Sydney Horizon Fellowships

THE UNIVERSITY OF SYDNEY

Sydney Horizon Fellowships

2024 COHORT

The Scheme, the support and the Fellows

We recognise and pay respect to the Elders and communities – past, present, and emerging – of the lands that the University of Sydney's campuses stand on. For thousands of years they have shared and exchanged knowledges across innumerable generations for the benefit of all.

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About the Scheme

The University of Sydney's flagship fellowship scheme, the Sydney Horizon Fellowships, empowers the world's best and brightest emerging academics to undertake innovative research that will contribute to the common good by addressing the complex challenges of climate change, health and sustainability.

The Sydney Horizon Fellowship Scheme demonstrates our strong commitment to early and mid-career researchers in the increasingly competitive and challenging landscape of academia.

The first program of its kind in Australia, it is designed to empower outstanding academics to focus on research, take risks, develop big ideas and establish a cohesive community to address the world's greatest challenges.

Climate change, health and sustainability are the most pressing challenges of our time. They are complex, and it is increasingly clear that they are interconnected. The Horizon Fellowship Scheme recognises that we need to develop bold new approaches to tackling these challenges, and that exploring their intersections from a multidisciplinary perspective holds the key to shaping a brighter future for us all.

Our Horizon Fellows represent some of the best emerging talent the world has to offer. I have no doubt that the comprehensive support this Scheme provides will accelerate their ambitious research programs, enable them to develop innovative solutions and place them firmly on the path to becoming Australia's future research leaders.

Prof Emma Johnston
Deputy Vice-Chancellor (Research)

From across the University, staff have come together to bring the Sydney Horizon Fellowship Scheme to life. This collaborative effort exemplifies our unprecedented commitment to supporting the best and brightest emerging researchers to maximise their potential and build a pipeline of future research leaders.

The Scheme will enable us to accelerate opportunities for further growth in increasingly pressing research areas, amplifying the impact of research that attempts to solve the greatest challenges for the common good.

I am delighted to see how the inaugural round has brought together a truly multidisciplinary and exceptional cohort of Horizon Fellows. Each and every Horizon Fellow will have a unique research journey and I am excited to see where their journey takes them in the years to come.

Prof Ben Eggleton
Pro-Vice-Chancellor (Research)

The Sydney Horizon Fellows are in an exciting position to role model exemplary global research leadership for future generations. They will be supported to be champions for collaborative and multidisciplinary research, and generous and resilient leaders. Through their outstanding research leadership, the Fellows will have positive influences on our university culture.

I am excited to see how the Fellows embrace this opportunity and make the most of the training, development and mentorship they are provided as they grow and scale their research. In particular, I am looking forward to seeing how they embrace the roles of supervisor and mentor, and support each other as they grow as a cohort. I know that the Horizon Fellows will influence future generations of researchers who come through their research programs and collaborations for decades to come.

My team and I are committed to assisting the Horizon Fellows to realise their potential and maximise the positive effect they can have on making the world a better place.

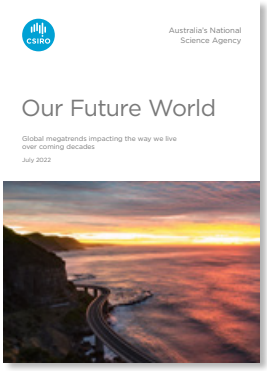
Prof Louise Sharpe
Pro-Vice-Chancellor (Researcher Training)

Overview of the Scheme

The Sydney Horizon Fellowship Scheme is a cornerstone of the University's Sydney in 2032 strategy and delivers on its ambition to be world-leading in research that benefits society at large.

The Scheme has enabled us to commit to the best and brightest early and mid-career researchers, whose focus on the complex challenges of climate change, health and sustainability will deliver outstanding research that addresses the greatest challenges for the common good.

In the process of designing the Scheme, 12 research clusters were identified in consultation with the University's faculties, schools and multidisciplinary initiatives (MDIs). These clusters established exemplary focus areas that would amplify the University's current and emerging disciplinary strengths. Underpinned by their links to CSIRO's global megatrends report, all clusters are aligned to the United Nations' 17 Sustainable Development Goals (SDGs).



CSIRO's global megatrends report

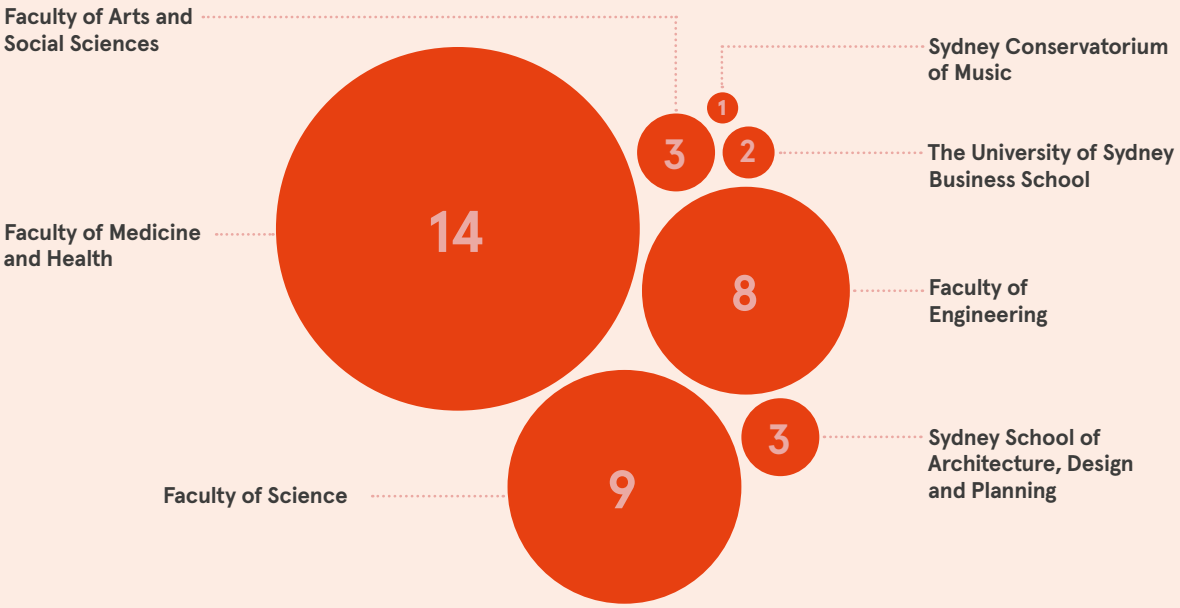
United Nations' 17 Sustainable Development Goals

From 12 initial research clusters, three thematically-linked research challenges emerged: *climate change, health and sustainability.*

Climate change, health and sustainability are core areas of need and growth in the Australian and global research ecosystems. Australia is highly vulnerable to the impacts of climate change, biodiversity loss, and related health impacts due to its unique ecosystems, agricultural systems, and coastal communities; we rank 22 out of 193 countries in the recent World Risk Report. Of the 'megatrends' that CSIRO found will shape research needs in the next 20 years, climate, health, and sustainability are the top three.

Fellowships awarded

The inaugural round of the Scheme saw a high quantity of extremely competitive applications, with 1,462 applications received from 66 countries, and candidates applying to every faculty and university school. After a rigorous selection process, 40 Horizon Fellowships were awarded to outstanding researchers as detailed below:



Dr Natalie Matosin

Dr Mengyu Li

Dr Shawna Foo

Dr Federico Tartarini

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Horizon Fellowship support

In addition to what is provided by local areas, Horizon Fellows receive targeted support from the Horizon Fellowship Project Team and Researcher Development Unit. In collaboration with other teams within the Research Portfolio, the aim is to pave the way to research success.

Support teams

There are two key teams within the Research Portfolio who provide support for the Horizon Fellowship cohort – the Horizon Fellowships Project Team and the Researcher Development Unit.

Support teams: (L–R) Alison Ward, Pat Songkhunawej, Eleanor Baker, Richard Withers.

Horizon Fellowship Team (HFT)

First point of contact for any 1:1 advice and introductions that will assist the fellows in their position, the HFT will partner with the RDU to ensure individual introductions and existing opportunities for development are provided.

Researcher Development Unit (RDU)

Responsible for the design and delivery of the development program, the RDU will work with Fellows by providing access to individual and existing development opportunities.

As the **Horizon Fellowship Project Team**, we manage the operations of the Scheme, from its design to coordinating the recruitment process and implementing its delivery.

We collaborate with a wide range of teams – both throughout the Research Portfolio and across areas such as HR, Finance, Advancement, External Engagement, Media and Marketing – as well as academic leadership staff from all faculties and university schools. As such, we consider ourselves the first point of contact for any questions or 1:1 advice related to the Scheme, including its guidelines, and expectations.

We appreciate that navigating the University and its many systems, policies and processes can be a challenge. We are fortunate to have an extensive network of contacts within the Research Portfolio and across the University. To that end, we are always happy to assist with finding the appropriate support or with any questions about the Scheme.

Richard Withers and Pat Songkhunawej
You can contact us at horizon.fellowships@sydney.edu.au

As part of the **Researcher Development Unit** we are excited to be providing the Horizon Fellows with a series of training and development opportunities that align with current best practice and are influenced by the insights of University research leaders.

The Horizon development program is not restricted to training. It encompasses many types of learning and growth, including experiential and social learning, allowing Fellows to learn from each other, from mentors and experts, and from direct experience as well as group workshops.

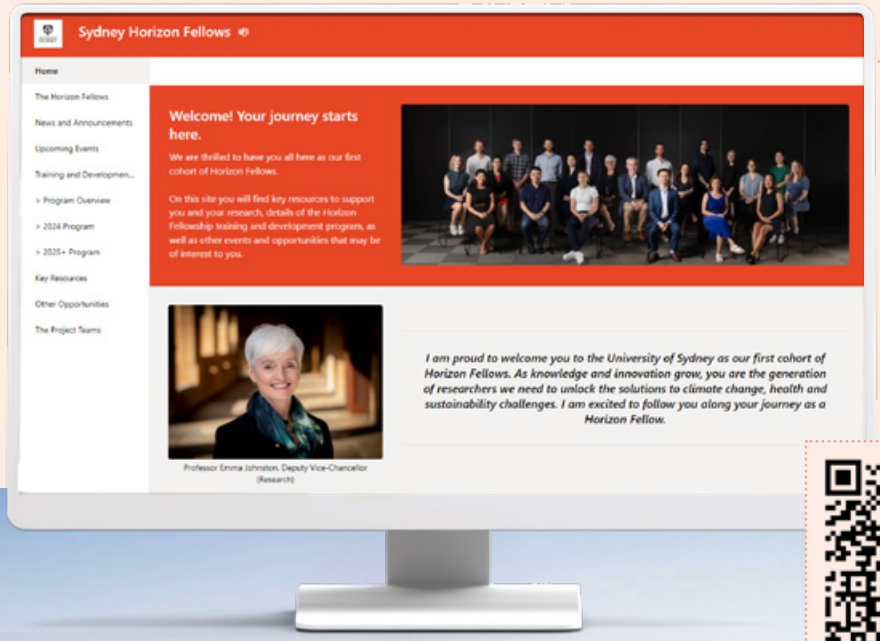
The program focuses on research leadership and provides access to other opportunities across the wider University community. There is no single path to becoming an effective research leader, so we will help the Fellows forge their own whilst enabling them to realise their research visions.

Alison Ward and Eleanor Baker
You can contact us at rdu.horizon@sydney.edu.au

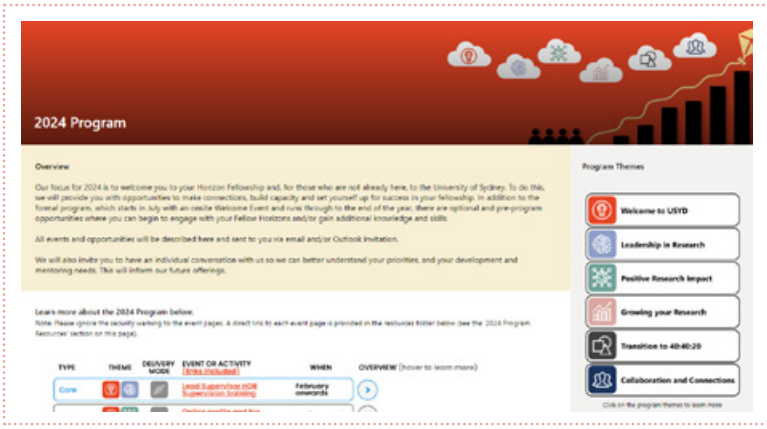
The Horizon Hub

The Horizon Hub is an online space to support the Horizon Fellows during their tenure. It will allow them to connect with other Fellows, see details of the Scheme and the training and development program, and find additional events and opportunities.

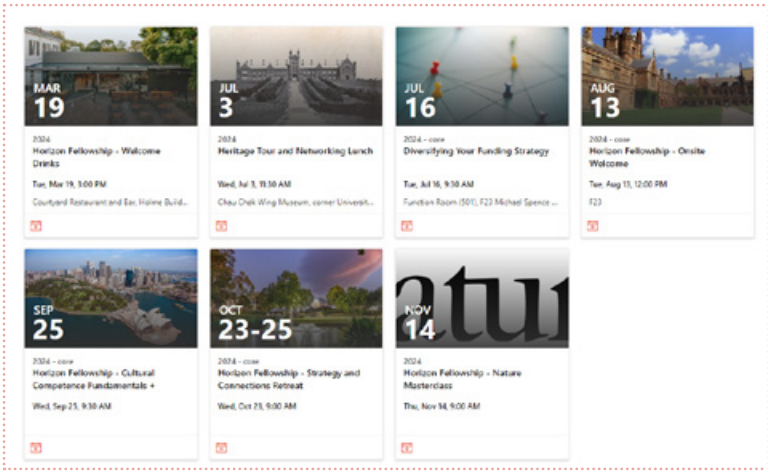
Throughout the five-year Horizon Fellowship journey, we will continue to add important resources, promote relevant events, and post cohort highlights through this Hub.



Horizon Fellows can access the Horizon Hub here.



Program training and development.



Events and opportunities.

Learn more about your fellow Horizons.

Training & development program

The Sydney Horizon Fellows are future global research leaders. To set them up for success, their training and development program will focus on the core elements of research leadership.

Program themes

The program is underpinned by the cross-cutting themes of **collaboration** and **connection** to support individual and Horizon Fellowship success. It is designed to flex according to individual needs, whilst supporting the cohort to grow together as a cohesive group throughout their 5-year fellowship.

It aims to enable Fellows to thrive at the University and in their research careers through supporting their research leadership growth under five key themes:

Welcome to the University

Enable successful navigation of the University 'system' and create lasting connections.

Leading research teams

Develop generous, resilient and collaborative leaders, able to assemble, align, inspire and lead high functioning teams.

Generating research impact

Enable the effective design and dissemination of impactful research, responding to complex global challenges and contributing to the common good.

Cultivating research programs

Lead, enable and support the growth of effective research programs delivering innovatively, sustainably and at scale.

Transition to 40:40:20

Prepare for the expansion of Fellows' roles by increasing teaching and GLE skills and experiences.

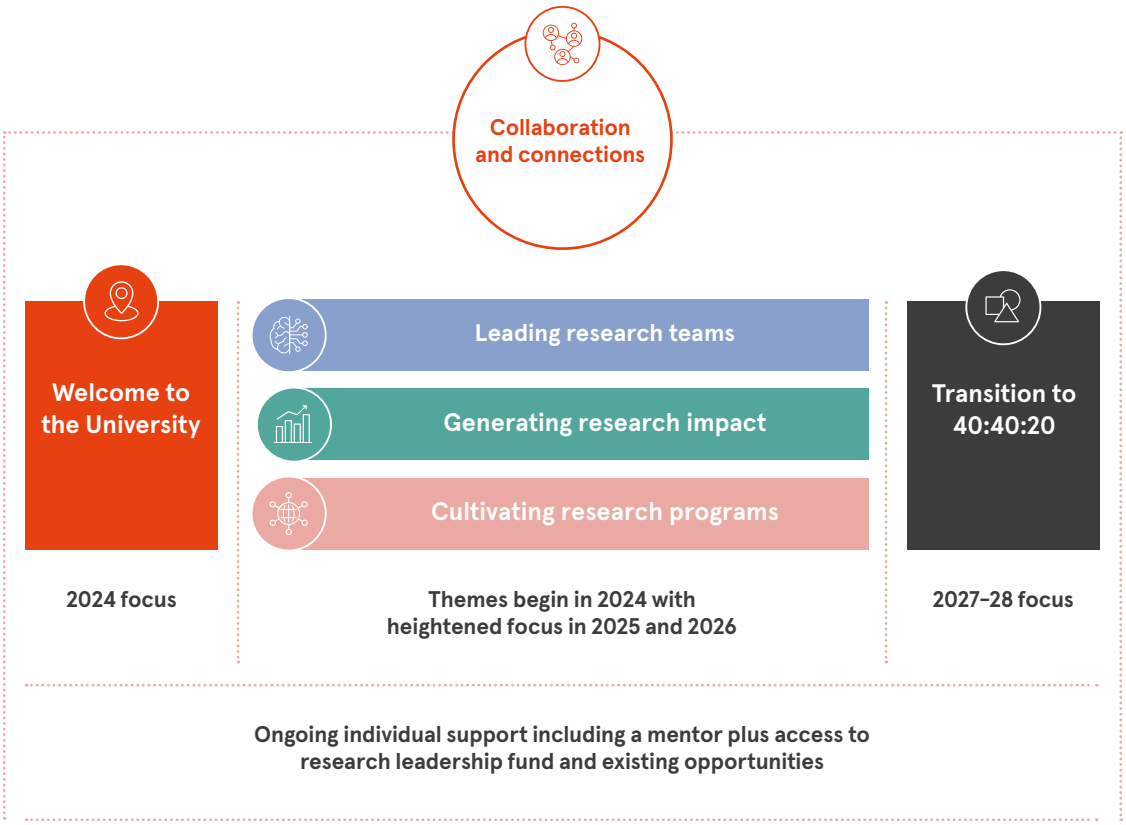
Program principles:
collaboration and connection.

Program delivery

The core themes of **leadership**, **impact** and **research** are integral to all offerings within the development program, with a particular focus in the middle years of the Fellowship. They are bookended by the **welcome**, aiming to set Fellows up for success at the University and build a cohort community; and the **transition**, aiming to support Fellows as they move towards increased teaching and service responsibilities.

The program consists of a combination of core and optional components. Participation in the core elements of the program is expected, some will be delivered in group format, others as 1:1 support.

Development is also available in various formats and from various teams across the University both locally and centrally. These can provide targeted support for individual or discipline-specific needs and the Fellows are encouraged to make use of them wherever they add value.'



Fellows will be able to access **development support** through three delivery modes.

The **group program** contains much of the core research leadership development, with additional social opportunities also made available.

Individual support and access to **existing programs** supplement the group program to provide more bespoke opportunities, acknowledging that no two routes to success are the same.

Year 1 Program: Welcome to the University of Sydney

Opportunities to build social connections

19 March
Informal welcome drinks

16 May
Tour of Sydney Nano and Horizon Fellow Ting Rei's lab

3 July
University heritage tour

25 September
Tribal Warrior cruise

Group program

16 July
Diversify your funding strategy seminar

13 August
Formal welcome event

13 August
Drinks with the Vice-Chancellor, Deputy Vice-Chancellor (Research) and guests

25 September
Cultural competence fundamentals workshop

23–25 October
3-day off-site connections retreat

Individual and existing opportunities

From commencement
Introductory meetings with the HFPT and RDU

Mentor matching

Academic Profile Online writing support

Choice of 3 programs per year
HDR lead supervisor training

As required
Small group media training

Funding strategy conversations

4 June & 14 November
Nature masterclasses

Horizon Fellows can access more information and resources including slides and recordings from this year's events on the Horizon Hub, along with more information about future years' offerings.

Dr Stephanie Partridge

Dr Alison Peel

Dr Ting Rei Tan

Dr Ann Na Cho

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Meet the Horizon Fellows

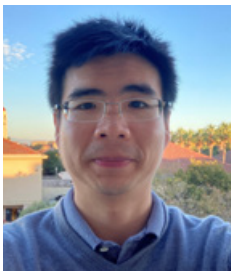
The 2024 cohort of Horizon Fellows are embarking upon an exciting array of diverse projects within the spheres of climate change, health and sustainability research.

2024 Horizon Fellows

Horizon Fellow	Faculty/University School	Climate Change	Health	Sustainability
Dr Sid Assawaworrarit	Faculty of Engineering	✓		✓
Dr Phillip Baker	Faculty of Medicine and Health		✓	✓
Dr Katrina Champion	Faculty of Medicine and Health		✓	
Dr Ann Na Cho	Faculty of Engineering	✓	✓	✓
Dr Wesley Dose	Faculty of Science	✓		✓
Dr Nicholas Fancourt	Faculty of Medicine and Health	✓	✓	✓
Dr Jasmine Fardouly	Faculty of Science		✓	
Dr Shawna Foo	Faculty of Science	✓		✓
Dr Shamila Haddad	Sydney School of Architecture, Design and Planning	✓	✓	✓
Dr Steffen Herff	Sydney Conservatorium of Music		✓	
Dr Aaron Jenkins	Faculty of Medicine and Health	✓	✓	✓
Dr Haihui Joy Jiang	Faculty of Science	✓		✓
Dr Danielle Kent	The University of Sydney Business School	✓		✓
Dr Liliana Laranjo	Faculty of Medicine and Health	✓	✓	✓
Dr Jiaying Li	Faculty of Engineering		✓	✓
Dr Mengyu Li	Faculty of Science	✓	✓	✓
Dr Elie Matar	Faculty of Medicine and Health		✓	
Dr Natalie Matosin	Faculty of Medicine and Health	✓	✓	✓
Dr Archita Mishra	Faculty of Medicine and Health		✓	✓

Horizon Fellow	Faculty/University School	Climate Change	Health	Sustainability
Dr Neda Mohammadi	Faculty of Engineering			✓
Dr Barbara Barbosa Neves	Faculty of Arts and Social Sciences		✓	✓
Dr Stephanie Partridge	Faculty of Medicine and Health	✓	✓	✓
Dr Alison Peel	Faculty of Science		✓	✓
Dr Zengxia Pei	Faculty of Engineering	✓		✓
Dr Mitchell Sarkies	Faculty of Medicine and Health		✓	
Dr Alistair Senior	Faculty of Science		✓	✓
Dr Arman Siahvashi	Faculty of Engineering	✓		✓
Dr Ting Rei Tan	Faculty of Science		✓	
Dr Federico Tartarini	School of Architecture, Design and Planning	✓	✓	✓
Dr Cara Vansteenkiste	The University of Sydney Business School	✓	✓	✓
Dr Blanche Verlie	Faculty of Arts and Social Sciences	✓	✓	✓
Dr Conrad Wasko	Faculty of Engineering	✓		✓
Dr Lee White	Faculty of Arts and Social Sciences	✓	✓	✓
Dr Kerrie Wiley	Faculty of Medicine and Health		✓	✓
Dr Aoni Xu	Faculty of Engineering	✓		✓
Dr Chun Xu	Faculty of Medicine and Health		✓	
Dr Jingjing You	Faculty of Medicine and Health	✓	✓	✓

Climate change | Sustainability



Dr Sid Assawaworrarit

Faculty of Engineering
School of Electrical and Computer Engineering

Using electromagnetics to solve energy and climate challenges

From solar energy to electricity transmission, the science of electromagnetics plays an important role in climate and energy applications.

Dr Sid Assawaworrarit is an electrical engineer who has garnered international acclaim for his pioneering work at Stanford University, where he developed novel ways of moving energy wirelessly, using light to convert one voltage supply to another, and harvesting renewable energy out of the cold universe.

His Horizon project will apply these theories of electromagnetics to solve some of the world's most intractable energy and climate challenges.

Photonics for energy applications

Dr Assawaworrarit was part of a collaboration that developed photonic transformers, a new method that uses light for dc voltage conversion. This innovation holds great promise for developing a dc converter for use in electronic devices that is efficient, noiseless, and can be integrated on a chip.

The Horizon project will investigate design improvements to enhance the robustness of photonic transformers, potentially creating a new paradigm for dc voltage conversion.

Dr Assawaworrarit has previously used radiative cooling to harvest renewable energy. He will now explore the potential of this method for cooling the earth, and potentially develop new materials such as paint and coating that will cool buildings.

He will also initiate a comprehensive research study looking at the potential of radiative cooling to alleviate global warming. This study will leverage photonics engineering to minimise absorption of solar heat and efficiently eject heat into the universe.

Robust wireless power transfer

While at Stanford, Dr Assawaworrarit developed a new method for transferring power wirelessly, based on parity-time symmetry.

This new adapts automatically to variations in transfer distance between the source and load, ensuring robust performance.

He will now broaden the research to achieve robust and efficient dynamic wireless power transfer to various scenarios.

Research keywords

Energy, Electrical and Electronic Engineering, Applied Physics.

Research methods

- Computational modelling
- Design and prototyping
- Science material
- Climate modelling
- Wireless/electronics work

Learn more or get in touch

Email:
sid.assawaworrarit@sydney.edu.au

Health Sustainability

Dr Phillip Baker

Faculty of Medicine and Health
Sydney School of Public Health

Putting sustainable first-food systems on the agenda

There is international interest in radical reform of our food systems to ensure food security and nutrition for future generations. But what's missing from the debate is the food consumed by infants and very young children.

That's largely because breastfeeding and infant feeding have historically been regarded as a health issue. Feeding children is highly gendered that has been ignored or deprioritised in debates about food systems and food sustainability.

Elevating the visibility of first-food systems

Dr Phillip Baker, a social scientist with a national and international reputation in the field of public health nutrition, is undertaking a Horizon project that is attempting to change this paradigm.

His work is trying to elevate the visibility of infant and young child nutrition in the food systems transformation agenda. He says feeding young children should be recognised as a crucial form of food security that should be valued and supported by research, policy and practice.

Work undertaken as part of his ARC Future Fellowship, recently published in *The Lancet* breastfeeding series, made the point that first-food systems should be included in UN Food standards. He says infant feeding is actually a carbon offset and should receive investment on that basis.

A first-food systems conceptual framework

Dr Baker's research program aims to synthesise a first-food systems conceptual framework, increase understanding of infant and young child diets in different countries, and understand how to generate political commitment for healthy first-food diets from sustainable first-food systems.

He is using systems approaches to accomplish these goals. His work is not interested in individual choices around breastfeeding or child nutrition, but rather the global systems that influence the diets of infants and young children and the effects of these on human and planetary health.

Research keywords

Nutrition & dietetics; public, environmental & occupational health; health policy & services.

Research methods

- Literature review
- Expert Delphi survey
- Interviews
- Descriptive statistics; multi-indicator cluster analysis
- Documentary analysis; case studies

Learn more or get in touch

Health

Dr Katrina Champion

Faculty of Medicine and Health
Sydney School of Public Health

MDI: Brain and Mind Centre

A digital intervention for a healthier lifestyle and better mental health

Addressing physical and mental health issues in adolescence presents a real opportunity for change, as establishing healthy behaviours at this age can set people on a more positive trajectory throughout the rest of their lives.

With increasing numbers of young people experiencing depression and anxiety as well as obesity, public health researcher Dr Katrina Champion's research focuses on the intersection of healthy lifestyle and mental health.

She is Program Lead of Healthy Lifestyles Research at the Matilda Centre for Research in Mental Health and Substance Use, where she is an expert at developing digital interventions to promote behaviour change in adolescents.

The Big 6 risk factors

The most significant risk factors for both mental health disorders and obesity are poor sleep and screen time, along with physical inactivity, poor diet, alcohol use and tobacco use (the Big 6 risk factors).

Dr Champion has previously addressed these risk factors through a digital school-based program she developed called Health4Life. It is delivered to Year 7 students in PDHPE class in the form of an online comic containing embedded health promotion messages.

Her randomised controlled trial in 6,640 Year 7 students showed Health4Life significantly increased students' knowledge of risk factors for up to two years, and reduced symptoms of depression and psychological distress.

Implementing the program

The Horizon project continues this research, looking at how to improve implementation, in collaboration with students and parents and by introducing new technology.

Dr Champion is developing a new intervention for young people from socially disadvantaged backgrounds, who are disproportionately impacted by the Big 6 risk factors, and is also addressing emerging threats to adolescent health such as vaping.

All her work is closely informed by young people themselves, and her collaborations with teachers, parents and adolescents increase the likelihood her interventions will be implemented effectively in order to achieve impact.

Research keywords

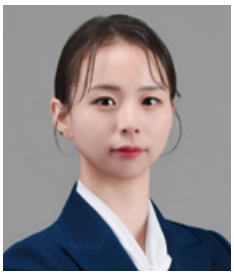
Substance Abuse; Public, Environmental and Occupational Health; Psychology; Pediatrics.

Research methods

- Digital health
- Co-design
- Multiphase Optimisation Strategy
- Randomised clinical trial

Learn more or get in touch

Climate change | Health | Sustainability



Dr Ann Na Cho

Faculty of Engineering
School of Biomedical Engineering

MDI: The University of Sydney Nano Institute, Charles Perkins Centre

The most complex human brain organoid ever developed

Dr Ann-Na Cho is a stem cell engineer, bio-manufacturer and neuroscientist who is recognised internationally for her work developing human brain organoids.

Brain organoids are miniaturised human platforms that mimic key features of the human brain, including cell composition and functionality.

They resemble the early embryonic human brain, so can be used to study brain development and also recapitulate brain-related disease, including neurological disorders, and test the effects of new drugs – without the need for animal testing.

Challenges

There have been significant challenges to the practical application of organoids, including immature functionality. Over the past 10 years, Dr Cho has overcome many of these problems by incorporating tissue engineering methodologies into the production of brain organoids.

She established the world's first bioengineered human brain-in-a-dish combining induced pluripotent stem cells, 3D brain-specific biomaterial and organ-on-a-chip. She has been awarded seven local and international patents.

Her Horizon project is furthering this work by creating brain organoids that mimic the vasculature and immune system of the human brain, the most complex human brain organoid yet developed.

A state-of-art brain model

Her new state-of-the-art 'vascularised-human brain model that incorporates neuroinflammation' will incorporate bioprinted vasculature and immune system-on-chip. For the first time, it will enable insights into the interactions between the blood and immune systems in the human brain, with particular applications for research into neurological and psychotic disorders.

Once the model is validated for neurological disorders and drug screening/delivery, it will be commercialised for disease modelling and drug development, particularly focusing on the compound crossing the blood-brain-barrier by monitoring subsequent neuroinflammation responses.

Research keywords

Cell & Tissue Engineering; Biotechnology & Applied Microbiology; Cell Biology; Neurosciences; Pharmacology & Pharmacy/Engineering, Biomedical; Materials Science, Biomaterials)/Health Infectious Diseases; Clinical Neurology; Transplantation.

Research methods

- Personalised stem cell
- Organoid biofabrication
- Organ-on-chip
- Tissue Engineering
- Biomedical Engineering
- Brain tissue-computer interface
- Regenerative medicine
- Neuroscience
- Personalised medicine

Learn more or get in touch

Climate change | Sustainability

Dr Wesley Dose

Faculty of Science
School of Chemistry

Understanding the chemistry of sustainable batteries

There are three central challenges facing the global endeavour to develop sustainable energy storage: using materials that are easily accessible, low cost and high-performance; understanding and preventing degradation and loss of performance; and how to recycle and upcycle materials from old batteries.

New forms of batteries are a key green technology, but they must be able to compete with existing batteries in terms of cost, performance and safety.

There is also an urgent need to address a growing environmental impact as the battery market rapidly increases, from sourcing minerals to recycling at end-of-life.

Studying new materials

Dr Wesley Dose's research aims to address these issues through developing materials that are more sustainable, lower cost, and higher energy.

For example, he is studying materials for batteries based on elements that are more abundant and equally distributed across the planet, such as manganese and sodium.

He is also studying changes in the structure and chemical composition of these materials across the battery's lifetime, and how they can be upcycled at end-of-life for re-use in the next generation of batteries.

Unique research

Dr Dose's project is using and developing a combination of techniques to understand how the materials function at the molecular and atomic level, including diffraction, NMR, mass spectrometry, electron microscopy and electrochemistry.

His unique focus on the basic science of the full cell – where both electrodes are present – is the key to unlocking profound advances in understanding with practical outcomes.

These new fundamental insights will enable the scientific design of functional materials for future energy storage.

Research keywords

Applied chemistry; Electrochemistry.

Research methods

- X-ray diffraction/ spectroscopy
- Mass spectrometry
- Electron microscopy
- Electrochemistry
- Material science

Learn more or get in touch

Email:
wesley.dose@sydney.edu.au

Climate change | Health | Sustainability

Dr Nicholas Fancourt

Faculty of Medicine and Health
Sydney Medical School

MDI: Sydney Southeast Asia Centre

Exploring the links between malnutrition and immune dysfunction

Children who have experienced acute malnutrition remain at increased risk of pneumonia for months after they recover. It appears that malnutrition causes an immune dysfunction, but little is known about how or why this occurs children.

With malnutrition on the increase worldwide, and pneumonia the leading cause of childhood mortality globally, Dr Nicholas Fancourt is creating world-first understanding of how the immunological effects of malnutrition influence the risk of pneumonia, including responses to pneumococcal conjugate vaccine (PCV).

Childhood malnutrition in Timor-Leste

Dr Fancourt is a paediatrician at The Children's Hospital at Westmead with a research interest in malnutrition, infection, immunology and respiratory disease. He has worked in both Darwin and Timor-Leste, where he visits regularly to support local scientists and healthcare professionals to improve communicable disease control and immunisation programs.

During his time in Timor-Leste, he has seen the consequences of malnutrition in children, with as many as 40 cases presenting to hospital every month. Even as these children recover and put on weight, they remain at higher risk of infection and death.

Malnutrition and pneumonia risk

His Horizon project is using longitudinal cohort studies to understand these children's risk of pneumonia. He will also use novel technologies to understand the mechanisms of how immune pathways are affected by malnutrition, such as assessing B- and T-cell responses using spectral flow cytometry, and measuring cytokine and nutrient levels.

He will apply public health methods to identify how to implement interventions such as biomarkers, targeted vaccination strategies and nutritional supplementation.

Dr Fancourt hopes his research will provide evidence to support global policy on opportunistic vaccination for children in low and middle income countries, and will help clinicians to stratify and support children most at risk of infection.

Research keywords

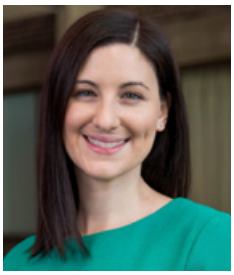
Paediatrics, Infectious Diseases, Immunology, Nutrition & Dietetics, Respiratory System.

Research methods

- Longitudinal cohort studies
- Randomized clinical trials
- Spectral flow cytometry
- RNA sequencing
- Mass spectrometry

Learn more or get in touch

Health



Dr Jasmine Fardouly

Faculty of Science
School of Psychology

The use of social media to improve young people's body image

Across all platforms, social media can harm users' body image if they view and post content promoting unattainable societal beauty ideals – an issue that has been linked to the development of eating disorders, depression, social anxiety and generalised anxiety.

Dr Jasmine Fardouly aims to change that paradigm, using social media as a tool for wellbeing.

Her ground-breaking, internationally recognised research has shown that viewing content that challenges societal beauty ideals, with diverse body sizes and unedited bodies, can improve body image among young women.

Increasing access to more positive content

Dr Fardouly aims not only to reduce the harm of social media on body image, but to use social media as a tool to promote wellbeing.

Her Horizon project is determining the feasibility and effectiveness of increasing users' access to body positive content on social media, and reducing their access to content that portrays unattainable beauty ideals.

Using mixed methods, she is looking at the effects of social media on boys in addition to girls, who are significantly under-researched in this area.

A multi-level approach

Changing the harmful body image effects of social media goes beyond the individual. Dr Fardouly's project examines the issue from several different angles to understand how beneficial content can be widely accepted and implemented in practice.

She is investigating ways of changing social norms among peers to encourage more positive social media use for body image, how to encourage influencers to post more beneficial content, and recommend policy initiatives to reduce the prevalence of idealised content on social media.

Research keywords

Communication;
Psychology, Developmental;
Psychology, Applied;
Psychology, Experimental;
Psychology, Social;
Women's Studies.

Research methods

- Longitudinal projects
- Mixed methods approach
- Qualitative studies
- Policymakers and stakeholder engagement
- Open science methods

Learn more or get in touch

Climate change | Sustainability

Dr Shawna Foo

Faculty of Science
School of Life and Environmental Sciences

MDI: Sydney Environment Institute

Understanding the impacts of global stressors on coral reefs

With 90 per cent of coral reefs projected to be in danger by 2030, governments are focusing on improving water quality and removing coral predators to protect Australia's reefs.

Marine scientist Dr Shawna Foo is taking a different approach, learning from the adaptations corals naturally make to survive in inhospitable environments.

Specifically, she is providing the insights into the impacts of mangroves on seawater chemistry, and the resultant impacts on the corals that live there.

The role of mangroves

Mangroves appear to offer promising climate refugia for corals, with several studies showing that coral species growing on or around mangrove roots are able to survive heatwaves.

This may be because corals and mangroves have important synergies that can help buffer each other through climate change. For example, mangroves can provide an extra source of nutrients in the water that might increase the coral's resilience to stress.

By looking at the corals that live in these conditions, Dr Foo hopes to discover interventions for land-sea management to help both ecosystems cope with future heatwaves.

An integrative approach

Her field research is conducted mainly in Orpheus Island and Low Isles on the Great Barrier Reef. She uses an integrative approach using remote sensing, new sensor technologies, in situ experiments and controlled experimentation to investigate how the mangroves and corals interact. This is coupled with microscopy and microanalysis techniques to examine the coral's skeleton and understand how it is adapting in each location.

It's hoped that the project will find potential solutions to actively restore coral ecosystems and alleviate pressures of climate change on coral reefs worldwide.

Research keywords

Biodiversity Conservation, Biology, Ecology, Developmental Biology, Environmental Sciences, Marine and Freshwater Biology, Remote Sensing, Reproductive Biology.

Research methods

- Animal models/systems
- Quantitative tools
- Remote sensing technology
- Stereo-imaging technology
- Microscopy
- Modelling
- Fieldwork (*in situ* experiments in extreme environments)

Learn more or get in touch

Climate change | Health | Sustainability

Dr Shamila Haddad

Sydney School of Architecture, Design and Planning
School of Chemistry

MDI: Sydney Environment Institute, The University of Sydney Nano Institute

Creating resilient housing for better health and wellbeing

Dr Shamila Haddad first understood the effects of thermal discomfort as a schoolchild struggling to concentrate in a hot classroom in her native Iran.

She went on to train as an architect with an interest in architectural design for health and wellbeing. Realising there are significant evidence gaps around the effects of buildings on health, she turned to research and completed her PhD in Architectural Sciences in 2016.

Dr Haddad is an expert in healthy buildings, indoor air quality, energy poverty and climate change mitigation technologies. She brings her professional skills together with research expertise to create compelling evidence for action to develop housing that is resilient to future climate change and that also supports health and wellbeing.

Healthy social housing

Dr Haddad's previous research has shown that many low-income dwellings in NSW operate outside the health and safety temperature limits recommended by the World Health Organization, with insufficient ventilation and poor air quality.

Working with the School of Architecture Design and Planning, Dr Haddad's Horizon Fellowship is about monitoring the indoor environment in terms of temperature, humidity and air quality in social housing and developing solutions towards healthy homes under future climate.

She will monitor indoor air and environmental quality in social housing across Australia, and evaluating housing condition and the temporal and spatial distribution of urban overheating in at risk areas. She will also model possible low-cost retrofitting solutions, based on future climate variables.

There has never been a project of this scale in Australia, and Dr Haddad hopes it will result in a mitigation and adaptation plan that will combat the environmental, social and financial burden of urban overheating faced by social housing occupants.

Research keywords

Architecture, Construction & Building technology, Energy & Fuels, Public, Environmental & Occupational Health, Materials Science Multidisciplinary, Regional & Urban Planning, Urban Studies.

Research methods

- Interviews with end users
- Real time measurements
- Sensors use and placement
- Microclimate simulation
- Architectural science and design
- Urban Energy Modelling

Learn more or get in touch

Health

Dr Steffen Herff

Sydney Conservatorium of Music

Using music for health, and supporting the health of musicians

During the COVID lockdowns, reports began to emerge that people were increasingly turning towards music for social solace.

Cognitive neuroscientist Dr Steffen A. Herff studied this phenomenon and showed that music can be used to systematically influence the intensity and emotional sentiment of imagination as well as induce specific thoughts – such as social interactions – into the imagined content.

Using music for health

Dr Herff is now investigating the ability of music to shape mental imagery and how specific musical elements affect the brain to enhance cognitive behavioural therapy techniques such as imagery exposure and imagery rescripting therapy.

Therapists could use music to help the patient conjure up images to exactly the right degree of intensity that they need for their treatment. For example, music can prevent the images from being so strong they accidentally trigger an anxiety attack, or so weak they don't provoke the desired cognitive response.

The beauty of music is that it allows a high degree of control and can be adapted almost instantaneously to increase or decrease the vividness of mental images according to patients' unique needs.

Supporting the health of musicians

Dr Herff's project is also giving back to the music community. Musculoskeletal disorders are very common amongst musicians and can spell the end of their professional career, placing a great burden on individuals, orchestras, and the health care system.

Based at the Sydney Conservatorium of Music, Dr Herff is monitoring musicians for musculoskeletal injuries and investigating how musicians' practise contributes to them.

He will then develop biofeedback-based solutions to the specific musculoskeletal dangers they face, allowing them to learn the signs of muscle fatigue and modify their practice.

Research keywords

Music; Humanities, Multidisciplinary; Physiology; Applied Psychology.

Research methods

- Bayesian modelling
- Randomised control design
- Computational analysis
- Electromyography/ physiology techniques
- Motion capture systems
- Multidisciplinary research

Learn more or get in touch

Climate change | Health | Sustainability

Dr Aaron Jenkins

Faculty of Medicine and Health
Sydney School of Public Health

Protecting the health of people and the planet

Dr Aaron Jenkins is Australia's leading scholar in the emerging field of Planetary Health, meaning he researches the connections between the conditions of our planet and the systems that affect human health.

Having spent most of his life living and working in Pacific nations, including 28 years in international development focusing on water resource management and climate change mitigation, he has seen first-hand the interconnections between the health of the planet and the health of people.

Drivers of ill-health

Poor water quality, in particular, is responsible for a large burden of infectious disease in the Pacific. Upstream factors such as degradation of ecological watersheds have a devastating impact on local ecosystems, fish supply, livelihoods, food safety and security and the cultural practices of local people – all of which have added effects on health.

Dr Jenkins' action research program is designed specifically to understand and address multiple, interconnected upstream drivers of ill-health to people and the environment in the Pacific. He works closely with individuals, communities, governments and NGOs to achieve positive change.

Solutions might be as simple as fencing cattle, regenerating riverbanks and addressing soil erosion, all of which he has shown to have a measurable positive impact on community health and wellbeing as well as co-benefits such as improved biodiversity and water quality.

Water resource management

His Horizon project builds on five successful years of the Watershed Interventions for Systems Health in Fiji (WISH Fiji) project, which takes an integrated approach to manage water resources to reduce water-related disease risk, improve the downstream ecosystem and support overall system health.

He will now implement integrated watershed management in Fiji, Solomon Islands and PNG to improve biodiversity, climate resilience and human health, and establish a model for scaling this up in the Pacific.

Research keywords

Public, Environmental & Occupational Health, Infectious Diseases, Ecology, Evolutionary Biology, Environmental Sciences, Fisheries, Forestry, Genetics & Heredity, Marine & Freshwater Biology, Microbiology, Water Resources, Social Sciences.

Research methods

- Participatory, research-action approaches that engage best practice for knowledge co-production across stakeholder groups, sectors and disciplines
- Nature-based solutions
- Health interventions
- Community-based syndromic surveillance
- Climate, water and soil quality monitoring systems,
- Health facility-based surveillance
- Pathology

Learn more or get in touch

Climate change | Sustainability

Dr Haihui Joy Jiang

Faculty of Science
School of Chemistry

Electrified chemical solutions to energy and climate challenges

Dr Haihui Joy Jiang is a chemist and materials scientist whose research integrates science with engineering to address important questions, ranging from curiosity-driven topics such as the chemical origin of life, to application-driven research such as solving energy, sustainability, and climate-related challenges.

To decarbonise the chemical industry, the HJ Jiang group explores plasma (air gap)-electrochemistry, magneto-electrochemistry, and zero-carbon polymers as three innovations for a lower carbon future.

Mimicking lightning-induced synthesis

Dr Jiang takes inspiration from nature, such as how lightning strikes caused nitrogen and water to combine to form nitrogen fertilisers on the early Earth.

She has developed experimental set-ups that mimic lightning strikes, turning affordable starting materials into valuable products with minimal carbon footprint. This process, known as plasma-electrochemical synthesis, may also one day be used to produce stratospheric ozone to repair the ozone hole.

Combining magnets with chemistry

Dr Jiang combines magnetic fields with electrochemistry, to drive chemical separations, develop ionic motors, and improve the performance of chemical processes. Her group is innovating ionic transmission technology, complementary to today's electronic technologies.

Low-carbon materials

Different from most everyday polymers, which are carbon-based materials, Dr Jiang explores sustainable inorganic and hybrid polymers that can be easily produced and fully recycled without waste.

These functional materials can be used for a wide range of applications, including thermal insulating materials, anti-fire coatings, high temperature adhesives, slow-release fertilisers for agricultural use, and nanoreactors for chemical synthesis and heavy metal extraction.

Research keywords

Chemistry, applied; Chemistry, physical; Electrochemistry; Engineering, multidisciplinary; Energy & fuels; Physics, fluids & plasmas; Materials science, multidisciplinary; Polymer science.

Research methods

- Plasma chemistry
- Electrochemical systems
- Radical reactions
- Device engineering

Learn more or get in touch

Climate change | Sustainability

Dr Danielle Kent

The University of Sydney Business School

Could optimism hold the key to arguing more effectively for investment in sustainability?

Locked down in a small apartment with a baby during COVID, behavioural economist Dr Danielle Kent turned to the literature to understand how to be more optimistic about her situation.

She discovered that optimists are less likely than pessimists to feel helpless in the face of overwhelming problems like climate change; they are also more likely to accept temporary costs of action if these will lead to permanent long-term gain in future.

As more people disengage from climate action because they feel the problem is too vast, Dr Kent believes reframing the way we talk about the issue could be enough to nudge governments and investors toward sustainability.

Testing the theory

She has tested her theory on a group of experienced portfolio managers. By emphasising an optimistic view of the world – that sort-term costs would ultimately lead to long-term benefits – she was able to switch their choices toward more sustainable options. Her findings have been replicated with the public.

Her Horizon project is applying optimism research to business sustainability. It involves a series of randomised controlled trials to test the effect of different framing used to communicate policies and guidance on sustainable decisions in organisational settings.

Working with bankers, public servants and executive policy makers, Dr Kent hopes to increase understanding of how our human bias for optimism can be exploited for more sustainable institutional decision making.

Research keywords

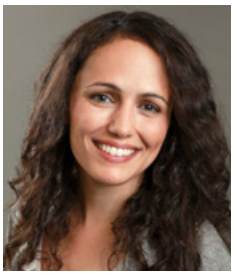
Social Sciences: Business, Finance.

Research methods

- Survey analysis
- Behavioural science
- Randomised controlled experiments.

Learn more or get in touch

Climate change | Health | Sustainability



Dr Liliana Laranjo

Faculty of Medicine and Health
Sydney Medical School

Chatting with AI to manage heart failure

Dr Liliana Laranjo first became interested in the uses of artificial intelligence (AI) for health back in 2018, when she realised it was possible to ask health questions of Siri.

Now an expert in digital health, she is researching the use of today's much more sophisticated AI to support people managing chronic conditions at home.

As a former GP, Dr Laranjo is acutely aware of the difficulties patients face in adhering to their medication regimes and following lifestyle advice. With insufficient support, people's conditions often deteriorate and they end up in hospital.

Managing chronic disease at home

Her Horizon project is developing the world's first personalised and interactive communication and support tool for patients with heart failure, a leading cause of hospitalisation, morbidity and mortality that is largely preventable with good quality self-management.

Patients will receive regular automated phone calls using conversational artificial intelligence to support their self-management needs and 'chat' with them in a personalised way.

CardioChat is capable of analysing patient responses during the conversation, using voice recognition software and natural language processing. Over 6 months, patients will receive 12 phone calls covering different monitoring and educational goals such as symptom management and when to see the GP. If at any point 'red-flags' emerge, such as symptom deterioration, patients receive a 'live' call from health staff.

Potential for other conditions

The intervention will be available in English, Mandarin and Arabic, and is co-designed with consumers and clinical partners. It will be tested in a randomised controlled trial.

Previous research has already shown that AI interventions are acceptable to patients, who feel more supported when they receive regular phone calls, even knowing they are automated.

If successful, *CardioChat* can be adapted for other chronic conditions and co-morbidities, potentially improving quality of life, reducing symptoms, and preventing thousands of hospitalisations in future.

Research keywords

Medical Informatics, Primary Health Care, Cardiac & Cardiovascular Systems

Research methods

- Qualitative research
- Meta-analysis
- Systematic review
- AI and machine learning
- Randomised controlled trial
- Co-design with end-users

Learn more or get in touch

Health Sustainability

Dr Jiaying Li

Faculty of Engineering
School of Civil Engineering

A new platform to detect biological and chemical markers for public health and wellbeing in wastewater

Wastewater surveillance is now well-recognised for its potential uses in monitoring illicit drug use as well as prevalence of diseases such as COVID.

Dr Jiaying Li is about to significantly expand the frontiers of wastewater-based epidemiology (WBE) through discovering new health-related chemical and biological biomarkers that can be detected in wastewater.

Searching for biomarkers

Dr Li comes to Sydney from the University of Queensland, the team that gained prominence for testing wastewater during COVID.

Her Horizon project is using analytical chemistry and molecular technologies including chemical analysis, DNA sequencing and biosensing to detect in wastewater minute traces of potential biomarkers found in human body fluids and excreta, at a resolution never accomplished before.

Potential disease markers could include those for infectious and chronic diseases, signs of oxidative stress and risky chemicals – as long as they are concentrated enough to be detectable and don't degrade in water.

Once these markers are found, Dr Li will use novel sampling and sensing techniques in combination with Geographic Information System (GIS) to collect samples, develop catchment-scale hydraulic modelling to understand what happens to the biomarkers and how they are distributed in the environment.

Environmental monitoring

She will apply multivariable data analysis to link socioeconomic and health data, and artificial intelligence for data-driven predictions, to establish an integrated method for environmental monitoring and a tool for public health early warning.

That means it will be possible to pinpoint disease markers at catchment, suburb, neighbourhood, and even building level - crucial information on public health, wellbeing, disease prevalence, and chemical exposure.

This unique project has the potential to create a paradigm shift in use of WBE as a public health tool.

Research keywords

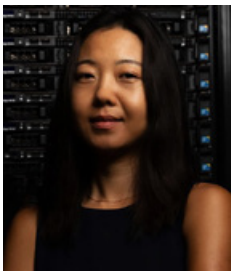
Engineering, Environmental; Environmental Sciences.

Research methods

- Analytical chemistry
- Microbiology
- Environmental monitoring
- Environmental biotechnology
- Wastewater engineering
- Epidemiology
- Geographic Information System (GIS)
- Hydraulic modelling
- AI
- Mass spectrometry

Learn more or get in touch

Climate change | Health | Sustainability



Dr Mengyu Li

Faculty of Science
School of Physics

MDI: Charles Perkins Centre

Modelling sustainable energy, climate and food systems

We cannot address climate change through technology alone. A crucial part of the puzzle is addressing production and consumption – from global economic systems and supply chains through to individual eating patterns and human psychology.

Dr Mengyu Li has a background in both engineering and sustainability. Her Horizon project is developing the first IPCC-compliant Integrated Assessment Model (IAM) for Australia, to help inform policy decisions for more sustainable energy, climate and food systems.

An Integrated Assessment Model

IAMs are systems models that represent key processes in social and physical systems, focusing on the interaction between economy, society and the environment. The models use data from many scientific disciplines and are central to assessments made by the Intergovernmental Panel on Climate Change (IPCC).

Dr Li will build an IAM using a high-performance computer at Sydney University. The comprehensive model will incorporate information on our energy system and food system, the global trade network, and individual consumption behaviour.

The IAM can then be used to model different technological and societal trajectories for staying within climate policy targets. This enables policymakers to understand what sort of transformations need to occur in different sectors for a comprehensive response to climate change.

IPCC-compliant

Dr Li is collaborating with the world's major IAM groups, meaning her model will align with the global IPCC standards. She also has a long-term collaboration with the Department of Primary Industries, so her findings can be rapidly translated for policy.

Her model will be the first IPCC-compliant Australia-specific IAM and will fill a major gap in our ability to align with international standards and meet our commitments to a zero-carbon sustainable future. It will also be the first to incorporate data on food systems, allowing the assessment of climate risks for nutrition security and associated health outcomes.

Research keywords

Engineering, multidisciplinary (Engineering & Technology); Energy & Fuels (Engineering & Technology); Environmental Sciences (Life Sciences); Agricultural Economics & Policy (Life Sciences); Health Policy & Services (Social Sciences); Economics (Social Sciences).

Research methods

- Quantitative modelling
- Quantitative analysis
- Disaster analysis
- Risk analysis
- Computing science/high performance computing

Learn more or get in touch

Health

Dr Elie Matar

Faculty of Medicine and Health
Sydney Medical School

MDI: The University of Sydney Nano Institute

Translational research into the intersection of neurology and sleep

Dr Elie Matar first became interested in the links between sleep and neurodegeneration in his early career as a neurologist, when he treated a group of older patients who presented with a sleep condition called 'isolated REM sleep behaviour disorder'.

Rather than being paralysed during their REM sleep as usual, these patients physically acted out their dreams. Almost all of them went on to develop Lewy body dementia or Parkinson's disease in the next 15 years.

Later in the course of his work, Dr Matar realised that other disabling symptoms of these neurodegenerative diseases, such as cognitive fluctuations, may also be explained by damage to the circuits of the brain that orchestrate the delicate balance between sleep and wakefulness.

Understanding the role of sleep

Dr Matar needed to understand more about the role of sleep in his patients and decided to also train as a sleep physician. He is currently the only dual-trained neurologist and sleep physician in NSW, practising at the Royal Prince Alfred Hospital.

As a clinician scientist, Dr Matar also leads a translational research program into the intersection of neurology and sleep. It's an under-researched area that holds huge potential for improving understanding and personalised treatment for neurodegeneration.

His Horizon project is looking at the role of the brain's circuitry in sleep disorders and later neurodegenerative symptoms such as hallucinations, fluctuations, and the propensity to become delirious.

The mechanisms of neurodegeneration

The research is investigating the potential of sleep disorders as a biomarker for early signs of disease, and may generate new understanding of the mechanisms that lead to the development of Lewy body dementia and Parkinson's disease.

Dr Matar will use the findings develop interventions that improve sleep to try to treat disabling symptoms and improve patients' quality of life.

Research keywords

Clinical neurology, neuroscience, neuroimaging.

Research methods

- Clinical, imaging and sleep assessments (including high-density EEG)
- Regression modelling
- Magnetic resonance imaging (MRI)
- Pathology
- Computational modelling
- Semi-quantitative scoring methods

Learn more or get in touch

Climate change | Health | Sustainability

Dr Natalie Matosin

Faculty of Medicine and Health
School of Medical Sciences

MDI: Charles Perkins Centre

How stress alters the biology of the brain

Nearly everything we experience changes the brain. Using sophisticated high-resolution technologies, it's possible to see that the molecules and cells in brain tissue are altered by exposure to extreme stress, possibly triggering severe psychiatric disorders like schizophrenia, depression, anxiety and bipolar disorder.

Dr Natalie Matosin is a leader in the field of molecular psychiatry, illuminating the causes and effects of psychiatric illness at a cellular and molecular level. Her research interest is the effects of stress on the brain.

The biological effects of trauma

Dr Matosin trained at the Max Planck Institute of Psychiatry in Munich during an influx of Syrian refugees into Germany. As a neuroscientist, she was interested in the biological effects of refugees' trauma and whether science could hold the key to addressing them.

Back at the University of Wollongong, she set up the MINDS Lab (Mental Illness, Neurobiology and Disorders of Stress), which aims to uncover fundamental brain functions and processes that lead to brain disorders by examining tissue from postmortem human brains.

Addressing stress-induced mental illnesses

Her Horizon Fellowship brings the MINDS Lab to the University of Sydney. Her research program will study how stress raises the risk of mental illness and develop better methods to identify and treat people with stress-induced mental illnesses.

Uniquely, the project is using postmortem brain tissue from people known to have been exposed to stress, held in biobanks at the NSW Brain Tissue Resource Centre and the Lieber Institute of Brain Development in the United States. The research is being conducted through the MIND Lab's international collaborations in the USA, Canada, Germany, Croatia, Iceland and Sweden.

Dr Matosin's project also includes working with historic refugees in Sydney, looking at DNA samples to see if the epigenetic effects of stress are passed on to their offspring.

Research keywords

Neurosciences, Psychiatry, Pathology, Microscopy, Genetics, Pharmacology & Pharmacy, Psychology.

Research methods

- Biochemistry
- Genomics
- Questionnaires/surveys
- Bioinformatics
- Transcriptomics
- Single-cell/spatial multi-omics

Learn more or get in touch

Health Sustainability

Dr Archita Mishra

Faculty of Medicine and Health
School of Medical Sciences

How microbes shape babies' immune systems in the womb

It was long assumed that the environment inside the womb was sterile and that only after birth were babies are exposed to the good bacteria that make up their gut microbiome.

But in 2021, Dr Archita Mishra turned that assumption on its head when she was the first researcher globally to demonstrate the presence of healthy microbes during fetal development. She showed that microbes travel from the mother to the fetus and play a role in priming the immune system in the womb.

Dr Mishra's work opened a new field of research exploring the role of microbiome in creating a 'memory' in the immune system that protects babies after birth. This has implications for childhood infections, allergy, response to vaccination and cancer.

Understanding the role of microbes

Coming to The University of Sydney from the Telethon Kids Institute, where she led a laboratory examining early-life microbial immunology, Dr Mishra is advancing this research to understand more about the critical role of microbes in shaping babies' immune systems.

She was attracted by the translational potential of research in Sydney, and is collaborating with the Children's Hospital at Westmead and the Royal Hospital for Women.

She is exploring how the mother's microbiome shapes her baby's immune system in the womb, using low biomass microbiome sequencing and spatial transcriptomics – new technology that looks at the spatial localisation of bacteria and immune cells in the gut.

She is also investigating how environmental changes like migration can affect this microbiome-immune association in second generation babies born to parents who recently immigrated to a new country.

This work will provide a clearer window into this critical period of immune formation. It will pave the way for tailored health interventions for infants, especially pre-term babies, for example with probiotics or vaccine adjuvants to prevent the deadly infections in early life.

Research keywords

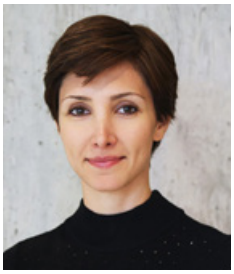
Immunology, Microbiology, Infectious diseases, Microbiome, Infant & Child health, Genomics, Developmental Immunology.

Research methods

- Metagenomics
- Single-cell RNA-sequencing
- Flow cytometry
- Spatial transcriptomics
- Metabolomics

Learn more or get in touch

Sustainability



Dr Neda Mohammadi

Faculty of Engineering
School of Project Management

Shaping smart, sustainable cities with dynamic digital models

Dr Neda Mohammadi's research lies at the intersection of humans and infrastructure systems – how humans interact with city systems like mobility, energy, healthcare and communication at various scales.

Using data and AI-enabled technologies, she pioneered the concept of 'Smart City Digital Twins'. These are living digital replicas of engineered systems that can update in real-time with new data and inputs on interactions between humans, infrastructure and technology, making them highly responsive to changing conditions and new information.

These computational models can be used to predict how human activities and infrastructure systems respond to changing climates and technological advancements, and to model scenarios to make cities more sustainable and resilient.

AI-driven modelling

Dr Mohammadi's Horizon project will expand her research to explore a variety of interconnected systems and to enhance the inclusion of human aspects in the models.

The aim is to enable infrastructure projects to effectively navigate the complexity and uncertainty in the interactions between humans and infrastructure systems, and transform the integration of new technology and investment.

Scaling Digital Twins

AI and Digital Twins are driving innovation in cities around the world, including Singapore, Barcelona, Amsterdam, Copenhagen, Dubai and several US cities. This project brings these concepts to Australia, positioning the City of Sydney as a pioneering testbed.

Dr Mohammadi hopes this research will not only advance knowledge on AI-driven and cyberinfrastructure-enabled engineering and technology management, but will also contribute to the United Nations Sustainable Development Goals (SDGs) and result in impactful economic, environmental and societal benefits.

Research keywords

Computer Science; Construction and Building Technology; Civil Engineering; Operations Research and Management; Transportation Science/Green & Sustainable Science & Technology; Social Science, Mathematical Methods; Regional & Urban Planning/Studies; Architecture.

Research methods

- User-centric design
- Scenario testing
- Data science
- Computational modelling
- AI-driven methods

Learn more or get in touch

www.linkedin.com/in/nedamadi

Health Sustainability

Dr Barbara Barbosa Neves

Faculty of Arts and Social Sciences
School of Social and Political Sciences

A landmark study of ageing and AI

Dr Barbara Barbosa Neves is a leading artificial intelligence (AI) social scientist, whose work is addressing extreme levels of loneliness and social isolation among aged care recipients.

Emerging technologies like AI hold great potential for addressing these issues, which are causing a rising burden of emotional distress, multimorbidity and dementia in older people across the world.

But the risks of these technologies have not been fully explored from the perspective of older people in different environments or those around them, such as their families and aged care staff.

Mapping and comparing AI technologies

Dr Neves' project is bringing the power of social sciences to undertake a world-leading and foundational analysis of AI in ageing, capturing the benefits and dangers of this technology.

Her landmark study will be the first to map and compare different AI technologies in different settings, at the same time. She is looking at how these technologies are being developed, implemented and used for social care in both aged care homes and for older people living alone in the community.

Addressing older people's diverse needs

The aim of Dr Neves' research is to inform technologies that reduce loneliness and isolation, meeting the diverse needs and preferences of older people without causing harm.

The insights gained from this project will help to inform effective, inclusive and sustainable strategies to tackle social health deficits in aged care, respecting the lived experience of older people and the diversity of later life.

Research keywords

Sociology, Gerontology, Artificial Intelligence, Social Issues, Social Sciences Biomedical.

Research methods

- Mixed methods design (qualitative, quantitative and participatory techniques)
- Surveys/community of practice creation
- Fieldwork, usability and accessibility tests
- Interviews
- Descriptive/inferential statistics

Learn more or get in touch

Climate change | Health | Sustainability

Dr Stephanie Partridge

Faculty of Medicine and Health
Sydney Nursing School

MDI: Charles Perkins Centre

Working with young people to address the issues that affect them

Dr Stephanie Partridge is passionate about working with and for young people. Her work in public health harnesses digital technologies to improve adolescent health and mental health, but she is best known for her work to increase youth engagement with science.

Adolescence is an ideal time to engage young people and set them up for healthy lifestyles into adulthood. Beyond addressing individual behaviour, it's also critical to create environments that support for young people to eat healthily and be physically active.

Impact of meal delivery apps

Dr Partridge's research has shown that meal delivery apps provide unfettered access to unhealthy 'junk foods', which are heavily marketed to young people. Her project is evaluating the impact of these apps on food accessibility and consumption, with data pulled together in a comprehensive publicly available digital dashboard.

She is also co-designing digital health interventions to address emerging health issues such as obesity prevention and mental health problems.

Partnering with young people

All of her worked is underpinned by her close partnerships with young people themselves. An important part of the Horizon project is to develop research methodologies and best practice around involving adolescents in research.

In previous work funded by the MRFF, Dr Partridge established a youth advisory group that is involved in every aspect of her team's work, from ethics right through to intervention co-design and dissemination.

Her youth advisors, then aged 13–18 years, co-authored a paper published in *The Lancet Child and Adolescent Health*, among the youngest authors ever to be published in a Lancet journal.

Dr Partridge is building further capacity in young people to participate in research through an online course, with the aim of creating a cohort of skilled and interested adolescents who can be connected to researchers throughout the University.

Research keywords

Public, environmental & occupational health; Nutrition and dietetics; Paediatrics; Health policy.

Research methods

- Digital health
- Co-design
- Multiphase Optimisation Strategy
- Randomised clinical trial
- Biostatistics

Learn more or get in touch

Health Sustainability

Dr Alison Peel

Faculty of Science
Sydney School of Veterinary Science

Improved understanding of bat viruses and their risk to human health

COVID has shown the possible global impact when a new infectious disease transmits from animals to humans. World health authorities are already preparing for the next pandemic, which they expect to also originate in animals.

Preventing this spillover of viruses from animals to humans may seem an almost impossible task, so global efforts focus on pandemic preparedness, such as developing new vaccine technologies.

But Dr Alison Peel, a veterinarian and wildlife disease ecologist, believes in prevention. She and her team have shown that understanding the underlying ecological, environmental and human mechanisms can lead to ecological solutions that prevent spillover, benefiting both human and environmental health.

Hendra virus

Dr Peel's expertise is in Hendra virus transmission in bats – the first in a group of newly discovered bat viruses that have emerged over the past 30 years.

Her work investigates how bats and their viruses naturally co-exist, and also the complex ways that this coexistence is affected as bats adapt to environmental change and human encroachment on their habitat.

Her insights have local, national and international relevance, from town planning decisions and species conservation, to viral surveillance and public health risk prediction, to progress in pandemic prevention policy at a global scale.

Research keywords

Public health, ecology, virology, and veterinary science.

Research methods

- Longitudinal field studies and sample collection
- RNA sequencing
- Metatranscriptomics
- Bioinformatics
- Ecological and Environmental Data science
- Predictive modelling
- Virome mining
- Interdisciplinary and transdisciplinary science

Learn more or get in touch

Investigating the bat virome

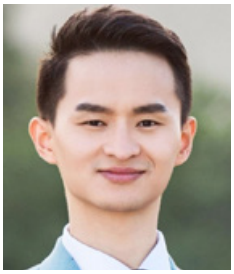
Dr Peel's previous research collected over 60,000 biological urine and faecal samples from flying foxes across 26 sites in Australia, the longest Hendra virus surveillance effort ever undertaken.

Her Horizon project is undertaking a major genomics program using RNA sequencing of about 2,000 samples to identify the broad mechanisms that promote virus excretion from bats, including during high-risk periods and from bats experiencing different ecological conditions across time and space. She is particularly interested in interactions between different viruses – at a population level and within individuals (co-infection).

This work is expected to generate billions of new sequences for virome mining. Using data science, it will then be possible to understand more about bat health and spillover risk.

Ultimately, Dr Peel hopes to generalise her findings to other bat species in Australia and internationally, broadening understanding of the broader virome within bats.

Climate change | Sustainability



Dr Zengxia Pei

Faculty of Engineering
School of Chemical and Biomolecular Engineering

Developing sustainable and safe zinc batteries

Energy storage using rechargeable batteries is the key to sustainable energy supply. But existing batteries made of lithium are unstable, and there is a limited supply of lithium worldwide.

Materials scientist Dr Zengxia Pei is studying an alternative form of battery, made of zinc. Zinc batteries are intrinsically safe because the electrolytes are dissolved in water and therefore cannot catch fire. Zinc is low-cost and highly sustainable, with Australia holding the world's largest deposit.

However, zinc ions are low density compared to lithium ions, meaning batteries would not be able to hold their charge.

Outperforming lithium batteries

Dr Pei's Horizon project aims to retain the advantages of safety and cost, while improving the energy density of zinc batteries to rival or even outperform lithium batteries.

The outcome will be energy-dense and durable rechargeable zinc-metal batteries that can be integrated with renewable energy for scalable energy storage.

He will do this through innovations in essential electrochemistry and nanofabrication. His approach is interdisciplinary, combining advanced material engineering, in-situ instrumental techniques and theoretical computation.

These batteries have commercialisation potential, and the new knowledge generated will improve understanding for further breakthroughs in innovative and affordable battery storage technology that can be integrated with renewable energy.

Research keywords

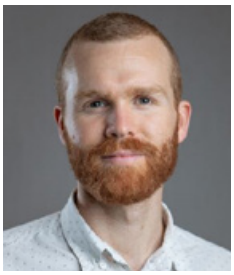
Engineering, Chemical; Chemistry, multidisciplinary; Electrochemistry; Nanoscience & Nanotechnology.

Research methods

- Solid-electrolyte interphase engineering
- Theoretical computation
- Microscopy and spectroscopy
- Functional device design
- *In-situ* electrocatalysis

Learn more or get in touch

Health



Dr Mitchell Sarkies

Faculty of Medicine and Health
Sydney School of Health Sciences

A new implementation science laboratory to bring research into policy and practice

The world is facing a tsunami of death and disability from chronic disease. Although we have the evidence for how to prevent this, the most effective treatments may not be reaching the patients who need them.

For example, less than half of people taking medication for high cholesterol achieve recommended treatment goals, and only one in four continue taking medication long term.

The problem is not due to lack of evidence, but rather an issue of implementation. For complex reasons, research is not being translated into health services effectively.

An implementation science laboratory

Dr Mitchell Sarkies is a health services researcher and implementation scientist whose project will establish an implementation science laboratory to improve health outcomes by speeding the translation of health and medical research innovations into practice.

The laboratory will coordinate implementation research within the University of Sydney to grow the field of implementation science and advance understanding of change within complex systems.

As an exemplar, the laboratory will start by testing implementation strategies for cholesterol lowering medications in a clinic in Royal Prince Alfred Hospital.

Finding strategies that work

Dr Sarkies will conduct a series of randomised controlled trials to test which strategies or combinations of strategies work to improve adherence to medications. He will then use a mixed methods approach to determine the effects of the strategies on different community groups.

This approach could be scaled to other health conditions and areas of science, including climate change, and significantly increase the speed with which research is applied to policy and practice.

Research keywords

Health Care Sciences & Services; Health Policy & Services.

Research methods

- Implementation Science
- Research translation
- Evidence-based implementation
- External stakeholder engagement
- Clinical practice guidelines development
- Randomised controlled trials
- Statistical analysis

Learn more or get in touch

Health Sustainability

Dr Alistair Senior

Faculty of Science
School of Life and Environmental Sciences

MDI: Charles Perkins Centre

Nutritional data science for lifelong health

While it's accepted that nutrition is a way of slowing the ageing process and preventing chronic disease, it's still not well understood which dietary patterns could lead to longer, healthier lives at a population level.

Another issue is that diets thought to provide optimal nutrition for late life, such as high-protein diets, may be less environmentally sustainable.

Dr Alistair Senior is an international leader in nutritional data science. He works primarily in the field of nutritional ecology, which seeks to understand how interactions between an organism and its nutritional environment affect health and evolutionary fitness.

With a background in biological sciences, he is driven to answer complex biological questions using computational mathematics. His research uses all kinds of systems ranging from the theoretical (e.g. mathematical and computational models), to the experimental (e.g. animal experiments) and ecological (e.g. observational/epidemiological data).

Dietary patterns for a longer, healthier life

By applying biostatistical methods to different datasets, he is able to unpick the high complex and interrelated factors that influence the effects of nutrition on the human body as it ages.

His Horizon project aims to identify dietary patterns that extend human and planetary healthspan while simultaneously minimising the environmental footprint of the diet and food system.

The result will be new ways of quantifying biological ageing, as well as guidelines around food systems and individual dietary choices for better long-term human and planetary health.

Based at the Charles Perkins Centre, where he is Senior Lecturer in complex systems and modelling, Dr Senior plans to collaborate widely across the University as well as internationally to undertake this potentially transformative research program.

Research keywords

Biology; ecology; mathematical & computational biology; nutrition & dietetics

Research methods

- Computational biology
- Biostatistics
- Data Science
- Machine learning
- Multi-omics system study
- Meta-analysis
- Multi-objective optimisation

Learn more or get in touch

Climate change | Sustainability

Dr Arman Siahvashi

Faculty of Engineering
School of Aerospace, Mechanical and Mechatronic Engineering

MDI: The University of Sydney Nano Institute

How can we liquify hydrogen and store it safely with minimal cost?

Dr Arman Siahvashi is an expert in hydrogen liquefaction, storage and transportation who has recently completed a Postdoctoral Fellowship at the Hydrogen Technology and Energy Center (HyTEC) at the Massachusetts Institute of Technology (MIT).

His Horizon project brings his expertise to Sydney, where he is developing Australia's first high-efficiency, modular and low-cost hydrogen liquefaction and storage system.

Green hydrogen holds immense potential for replacing fossil fuels, but it is costly and flammable, while storage and transportation remain problematic hurdles. We need significantly better fundamental understanding, engineering development and novel breakthroughs to turn the efficient, low-cost and safe production and use of liquid hydrogen into reality.

A low-cost way to liquefy hydrogen

Dr Siahvashi is proposing a revolutionary scientific solution that will address these issues. The aim is to develop a system for widespread use that can liquify hydrogen on demand, at the lowest cost possible.

Using his knowledge of advanced cryogenics and liquefaction thermodynamics, he is creating a refrigeration system that will liquify hydrogen at extremely low temperatures, up to -253 degrees Celsius.

Such technology currently exists only in the laboratory. Dr Siahvashi's modular system can be scaled from small portable scale to large-scale industry applications.

Boosting Australia's hydrogen export industry

Australia is the ideal environment for this research as we are world leaders in producing and exporting liquefied natural gas (LNG). Liquified hydrogen could use the same infrastructure and know-how.

If successful, this project will be commercialised to provide access to clean energy, especially in remote areas. It also has the potential to establish Australia as a world leader in the nascent hydrogen export industry.

Research keywords

Engineering (Mechanical, and Chemical); Energy & Fuels; Automation & Control Systems, Instruments & Instrumentations, Materials Sciences; and Green & Sustainable Science & Technology, Thermodynamics; and Physics (Applied & Fluids).

Research methods

- Experimental design and development of cryogenic and high-pressure systems
- Analytical models and software design
- 3D printing and prototype design and testing
- Open access software
- Algorithm design
- Multidisciplinary research

Learn more or get in touch

Health

Dr Ting Rei Tan

Faculty of Science
School of Physics

MDI: The University of Sydney Nano Institute

Exploring the chemical applications of quantum computing

Dr Ting Rei Tan is pioneering the use of quantum computing to tackle some of the most challenging simulation problems in chemistry.

A highly regarded quantum physicist who trained under Nobel-laureate physicist David Wineland, Dr Tan is using trapped-ion quantum computing systems to simulate chemical reactions at a sub-atomic level.

His team, based in the Sydney Nanoscience Hub, is developing a way to simplify and enable accurate quantum simulations that radically improve modelling of photoactive chemical reactions.

Observing the quantum dynamics of a chemical process

Some chemical processes happen in femtoseconds – a billionth of a millionth of a second – so it's impossible to observe them in real-time. Conventional computers are unable to accurately predict quantum chemical dynamics in molecules.

The new approach, published in Nature Chemistry in 2023, enables scientists to observe and measure the quantum dynamics of a chemical process, using a quantum computer to slow down the process by a factor of 100 billion times.

In a world-first collaboration, Dr Tan is working with dermatology specialist Professor Pablo Fernandez Peñas and theoretical chemist Professor Ivan Kassal to apply the method to the design of new drugs used for phototherapy, such as those used to treat skin cancers.

This technology also holds huge potential for Australia's quantum technology industry more broadly and could eventually impact industries in the pharmaceutical, chemical, and energy sectors.

An international research career

Dr Tan's research career spans three institutes across three continents, each resulting in publications in top journals. His projects are funded by the Australian Research Council, Wellcome Leap, US Army Research Office (ARO), the US Office of Naval Research (ONR), the US Air Force Office of Scientific Research (AFOSR), and Lockheed Martin.

As well as his simulations with trapped ions, he is internationally recognised for his work on quantum control engineering, precision metrology, and atomic clocks.

Research keywords

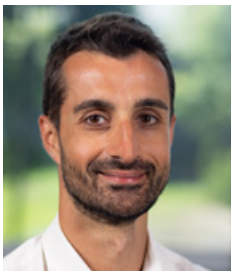
Quantum information, Quantum computation and simulations, Atomic and Molecular Physics.

Research methods

- Neural network and machine learning
- Quantum computing
- Joint theoretical-experimental research
- Algorithms development
- Hardware infrastructure development
- Drug development through quantum chemistry

Learn more or get in touch

Climate change | Health | Sustainability



Dr Federico Tartarini

Sydney School of Architecture, Design and Planning

MDI: Sydney Environment Institute, Charles Perkins Centre

A new public warning system to beat the heat

Heat stress can be a killer, especially for the elderly and people with certain health conditions. As the world warms, we'll need better ways of protecting the public against the effects of extreme heat.

Dr Federico Tartarini's project, 'Beat the Heat', aims to reduce heat-related illnesses, especially for vulnerable groups.

The 'HeatWatch' app

An engineer by training, Dr Tartarini is an expert the field of thermal comfort. He has developed several free and open-source tools that are used by thousands of users around the world every year.

He's refining a free online tool he developed, the 'HeatWatch' app, that will allow people to calculate their personalised heat health risk and take action to protect themselves, in the same way as they may use online tools to understand the UV index or calculate bushfire risk.

The outcome will be an easy way for the public, caregivers and public health officials to calculate personalised heat stress risk, plan for outdoor activities, and deliver evidence-based cooling strategies that are effective in reducing heat stress.

Understanding heat stress in different groups

The first part of Dr Tartarini's Horizon project will gather evidence on how different people are impacted by heat. Current predictions are based on healthy adults rather than vulnerable groups most susceptible to heat-related illnesses, such as older adults and children.

Dr Tartarini will also consider the other factors that contribute to heat stress beyond the temperature alone, such as people's age, clothing and activity level as well as environment factors such as the wind and humidity.

He will then build a free web application and use it to simulate the efficacy of different warning systems and public cooling initiatives, ranging from urban planning to individual advice.

Research keywords

Architecture; construction & building technology; public, environmental & occupational health; sport sciences; regional & urban planning; green & sustainable science & technology.

Research methods

- Computer science
- Human thermal physiology
- Risk perception and communication
- Computer modelling
- Open-source software and web-based tools

Learn more or get in touch

Climate change | Health | Sustainability

Dr Cara Vansteenkiste

The University of Sydney Business School

Harnessing the power of corporate giving for good

Corporate philanthropy is growing rapidly – in 2021, U.S. corporations alone donated more than $21 billion to charity – yet it is counterintuitive to traditional economic theory as it contradicts firms' profit-making incentives.

Finance expert Dr Cara Vansteenkiste aims to understand this conundrum – to identify what drives companies to give to charity, and how their giving can be mobilised to address global challenges.

Developing a global database

One of the reasons we don't fully understand corporate philanthropy is the lack of detailed global data and measurable outcomes. Dr Vansteenkiste will address this gap by developing a large-scale novel database on global corporate giving and link it with corporate and societal outcomes.

Her aim is to identify patterns in international corporate philanthropy, the effects of the political environment, regulation, supply chains and corporate takeovers, and how corporate giving can provide value not only for shareholders, but also for society.

Incentivising corporate philanthropy in Australia

Dr Vansteenkiste hopes this project will contribute to a framework on corporate giving and provide much-needed evidence to support policy.

With philanthropy by Australian corporations lagging behind that in many developed countries, her findings will help develop policies to increase incentives to donate and ensure donations align with societal needs in climate change, sustainability and health.

Research keywords

Business, Finance, Economics, Law

Research methods

- Database development
- Statistical methods
- Web scraping/manual data collection
- Empirical analysis
- Interdisciplinary collaboration

Learn more or get in touch

Climate change | Health | Sustainability

Dr Blanche Verlie

Faculty of Arts and Social Sciences
School of Humanities

MDI: Sydney Environment Institute

Reporting from the front lines of climate crisis

Dr Blanche Verlie is a social scientist whose research considers how people understand their relationship with climate and climate change.

Levels of distress and climate anxiety are increasing as more people are affected by disasters caused by climate change. Dr Verlie sees this phenomenon as a result of structural oppression, caused by systemic policy failures over a number of decades.

Rather than viewing climate distress as an individual mental health issue to be treated, her research characterises it an issue of environmental injustice demanding systemic social transformation.

Valuing people's experiences

Her Horizon project is looking at the perspectives of people who have lived through recent climate disasters such as bushfires and floods, many of whom experience mental health impacts both from their experiences as well as from fear of future events.

Dr Verlie aims to acknowledge the importance of these everyday people's experiences and emotional responses. Through their voices, she will investigate, illustrate and theorise the social dimensions of post-disaster climate anxiety.

Addressing the complexities of climate anxiety

She will conduct an ethnography of community experiences and responses to post-disaster climate anxiety throughout south-eastern New South Wales, where there have been multiple disasters in recent years.

She will investigate what local community organisations are doing that is helpful, and how social networks support people to face up to challenges and address them.

Dr Verlie's project will provide urgently needed knowledge on the social and emotional complexities of post-disaster climate anxiety; the social, political and cultural structures that amplify such climate distress; and effective social strategies to address these issues.

Research keywords

Environmental studies, Sociology, Geography, Cultural studies, Political sciences, Women's studies, Anthropology, Education, Special [Environmental].

Research methods

- Ethnography
- Discourse analysis
- Policy analysis

Learn more or get in touch

Climate change | Sustainability

Dr Conrad Wasko

Faculty of Engineering
School of Civil Engineering

An Australian framework for flood risk assessment under climate change

The risk of flooding is traditionally calculated by engineers based on historical observations. This advice then informs flood planning and infrastructure design. For example, new houses are built above a flood that could be expected to occur historically with a 1% (1 in 100) chance in any given year.

But with climate change, that historical data no longer provides an accurate picture of flood risk. There's an urgent need to update Australia's flood guidance to be consistent with the current science.

The drivers of flood risk

Dr Conrad Wasko is a trained civil engineer who is known internationally for his work on how climate change is affecting extreme weather events and flooding.

His previous research has shown that the mechanisms that cause flooding are changing. For example, fewer troughs and more high-pressure systems across the south-west of Australia are significantly affecting water supply, leading to projected declines in flooding in Perth. In the east, a shift in rainfall means the soil is drier and streamflow is declining, but extreme rainfall may lead to rare flooding events.

That means that the risk of major, damaging flood events is increasing, but the rate of minor floods that we need to fill our reservoirs is decreasing – with huge variation across Australia.

A new framework

Dr Wasko's project is understanding the mechanisms that drive flood risk across Australia. He is using climate modelling to quantify how those drivers are changing, and then developing a framework to translate these findings to engineering practice.

His findings will also support planning for future water supply, inform insurance industry projections, and improve the public's understanding about the probability of extreme flooding in a world with an unpredictable climate.

Research keywords

Water Resources, Geosciences, Multidisciplinary, Environmental Sciences, Meteorology & Atmospheric Sciences, Engineering, Civil, Limnology.

Research methods

- Mathematical modelling
- Probability framework
- Computer modelling
- Climate projections
- Risk perception and communication

Learn more or get in touch

Climate change | Health | Sustainability

Dr Lee White

Faculty of Arts and Social Sciences
School of Social and Political Sciences

MDI: Sydney Environment Institute

Considering wellbeing in the transition to renewable energy

The transition to renewable energy has massive social implications. Our reliance on energy for day-to-day life means well-designed energy policies can potentially bring wellbeing and equity benefits alongside the environmental benefits.

But equity and justice aspects are not always considered as our energy systems move towards sustainability.

Measuring energy poverty

A key issue is that there is no simple yet comprehensive way of measuring energy poverty – defined as the inability to afford enough energy to function and thrive. Australia has very limited largescale ways to estimate energy poverty, which is done through financial metrics, such as the number of disconnections or applications for hardship benefits. This does not capture all the ways that people can struggle with energy costs, and misses people who self-curtail their energy use to avoid high bills.

Energy policy expert Dr Lee White will address this gap by developing a new measure that will capture energy poverty in terms of peoples' ability to live a life that they value.

Supporting equity in energy policy

Using capabilities theory and drawing on the energy justice literature, Dr White is developing a short series of questions suitable for large scale surveys to assess energy poverty.

She will apply the validated instrument in Australia-wide surveys and use methods of statistical analysis (regression analysis) to test correlations between energy poverty and policy protections in Australian jurisdictions. This will enable her to understand which policies entrench versus alleviate existing inequities.

With an important policy window now open as governments redesign energy systems and associated policy, Dr White hopes this work will contribute to new energy systems that support social as well as environmental goals.

Research keywords

Political Science, Environmental Studies, Social Sciences (interdisciplinary), and partially with Geography due to shared emphasis on equity.

Research methods

- Interviews
- Stakeholder engagement, pilot surveys
- Literature reviews
- Statistical analysis (regression analysis)
- Multidisciplinary work

Learn more or get in touch

Health Sustainability

Dr Kerrie Wiley

Faculty of Medicine and Health
Sydney School of Public Health

How social science is vital for improving vaccine uptake

Dr Kerrie Wiley originally trained as a clinical microbiologist and worked in research and development / technical services for several pharmaceutical companies for over a decade before she decided to retrain in clinical epidemiology and public health.

Along the way, she discovered qualitative research and fell in love with how it could provide insights into complex public health problems. She left her clinical life behind and became a leading social scientist who is using mixed methods research to tackle the issue of vaccination uptake.

The role of social science

While she's still fascinated in the epidemiology of disease, Dr Wiley believes it cannot be addressed without also using social science to understand the influence of human behaviour. Social science explains why people make the choices they do, what motivates them to act, and how barriers can be removed.

In the field of vaccination, her methods provide insights into how to improve access, how to normalise vaccination, and how to address vaccine hesitancy.

Improving vaccine uptake in agriculture

Her Horizon project aims further understanding of the enablers and barriers to vaccination of both humans and animals, with the aim of developing new approaches to increase vaccine uptake in agriculture as well as human health.

The project will look at human and animal vaccination in Timor Leste, Australia, Canada and Tanzania. Importantly, it also aims to establish best practice for embedding social science in public and animal health decision making.

Research keywords

Social Sciences, Interdisciplinary; Social Sciences Biomedical; Public, Environmental & Occupational Health; Infectious Diseases; Primary Healthcare; Multidisciplinary Sciences; Veterinary Sciences.

Research methods

- Mixed social science methods (including qualitative interviews, quantitative surveys, and network mapping)
- Literature review
- Co-design with community stakeholders (overseas and domestic).

Learn more or get in touch

Climate change | Sustainability

Dr Aoni Xu

Faculty of Engineering
School of Chemical and Biomolecular Engineering

MDI: The University of Sydney Nano Institute

Towards a digital revolution in electrocatalysis engineering

To achieve net-zero emissions, it will be necessary to use renewable electricity from intermittent wind and solar to convert abundant, renewable sources like water, carbon dioxide, air and biomass into valuable chemicals and fuels.

A key part of this process is electrocatalysis, in which a catalyst participates in an electrochemical reaction that transforms precursors into the desired products.

Discovering new electrocatalysts

Dr Aoni Xu is a computational chemist who uses computational modelling and lab automation to speed up the discovery of new electrocatalysts.

Where the trial-and-error approach traditionally used in chemical engineering might take weeks to develop a suitable electrocatalyst, computer technology can find answers in hours. In future, quantum computing promises to make the process even more efficient.

Dr Xu comes to the University of Sydney from the Technical University of Denmark, where she worked with the group that is pioneering this approach. Her Horizon Fellowship focuses on electrocatalysts to be used to make green hydrogen storage more efficient, produce green ammonia for fertiliser, and reduce carbon dioxide.

Accelerating research

Her program of work will establish the first computational solid-state material database in Australia; use machine learning to screen potential material and propose new material structures; and build a next-generation laboratory to produce reliable and reproducible datasets.

This research will provide invaluable new insights into the mechanisms of electrocatalysis, and has the potential to lead to a next-generation R&D platform in Australia that leverages digitalisation and automation to accelerate materials research as we move towards net-zero.

Research keywords

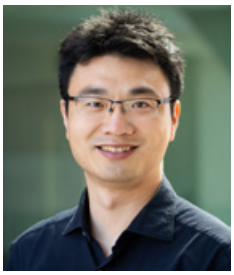
Chemical Engineering, Chemical engineering modelling, Process dynamics and control, Energy & Fuels, Nanoscience & Nanotechnology, Multidisciplinary Materials Science, Characterization & Testing Materials Science, Green & Sustainable Science & Technology, Multidisciplinary Engineering.

Research methods

- Computational modelling
- Machine learning-based optimisation
- Automated experiments
- Chemical synthesis
- Raman spectrometry
- Automation

Learn more or get in touch

Health



Dr Chun Xu

Faculty of Medicine and Health
Sydney Dental School

MDI: The University of Sydney Nano Institute, Charles Perkins Centre

Materials science finds solutions for clinical challenges

Dr Chun Xu is a materials scientist with a background in dentistry. His clinical experience combined with his expertise in biomedical engineering and nanotechnology mean he is able to design materials that have real-world clinical applications.

He has pioneered several groundbreaking solutions for medical challenges such as bone regeneration and the use of 3D printing to fabricate biomaterials that are customised for the patient's precise needs.

For his Horizon project, Dr Xu is developing a new type of nanoparticle platform for biomedical application, especially for genome editor delivery.

New nanoparticles for genome editor delivery

While genome editing using CRISPR technology holds huge potential for human health, there are still problems with delivering the technology into the body in a targeted and regulated way.

Dr Xu's platform will deliver genome editing tools using synthetic porous nanoparticles developed by his team. These are very tiny particles like sponges with numerous holes on them that carry large amounts of proteins and drugs and deliver them efficiently into special cells in the body.

This technology will enable precise control over the delivery of genome editing tools into specific tissues and cells, and the ability to track this with imaging. The result will be fewer side effects and improved efficiency compared to existing methods.

These new synthetic nanoparticles can be fabricated on a large scale with high reproducibility and quality control, unlike existing delivery platforms such as viral vectors. If the project is successful, they could be commercialised for use in a broad range of biotechnology solutions.

Research keywords

Nanoscience & Nanotechnology; Dentistry, Oral Surgery & Medicine; Engineering, Biomedical; Materials Science, Biomaterials.

Research methods

- Nanomatherial synthesis
- Nanoparticle characterisation
- Fluorescence imaging
- Organic chemistry
- Animal studies capability
- Tissue culture techniques

Learn more or get in touch

Climate change | Health | Sustainability

Dr Jingjing You

Faculty of Medicine and Health
School of Medical Sciences

Harvesting the power of collagen

Dr Jingjing You is primarily a solver of clinical problems – she researches and develops biomaterials for use in regenerative medicine and other clinical applications.

Her main interest is biomaterial development for tissue repairing and drug/cell deliveries. Her group was the first in the world to develop a printable bioink made of collagen to rebuild human corneas, and a printable healing material for corneal repairing (the iFix system). The latter has spun off into a start-up company. She holds several international patents.

Biomaterials made of collagen

Dr You's Horizon project will continue her collagen research. Biomaterials made from human collagen fibres are stronger than steel, and can be used for building and repairing tissues, for example in the eye and brain.

An obstacle facing the multi-billion-dollar collagen industry is obtaining human collagen for clinical use. The collagen currently in use is prohibitively expensive and must be harvested from biobanks or surgical waste.

Economical collagen production

Dr You is finding a new, economical way of producing collagen using human cells to spin the fibres, like silkworms.

The product developed by this mini cell factory will then be developed into ophthalmic biomaterials that can be used to treat various tissue injuries including eye and brain tissues.

Dr You hopes her program of work will support and encourage development of collagen medical products in general, and guide how human collagen will be produced and regulated in the health system.

Research keywords

Medical Laboratory Technology; Medicine, Ophthalmology; Pathology; Surgery; Transplantation; Material Science, Biomaterials; Engineering, Biomedical; Green & Sustainable Science & Technology; Cell & Tissue Engineering.

Research methods

- Bioengineering
- Biomaterials manufacturing
- Machine learning
- Drug development
- Drug delivery
- Tissue engineering

Learn more or get in touch

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