersive environment able to visualise the unpredictable behaviour of extreme fires.

The 3D systems are networked across a range of platforms using software that enables users to interact with each other by sharing the same 3D setting in real-time, no matter their platform. Platforms range from mobile 3D cinemas, virtual production volumes, LED walls, and head-mounted displays to laptops and tablets, providing interaction for multiple distributed users simultaneously.

The software is underpinned by an AI framework that analyses, learns from, and responds to, individual and group behaviour in real-time.

Collaborators include UNSW iCinema Centre, UNSW Climate Change Research Centre, University of Melbourne, University of Canberra, CSIRO/ Data61, the Australian Broadcasting Corporation, Australasian Fire & Emergency Service Authority Council, Fire and Rescue NSW, and San Jose State University.

> A prototype Immersive Training Simulator will be installed at the Fire and Rescue NSW Emergency Service Academy for ongoing testing and development regarding firefighter situational awareness during extreme fires.

> ABC Online News will use the project's high-fidelity representation of extreme fires to inform the public about their dangers.

> The project has been invited to multiple international art exhibitions in Europe and Australia to showcase its developments.



> Marine heatwaves: a growing challenge for marine ecosystems

- > First global assessment of the socioeconomic impacts of marine heatwaves.
- > New understanding of how marine heatwaves can be triggered from distant key locations around the world.

• Multidisciplinary research into the causes and impacts of marine heatwaves

Research group

With continued global warming, marine heatwaves increasingly disrupt marine ecosystems and, in extreme cases, leading to mass mortalities of important species. This has resulted in losses of habit-forming species, fisheries closures, and disruption to tourism. Some extreme events have led to hundreds of millions of dollars in economic loss.

The Climate Change Research Centre – Ocean Extremes is working to understand what triggers these events, whether they are predictable, how they affect other extremes like terrestrial rainfall and tropical cyclones, and how they impact different marine species.

> Resilient towns initiative

Community-centred disaster preparedness and recovery for real

Research project

Following a disaster such as a bushfire or flood, community-centred recovery is considered the 'gold standard' by responding agencies, including government, emergency services and NGOs. In reality, top-down response often does not match bottom-up priorities.

Our Resilient Towns Initiative (RTI), a pilot project funded by Regional NSW, draws on lessons from international experience where recovery actions by responding agencies are informed by community priorities, voices, wants and aspirations. The team partnered with communities, NGOs, and state and local governments to test, refine and scale up their approach.

The project has facilitated community-prioritised risk reduction actions and employed 'big maps' to help communities identify and implement risk reduction and response strategies. This approach has been recognised and adopted by the NSW Reconstruction Authority and, in 2023, was shortlisted for a NSW Government award. Additionally, it has launched a new initiative called HowWeSurvive, which aims to reshape disaster recovery by prioritising community voices.

- > Adoption and scaling of a community-centred recovery approach by NSW Reconstruction Authority.
- > People and communities across several small towns in NSW enacted improved disaster recovery and preparedness activities.

> UNSW bushfire

Improving understanding of bushfires and associated processes, their relation to firefighter and community safety, and sustainable environmental outcomes

Research group

UNSW Bushfire is at the forefront of bushfire research in Australia and globally, with research focused on dynamic fire propagation, extreme fire development, critical fire weather events, fire behaviour modelling, ember spread, bushfire risk at the wildland-urban interface, and more.

UNSW Bushfire researchers conduct fundamental and applied research into bushfire drivers, behaviour and propagation, filling key knowledge gaps and developing scientifically rigorous models that integrate with fire safety and risk management systems.

State-of-the-art mathematical and computational tools are employed to understand and predict bushfire behaviour, the extremity and prevalence of which is amplified by climate change. The group has a particular focus on pyrocumulonimbus (pyroCb) firestorms, a catastrophic and non-suppressible manifestation of bushfire that is not adequately accounted for in current textbook and operational fire models. PyroCbs generate their own weather, creating violent and unpredictable bushfire conditions.

UNSW Bushfire's research has a significant real-world impact that has been adopted into new practical training materials and operational strategies for Australian bushfire agencies.

- > Contributed to the development of the new Australian Fire Danger Rating System and involved in the ongoing development of Fire Impact and Suppression Indices.
- > Key research findings have been incorporated into standard operating protocols for Fire Behaviour Analysts, informed new national firefighter education and training materials, and influenced how modern fire agencies monitor fire weather conditions.
- > Delivered a world-first warning system for extreme bushfires – an invaluable tool for firefighting services.



Climate

Waste reduction & recycling



> Converting coffee cups into asphalt additives

New EPA-approved technology that will divert up to 10,000 tonnes of paper and plastic waste into construction materials to build roads

Research project

State Asphalts NSW, a manufacturer of road products, partnered with the UNSW School of Civil and Environmental Engineering to incorporate recycled waste materials (coffee cups) into their asphalt production. The company accessed UNSW's resources and capabilities through a Cooperative Research Centre Project (CRC-P) grant and participated in UNSW's Australian Graduate School of Engineering (AGSE) Industry PhD Program. This partnership led to the refinement and commercialisation of PAK-PAVE Roads, an environmentally sustainable asphalt product, recently receiving full EPA and Transport for NSW approval.

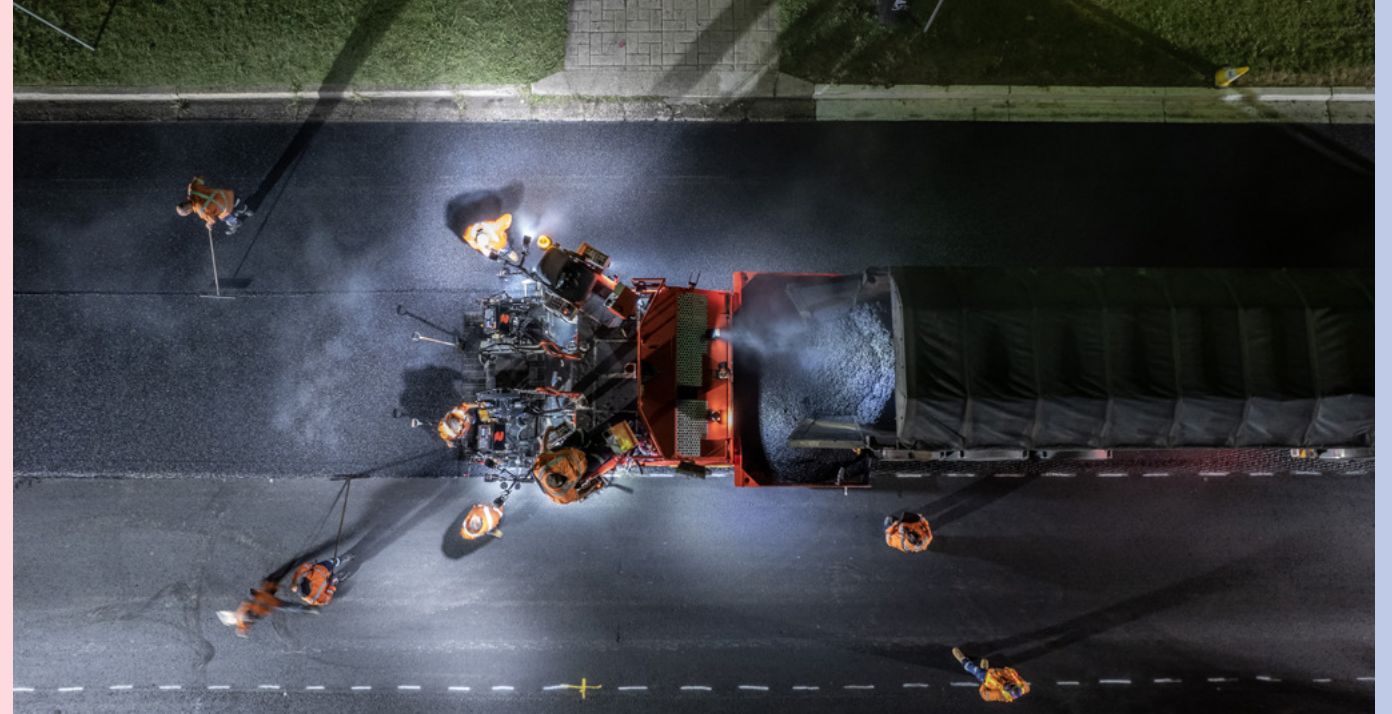
The collaboration involved in-depth investigations using high-tech imaging to analyse the behaviour of recycled materials in asphalt. The findings from this research were instrumental in the NSW Environment Protection Authority (EPA) and the commercialisation readiness of PAK-PAVE Roads. These roads offer significant environmental benefits in addition to their superior durability, wet weather skid resistance, and noise reduction due to their unique surface texture. They reduce carbon footprint by 24% and conserve raw materials, making them a sustainable choice for road construction.

With the recent EPA approval, PAK-PAVE Roads have completed trials and commercial demonstrations in Western Sydney, indicating their significant commercial potential. This successful initiative has paved the way for more collaborative research and prompted State Asphalts to adapt their HR strategy. In continued partnership with UNSW, they increasingly involve PhD students in practical, industry-based research projects, further enhancing the potential of PAK-PAVE Roads and the company's future sustainability efforts.

> Utilised UNSW's research capabilities to integrate recycled materials into asphalt, boosting sustainability.

> PAK-PAVE Roads: EPA & Transport for NSW approved product with a 24% reduction in carbon footprint and enhanced road safety features.

> Active trials in Western Sydney signal a promising commercial future and inspire ongoing research collaborations.





> Digital twin & land tenure engineering lab

- > The research outcome is licensed to a Melbourne-based company that uses it to save significant time and effort in 3D modelling while serving an international market.
- > The research outcomes are being adopted by a demolition company in NSW to develop sustainability indicators for their operations.

• Digital twins for climate action and innovation

Research Group

The Digital Twin & Land Tenure Engineering Lab revolutionises 3D infrastructure modelling for climate action. Traditional methods of generating digital twins from 3D images are manual, time-consuming, and expensive. In addition, Australia's reliance on offshore drafting services poses sovereign risks and limits scalability.

The lab pioneers automated digital twin creation methods that streamline infrastructure modelling and support climate action initiatives. By eliminating manual processes, the lab enables faster and more accurate representation of cities and infrastructure to facilitate effective planning and resource management. The lab's innovative approach promises significant cost savings and the creation of new jobs, while bolstering economic growth.

The lab seeks to advance sustainability efforts on a global scale by implementing its solutions to optimise the management of construction demolition waste, recover and recycle construction material, and apply quality control to minimise construction waste.

> Lithium-ion battery degradation & recycling

• Sustainable solutions for recycling lithium-ion batteries

Research group

Lithium-ion batteries, used in portable electronics, electric vehicles, and grid-scale energy storage systems, must be recycled or repurposed at end-of-life. As the adoption and use of these batteries increases, so too does the need for effective recycling strategies.

UNSW is advancing recycling technology by making it simpler and more accessible to the public. The team collaborates with industrial partners and research groups to: enhance efficiency and reduce complexity in recycling operations, explore the sustainable use of chemicals in recycling processes, and remanufacture and test recycled materials for battery production.

The scope of their research continues to expand, investigating solutions to the recycling challenges that loom on the horizon, including:

- Demonstrating that partner recycled materials are battery-grade ready.
- Mechanochemical milling as a route to minimise downstream chemical use.
- Short-loop recycling opportunities.
- Feasibility of single-source recycling.
- Alternative waste streams as sources for battery materials.

- > Created a short-loop recycling process that repurposes waste from various industries for use as electrodes or components in lithium-ion and next generation batteries.
- > Demonstrated that materials from lithium-ion batteries can be recycled and used to create new lithium-ion batteries.



> New catalysts for advanced plastic recycling

• **Designing innovative catalytic materials and chemical processes to convert plastic waste into plastic polymers and high-value products**

Research project

One person uses about 50kg of plastic every year. A third of that plastic is single use. Only 6% of plastic feedstock is made from recycled materials, and the rest is fossil-based. In this scenario, developing new plastic recycling technologies that allow widespread and efficient recycling is imperative.

Catalytic hydrogenolysis on supported metal nanoparticles has recently emerged as a promising technique for converting polyolefin-based plastic waste, such as polyethylene and polypropylene, into useful products under moderate conditions. However, more control over product distribution is needed for this process to be employable at an industrial scale.

Using computational chemistry tools, this project seeks to understand how the nanoparticle design can narrow the product distribution and scale-up this technology. It involves strong collaboration with leading experimental scientists working in nanoparticle synthesis and plastic recycling.

> Established accurate models and protocols to simulate the catalyst surface under experimental conditions.

> Built a strong, international team of computational and experimental scientists to collaborate on the project.

> The use of geopolymers concrete incorporating recycled glass was showcased in collaboration with the industry partner, John Holland.

> The initiative has secured over \$6 million in grant funding.

> The PhD research associated with this project has been published in reputable journals such as *Resources, Conservation and Recycling*, and nominated for the Dean's Award.

> Resource recovery for sustainable construction

• **Adopting circular economy for low-emission and clean construction technologies**

Research group

Coal fly ash, produced by combustion in coal-fired power stations, has been a staple supplementary cementitious material (SCM) in the construction industry for decades and is expected to remain crucial. In alignment with the Paris Agreement, Australia has phased out multiple coal-fired power plants in recent years, leading to a decrease in coal energy production and, consequently, the reduced availability of coal fly ash. The price of coal fly ash is expected to rise as the transition to a fossil-free future progresses and the need for substitute materials is clear.

UNSW research is exploring the use of thermally-treated soil and recycled glass as replacements for coal fly ash in concrete. It also investigates the feasibility of producing cement-free construction components.



> SMaRT developed green ceramics partnered with noveco surfaces

- > Secured both Innovation and Standard patent for a proprietary method of using waste to create high-performing surface products.
- > Transitioned from lab-based innovation to a fully commercialised production site, built directly into Shoalhaven Waste Centre to streamline raw material access.
- > Will achieve nearly \$1M in revenue from tile and benchtop sales in the first full year of production, with triple-digit growth anticipated in FY25.

Developing an engineered stone alternative with green ceramic technology

Technology licensee

Noveco Group has partnered with the inventors of green ceramics, the SMaRT Centre at UNSW, to become the official technology licensee and exclusive manufacturer of Noveco Surfaces.

Made from waste glass and textiles that are traditionally not subject to recycling, Noveco Surfaces is a new generation of high-performance surface products (tiles and benchtops) and furniture for architectural and decorative applications.

With the ban on engineered stone for benchtops, this non-crystalline, silica-based product could disrupt a \$300M+/year market.

> Smarter regulation to save more of Australia's food

Uncovering smarter legal and policy solutions to keep more food in our food systems and better manage unavoidable food waste

Research project

Australia's waste of food imposes at least \$36 billion in economic, social, and environmental costs each year, making it one of the country's largest market and regulatory failures. In recent years, Australian governments have escalated their responses to this problem through an expanding range of regulatory tools. However, research shows we need stronger action to ensure Australia achieves its 2030 target of halving food waste.

Government responses address two separate but related problems: the need to save more food for human consumption, and the need to better manage the remaining food waste. One example is encouraging the reuse of food waste on farms as compost or biosolids from sewage treatment facilities, however this can create health risks if the flows of waste are not well regulated.

To tackle these twin problems and move closer to achieving the 2030 target, UNSW research uncovers nine smarter, evidence-based approaches.

- > A significant research proposal that mandates the reporting of wasted food levels by large food businesses and institutions throughout the NSW food supply chain has been included in the NSW Parliament's Food Production and Supply 2022 report.
- > The Food Production and Supply 2022 report has also adopted a proposal recommending that NSW update its waste policy to incorporate a new strategy for addressing food waste.



- > RHelped Canberra's premier concrete supplier reduce cement content by 7% in production.
- > This has decreased embedded carbon in about 30% of Canberra's concrete structures over the last five years.
- > The rammed-earth research project pioneers eco-friendly construction techniques in Canberra's Dairy Road precinct by reusing on-site soil.

> Sustainable infrastructure research group

• **Empowering communities and industry toward net-zero through sustainable infrastructure and circular economy innovation**

Research group

Sustainable infrastructure is essential in today's world, and the Sustainable Infrastructure Research Group is at the forefront of this innovation. The team recognises the importance of balancing functionality, efficiency, and environmental stewardship in constructing our future. It aims to develop solutions that meet current needs while paving the way for a greener, more equitable tomorrow.

The researchers actively collaborate with government bodies, industry leaders, and research institutions to tackle the complex challenges of sustainability. Their multidisciplinary approach, which includes innovative structural systems and cutting-edge construction materials, facilitates tangible change.

The group's impact extends beyond academic publications. It has influenced local concrete practices, significantly reducing cement use and carbon emissions. Additionally, the group is a pioneer in rammed-earth construction within the Dairy Road precinct in Canberra, contributing to the development of a sustainable, regenerative community.

The Sustainable Infrastructure Research Group is dedicated to constructing a future where infrastructure fulfils human needs while preserving the planet for future generations.



> TRaCE SMaRT Centre x Jamestrong packaging green aluminium

• **Sustainably remanufacturing waste into green aluminium for packaging**

Research project

Worldwide, supply chain challenges have led to an increased interest in the circular economy, with the remanufacturing of engineered products emerging as a smart solution.

Jamestrong is a regional manufacturer of aluminium packaging used by Australian and international brands wanting to deliver more sustainable outcomes. The company has joined forces with Professor Veena Sahajwalla and her team at the UNSW SMaRT Centre to explore how they can repurpose waste as a resource in their Taree-based aluminium plant.

Their ground-breaking project positions Jamestrong as a global leader, becoming one of the first aluminium aerosol-can manufacturers to produce cans from recycled content while also using non-recyclable waste containing mixed materials, such as plastics.

Supported by the Trailblazer for Recycling and Clean Energy (TRaCE) program, this Green Aluminium partnership is set to commercialise UNSW SMaRT Centre's advanced MICROfactorie™ recycling technology into Jamestrong's manufacturing process.

- > Proven technology to recover clean, green aluminium from waste packaging.
- > Foundation laid for a new casting process that will enable waste remanufacturing into aluminium feedstock.



> UNSW Promo lab – solar panel recycling program

- > Development of new delaminator and leaching prototypes, as well as off-gas and wastewater treatment units.
- > Formulated advanced numerical models to optimise the prototypes' design for the mobile-based recycling system.
- > Established a whole, pilot-scale recycling system.

• Novel recycling technology for end-of-life silicon photovoltaic panels towards a circular economy

Research group

The current low efficiency and poor flexibility of recycling technologies for end-of-life silicon photovoltaic panels are impractical and impede industry commercialisation.

Inspired by hydro-metallurgy engineering, this project is developing highly efficient, mobile and flexible recycling technologies to recover valuable metal, glass, and silicon from end-of-life solar panels.

The project is informed by interdisciplinary research expertise from UNSW, University of Sydney and University of Technology Sydney in the fields of process and reactor design, solar panels, catalysis, and metallurgy. The team also collaborates with leading solar-industry representatives from across the supply chain.

The project is currently in the early stages of industry scale-up.

> Vecor ceramics

• Incorporating state-of-the-art ceramics for high-performance applications in paints, coatings, rubber, and plastics

Research project

The Vecor Ceramics project builds on an enduring research partnership with UNSW that has led to significant outputs in transformation and high-volume use of industrial by-products. The current project aims to develop value-added aluminosilicate products from industrial by-products to partially replace expensive mineral components in multiple applications, including paints, industrial coatings, rubber, and plastics.

The research uses patented processing and engineering of the morphological, chemical, and optical properties to enable these advanced materials to deliver economic and environmental benefits while meeting performance metrics (mechanical, thermal, and tribological).

The project is focused on extending the fabrication process from laboratory-scale to pilot-scale. It also conducts lifecycle assessment (LCA) and lifecycle costing (LCC) to validate environmental and economic superiority in comparison to current technologies.

- > Addition of VCP to plastics and rubbers as a replacement for inorganic fillers resulted in faster processing times and excellent mechanical properties.
- > Addition of VCP as an extender to architectural paints resulted in coatings with comparable optical properties at lower economic costs.

> WorkbenchX

Circular economy supply chain platform that closes the loop for industrial components

Founders start-up

Over 90% of industrial equipment components are scrapped because it is:

- Easier and less expensive than capturing the residual value.
- Hard to find, and manage, value retention partners.
- Expensive to assess the condition of the core at end of use.

Discarding these components wastes raw materials that contain embodied energy with intrinsic value. It also results in the use of more carbon-intensive processes to convert scarce raw materials into new components.

WorkbenchX is building the world's first Circular Resource Planning (CRP) software platform to solve this problem. The evolution of Enterprise Resource Planning (ERP) is designed to facilitate circular economy supply chains.

WorkbenchX's innovative network platform:

- Connects businesses that support circular processes of reuse, repair, refurbishment, remanufacture, repurpose, and recycling.
- Assesses the quality of end-of-use equipment with AI-based advanced quality control methods.
- Tracks financial and ESG metrics through the lifecycle with Digital Product Passports.
- Securely exchanges data between original equipment manufacturers (OEMs), customers, and suppliers.

> Raised \$630k in 2023 through equity and grants.

> Significant pull from large OEMs looking for solutions to support circular economy transactions.





**Discuss your project or idea
with UNSW**

