The University Of Queensland
AUSTRALIA

CREATE CHANGE

UQ Dow Centre for Sustainable Engineering Innovation

Annual Report 2024

Contents

Message from the Vice-Chancellor, President, and Chair of the UQ Dow Centre Advisory Board

2024 has been a pivotal year for the UQ Dow Centre – one marked by renewal, strategic focus, and a celebration of a decade of impact. Since its inception, the Centre has grown into a driver of thought leadership and innovation in sustainable technologies. This milestone year not only reflects on our journey so far but also sets the stage for the next chapter in advancing Australia's decarbonisation.

The global context in which the Centre operates is shifting rapidly. Climate targets are tightening, and geopolitical dynamics are reshaping energy markets. In response, the Centre has placed stronger emphasis on deep technology, aimed at translating cutting-edge research into tangible, real-world solutions. This approach included a significant deepening of skill sets and an integration of diverse technological branches to ensure that breakthrough innovations are more than theoretical concepts, but solutions that can be effectively deployed across industries. This aligns with the University's broader mission to drive impact beyond academia.

In this context, we have also begun exploring how the UQ Dow Centre can intersect with the broader Australian economy, contributing uniquely through the nation's distinctive characteristics. Australia's small, compact economy offers a unique advantage in implementing technology solutions: agility. This allows us to test, iterate, and deploy new technologies with a level of ease that could serve as a model for larger global markets, offering valuable insights into scaling up new solutions.

This year, the launch of the ARC Centre of Excellence for Green Electrochemical Transformation of Carbon Dioxide (GETCO2) in July was a highlight. It underscores the Centre's ongoing leadership in decarbonisation and its capacity to lead large-scale, collaborative research tackling urgent global challenges. The momentum behind GETCO2 reflects a readiness to respond to rising international demand for climate solutions that are scalable, practical, and grounded in technical innovation.

The Net Zero Australia project continues to be a flagship initiative, with progress being made towards its next phase. The project is well-placed to continue to contribute meaningfully to policy and industry dialogue both nationally and internationally, at the same time as informing decision-making at scale.

Throughout 2024, the Centre demonstrated a strong commitment to engagement and inclusive growth, holding a series of consultations and discussions with affiliates. These conversations are vital to ensuring that the Centre's strategic direction reflects the needs of its stakeholders and the evolving energy and climate landscape.

Looking forward, the Board remains confident in the Centre's vision and its capacity to translate research into real-world outcomes. We are particularly supportive of the Centre's continued investment in its people, which is essential for building a resilient and vibrant research ecosystem. By nurturing talent, strengthening capability, and embracing new ways of working, the Centre is poised to shape the next decade of sustainable innovation.

On behalf of the Advisory Board, I thank the Centre's leadership, researchers, and partners for their dedication and support. Your efforts continue to drive impact and strengthen the Centre's role as a strategic force in advancing the transition to a low-emissions future.

Professor Deborah Terry AC

Vice-Chancellor and President
The University of Queensland
Chair of the UQ Dow Centre Advisory Board

Director's Message

2024 marked the tenth anniversary of the UQ Dow Centre. As we look back on the past year, it has been a time of reflection and renewal and an opportunity to celebrate our achievements and refocus our vision for the future.

Over the past decade, the Centre has made meaningful strides in research and innovation, with a strong emphasis on sustainable technologies. Importantly, this work extends beyond technological advancement. By embedding techno-economic analysis into research efforts, innovations are designed to be not only groundbreaking but also viable for real-world application. This integrated approach is central to the Centre's mission and distinguishes its contributions in the field.

The nature of innovation is changing. To maximise impact, we must move beyond traditional models of university-led research and embrace more agile, co-created partnerships with industry and government. This year, we took purposeful steps to deepen interdisciplinary collaboration and strengthen engagement with our partners across our research programs. Our goal is clear: to ensure that breakthrough innovations move beyond the lab and become practical solutions to complex global challenges. This integrated approach enables us to develop solutions that are not only scientifically robust, but also scalable, adaptable, and aligned with the evolving needs of industry, government, and society.

In 2024, the Centre undertook a range of projects across its core research themes:

- Creating a circular carbon economy to achieve a net-zero future through carbon dioxide utilisation
- Utilising techno-economic analysis data to pursue research projects with significant global impact
- Catalysing the sustainable production of green hydrogen
- Advancing electromobility and sustainable transport solutions by decarbonising passenger and heavy vehicles

I invite you to read on and discover more about these exciting and impactful projects.

A standout moment in 2024 was undoubtedly the official launch of the ARC Centre of Excellence for Green Electrochemical Transformation of Carbon Dioxide (GETCO2) in July, which marked a significant milestone for GETCO2. It reinforced our commitment to decarbonisation through carbon dioxide transformation. We look forward to the exciting research and partnerships over the coming years.

Another key focus was the Net Zero Australia project. Throughout the year, we engaged with a wide range of partners across sectors to build a robust foundation for the project's next phase. Having reviewed and developed the impact plan, engagement strategy and modelling approaches, we are excited to see Phase Two take shape in 2025.

Recognising that our success is deeply tied to the people and community around us, we undertook several broad consultations and strategic planning sessions with our affiliates throughout the year. These conversations offered valuable insight into how the Centre can better support our affiliates and community and how we can continue to grow in ways that are inclusive, responsive, and forward-thinking.

Looking ahead, we remain committed to driving the translation of research into practice while investing in the next generation of researchers. We will continue to support and nurture our students and early- and mid-career researchers (EMCRs), ensuring that we foster a vibrant and sustainable research ecosystem.

I am deeply appreciative of the guidance and support of our Advisory Board members: UQ Vice-Chancellor and President, Professor Deborah Terry VC (Chair), Ms Karen Dobson (Managing Director, Dow Australia and New Zealand), Dr Julia Woertink (Chief Technology Officer, Dow Asia Pacific), Mr Noel Williams (Specialist Manufacturing Advisor and UQ Alumni Representative), and UQ colleagues: Professor Sue Harrison, Professor Justin Cooper-White and Professor Alan Rowan. I also take this opportunity to acknowledge Dr Rui Cruz (Vice-President of Core R&D, Dow), who stepped down from the Advisory Board this year, and thank him for his valuable contributions and dedication during his time on the Board.

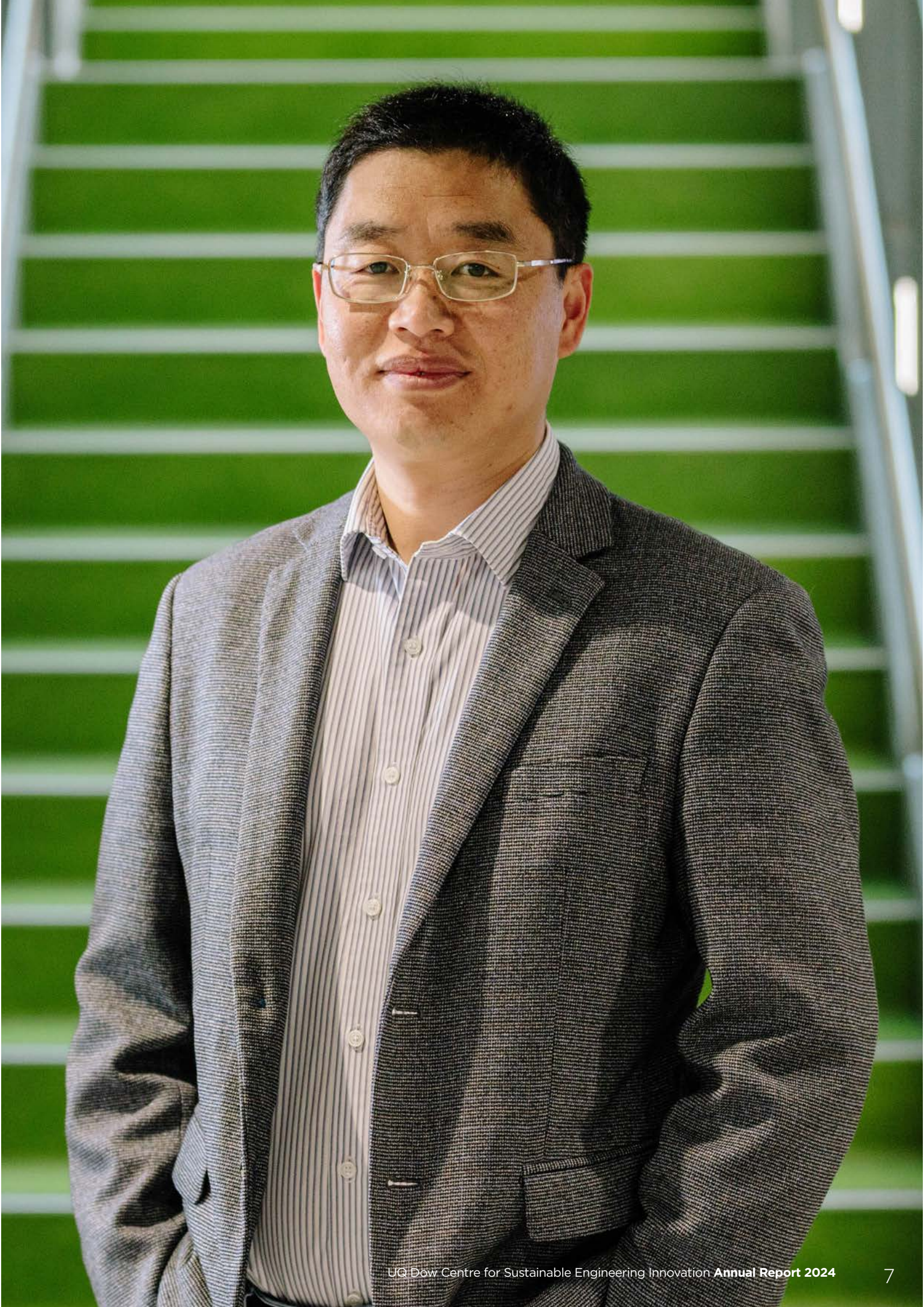
I also would like to extend my heartfelt thanks to my other UQ colleagues: Ms Caroline Stott (Associate Director, Energy Transitions, Strategic Partnerships - Government and Industry), Professor Adrian Panow (Director, Energy Transitions Network), Associate Professor Simon Smart (Deputy Director, UQ Dow Centre) for their support and commitment, and to all our affiliates for their dedication and hard work. Your contributions drive the success and evolution of our Centre. Together, we are shaping a future defined by innovation, impact, and meaningful change.

Professor Xiwang Zhang, FTSE

Endowed Dow Chair in Sustainable Engineering Innovation

Director of the UQ Dow Centre

Professor and ARC Future Fellow at the UQ School of Chemical Engineering



People

Advisory Board Members

Professor Deborah Terry AC

Vice Chancellor and President, UQ, and
Chair of the UQ Dow Centre Advisory Board

Professor Deborah Terry AC is a highly experienced leader in the Australian university sector – and an internationally recognised scholar in psychology.

Since August 2020, Professor Terry has served as Vice-Chancellor and President of The University of Queensland (UQ). Prior to this, she was Vice-Chancellor of Curtin University in Western Australia, from 2014 to 2020.

Having grown up in Perth and Canberra, Professor Terry completed her PhD in Social Psychology at the Australian National University in Canberra. She moved to Brisbane in 1990 to begin her academic career in UQ's School of Psychology. Between 1990 and 2014, Professor Terry progressed through a range of academic positions at UQ before moving into senior university leadership roles, eventually becoming Senior Deputy Vice-Chancellor.

Professor Terry is a Fellow and past President of the Academy of Social Sciences in Australia and an appointed member of the Australian Research Council Advisory Council. She currently serves on the Boards of AARNET and Westpac Scholars, and she is also a member of the Universitas 21 Executive Committee.

Professor Terry has previously served as Chair of the Board of Universities Australia.

She was appointed a Companion of the Order of Australia (AC) in January 2024 for "eminent service to tertiary education as an institutional leader and academic, to the strengthening of higher education through collaboration and innovation, and to the community".

Ms Karen Dobson

Managing Director
Dow Australia and New Zealand

Karen Dobson is Managing Director of Dow Australia and New Zealand, based in Melbourne, Australia.

Having joined Dow's Australian manufacturing operations as a graduate chemical engineer from the University of Melbourne, Karen has over 35 years' experience with the company. She has held a variety of technical, marketing and business management roles in that time, including global roles in Dow's water treatment technologies and mining chemicals businesses, based over the years in Hong Kong, the United States and China.

Karen is the Chair of Chemistry Australia and serves on the Board of the Business Council of Australia. She is a member of the Australian Industry Group's Victorian and National Advisory Councils, and is a Council member of the Royal Institution of Australia.

Karen was appointed as a Fellow of the Australian Academy of Technological Sciences and Engineering in 2024.

Dr Rui Cruz

Global R&D Director for Industrial Solutions
Dow Corporate

Dr. Rui Cruz is currently the Global R&D Director for Industrial Solutions at Dow, responsible for the business innovation pipeline and a global organization dedicated to technical services, process, product and application development for a diverse pool of technologies dedicated to enabling manufacturing at our customers, with focus in key market segments among which Crop Defense, Performance Lubricants, Electronics and Coatings. He joined Dow in Brazil in 2001, having worked in Human Resources, Customer Services, Technical Services, and Research and Development for several different businesses and technologies. In 2010 he moved to Freeport, Texas, serving as the leader for Polyglycols and Surfactants R&D and later for Epoxy Process Research, Amines and Chelants, Plastics Additives and Oil and Gas.

Dr Cruz studied Chemical Engineering at the Polytechnic School of the University of São Paulo and the Karlsruhe University in Germany and holds a PhD in Chemical Engineering by the University of São Paulo, having a strong background in modelling, process evaluation, product and application development, pulp and paper technology, alternative feedstocks and biotechnology. In 2014, he received the prestigious HENAAC Great Minds of STEM Professional Achievement award.

Note: Dr Rui Cruz stepped down from the Advisory Board in July 2024.

Ms Julia Woertink

Chief Technology Officer
Dow Asia Pacific

DrJulia Woertink is the chief technology officer (CTO) for Dow's Asia Pacific region, based in Singapore. She oversees R&D in the region, focusing on innovation strategy, technology roadmaps, customer engagement, talent strategy, growth platforms, and external partnerships. Previously, she was the R&D Director for Growth Innovation, R&D Recruitment and External Technologies at Dow, managing disruptive research, technical partnerships, new business development and recruitment strategy.

Julia joined Dow in 2010, where she led semiconductor packaging product development and served as site implementation leader for Dow's Women's Innovation Network. She later became R&D Strategy Leader, then associate R&D director for M&A Integration responsible for the R&D integration activities related to the DowDuPont merger. In 2017, she directed global departments in Dow's Packaging & Specialty Plastics business.

Julia holds a Ph.D. in Chemistry from Stanford University and a B.S. in Chemistry from the California Institute of Technology. She has eight patents and over twenty publications.

Mr Noel Williams

Specialist Manufacturing Advisor
UQ Alumni Representative

After a career with Dow spanning 36 years as a chemical engineer and later as a senior executive, Mr Noel Williams now works in consultancy as a Specialist Manufacturing Advisor and on charitable not-for-profit boards. Most recently in his career at Dow, Mr Williams was appointed as Vice President to lead Dow's Business Development efforts in Asia Pacific, while previously he had been President of Dow in South East Asia, Australia and New Zealand, all based in Singapore.

Mr Williams is a past Chairman of the Board of the Institution of Chemical Engineers (IChemE) in Australia, and was a Governor and Treasurer of the American Chamber of Commerce in Singapore. He is a past President and Director of the Australian Plastics and Chemicals Industry Association (now Chemistry Australia). Mr Williams also serves as chairman on the UQ School of Chemical Engineering Advisory Board.

Professor Sue Harrison

Executive Dean
Faculty of Engineering, Architecture and Information Technology, UQ

Professor Sue Harrison is the Executive Dean of the Faculty of Engineering, Architecture, and Information Technology (EAIT) at The University of Queensland, in which she is focused on the delivery of educational programmes and research that are leading edge in terms of technology, socially relevant, focused on addressing global challenges and deliver transformational excellence.

Prior to this, she served as Deputy Vice-Chancellor: Research and Internationalisation at the University of Cape Town, where her portfolio included research, innovation, postgraduate studies, and internationalisation with a strong focus on embedding social responsiveness into research. Sue has a long, varied track record in management and leadership in the academic arena, built up through a 30-year academic career in the field of bioprocess engineering and its application to the circular economy, green technologies for the resource sectors and improved health care and well-being.

Note: Professor Sue Harrison has been appointed as UQ's Deputy Vice-Chancellor (Research and Innovation) (DVCR&I) and will take up the role in May 2025.

Professor Justin Cooper-White

Head of School
School of Chemical Engineering, UQ

Professor Justin Cooper-White is a global leader in using engineering to solve problems in biology. In addition to holding the position of Head of School and Professor of Bioengineering in the School of Chemical Engineering, he is Affiliate Professor in the AIBN, Director of the Australian National Fabrication Facility-Queensland Node, Research Director of the Herston Biofabrication Institute (a partnership between UQ and Metro North Health) and co-Director of the Australian Organoid Facility at UQ.

Professor Cooper-White is a past President of both the Australasian Society for Biomaterials and Tissue Engineering and the Australian Society of Rheology and held the position of CSIRO Office of the Chief Executive (OCE) Science Leader. He has previously held a Visiting Professor Fellowships at ETH Zurich (2007) and Politecnico di Milano (2012-2013). Professor Cooper-White is the Australian representative and Past President of the Asian Biomaterials Federation; an elected Fellow of and Australian representative on the International Union of Societies for Biomaterials Science and Engineering (IUSBE), an elected Fellow of the Tissue Engineering and Regenerative Medicine International Society, and an elected Fellow and past vice President of the Queensland Academy of Arts and Sciences.

Professor Alan Rowan

Executive Institute Director
Australian Institute for Bioengineering and Nanotechnology, UQ

Professor Alan Rowan is the Director of the Australian Institute for Bioengineering and Nanotechnology at The University of Queensland, where he leads more than 500 researchers and professional staff. Since his appointment in 2016, Professor Rowan has championed partnerships that move research from the bench to business, driving the translation of scientific breakthroughs into real-world applications that help solve society's biggest problems.

A globally recognised leader in bioengineering and nanotechnology, Professor Rowan is renowned for his work at the interface of chemistry, biology, and materials science including the development of the world's first biomimetic hydrogel that mimics the mechanical properties of human tissue - an innovation that has opened new possibilities in regenerative medicine, wound healing, and drug development.

Management

Professor Xiwang Zhang

Endowed Dow Chair in Sustainable Engineering Innovation at The University of Queensland

Director of the UQ Dow Centre

Director of ARC Centre of Excellence for Electrochemical Transformation of Carbon Dioxide (GETCO2).

Professor and ARC Future Fellow
School of Chemical Engineering, UQ

Professor Xiwang Zhang is the Endowed Dow Chair in Sustainable Engineering Innovation at the University of Queensland, Director of UQ Dow Centre, and Director of ARC Centre of Excellence for Electrochemical Transformation of Carbon Dioxide (GETCO2). He was the Founding Director of ARC Industry Transformation Research Hub for Energy-efficient Separation (EESep) and the Deputy Director of Monash Centre for Membrane Innovation (MCMI) at Monash University before he moved to UQ in early 2022.

Professor Zhang has more than 15 years of R&D experience in both academia and industry with demonstrated achievements in technology development and translation. His research focuses on membrane and advanced oxidation technologies for energy-efficient separation, resource recovery, green chemical synthesis, carbon dioxide conversion and renewable energy generation. Professor Zhang was the recipient of the prestigious ARC Australian Research Fellowship, Future Fellowship and Monash Larkins Fellowship. In 2024, he was elected as a Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE).

Associate Professor Simon Smart

Deputy Director, UQ Dow Centre

Associate Professor,
School of Chemical Engineering, UQ

Associate Professor Simon Smart is the Deputy Director of the UQ Dow Centre. He is the UQ Director of the Net Zero Australia study and a Chief Investigator in GETCO2. Simon completed his BE/BSc and PhD degrees in Chemical Engineering at The University of Queensland in 2003 and 2008 respectively. From 2008 until 2012, Simon was a research fellow in the Films and Inorganic Membrane Laboratory Group of Emeritus Professor Joe Diniz da Costa, where he led inorganic membrane research into hydrogen production, carbon dioxide capture, oxygen production, desalination and membrane reactor technologies. He pioneered metal, metal oxide silica and organosilica membranes, and was amongst the first researchers globally to apply Rapid Thermal Processing (RTP) to inorganic membranes.

Simon has been working with the UQ Dow Centre since its inception in 2014, where he has focussed on the use of molten metals and molten salts as liquid catalysts for the production of turquoise hydrogen from methane using pyrolysis and CO2 utilisation to produce syngas using dry reforming. He also specialises in broader energy system modelling and decarbonisation pathways, exemplified in projects with the Future Fuels CRC, Net Zero Australia study and GETCO2.

Affiliates

Professor Lianzhou Wang

Professor and ARC Australian Laureate Fellow, School of Chemical Engineering, UQ

Director, Nanomaterials Centre

Senior Group Leader, Australian Institute for Bioengineering and Nanotechnology, UQ

Professor Lianzhou Wang is an Australian Research Council (ARC) Australian Laureate Fellow in the School of Chemical Engineering and Australian Institute for Bioengineering and Nanotechnology (AIBN). He received his PhD degree from Shanghai Institute of Ceramics, Chinese Academy of Sciences in 1999.

Professor Wang has received multiple awards and recognitions: ARC Queen Elizabeth II Fellow, ARC Future Fellow, Australian Laureate Fellow and most recently, Fellow of the Australian Academy of Technological Sciences & Engineering. He has also received over 30 competitive ARC grants, two CSIRO Flagship Cluster projects, five major CRC programs, and numerous industry funds, totalling over $55 M.

Note: Professor Lianzhou Wang has accepted up a position with The Hong Kong Polytechnic University and will join them in 2025.

Professor Liu Ye

Professor, School of Chemical Engineering, UQ

Professor Liu Ye is dedicated to finding innovative and practical solutions to tackle challenges in achieving net zero emissions, climate resilience, and sustainability. As the Greenhouse Gas (GHG) research program leader at UQ urban water engineering, she has established national and international leadership in the research field of net-zero emissions from urban wastewater systems.

Professor Ye has been awarded over AU$10M competitive research funding and has a broad research collaboration within academia and industry. She collaborated extensively with over 15 Australian and overseas bodies including the Australian state Government, Water Services Association of Australia (WSAA), Water Research Australia (WarterRA) and technology companies (e.g., Jacob, Suez, Veolia). She has also received more than eight scientific awards, including Research Innovation Award from Australia Water Association, UQ Foundation Research Excellence Award and the EAIT faculty teaching excellence award.

Professor Mark Hickman

Professor and Chair of Transport Engineering, School of Civil Engineering, UQ

Deputy Head of School of Civil Engineering, UQ

Professor Mark Hickman is the Transport Academic Partnership (TAP) Chair and Professor of Transport Engineering within the School of Civil Engineering at The University of Queensland. Professor Hickman has taught courses and performed research in public transit planning and operations, travel demand modeling, and traffic engineering. His areas of research interest and expertise include public transit planning and operations, urban transportation planning, and the application of remote sensing technology for traffic management.

Dr Muxina Konarova

Advance Queensland Industry Research Fellow

Senior Lecturer, School of Chemical Engineering, UQ

Dr Muxina Konarova is Advance Queensland Industry Research Fellow (Mid-Career) and Senior Lecturer in the UQ School of Chemical Engineering. She gained her PhD in Chemical Engineering at Tokyo Institute of Technology, Japan. Dr Konarova has led four academia/industry projects since 2016, securing >$2M as lead CI and her team partnered with five large organisations under her Advance Qld Research (Early) and Mid-Career Fellowships, ARENA UQ, ARC Linkage and Innovation Connections.

Dr Konarova's research team focuses on the development of sustainable chemical processes and is directed to address climate change, waste utilisation and provide technical solutions for a circular economy.

Professor Tapan Saha

Professor, School of Information Technology and Electrical Engineering, UQ

Professor Saha received his PhD from The University of Queensland in 1994. He joined UQ in 1996 and has been a Professor of Electrical Engineering since 2005. He is a Fellow of the Institute of Electrical and Electronic Engineers (IEEE) and the Institution of Engineers Australia. He is also a Chartered Professional Engineer (CPEng) of Engineers Australia and a Registered Professional Engineer of the State of Queensland (RPEQ).

Professor Saha is the founding director of the Australasian Transformer Innovation Centre and leads a number of programs and initiatives across UQ, such as UQ Solar, Power, Energy and Control Engineering Discipline and Industry 4.0 UQ Energy TestLab. His current research projects are in the fields of renewable energy integration to electricity grid and smart condition monitoring for transformers and other ageing assets.

Associate Prof. Jingwei Hou

Associate Professor and ARC Future Research Fellow, School of Chemical Engineering, UQ

Associate Professor Jingwei Hou received his PhD in Chemical Engineering from the University of New South Wales in 2015. He then joined the UNESCO Centre for Membrane Science and Technology (2015-2017) and University of Cambridge (2017-2019, affiliate of the Trinity College). In 2019, he joined the School of Chemical Engineering (UQ) as an ARC DECRA Fellow, which was followed by an ARC Future Fellowship in 2021.

Associate Professor Hou is currently the group leader of the Functional Materials Engineering (FME) Lab, leading a team of over 15 enthusiastic and talented researchers in pushing the boundaries of science. His main research focuses on understanding the physical properties of the microporous materials and translating them into useful devices for membrane separation, optics, energy storage and catalysis.

Associate Prof. Tom Rufford

Associate Professor, School of Chemical Engineering, UQ

Tom Rufford is an Associate Professor in the UQ School of Chemical Engineering and a Chief Investigator in the GETCO2. Tom completed his BE and PhD degrees in Chemical Engineering at the University of Queensland in 2000 and 2009, respectively. From 2001 to 2005 he worked as a process engineer and technologist on the crude distillation columns, naptha reformers and hydrogen purification plant at Shell's Geelong Oil Refinery. From 2010 to late 2012, Tom was a research fellow at the University of Western Australia working on natural gas processing and LNG production research projects with the UWA's Chevron Chair in Gas Process Engineering, Prof. Eric May. He returned to UQ as a teaching and research academic in December 2012.

Tom is a chartered member of the IChemE and Engineers Australia (chemical engineering).

Associate Prof. Shihu Hu

Amplify Senior Lecturer, School of Chemical Engineering, UQ

Associate Professor Shihu Hu has an excellent track record in both undertaking ground-breaking research works and applying fundamental research to develop practical solutions. A/Prof Hu's research and discoveries help established previously unrecognised links between the global carbon, nitrogen and metal cycles. His publications in Nature, Nature Microbiology and Nature Communications pointed out significant implications in methane emissions from aquatic environments. A/Prof Hu works in collaboration with Australian and international water utilities on sulphide control and carbon and nutrients removal and recovery in wastewater, with industry projects totalling over $15 M in budget.

Dr Hong Peng

Amplify Senior Lecturer, School of Chemical Engineering, UQ

Dr Hong (Marco) Peng obtained a Bachelors in Minerals Engineering and a Master in Microbiology at Central South University, China followed by a PhD degree in Chemical Engineering at UQ. Before joining UQ, he had industry experience as a chemical engineer at Olympic Dam site and Newcastle Technology centre, BHP Billiton.

His research focuses on fundamental aspects of chemical engineering processes, with a specialization in unlocking nucleation and crystallization phenomena with projects on utilization of waste resource as functional materials for critical metals and carbon capture & utilization. Dr Peng is a CI for ARC Research Hub for Photovoltaic Solar Panel Recycling and Sustainability (PVRS) and ARC Training Centre for the Global Hydrogen Economy. He is the recipient of the prestigious Advance Queensland Industry Research Fellowships (Early- and Mid-Career).

Research Fellows

Dr Dia Smith Adhikari

Tritium Fellow in Electromobility, UQ

Dr Dia Adhikari Smith is the Tritium E-Mobility Research Fellow at The University of Queensland's Dow Centre for Sustainable Engineering Innovation and the Transport Engineering Group (School of Civil Engineering). Her current research focusses on advancing the performance, economics, and uptake of E-Mobility globally, with a particular focus on the decarbonisation of both on-road and non-road heavy vehicles used in transport, construction, and mining sectors in Australia. Dia's research expertise in low and zero emission heavy vehicles powered by electric, hydrogen and advanced biofuels, has been demonstrated through several industry and government engagements to deliver decarbonisation feasibility studies, emissions modelling, cost benefit analyses, total cost of ownership scenarios and developing strategic roadmaps and recommended policy packages to achieve net zero emissions. Dia has a PhD in Power and Energy Systems Engineering from Glasgow Caledonian University, UK and worked as a Postdoctoral Fellow at the Centre for Integrated Renewable Energy Generation and Supply, Cardiff University, UK.

Dr Haijiao Lu

ARC DECRA Research Fellow, UQ

Dr Haijiao Lu obtained her dual bachelor's degrees in Science and in Engineering from Nankai University and Tianjin University (China) respectively in 2014. Supervised by Academician of Chinese Academy of Engineering Prof Jingkang Wang, she obtained PhD degree from Tianjin University in 2019. She worked as a postdoctoral research fellow at The Australian National University (ANU) in 2019-2021, and then at UQ with Prof Lianzhou Wang. In Jan 2023, she commenced as an ARC Discovery Early Career Researcher Award (DECRA) Research Fellow. Her research is characterised by its interdisciplinary feature, laying at the intersection of materials science, photo(electro)catalysis, and chemical engineering. Dr Lu has secured funding from the Australian Nuclear Science and Technology Organisation (ANSTO), 2023 Philanthropic grants for EAIT Early Career Researchers and 2023 QUEX institute accelerator grant. She has also received research awards including the 2022 Early Career Researcher Award (EAIT Faculty), the 2022 Research Excellence in Energy Nanomaterials (Nanomaterials Centre), and Inaugural (2023) Early Career Research Leadership Award (EAIT Faculty).

Dr Kai Li Lim

St Baker Fellow in Electromobility, UQ

Dr Kai Li Lim is the inaugural St Baker Fellow in Electromobility at The UQ Dow Centre for Sustainable Engineering Innovation. As a trained computer engineer with more than nine years of experience developing mobility and navigation frameworks, his early forays saw him designing navigational algorithms for mobile robots and indoor pedestrians. More recently, his applications employ techniques relating to data engineering, the Internet of Things, cloud computing, computer vision and deep learning, resulting in tangible products for real-time vehicle and infrastructural telematics and computer vision based autonomous driving. Kai Li received the BEng (Hons) degree in electronic and computer engineering from the University of Nottingham in 2012, the MSc degree in computer science from Lancaster University in 2014 and the PhD degree from The University of Western Australia in 2020, where he was fully supported by the Australian Government under the Research Training Program.

Dr Mike Tebyetekerwa

ARC DECRA Research Fellow, UQ

Dr Tebyetekerwa is an ARC DECRA Fellow and Sub-Group Leader at UQ Dow Centre for Sustainable Engineering Innovation and GETCO2.His current main research interests at UQ School of Chemical Engineering rotate around water and electrochemical systems such as electrochemical CO2 capture and conversion to valuable chemicals and electrochemical production of hydrogen peroxide and/or hydrogen. He is deeply interested in designing scalable and industry-relevant chemical cells and generators.
He completed his PhD from The Australian National University (ANU), where his research focused on optical spectroscopy and advanced characterization of semiconducting materials and their devices (Supervised by Prof Dan Macdonald, A/Prof Hieu T. Nguyen and Prof Yuerui (Larry) Lu).

Dr Xiangkang Zeng

ARC DECRA Research Fellow, UQ

Dr Xiangkang Zeng is currently an ARC DECRA fellow. He earned his PhD in Chemical Engineering from Monash University, Australia in 2017. Prior to that, he obtained a Master in Fermentation Engineering and a bachelor's degree in Biological Engineering in 2012 and 2010, respectively at Jiangnan University. His current research is centred around the development of 2D functional catalysts, metal-organic frameworks (MOFs), and covalent-organic frameworks (COFs) for applications in renewable energy to chemical energy conversion, water treatment, and antibacterial purposes.

Dr Rijia Lin

ARC DECRA Research Fellow, UQ

Dr Rijia Lin obtained his PhD from the School of Chemical Engineering at The University of Queensland in 2016. His main research interests include metal-organic frameworks, membrane gas separation, and porous glass materials. He has published over 50 articles in high-impact journals. He was awarded the ARC DECRA fellowship in 2022 and commenced his fellowship in July 2023.

Dr Zhe Yang

ARC DECRA Research Fellow, UQ

Dr Zhe Yang currently is an ARC DECRA fellow (Mentor: Prof. Xiwang Zhang) in the School of Chemical Engineering/Dow Centre for Sustainable Engineering Innovation at The University of Queensland since Dec 2023. He obtained his PhD degree in Environmental Engineering in 2018 at the University of Hong Kong (PhD supervisor: Prof. Chuyang Tang). He was appointed as Research Assistant/ Post-doc Fellow/Research Assistant Professor at HKU from Nov 2018 to Dec 2023. Dr. Yang has more than 10 years of R&D experience in membrane technology in the context of resource recovery, desalination, water reuse, and water/wastewater treatment.

Dr Zhiliang Wang

ARC Research Future Fellow, UQ

DDr Zhiliang Wang is an ARC Future Fellow in The University of Queensland. He has focused on renewable energy conversion processes, including water splitting, carbon dioxide fixation and methane conversion. He has accumulated rich experiences in the design of photocatalysts and photoelectrodes and achieved over 80 publications in highly ranked journals with over 7000 citations. He has received multiple awards, including the ARC DECRA award, J G Russell Award by the Australia Academy of Science, UQ FREA award and the ECR Research Award by UQ.

Dr Chao Xing

Dr Chao Xing commenced with the Centre in March 2023. He was awarded his Bachelor's degree in Science from Griffith University in 2019 and Bachelor's degree in Pharmaceutical Engineering at Dalian University of Technology in 2016. He then undertook his PhD in Chemical Engineering at Griffith University (2019- 2022), studying the application of two-dimensional material membranes in water purification and energy storage. His postdoctoral work involves the development of membrane-related equipment, and the application of two-dimensional material membranes in the fields of clean energy and protein separation.

Dr Zhuyuan Wang

Dr Zhuyuan Wang commenced in Jan 2023, and is an active researcher in the field of membrane separation with 6 years of experience. Previously, he worked at a listed membrane manufacturing company in China (2016 2019), focusing on developing Polyamide Thin Film Composite (PA-TFC) for water treatment. He then commenced his PhD at Monash University under the supervision of Prof Xiwang Zhang and Prof Huanting Wang (2019-2023). Through GETCO2, Zhuyuan is currently developing ion-exchange membranes, especially proton exchange membranes, and in their application around electrolysers for green hydrogen production and CO2 electrochemical reduction.

Professional Staff

Dr Hui Ying Hoh

Centre Manager
Research Operations, UQ
Dow Centre for Sustainable
Engineering Innovation

Hui Ying Hoh is passionate about supporting researchers in tackling real-world challenges through the translation of technologies and fostering engagement with non-academic partners. As Manager of the UQ Dow Centre for Sustainable Engineering Innovation, she contributes to the Centre's mission to drive solutions in energy and materials by supporting strategic initiatives and building relationships with key stakeholders.

Hui Ying holds a PhD in Chemistry from the National University of Singapore. Throughout her career, she has held roles across research, teaching, and administration at institutions including The University of Queensland, Griffith University, and Monash University. In research administration, she has led major funding submissions, and supported researchers to enhance grant competitiveness.

Emilyn Tan

Acting Centre Manager
Research Operations, UQ
Dow Centre for Sustainable
Engineering Innovation

Emilyn Tan commenced as the Acting Dow Centre Manager in July 2023. Her previous role as a Lab and Quality Assurance Manager at the UQ Protein Expression Facility has given her broad project management skills and experience in customer service. In 2022, Emilyn won a UQ Award for Excellence in Innovation as PEF's Lab and Quality Assurance Manager, leading the ISO9001 accreditation process.

Ms Emilyn Tan departed from the Centre in April 2024

Catherine Johnson

Executive Assistant
UQ Dow Centre for Sustainable
Engineering Innovation

Catherine Johnson commenced with the Centre in March 2023. Catherine has worked at UQ for over 12 years and has gained knowledge and skills in various departments across the University, which will certainly be utilised in her role as Executive/Administrative Assistant with the Centre.

Ms Catherine Johnson departed from the Centre in Feburary 2024.

Visiting Academics

Dr Chuanbiao Bie

Dr Chuanbiao Bie joined the Centre in November 2023 as a visiting scholar for a one-year term. He received his PhD in Materials Science and Engineering from Wuhan University of Technology in 2021 and is currently a postdoctoral researcher at the Laboratory of Solar Fuel of China University of Geosciences (Wuhan). His research interests focus on semiconductor photocatalysis, including H2 evolution, H2O2 production, CO2 reduction, and organic synthesis.

Dr Bie retuned to his host university in November 2024.

Prof Hongguo Zhang

Professor Hongguo Zhang joined the Centre in June 2024 as a visiting academic from Guangzhou University for six months. Prof Zhang has profound expertise in environmental science and engineering. His current research focuses on environmental electrochemical technology for directional transformation and resource utilisation of pollutants.

HDR Students

Mr Alister Sheil

Project/Research interests:
Methane pyrolysis in molten salts to produce low emission hydrogen.

Mr Gabriel Rioseco

Project/Research interests:
Economics of energy systems, specifically the integration costs of variable renewables and impact on the rate of deployment of renewables.

Mr Gregory Siemon

Project/Research interests:
Enterprise-wide optimisation in steelmaking.

Mr Hao Zhang

Project/Research interests:
Rational design and engineering of two-dimensional membranes for ionic and molecular separation.

Ms Hongxia Zhang

Project/Research interests:
Preparation of bipolar membranes and their application in CO2 reduction.

Ms Jie Yang

Project/Research interests:
Development of membrane materials with high efficiency proton transmission ability.

Mr Jindi Yang

Project/Research interests:
Development of photocatalyst and bipolar membrane for sustainable production.

Mr Junyang Zhang

Project/Research interests:
Development of photocatalytic membranes for water purification.

Mr Kaige Sun

Project/Research interests:
Energy-efficient electrochemical CO2 capture for high-performance CO2 capture materials and devices.

Miss Lijun Guo (visiting student)

Project/Research interests:
Development of biomass materials for water purification.

Mr Mark McConnachie

Project/Research interests:
Novel process to produce near-zero-CO2 hydrogen and fuels through methane pyrolysis.

Mr Ming Yong (visiting student)

Project/Research interests:
Sustainable Lithium Extraction from Brines Using Membrane Technologies.

Mr Ryota Okajima

Project/Research interests:
Investigating bubbles and solid particle behaviour in molten metals/salts for hydrogen production technology through methane pyrolysis.

Mr Umer Javed

Project/Research interests:
Development of electrode nanomaterials for electrochemical energy conversion and storage devices.

Mr Wenming Zhao

Project/Research interests:
Sustainable Hydrogen Production from Used Water.

Mr Xin Sun

Project/Research interests:
Development of advanced polymer-based catalysts for efficient production of hydrogen peroxide from water, air, and sunlight.

Mr Xuefeng Li

Project/Research interests:
Development of polymeric membranes for protein separation.

Mr Zhonghao Xu

Project/Research interests:
Constructing vertically-aligned, chemically-tailorable and porous 2D nanosheets for high-precision selective membranes.

Dr Mike Tebyetekerwa: Shaping Tomorrow's Technologies in Clean Water and Energy

Dr Mike Tebyetekerwa holds a Discovery Early Career Researcher Award (DECRA) from the Australian Research Council (ARC). He is a Sub-Group Leader at UQ Dow Centre for Sustainable Engineering Innovation and an associate investigator of the ARC Centre of Excellence for Green Electrochemical Transformation of Carbon Dioxide (GETCO2)

Mike's research at The University of Queensland (UQ) spans several innovative and impactful areas, aimed at addressing critical environmental challenges related to water and energy. He is particularly interested in creating chemical cells and generators that can be scaled up for industrial use.

One major focus of his work is developing scalable electrochemical methods to produce chemicals such as hydrogen peroxide and formic acid. These chemicals are essential for various industrial processes and clean energy applications. Creating efficient and scalable production methods will lead to more sustainable industrial practices and the advancement of clean energy technologies.

Another significant area of his research is the electrochemical capture of carbon dioxide (CO_2) and its conversion into valuable chemicals. This approach not only helps mitigate the effects of climate change by reducing atmospheric CO_2 levels but also provides a sustainable source of raw materials for various industries.

What motivated you to pursue a career in research?

Initially, a research career wasn't my intended path. I started working after completing my Bachelor of Science degree, like most people around me in Uganda. My first job from university was as a research assistant on a project led by Dr Goylette Chami from the University of Cambridge. This project, supported by the Uganda Ministry of Health, explored how social networks influence disease control. During this time, long conversations with Goylette sparked a deep interest in research within me, particularly seeing how her work uncovered why tropical diseases persist despite available treatments. I realised that solving complex problems requires deep inquiry. Since then, I became more interested in and committed to research, especially towards materials science and energy, building on my undergraduate training.

My motivation lies in addressing global energy challenges and advancing materials circularity through science. More importantly, a research career has allowed me to collaborate with a diverse group of people and institutions and opened opportunities to travel, something recommended to me by Goylette .

How do your past research experiences, including your time at ANU and Donghua University, shape your current work at UQ?

My research journey across Donghua University, China, National University of Singapore (NUS), and The Australian National University (ANU) has deeply shaped the way I approach my work at UQ. At Donghua University, I was introduced to materials science and engineering, where I developed a strong foundation in energy storage and sensor-related materials. I learned the value of focus, consistency, and productivity in research. During my time NUS, I gained a new perspective on problem-solving, seeing research not just as academic work but as a tool to create practical, real-world impact. Later, my PhD at ANU challenged me to think critically and creatively. It taught me to be inquisitive and to use basic scientific principles to explore innovative directions in materials characterisation and device design. Together, these experiences have equipped me with a diverse, interdisciplinary mindset that now guides my current research on developing sustainable materials and electrochemical systems.

How has your research interests evolved?

My research interests have evolved significantly over time, shaped by diverse academic and cultural experiences. In Uganda, I developed a strong


Mike Tebyetekerwa

foundation in textile polymer materials and technology focused on practical problem-solving and industrial application. Next, during my master's research in China and briefly in Singapore, I was introduced to materials science and electrochemistry, particularly in energy storage and functional fibres. I learned how materials can be engineered at the nanoscale to serve broader applications. My PhD in Australia took another turn where I was introduced to physics and semiconductor materials, investigating functional devices like solar cells, transistors and LEDs. During my PhD, I gained expertise in state-of-the-art tools which furthered my interest in the fundamental science behind materials behaviour. Now at UQ, my research brings all these threads and pieces of knowledge together. This journey has shaped me into a multidisciplinary researcher dedicated to solving energy and sustainability challenges through materials innovation.

What were the biggest challenges you faced, and how did you overcome them?

One of the biggest challenges I faced was adapting to life and research environments far from home, especially in countries where English was not the primary language. During my time in China and later in Singapore, I encountered language barriers in both everyday life and academic settings, which made communication, collaboration, and even daily routines difficult at first. Being far from family and familiar cultural support systems added to the emotional challenge. I overcame these obstacles by intentionally immersing myself in the local environments, learning basic language skills, building friendships across cultures, and staying focused on the purpose of my research journey. These experiences taught me resilience, adaptability, and the value of cultural exchange, and they continue to shape how I approach collaboration and leadership in global research settings.

What do you find most rewarding about your work?

I often say I have never truly "worked" a day in my life because I genuinely love what I do. What I find most rewarding is the constant learning; every day in research feels like being a curious child again, discovering something new that perhaps very few people in the world know. Research is a career where curiosity is not only encouraged but necessary. I am driven by the excitement of solving meaningful problems and the freedom to explore big ideas that can create real impact. That sense of discovery and purpose is what makes this work incredibly fulfilling for me.

Can you discuss any significant projects or initiatives currently underway?

Among several exciting projects, two stand out as particularly transformative. First is our work on the electrochemical production of hydrogen peroxide. Over the past few years at UQ, we have developed a method to produce hydrogen peroxide safely, on-site, on-demand and in any concentration required. This has the potential to replace centralised, hazardous supply chains with cleaner, distributed production. We are working with an Australian partner, Evimien Energy, to advance this technology toward commercialisation. The second major project is on electrochemical carbon dioxide (CO_2) capture, a solution I believe could play a critical role in tackling emissions, especially in transport like ships and vehicles. We are currently working towards patenting this system, which has the potential to redefine how we think about decentralised carbon management. Both projects reflect my commitment to using electrochemistry to address real-world energy and environmental challenges.

What are your goals for the future, both professionally and personally?

Professionally, my goal is to continue advancing sustainable materials and electrochemical technologies that address global challenges in energy, emissions, and circularity. I aim to lead impactful, multidisciplinary research programs that translate fundamental science into real-world solutions particularly through scalable innovations such as on-demand hydrogen peroxide production and electrochemical CO2 capture. I also hope to mentor and inspire the next generation of researchers by fostering curiosity and inclusivity, just as I was supported in my own journey. Personally, I want to stay grounded in purpose, contributing meaningfully to the global community, staying connected to my roots, and continuing to learn every day. For me, success lies not in titles or prestige, but in creating knowledge that benefits society and empowering others to do the same.

What advice would you give to someone just starting out in research?

My advice is simple: be genuinely curious. Research isn't about titles, publications, or polished résumés. It is about asking questions, being open to not knowing, and having the drive to explore anyway. If you are starting out, don't worry about having all the right skills or credentials. What matters most is your motivation, your willingness to learn, and your passion for discovery. I have seen firsthand that some of the most innovative work from students who began with limited experience but brought real enthusiasm and a fresh perspective to the lab. Research is not a career you chase for prestige. You do it because you love it, because you are drawn to the unknown, and because you believe in the power of knowledge to create change. With this mindset, everything else will follow.

Engagement

Meaningful engagement is integral to advancing the strategic objectives of the UQ Dow Centre. Throughout 2024, the Centre maintained strong connections with its affiliates and external stakeholders through a range of activities including seminars, workshops, and media outreach. These initiatives provided a platform for the exchange of insights and innovative practices, facilitating collaboration and the dissemination of knowledge.

Internal Engagement

In March, we held a consultation session to gather feedback on their priorities for the Centre's future initiatives. The session focused on understanding the specific needs of researchers, particularly early- and mid-career Researchers (EMCRs). Key areas identified included strengthening connections with industry and government partners such as the development of pilot- or demonstrator-scale projects, increasing research visibility, and providing more structured guidance for grant writing. Participants also shared valuable insights on how the Centre can better support researchers at all career stages by facilitating networking opportunities, delivering targeted support, and fostering an environment that promotes both professional growth and research excellence.

A workshop was held in November to explore how the Centre can better position itself to support UQ's strategic priorities and identify gaps in research infrastructure. Attendees articulated the importance of supporting longer-term, applied research projects that typically fall outside the scope of consultancy work. The Centre's strengths in academic rigour, policy expertise, and its capabilities in techno-economic and life-cycle assessment (TEA and LCA) were recognised as key enablers in this space. The management of potential overlaps with other UQ units, as well as leveraging networks such as the Energy Transition Network and the policy expertise of the Global Change Institute, were also discussed. In support of these objectives, the discussion emphasised the need for versatile, modular research infrastructure to accommodate a broad range of applications and maximise utilisation. Participants also stressed the importance of testing technologies across varying Technology Readiness Levels (TRLs), from laboratory environments to real-world operational settings, with a specific focus on research areas that are distinctive to Queensland and Australia.

Professor Xiwang Zhang (centre), Dr Julia Woertink (second from right) and the team in Dow Chemical Pacific (Singapore)

UQ Dow Centre affiliates and colleagues in Jilin University

External Engagement

Beyond internal engagement, the Centre also strengthened its connections with industry partners, government bodies, and the broader community, working together on decarbonisation strategies, sustainable transport solutions, and green manufacturing initiatives. This collaborative approach enabled the Centre to drive meaningful progress and influence the development of sustainable policies and technologies across multiple sectors.

In May, Professor Xiwang Zhang visited the Singapore Development Center and Customer Innovation Center, where he met with the Dow Chemical Pacific (Singapore) team, including our Advisory Board member, Dr Julia Woertink. During the visit, Professor Zhang held a productive meeting with Dr Woertink, joined by fellow Advisory Board members Professor Justin Cooper-White and Ms Karen Dobson.

Several of our affiliates attended a Young Scholars Symposium hosted by the International Center of Future Science in Jilin University (JLU) in November. UQ and JLU researchers shared expertise on advanced materials and technologies for sustainability and energy efficiency and discussed collaboration opportunities. The UQ researchers also visited the State Key Laboratory of Inorganic Synthesis and Preparative Chemistry, a world-class teaching and research institution in inorganic synthesis and preparative chemistry.

The Centre hosted a number of visits throughout the year, including a delegation from the Faculty of Engineering at the University of Hong Kong (HKU). The visiting cohort, primarily undergraduate students, was introduced to the Centre's sustainability-focused research projects. The Centre also engaged with participants from the National Energy Transition Accelerator (NETA), an eight-week program led by Curtin University under the Resources Technology and Critical Minerals Trailblazer initiative, aimed at supporting early-stage Australian startups in the global energy transition. Associate Professor Simon Smart delivered a presentation on key findings from the Net Zero Australia study, and Centre researchers presented ongoing work in membranes and wastewater treatment. The visit ended with a series of round-table discussions between NETA participants and Centre researchers, focused on the challenges associated with research commercialisation.

In December, we welcomed a delegation from China comprising of research collaborators from the Chinese Academy of Sciences and leading academics in industrial wastewater treatment, water pollution control and resource recovery technologies. The delegation toured laboratories and facilities within the Andrew N. Liveris Building and participated in several constructive meetings with UQ colleagues. The visit concluded with site tours of water treatment facilities and dialogues with industry partners.

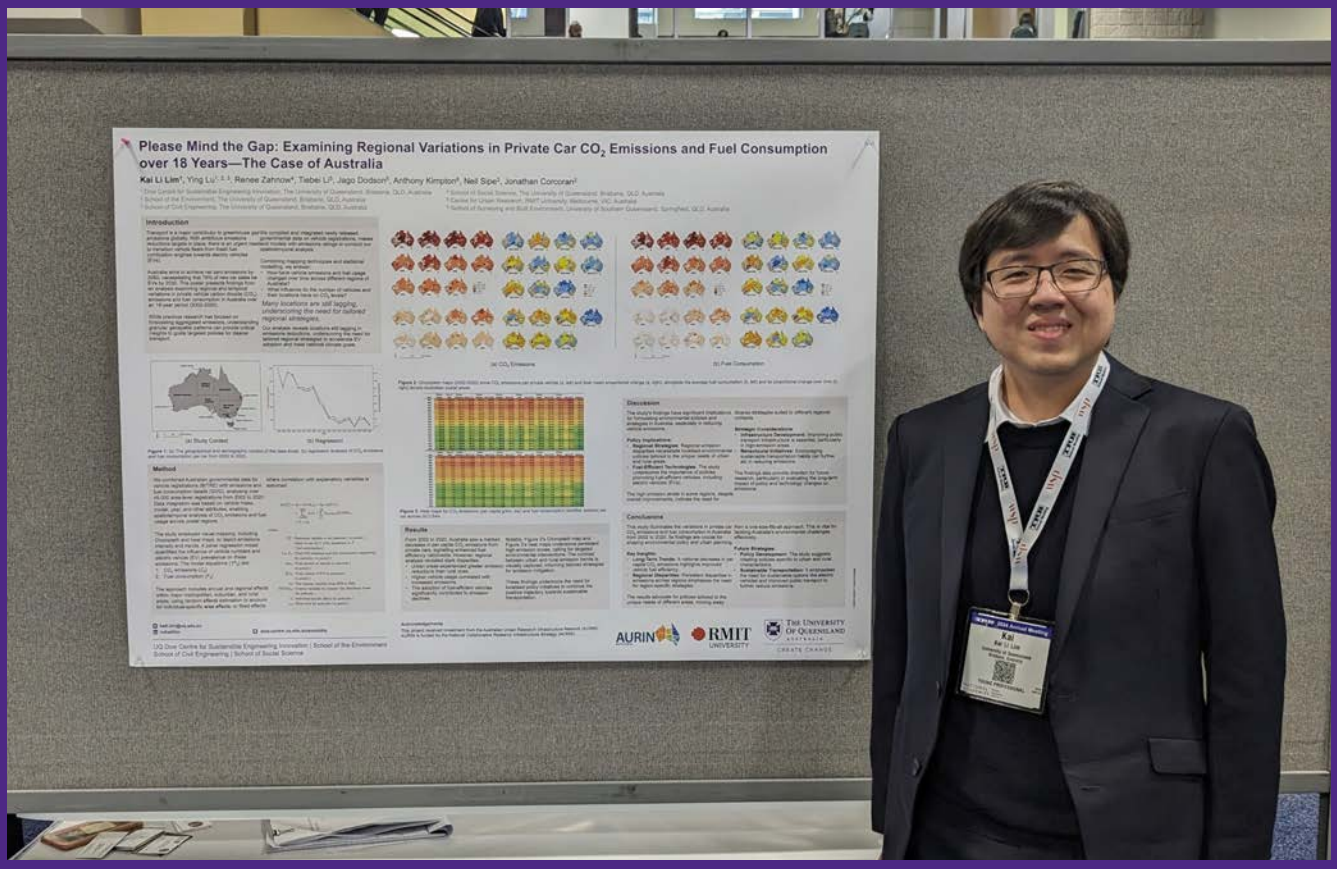
In 2024, the UQ E-mobility team delivered approximately 20 seminar and keynote presentations across Australia and internationally, addressing critical topics such as the decarbonisation of construction sites, sustainable freight solutions, and the role of green hydrogen in heavy vehicle transport. Highlights included presentations at the 37th Electric Vehicle Symposium in Seoul, Sustainable Built Environment National Research Centre Workshop, 11th International Workshop on Sustainable Road Freight in Shanghai, Public Transport Association Australia New Zealand (PTAANZ) webinar series, and a visit to the Energy Data Research Center at Chung Ang University in South Korea. The team was also featured at a reception during the Transportation Research Board (TRB) Annual Meeting at the Australian Embassy in Washington, D.C.

Throughout the year, the team maintained a strong media presence, contributing expert commentary across major Australian news outlets such as ABC News, SBS News, and The New Daily as well as on social media. Articles authored or informed by the team appeared across print and digital platforms, including a widely circulated opinion piece with a potential reach of 160 million readers.1 Topics included the economic and environmental benefits of electrifying construction equipment, the challenges of public EV charger reliability, and the role of policy in supporting clean transport innovation. Dr Dia Adhikari Smith and Dr Kai Li Lim were frequently featured in interviews with ABC Radio, discussing key developments in the EV sector, such as the National EV Strategy, public charging infrastructure, and consumer behaviour. Dr Dia Adhikari Smith also regularly provides expert insights to industry partners, including Lendlease Corporation and the Volvo Group.

The E-mobility team actively contributes to policy development through participation in government consultations (See Policy Engagement under Research: Electromobility section). Dr Dia Adhikari Smith further supports this work through her roles as a member of the Brisbane City Council's Transport and Infrastructure advisory board, the Committee for Brisbane's Connectivity, and the Public Transport Association Australia and New Zealand (PTAANZ). The sustained outreach and media presence not only enhances the visibility of their work but also promotes informed public discussion and drives evidence-based policy and decision-making in the field.

1 https://www.abc.net.au/news/2024-05-30/australia-electric-car-manufacturers-ev-renewable-energy-market/103906234?utm_campaign=abc_news_web&utm_content=link&utm_medium=content_shared&utm_source=abc_news_web

UQ Dow Centre researchers with the Chinese delegation and industry partners at Luggage Point wastewater treatment plant



Dr Kai Li Lim at the 2024 Transportation Research Board (TRB) Annual Meeting in Washington, D.C.

Opposite: Dr Dia Adhikari Smith at the Queensland Fire and Emergency Services (QFES) Prime Mover delivery and Official Handover at the Volvo Group, Wacol, Brisbane

Research Success

Our researchers have secured almost $2 million AUD in external funding in 2024. Below is an overview of the research grants awarded.

Project focus	Investigators and partners	Grant value (AUD)
Nanochannel engineering of proton-exchange membranes to boost iron-flow-battery performance Advanced Queensland Industry Research Fellowships	Dr Chao Xing Energy Storage Industries - Asia Pacific	$240K
Engineering Nanomembranes for Direct Air Capture of Carbon Dioxide ARC Discovery Early Career Researcher Award	Dr Min Liu	$402K
Transitioning to zero emission construction machinery	Dr Dia Adhikari Smith, Lendlease	$41K
Sustainable scaled-up production of high-quality nanosheets ARC Linkage Projects 2024 round 1	Professor Xiwang Zhang, Dr Zhuyuan Wang, Dr Mike Tebyetekerwa, Professor Darren Martin and Dr Matthew David GrapheneX	$709K (ARC) $510K (Industry)

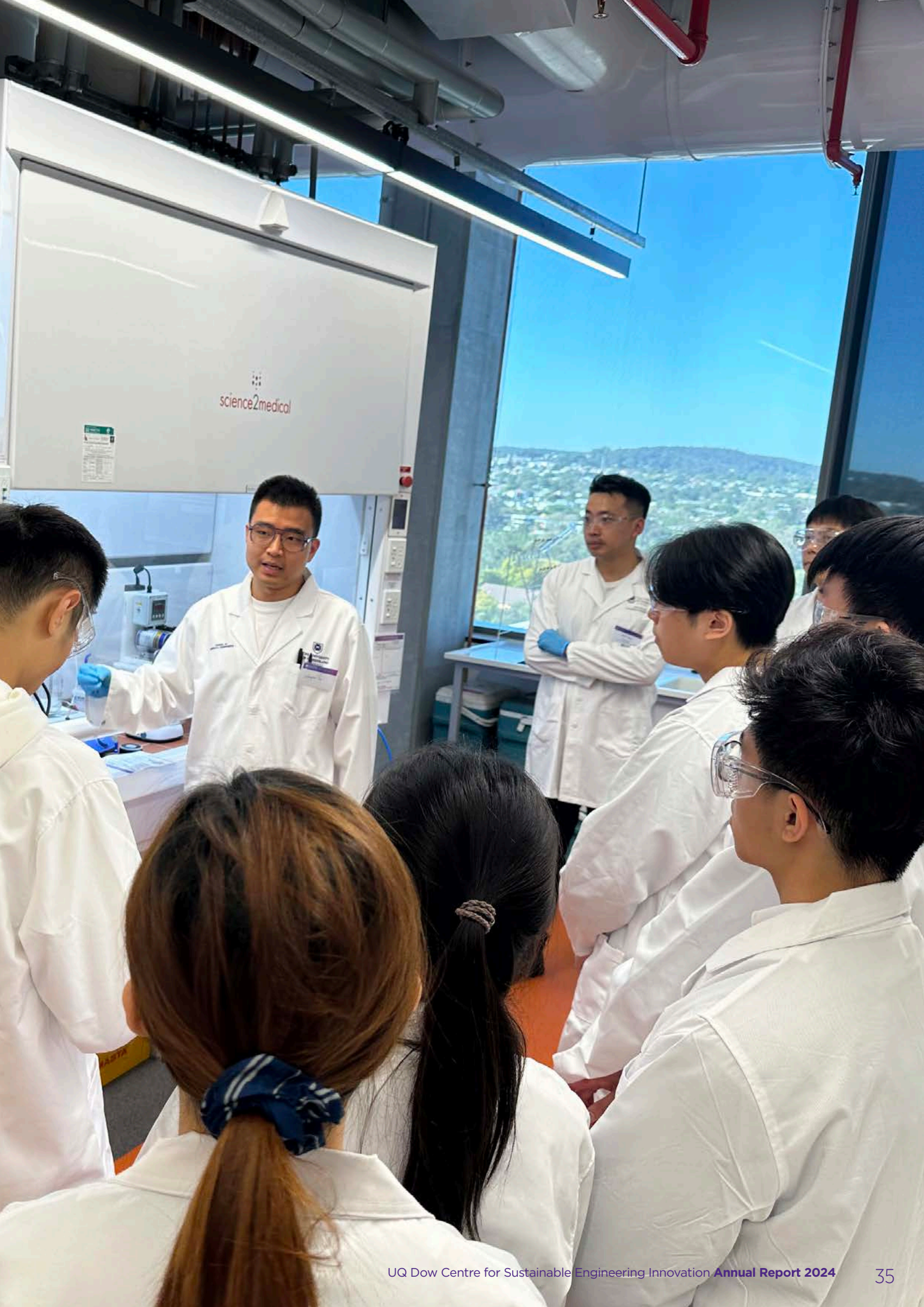
In addition to our success in securing research grants, three researchers, Professor Xiwang Zhang, Professor Lianzhou Wang and Dr Zhe Yang, have been recognised as Clarivate Highly Cited Researchers for 2024.[2] These researchers are recognised as the top 1% most cited in their respective field. The recognition underscores the impact of their work and further elevates the Centre's reputation for excellence in research.

In October, Professor Lianzhou Wang and Professor Xiwang Zhang were named as the 2024 Fellows of the Australian Academy of Technological Sciences and Engineering (ATSE). They joined the ranks of 900 leading engineers and applied scientists, contributing to the Academy's mission of applying science, technology and engineering to solve the big issues facing Australia in a fast-changing world.

Professor Wang was recognised as a semiconductor materials innovator for developing novel nanomaterials for wide-ranging commercial applications from solar cells and light-emitting materials to advanced device manufacturing and mineral processing.

Professor Zhang was recognised as a sustainable technology innovator for applying membrane science and technology for various environmental applications including clean water production and leading a national initiative to convert carbon dioxide into valuable products such as fuels and chemicals.

2 https://www.abc.net.au/news/2024-05-30/australia-electric-car-manufacturers-ev-renewable-energy-market/103906234?utm_campaign=abc_news_web&utm_content=link&utm_medium=content_shared&utm_source=abc_news_web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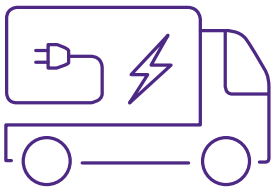
Research Themes



Electromobility

Background

The transport sector contributes significantly to Australia's overall carbon footprint, accounting for 21% of the country's emissions.[3] The increasing need to reduce emissions, combined with volatile fuel prices, has boosted the shift to electromobility (e-mobility). At the UQ Dow Centre, the e-mobility team focus on several key areas to target barriers to decarbonisation in the transport sector.

Decarbonising Heavy Vehicles

Heavy vehicles include electric buses, low and zero emission trucks and freight more broadly, construction heavy vehicles and equipment and emergency vehicles and other hard-to-decarbonise edge-use case transport scenarios. The E-mobility team conducts research on the transport and construction sectors through feasibility studies, emissions modelling, cost-benefit analyses, total cost of ownership scenarios, strategic roadmap development, and policy assessments.

The team works closely with the Department of Transport and Main Roads (TMR) in Queensland through the Transport Academic Partnership (TAP). Ongoing TAP projects investigate public transport, electric range extender vehicles for edge-user applications, heavy vehicle charging and transport for Brisbane 2032 Olympics. The Mobility-as-a-Service customer impact trial, first launched in UQ in 2021 and completed in 2023, was expanded to the Gold Coast in August 2024 after securing new funding from iMOVE Australia Cooperative Research Centre (CRC) in partnership with Griffith University. This project is led by Professor Mark Hickman and Dr Ying Lu.[4]

Another iMOVE collaborative project with the Transport for New South Wales (TfNSW) and the Department of Planning & Environment (DPE) supported the development of Transport for NSW's Net Zero Freight Emissions Policy. By conducting emissions and economic assessments through to 2060, the study reviewed best practices in reducing freight emissions, baseline emissions modelling, and the evaluation of potential policy interventions. Industry uptake of low-emission solutions and the economic and health impacts of proposed policies were assessed, providing recommendations to overcome deployment barriers. Dr Dia Adhikari Smith shared these findings at various government symposiums and meetings throughout 2024, contributing to the broader discussion on sustainable transport.

The E-mobility team has been working with Lendlease since 2022 to investigate technologies for zero emission construction sites. The One Sydney Harbour R3 project demonstrated a significant shift towards sustainable construction in Australia, focusing on replacing diesel with electric machinery. This research offers a comparative analysis based on empirical data, examining energy efficiency, carbon emissions, and cost implications of electric versus diesel concrete pumping. The findings highlight the environmental and economic advantages of electrification, presenting a factual overview that supports the transition to fossil fuel-free construction sites.[5] Dr Dia Adhikari Smith presented the results with Lendlease at the Sustainable Construction Industry Forum in February 2024.

The team is also working with Lendlease and the Queensland Government on a three-year initiative aimed at establishing a fossil fuel-free construction site at 1 King Street. This pioneering venture will undertake a comprehensive feasibility study, followed by the development of an execution plan, to pioneer low or zero emission construction methodologies. It plans to meticulously measure and evaluate the site's performance, using these insights to craft operational best practices for eco-friendly construction in Australia. The project also seeks to engage with industry stakeholders to promote the wider adoption of sustainable construction technologies and practices, while contributing to the formulation of policies and regulations that support low/zero emission standards in construction projects.

Charging and Mobility Behaviours

The shift to renewable energy and the electrification of transport are crucial for achieving net-zero emissions. Understanding consumer behaviours and preferences helps identify challenges in electric vehicles (EVs) adoption and inform policies and strategies to accelerate the progress. EVs can act as "batteries on wheels," storing energy during peak renewable production and releasing it during peak consumption. However, if EVs are charged mainly during peak demand, they could also strain the grid.

The UQ Teslascope Research Project, initiated by former Tritium Fellow Dr Jake Whitehead, has moved to a new phase – the UQ CHARGE-EV project led by Dr Andrea La Nauze. Building on the methodologies and findings on the initial study, the new phase focused on investigating energy tariff mechanisms for EV owners through a randomised control trial on shifting charging times outside peak hours.

3 Australia's emissions projections 2022, https://www.dcceew.gov.au/sites/default/files/documents/australias-emissions-projections-2022.pdf

4 https://imoveaustralia.com/project/mobility-as-a-service-customer-impact-trial-gold-coast-australia/

5 https://www.lendlease.com/siteassets/lendlease/shared/missionzero/documents/mission-zero-electric-concrete-pump-research-report.pdf

Driving and charging patterns of 400 Australian vehicles are tracked using telematics data. Dr Kai Li Lim has developed a visualisation dashboard and a redesigned data back-end providing real-time insights. This will drive innovation in the e-mobility data landscape and support data-driven decision-making.

Dr Kai Li Lim completed a Visiting Fellowship at the Institute of Transportation Studies (ITS) at The University of California, Davis in February 2024. During the Fellowship Dr Lim worked with Dr Gil Tal and Dr Scott Hardman, Director and Assistant Director of the EV Research Center, respectively, on several initiatives exploring EV adoption and charging behaviour in Australia and California. These included a California Energy Commission project on charging reliability and ChargeX industry working groups. Dr Lim continues to participate in the ChargeX working groups and is currently working through a data sharing agreement with the EV Research Center. The Fellowship has fostered ongoing collaborations, contributing valuable insights to the field and influencing policies in both Australia and the United States.

Infrastructure Planning and Management

Infrastructure planning and management focuses on the strategic placement, energy management, and grid integration of charging stations for EVs, including electrified construction sites. This is important for ensuring efficient, accessible, and sustainable infrastructure that supports the transition to cleaner transportation and energy systems.

The Green Australian Vehicle Ownership (GreenAVO) Capability project has concluded, with the results disseminated in Australasian Transport Research Forum 2023 in Perth, the Transportation Research Board Annual Meeting 2024 in Washington, D.C., as well as a publication in the Journal of Transport Geography and a piece in The Conversation.[6] This project, funded by the Australian Urban Research Infrastructure Network (AURIN), was a collaboration among several UQ units including School of Earth and Environmental Sciences, RMIT University, University of Southern Queensland. The longitudinal spatial study of CO2 emissions and fuel consumption from private vehicles across Australia (2002-2020) revealed uneven progress, with rural areas lagging urban centres. The findings highlight the need to target high-emission areas for the transition to EVs and offers valuable insights for low-carbon transport planning.

6 https://theconversation.com/cars-in-australian-cities-are-emitting-less-but-in-the-regions-exhaust-emissions-are-growing-241017

Policy Engagement

The e-mobility team actively participates in discussions, government consultations, and feedback processes to help shape and inform key policy decisions. By sharing their expertise and insights, they play a crucial role in supporting the development of policies that promote industry growth, foster innovation, and accelerate the transition to low-carbon transportation and energy solutions. The submissions in 2024 include:

- Consultation on Future Made in Australia: Unlocking Australia's low carbon liquid fuel opportunity (https://www.infrastructure.gov.au/sites/default/files/documents/lclf2024-university-of-queensland.pdf)
- Transport and Infrastructure Net Zero Consultation Roadmap – Heavy Vehicles. https://www.infrastructure.gov.au/infrastructure-transport-vehicles/towards-net-zero-transport-and-infrastructure
- Inquiry into the transition to electric vehicles, Parliament of Australia https://www.aph.gov.au/Parliamentary_Business/Committees/House/Climate_Change_Energy_Environment_and_Water/Electricvehicles
- Enabling supply of renewable diesel in Australia - a consultation paper on an Australian paraffinic diesel fuel quality standard (https://consult.dcceew.gov.au/supply-of-renewable-diesel-australian-paraffinic-diesel-fuel-quality-standard

Dr Dia Adhikari Smith at an UQ Alumni event

Dr Kai Li Lim visited the University of Michigan in Ann Arbor

Socio-Techno-Economic Analysis

Socio-techno-economic analysis examines the social, technological, and economic impacts of innovations, helping to assess their feasibility, sustainability, and broader implications. This analysis is important for emerging technologies as it helps identify potential barriers to adoption, such as cost-effectiveness, regulatory challenges, environmental considerations and public perception. Addressing these factors early allows informed decision-making, reduces risks, and increases the chances of successful adoption in real-world contexts.

Net Zero Australia

The Net Zero Australia (NZAu) Advisory Board has formally approved Phase II of the NZAu project. Throughout 2024, the project was in the preparatory stage, with active engagement maintained with key partners including APA Group, Australian Pipeline Industry Association, EnergyAustralia, Iberdrola Australia Limited and Future Energy Exports Cooperative Research Centre (FEnEx CRC). These collaborative efforts have been instrumental in aligning objectives, defining the scope and laying the groundwork for the project.

NZAu Phase II will focus on a set of high-priority areas: Biodiversity and System Planning; Energy System Security and Reliability; Heavy Industry and Carbon Capture and Storage (CCS); Infrastructure Delivery; and Financing the Transition. Over 2025-26, the proposed impact plan includes updated project costings, a detailed framework for measuring progress against defined targets through a range of quantitative metrics, and the integration of biodiversity, planting, and agricultural practices into energy system planning. Regional case studies will be conducted to inform context-specific implementation strategies. The project will also place emphasis on the quantification of risk and identification of planning requirements associated with major clean energy infrastructure projects.

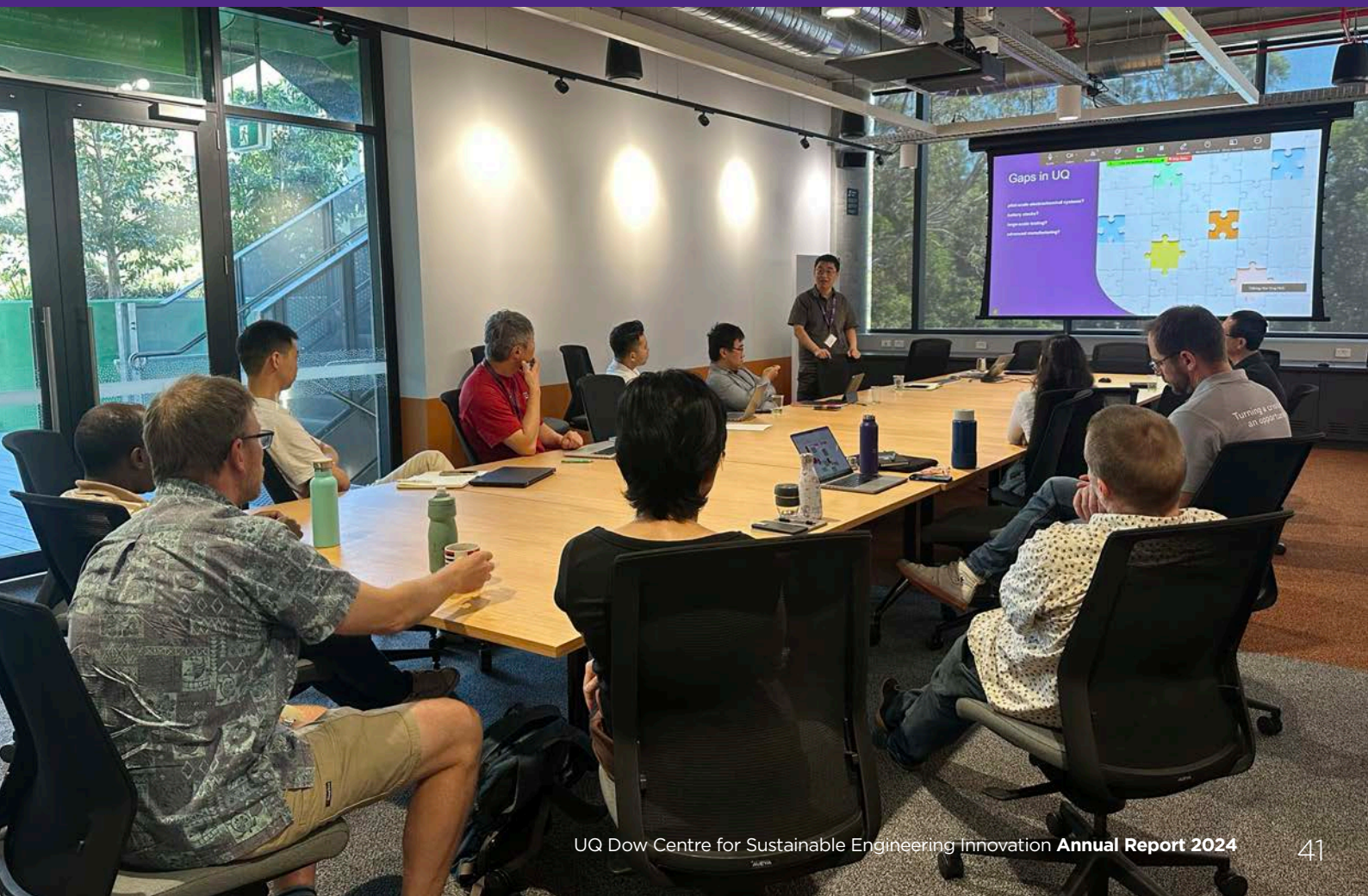
Blue Methane Pyrolysis for Hydrogen Production

The use of fossil fuels remains the primary source of anthropogenic greenhouse gas (GHG) emissions, prompting the urgent need for cleaner energy solutions. Among fossil fuels, natural gas stands out for offering the highest energy yield per unit of carbon dioxide emitted, while also being abundant and relatively low-cost in many regions. This project, funded through the Future Fuels Cooperative Research Centres (CRC), aims to develop zero CO2 pathways for producing hydrogen, chemicals, and liquid fuels by leveraging alternative chemical processes. The current research focused on methane pyrolysis using liquid metal and molten salt catalysis, which enables the production of hydrogen and solid carbon without CO_2 emissions. A key innovation lies in the use of liquid catalysts, which avoid the deactivation issues common in traditional solid catalysts. Additionally, the molten metal/salt system facilitates efficient carbon removal due to natural density differences between the phases.

Research on molten salt slurries, incorporating heterogeneous metal sulphide catalysts with non-catalytic molten salts, has demonstrated a significant enhancement in hydrogen production at around 800°C, well below the temperatures required in conventional methane pyrolysis methods. We seek to explore carbon cleaning methods through a separate project.

Several 3D simulations of bubble behaviour in the molten bubble column has been developed. The primary objective is to describe bubble dynamics in small lab-scale reactors and design a larger reactor suitable for integration into iron/steel works for hydrogen production. This integration will be evaluated and optimised using process modelling tools.

This project has generated significant interest from industry. Newcrest has reached out about our molten salt slurry research with a molybdenum-based catalyst, and Saudi Aramco is interested in our methane pyrolysis and dry reforming combination. Additionally, a student who worked on the project accepted a position at Hazer, Australia's only company focusing on methane pyrolysis technology.



Carbon Dioxide Utilisation

Carbon dioxide (CO_2) utilisation is increasingly critical for Australia as we seek to meet our climate goals while maintaining economic growth across key emitting sectors like energy, manufacturing, and agriculture. Recent research underscores electrochemical conversion as the most promising method for CO_2 utilisation, particularly given Australia's abundant capacity to generate renewable electricity and declining costs. Leveraging this advantage, the goal is to shift the paradigm, by recognising CO_2 not merely as a pollutant, but as a feedstock for sustainable fuels and high-value chemicals.

One breakthrough this year was the development of a prototype nanogenerator which produces electricity from carbon dioxide. Inspired by selective ion transport in biological processes and carbon capture systems that selectively absorb CO_2 from industrial flue gas, the researchers developed a new material based on functionalised hexagonal boron nitride nanosheets and agarose hydrogel matrix. When used in a device, this material captures CO_2 and effectively separates the charged particles (ions) formed. The ion separation generated a voltage across the hydrogel sufficient to power an LED bulb.

This breakthrough could not only enhance energy efficiency in CO_2 capture but also pave the way for cleaner, more sustainable energy solutions in a range of industries, potentially transforming the way we manage carbon emissions in the future. The work has been published in Nature Communications and covered by over 270 separate media coverage including ABC breakfast news, Daily Mail, The Age, 7 News TV story and ABC TV live interview.

Another highlight this year is the official launch of the ARC Centre of Excellence for Green Electrochemical Transformation of Carbon Dioxide (GETCO2) on 30 July 2024, marking a significant step forward in the global effort to combat climate change.

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Our centre director, Professor Xiwang Zhang, who is also the director of GETCO2, highlighted the significant potential of electrochemical conversion, transforming CO_2 from a major problem into a valuable resource. Senator Chisholm and Dr Johnston stressed GETCO2's role in advancing Australia's path to net zero and green manufacturing revolution, while Professor Karen Hussey, Chair, Emissions Reduction Assurance Committee (ERAC), Department of Climate Change, Energy, the Environment and Water, emphasised the urgency for action.

Following the official proceedings, the guests toured the laboratories and facilities at the Andrew N. Liveris Building. In the afternoon, the guests took part in an industry workshop focused on the challenges faced by industry in decarbonisation and broader net zero efforts, as well as emerging opportunities within the current research landscape.

From left: Professor Sue Harrison (Executive Dean, Faculty of Engineering, Architecture & Information Technology, UQ), Professor Aidan Byrne (Provost, UQ), Professor Xiwang Zhang (Director, UQ Dow Centre and GETCO2, UQ), Professor Rachel Caruso, (Deputy Director, GETCO2, RMIT), Professor Justin Cooper-White (Head of School, School of Chemical Engineering), The Honourable Senator Anthony Chisholm (Assistant Minister for Education) and Dr Richard Johnson (Acting Chief Executive Officer, Australian Research Council).

Green Hydrogen Production (Green Chemicals)

As a highly efficient energy carrier, hydrogen has been regarded as a promising clean fuel for applications ranging from fuel cells in vehicles to power generation. Hydrogen as a fuel is typically classified into three types based on its production method: grey, blue, and green. Grey hydrogen is produced from natural gas through steam methane reforming (SMR), which, while efficient, emits significant amounts of carbon dioxide (CO_2), making it a high-carbon option. Blue hydrogen is also produced using SMR but incorporates carbon capture and storage (CCS) technology to reduce emissions, offering a cleaner alternative. Green hydrogen, in contrast, is produced through the electrolysis of water using renewable energy sources like wind, solar, or hydro power, offering the cleanest option with no direct carbon emissions. This process splits water into hydrogen and oxygen using electricity, making it a key enabler of the low-carbon economy. The development of advanced electrolysis technologies, such as proton exchange membrane (PEM) electrolysers, is making green hydrogen production more efficient and cost competitive. As a clean energy carrier, hydrogen, particularly green hydrogen, plays a vital role in the transition towards a more sustainable, low-carbon economy.

However, despite its potential, challenges in hydrogen production, storage, and transportation have hindered its widespread adoption. Therefore, research in the UQ Dow Centre is increasingly shifting focus to the production of green chemicals such as renewable fuels and hydrogen peroxide. Hydrogen carriers, such as ammonia, are gaining attention for their ability to store and transport hydrogen more efficiently. This shift facilitates the development of more sustainable alternatives, advancing more practical and scalable clean energy solutions across various industries.

Sustainable Hydrogen Production from Used Water

This joint project between UQ and Monash University addresses the critical issue of water scarcity in hydrogen production by exploring the use of recycled water in electrolysis. It aims to understand how impurities in used water affect the performance and durability of water electrolysers, particularly PEM systems. The outcomes will inform the design of more resilient electrolysers and guide the integration of hydrogen production into existing wastewater treatment infrastructure. By advancing scalable and sustainable hydrogen production methods, the project supports Australia's efforts to position itself as a global leader in the emerging hydrogen economy.

At UQ, experiments evaluated the effects of water impurities on PEM electrolyser performance. Results showed significant efficiency losses when deionised water was replaced with treated wastewater, with cell potentials rising from 1.6 V to over 4.7 V due to impurity buildup. Acid cleaning provided only temporary recovery, with subsequent rapid degradation. Elemental analysis identified key contaminants such as magnesium, manganese, and calcium affecting membrane and electrode function. Meanwhile, researchers in Monash University investigated hydrogen peroxide (H_2O_2) treatment of recycled water, finding that higher H_2O_2 doses significantly reduced algal growth and improved water quality. These findings highlight both the challenges and potential strategies for using recycled water in hydrogen production systems.

Efficient Conversion of Hydrogen to Future Fuels

The conversion of carbon dioxide (CO_2) into methanol via catalytic hydrogenation presents a promising pathway for producing sustainable fuels while mitigating greenhouse gas emissions. To support this goal, this project focused on advancing membrane reactor technology that enables more efficient CO_2-to-methanol conversion under practical conditions. The project brings together research institutions, UQ, The University of Melbourne, and The University of Adelaide, with key industry partners including Woodside, GPA Engineering, Santos, Jemena, and APA.

Catalyst evaluation has revealed that Metal-Organic Framework (MOF) precursors are the most effective catalysts for the direct conversion of CO_2 and H_2 to methanol. MOFs are porous, crystalline structures built from metal ions connected by organic ligands. The MOF precursors were assessed, with the CAU-45 supported binary catalyst containing 10 wt% Cu identified as the most high-performing, achieving 79% methanol selectivity, a significant improvement over the conventional Cu/ZnO/Al_2O_3 catalyst at 56%. The catalyst demonstrated stable performance across multiple reaction cycles. Various integration techniques were investigated to apply the catalyst onto polymeric membranes, with spin coating using compatible solvents proving most successful in ensuring strong adhesion. Although thermal treatments were also considered, challenges arose due to the limited high-temperature resistance of some polymers. The work culminated in the development of a high-performing catalyst and its successful incorporation into membrane structures using validated synthesis and fabrication methods. This project has been completed with the final report accepted. The research outcomes were presented in a webinar in July 2024.[1]

1 https://www.futurefuelscrc.com/project/rp1-3-04-efficient-conversion-of-hydrogen-to-future-fuels/

Hydrogen Peroxide Production

The production of hydrogen peroxide (H_2O_2) is closely related to the emerging focus on green chemicals and hydrogen carriers. It is a key chemical that can play a role in both industrial processes and sustainable energy systems, such as the treatment of wastewater and the production of green chemicals. Traditionally, H_2O_2 is produced using the anthraquinone process which involves petrochemical feedstocks and generates significant energy consumption and carbon emissions. Sustainable methods with lower environmental impact are being studied currently. In the Centre, we are looking at the direct synthesis of H_2O_2 from hydrogen and oxygen using advanced catalysts and membrane technologies

Green Peroxide for Pollutants Removal

Micropollutants (MPs) such as pharmaceuticals, endocrine-disrupting chemicals, and pesticides pose significant risks to human health and the environment. Hydrogen peroxide (H_2O_2) is effective in degrading micropollutants through advanced oxidation processes. The concentrated H_2O_2 currently in use is expensive and poses significant safety risks during transport, storage, and handling. By combining advanced oxidation processes (AOPs) with on-site H_2O_2 generation, challenges associated with centralised production can be effectively addressed. Partnering with the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, this collaborative project is currently in its third stage. Two promising electrocatalysts were synthesised and integrated into a flow electrochemical cell capable of continuously producing ~7 wt% H_2O_2 in water without added salts. Efforts are now focused on coupling this device with AOPs for pollutant degradation.

Bioinspired Photocatalysts for Solar-Driven Hydrogen Peroxide Production

Inspired by natural photosynthesis, this project aims to develop advanced photocatalysts that can efficiently produce hydrogen peroxide from only water, air, and sunlight. The research focuses on the design of reaction-oriented conjugated polymer-based photocatalysts at the atomic and molecular nanostructure levels. The goal is to generate new knowledge in functional materials for artificial photosynthesis and sustainable hydrogen peroxide production. This project is now in its final stage. The team has synthesised two promising catalysts and is currently investigating the mechanism for hydrogen peroxide production, with plans to publish findings.

Below: Dr Zhuyuan Wang and Professor Xiwang Zhang with a prototype.nanogenerator..

Membranes

Membranes play a critical role in advancing the production and utilisation of green chemicals and hydrogen carriers by enabling efficient separation, filtration, and transportation processes. In hydrogen production, membranes are integral to technologies like proton exchange membrane (PEM) electrolysers, which separate hydrogen from water through electrolysis, offering a clean and efficient method of hydrogen generation. Additionally, membranes are essential for the purification and selective separation of hydrogen from other gases, improving the overall efficiency of hydrogen storage and transportation. In the context of hydrogen carriers like ammonia, membranes can facilitate the selective permeation of hydrogen during processes such as ammonia synthesis and decomposition. They also play a role in enabling the recovery of hydrogen from ammonia in a controlled and energy-efficient manner, thus addressing challenges related to hydrogen release and ensuring a smoother transition between hydrogen storage and its use as a clean fuel. Ultimately, membranes are key to making the hydrogen economy more efficient and scalable, by ensuring effective separation, storage, and transport of hydrogen and hydrogen-rich compounds.

Epitaxial Stacking of Nanoporous Nanosheets for Next-generation Membranes

Efficient separation of similar substances is a major challenge in many Australian key industries, including pharmaceutical, dairy and mining. This project aims to develop next-generation filtration membranes capable of high-precision solute-solute separation. Two-dimensional porous nanosheets are used as building blocks to construct vertically-aligned nanochannels with customisable pore sizes and chemical properties to selectively filter specific molecules. Our researchers have successfully synthesised a water- and acid-stable zirconium-based (Zr-BTB) MOF using a bottom-up approach. Membranes constructed by these nanosheets demonstrated excellent performance in the pervaporation of butanol dehydration. By intercalating positively charged polymers, the membrane operates efficiently at low temperatures, significantly reducing energy consumption. The next stage of this project involves optimisation of the material synthesis and membrane fabrication steps to elucidate the solute transport mechanisms. Outcomes of this project will contribute vital knowledge and practical solutions for energy-efficient, high-precision separation technologies.

Below: PhD Student Rizal Evans with a peroxide transformer.

Development of Water Purification Systems for Remote Communities

The ARC Research Hub for Energy-Efficient Separation, now concluded, delivered transformative innovations for key Australian industries such as water, mining, chemicals, oil, and gas by advancing separation processes, making them more energy-efficient, cost-effective, and environmentally sustainable. As part of the Hub's initiatives, our researchers collaborated with Oxfam Australia on a project aimed at developing appropriate water purification technologies for remote communities.

In partnership with an Indigenous community, the team conducted field testing and subsequently designed a compact, solar-powered, chemical-free water treatment system. The system integrates foldable solar photovoltaics with low-pressure membrane technology. Notably, the membranes were engineered to operate for extended periods without requiring chemical cleaning. Two portable prototypes underwent laboratory stability testing, demonstrating the system's capacity to provide clean water for a small community of up to five families. The project has now been successfully completed.

Integrated Solar to Chemical Production and Membrane Concentration System

This project, led by Associate Professor Jingwei Hou, aims to develop an efficient artificial photosynthesis system for converting low-cost raw materials into valuable chemicals. The system mimics natural processes to convert solar energy into chemical products by integrating a photoreactor and membrane separation device. It is designed for efficient photocatalytic water splitting, producing hydrogen and ultrapure hydrogen peroxide. Currently, the main research challenges include fabrication of highly selective and stable scalable catalysts which can effectively harnessing the full spectrum of light, particularly the low-energy, long-wavelength portion. Moreover, the synthesis methods should be easily scalable for future commercialisation.

One significant achievement made was the development of a novel composite photocatalyst system, based on lead halide perovskites embedded in functionalised Metal-Organic Framework (MOF) glass. Perovskites are a class of crystalline materials with a distinctive crystal structure, known for their excellent light-absorbing and charge-transport properties in solar and photocatalytic applications. Ongoing work is being done to exploring the optoelectronic interactions between MOF glass and perovskites, which will further inform the design and optimisation of nanocomposite photocatalysts for advanced chemical syntheses.

Below: Dr Chao Xing and PhD Student Ming Yong with the portable water purifying system.

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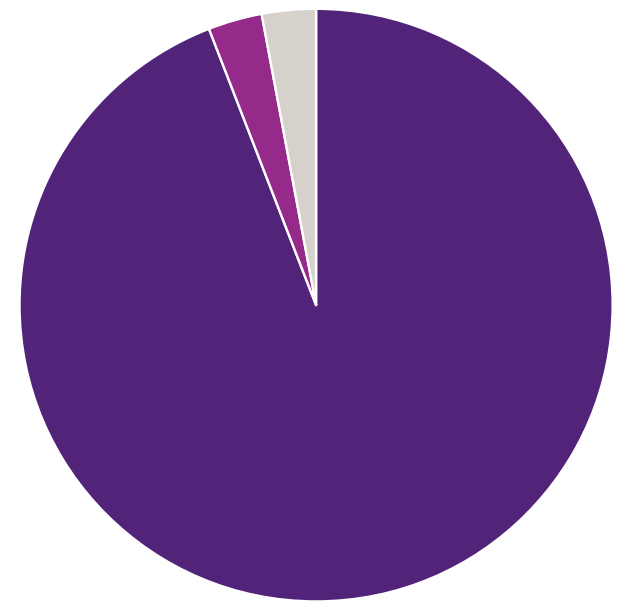

34

publications

385

Citations, an average of **11.3** citations per paper

32

publications in Quartile 1 journals

25

publications contributed to **United Nations Sustainable Development Goals**, with the highest number (14) mapped to **SDG 7: Affordable and clean energy.**

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Thank You

The UQ Dow Centre sincerely thank our valued donors: Dow Chemical, The Trevor and Judith St Baker Family Foundation and industry partners.

The vision and generosity of our donors has enabled the endowment of the Dow Chair in Sustainable Engineering Innovation and the Tritium and St Baker E-mobility Research Fellows. The support we received enables researchers to innovate and accelerate research outcomes that contribute to a sustainable future.

To learn more about opportunities to make an impact, please visit: **alumni.uq.edu.au/giving** or contact: **dowcentre@uq.edu.au**.


4

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AUSTRALIA

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UQ Dow Centre for Sustainable Engineering Innovation

E dowcentre@uq.edu.au

The University of Queensland
School of Chemical Engineering
Brisbane QLD 4072
Australia

dow.centre.uq.edu.au