THE UNIVERSITY OF
MELBOURNE

POSTERA CRESCAM LAUDE

Melbourne
Energy Institute

Annual Report
2023

Contents

Message from the Director

Each year, I look forward to writing this Director's Report as an opportunity to reflect on the outstanding work and collaborative spirit of MEI's affiliated students and staff. Yet again, many colleagues have worked very hard on important projects over the last year.

This includes ongoing work with two of the National agencies that govern and operate our energy system, the *Australian Energy Market Commission (AEMC)* and the *Australian Energy Market Operator (AEMO)*, as well as CSIRO, Monash University and others. University researchers are working on new methods to enhance system reliability, particularly as more and more renewables enter the fleet and old, thermal plant retire. We are also working on how Distributed Energy Resources should be integrated into electricity systems that have been traditionally dominated by utility-scale resources.

At the same time, our partnerships with *General Electric* and *Mitsubishi Heavy Industries* continue to research different forms of advanced, low emission power generation. This work is pushing the limits of computational analysis and control theory, and includes University staff winning an immense allocation on the world's most powerful computer, Frontier, in the US. Remarkably, this allocation for one University project is significantly larger than the domestic high-performance computing resource available annually to all Australian University researchers through the National Merit Allocation Scheme!

The *Australian Centre for Advanced Photovoltaics (ACAP)* also kicked off its second phase of life with new funding from ARENA. As the University commences important new projects with its ACAP partners, MEI will support University investments in related expertise for a very simple reason: solar PV will likely be the largest form of electricity generation Nationally within a decade, if not sooner. A fine university must therefore have deep expertise in this important technology if we wish to be excellent contemporary teachers and scholars.

Finally, I must mention the *Net Zero Australia (NZAu) Project*, which is a collaboration with the *University of Queensland, Princeton University,* and the *Nous Group*. The NZAu Project delivered its Final Modelling Report in April and its Mobilisation Report in July, and quantified the size, costs and spatial implications of the Australian energy transition for the first time. The NZAu Project has briefed many groups in government, industry and the community, and has been a wonderful collaboration across both the University *and* with UQ, Princeton and Nous.

MEI looks forward to more important work from these and other efforts in 2024.

As we do so, the professional staff support within MEI will continue to focus, week in and out, on helping University students and staff engage with industry, government and the wider community. From our *Spotlight on a Student* series that profiles our wonderful PhD students, to our many, focused seminars and specialist support of major initiatives.

I am deeply grateful for my colleagues' efforts and thank them most sincerely.

All the best,

Professor Michael Brear
FTSE, FCI, FIEAust
Director, Melbourne Energy Institute

About the Melbourne Energy Institute

The Melbourne Energy Institute (MEI) delivers influential, interdisciplinary research on the transition to a clean energy system. We work with the community, industry and government on some of the world's most pressing energy challenges.

MEI has over 300 specialists across architecture, economics, engineering, health, law, planning, science and social science. They include a former Chief Scientist of Australia, several recipients of Australia Day Honours, several Fellows of Learned Academies and numerous Fellows of Professional Societies.

MEI researchers work together in four programs:

Energy Systems

Power Generation and Transport

Heavy Industry and Resources

Energy Materials

We work with many leading organisations in Australia and overseas, and welcome all enquiries at mei-info@unimelb.edu.au.

Meet the team

MEI is run by a team of dedicated staff who look after the Institute's external and internal research programs, stakeholder engagement, and communication activities.

Professor Michael Brear
FTSE, FCI, FIEAust
Director

Ms Anita La Rosa
Institute Manager

Ms Celia Logue
Communications Coordinator

Professor Pierluigi Mancarella
Program Leader Energy Systems, and Chair Professor of Electrical Power Systems

Professor Kathryn Mumford
Program Leader Heavy Industry and Resources, and Head of Department, Chemical Engineering

Dr Adrian Panow
Director Major Projects

Ms Monica Pater
Executive Assistant

Professor Richard Sandberg
Program Leader
Power Generation and Transport, and Chair of Computational Mechanics

Ms Franca Tomaras
Events Coordinator

Associate Professor Wallace Wong
Program Leader Energy Materials, and Associate Professor, Chemistry

MEI's partners

Collaboration and knowledge transfer with industry and government are the cornerstone of MEI's work. Some of MEI's industry partners include:

- APA Group
- AusNet Services
- Australian Energy Market Commission
- Australian Energy Market Operator
- Australian Energy Regulator
- Australian Renewable Energy Agency
- BHP
- Centre for New Energy Technologies
- Clean Energy Regulator
- CSIRO
- Department of Defence
- Energy Networks Australia
- Energy Power Systems Australia
- Ford
- Future Battery Industries CRC
- Future Energy Exports CRC
- Future Fuels CRC
- GE Aerospace
- Grattan Institute
- Kawasaki Heavy Industries
- Mitsubishi Heavy Industries
- Nous Group
- Princeton University
- RWTH Aachen University
- Siemens Energy
- The Minderoo Foundation
- University of Queensland
- Victorian State Government

Highlights of 2023

Reducing aviation emissions: MEI researchers secure simulation hours on the world's fastest supercomputer

New research into surface roughness in gas turbines could improve efficiency and reduce fuel use and global emissions, via supercomputer simulations conducted by Melbourne researchers in the United States.

A team led by Professor Richard Sandberg from the Melbourne Energy Institute, together with researchers from the University of Melbourne and General Electric Aerospace, has been awarded a place in the United States-based INCITE program, a competitive tender to receive allocations for supercomputer access to perform high-impact research in science, engineering and computer science domains.

Read more →

Bubble busters: Meet the team pushing the boundaries on green hydrogen

A new electrolyser research facility is being established at the University of Melbourne, combining expertise in chemical, electrical and mechanical engineering.

The new facility gives an unprecedented and close-up view of green hydrogen production, down to the scale of tiny bubbles – a significant cause of energy loss in the production process, yet one that remains poorly understood.

Multiscale modelling, improved efficiency measures and integration with renewables are also being explored, making the connections that will enable green hydrogen to become an important part of our energy system.

Read more →

Highlights of 2023

Net Zero Australia: Groundbreaking study charts Australia's energy future

What might net zero look like for Australia? What changes might we have to make to our economy, infrastructure, and outlook to achieve net zero emissions by mid-century?

The Net Zero Australia study, a groundbreaking multi-year study into how Australia can achieve a net zero emissions economy, released its final modelling results at a public launch on 19 April 2023.

The results trace pathways to net zero, giving a detailed breakdown of possible scenarios and sensitivities, and offering comprehensive mapping of the transition to net zero emissions. The report concluded that net zero is both an immense challenge and a once in a generation, globally significant and nation building opportunity.

An additional report was released in July 2023 discussing what governments, businesses and households should do to accelerate towards a net zero future. Drawing on extensive research and findings from the previous reports, the Mobilisation Report addresses key questions about which net zero options to accelerate, what role Australia should play in global decarbonisation, how to share net zero's costs and benefits among Australians, and how to roll out renewables while improving the environment.

Read more →

New research explores lower-income households' views on energy transformation

New research has highlighted the importance of providing trusted and tailored support to lower-income households to ensure they can fully participate in and benefit from the energy transition.

Led by Dr Sangeetha Chandrashekeran, Senior Research Fellow at the ARC Centre of Excellence for Children and Families over the Life Course at the University of Melbourne, in collaboration with the Brotherhood of St. Laurence, the research surveyed households facing energy stress to understand their attitudes towards moving from gas to electricity and the barriers they face in making the transition.

The research suggests several strategies, including accelerating retrofits for lower-income homes (including social housing), a one-stop-shop that provides tailored and trusted electrification information and advice, support to help renters electrify, and providing incentives for low-income homeowners.

Read more →

New Global Research Centre to provide EPIC clean energy boost

The University of Melbourne will co-lead the Australian arm of a new research centre, which will fast-track the development of a completely renewable energy power grid – a major hurdle in decarbonising the energy sector – and help to dramatically reduce global carbon emissions.

The Electric Power Innovation for a Carbon-Free Society (EPICS) Centre will address challenges in energy production and storage through innovation and collaboration with world leaders in clean energy research, technology transfer and policy development.

EPICS will be funded through the National Science Foundation Global Centres in Climate Change and Clean Energy (NSF Global Centres) program and will involve collaboration between Australia, the USA and the UK, who have pledged a multi-million dollar investment over five years to tackle challenges posed by climate change as the world moves towards net zero.

Read more →

Greening gas turbines: Optimising hydrogen-methane combustion

Gas turbines play an important role in producing the energy that powers our homes, offices and factories.

But as the world moves rapidly towards cleaner sources of energy, researchers are exploring the use of cleaner fuel sources like hydrogen to reduce emissions and improve efficiency.

A collaborative research project, led by the University of Melbourne with support from the Melbourne Energy Institute, the Norwegian University of Science and Technology (NTNU) and Siemens Energy, has been working to improve how gas turbines handle hydrogen and methane mixtures.

Read more →

Highlights of 2023

Get outta my dreams, get into my car: Transitioning to sustainable mobility in a car-dependent world

The adoption of electric vehicles (EVs) has accelerated rapidly in Australia over the past 3 years after languishing behind global progress for many years prior.

Yet many questions remain about how to build and sustain a flourishing EV ecosystem in Australia, such as: *How much charging infrastructure is needed and where? How will EV batteries be collected, reused, and recycled at end-of-life? How will EVs integrate with an increasingly distributed and renewable electricity grid?*

Exploring answers to these challenges is the primary research interest of Associate Professor David Keith, who was recently appointed as Associate Professor of Innovation and Sustainability in the Centre for Sustainability and Business at Melbourne Business School after 9 years in the faculty at the MIT Sloan School of Management.

Read more →

MEI Research Programs

Energy Systems

The Energy Systems Program considers how different energy technologies interact with one another, society and the environment. The program includes the technical, economic and environmental analysis of energy networks, wholesale and retail energy markets and energy system planning.

Capabilities

- Energy network, system and market integration of renewable energy sources
- Distributed energy resources and smart grids
- Integrated energy networks and multi-energy systems
- Security, reliability and resilience assessment of future energy systems
- Retail energy markets and consumer behaviours control trials, big data and machine learning

Impact

- The Net Zero Australia Project demonstrated the potential scale, costs, land impacts and workforce required to achieve net zero emissions by mid-century to many industry, government and community groups
- Collaborations with AEMC and AER on power system resilience and reliability
- Modelling work on future system security and energy markets commissioned by the Finkel Review
- AEMO demand and reserves forecasting using AMI data and machine learning approaches
- Integrated electricity-gas-hydrogen modelling for the Future Fuels CRC

Research Centres

Centre for Market Design
Centre for Resources, Energy and Environmental Law
Power and Energy Systems
Thermodynamics Laboratory

Key Researchers

Program Leader: Professor Pierluigi Mancarella
Professor Lu Aye
Professor James Bailey
Professor Robin Batterham
Professor Howard Bondell
Professor Michael Brear
Professor David Byrne
Dr Sangeetha Chandra-Shekeran
Professor Robert Crawford
Professor Rob Evans
Dr Christopher Hall
Professor Glenn Hoetker
Professor William Ho
Professor Chris Leckie
Professor Chris Manzie
Associate Professor Leslie Martin
Professor Brendon McNiven
Dr Reihana Mohideen
Professor Nando Ochoa Pizzali
Dr Behzad Rismanchi
Professor Prakash Singh
Professor Kate Smith-Miles
Dr Maria Vrakopoulou

Power Generation and Transport

The Power Generation and Transport Program brings together researchers who investigate several forms of renewable and low emission power plants for stationary and mobile applications. This includes advanced wind, solar, gas turbine, reciprocating engine and energy storage technologies.

Capabilities

- Gas turbine systems
- Reciprocating engine systems
- Conventional, hybrid and electric powerplant for land, sea and air
- Wind turbines/farms, solar PV and energy storage dynamics and optimisation
- Conventional fuels and emissions chemistry
- Transport, storage and use of hydrogen and other clean fuels
- Low drag vehicles for land, sea and air
- Advanced computational methods and machine learning in energy applications
- Atmospheric chemistry
- Public health impacts of air pollution

Impact

- Improved aircraft engine aerodynamics for General Electric Aerospace
- Propulsion, engines and fuels for Ford, DST Group and MHI
- Hydrogen and clean fuels with Caterpillar
- Operational forecasting of wind and solar farm power generation with Meridian Energy Australia and others

Research Centres

ARC Centre for Exciton Science

Fluid Mechanics Group

Peter Cook Centre for CCS Research

Thermodynamics Laboratory

Key Researchers

Program Leader: Professor Richard Sandberg

Professor Robin Batterham

Dr Graeme Beardsmore

Professor Michael Brear

Professor Mark Cassidy

Associate Professor Shiao Huey Chow

Professor Shyamali Dharmage

Dr Eirini Goudeli

Professor Ralf Haese

Professor Lloyd Hollenberg

Associate Professor David Keith

Professor Sandra Kentish

Dr Patricia Lavieri

Professor Chris Manzie

Associate Professor Leslie Martin

Professor Stephan Matthai

Professor Jason Monty

Professor Paul Mulvaney

Professor Guillermo Narsilio

Professor Peter Rayner

Dr Behzad Rismanchi

Associate Professor Robyn Schofield

Professor Mark Stevenson

Associate Professor Mohsen Talei

Professor Yinghui Tian

Dr Claire Vincent

Professor Rachel Webster

Associate Professor Yi Yang

MEI Research Programs

Heavy Industry and Resources

The Heavy Industry and Resources program focuses on research that accelerate the decarbonisation of heavy industry and the resources sector. The program studies clean fuels, storage, production; carbon dioxide capture, utilisation; and storage and industrial electrolysis.

Capabilities

- Renewable integration into mining process
- Hydrogen to clean fuel conversion and process safety
- Industrial electrolysis for carbon dioxide conversion and hydrogen production
- Hydrogen production from fossil fuels with carbon capture and storage (CCS)
- Carbon dioxide capture technologies for hard to abate sectors
- Sub-surface storage of hydrogen and carbon dioxide
- Resource economics
- Resource Law

Impact

- The Net Zero Australia project showing that onshoring of mineral processing can have a sustainable competitive advantage compared to offshore processing
- Advisory to the Australian Government's updated National Hydrogen Strategy
- Provision of expert advice to the Hydrogen Energy Supply Chain (HESC) Project
- Provision of expert advice to the Australian Government's Hydrogen Guarantee of Origin scheme

Research Centres

Centre for Resources, Energy and Environmental Law

Peter Cook Centre for CCS Research

Thermodynamics Laboratory

Advanced Separation Technologies Group

Clean Energy Lab

Key Researchers

Program Leader: Professor Kathryn Mumford

Professor Robin Batterham

Dr Joe Berry

Professor Peter Cook

Dr Glen Farivar

Dr Eirini Goudeli

Professor Ralf Haese

Professor Sandra Kentish

Dr Aaron Li

Associate Professor Gang Li

Professor Stephan Matthai

Professor Richard Sandberg

Associate Professor Colin Scholes

Associate Professor Mohsen Talei

Associate Professor Yi Yang

Energy Materials

The Energy Materials Program assembles researchers working in materials science and engineering, and focuses on the discovery and optimisation of materials for energy applications. This includes materials for energy generation, storage, transport, and consumption such as hydrogen electrolysis, batteries, solar energy conversion and lighting.

Capabilities

- Energy materials design aided by theory and computation
- Developing next-generation catalysts for carbon dioxide reduction
- Novel materials and processes for gas separation and capture
- Graphene materials in low-energy electronics and energy storage
- Materials and device optimisation in thin film solar technologies

Impact

- Reduce energy consumption of separation processes for BHP, Masan and Ekos
- Developing organic and earth-abundant inorganic thin film solar photovoltaic technologies for ACAP
- Improve performance and reduce cost of anode materials in batteries for the Future Battery Industries CRC in conjunction with industry partners including Syrah Resources and AnteoTech
- Computational materials design for lightweight structural components in electric vehicles for Ford Motor Company

Research Centres

ARC Centre of Excellence in Exciton Science

ARC Training Centre in Future Energy Storage Technologies

Experimental Condensed Matter Physics Group

Integrated Computational Materials Engineering Group

Key Researchers

Program Leader: Associate Professor Wallace Wong

Dr Christian Brandl

Dr James Bullock

Dr Daniel Creedon

Professor Amanda Ellis

Professor George Franks

Professor Ken Ghiggino

Professor David Jamieson

Associate Professor David Jones

Professor Sandra Kentish

Professor Dan Li

Associate Professor Gang Li

Associate Professor Wen Li

Dr Tesfaye Molla

Professor Paul Mulvaney

Professor Kathryn Mumford

Professor Greg Qiao

Professor Graham Schaffer

Associate Professor Colin Scholes

Professor Trevor Smith

Associate Professor Jo Staines

Students of MEI

Supporting early career researchers is central to MEI's growth. By fostering the ambitious talent of early career researchers, we can help them become future thought leaders in the energy sector.

Spotlight on a student

Numerous graduate students are working on important energy projects within MEI. Below, meet some of our talented students whose work is contributing to a sustainable energy transition.

PhD graduate Joshua Butson is quickly making strides in clean energy. From a physics and chemistry background, his experiments with green energy technologies have already resulted in published work and patented materials to improve the performance of solar water splitting.

Just because a process is circular doesn't necessarily mean it's sustainable. PhD student Anna Luthin is exploring ways to assess the sustainability of circular economy models, through a German-Australian collaboration on energy and sustainability research.

Decarbonising our energy system is a big task, with multiple pathways and scenarios to consider. Yimin Zhang is on the verge of completing his PhD, with a focus on the role that hydrogen can play in coupled energy systems.

PhD student Jia Ming Goh is thinking inside the box. Her research proposes a modular system that can turn vessels the equivalent of 'beach balls' into 'Lego blocks', allowing for greater efficiency and flexibility in the storage and transport of hydrogen.

PhD student Seyedmostafa Mousavi is wrapping up his thesis on some innovative and effective new materials that could change the way we cool buildings.

Gas turbines play an important role in power generation and industrial processes, but add to greenhouse gas emissions and face other challenges including combustion instability. PhD student Pavel Panek is developing efficient simulation tools to accurately model combustion processes and identify potential instabilities.

Agriculture contributes around 17% of Australia's annual greenhouse gas emissions – a figure that's rising. Maria Lopez Peralta, veterinarian and PhD student, is modelling greenhouse gas emissions at the farm level using case studies across major grazing regions in Australia to determine whether emissions reductions achieved on farms can support industry level targets.
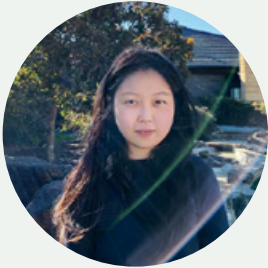
Research Fellow Peiyao Wang is gaining recognition for her research into electrochemical energy storage. Her work includes a publication that has been recognised as one of ESI's top 1% cited papers.
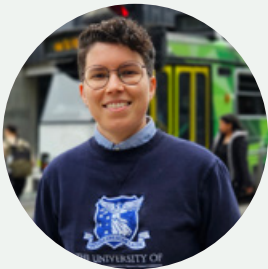
Important work is underway to encourage consumers to charge their electric vehicles at times of the day when renewables are at their peak and electricity prices are at their lowest. Ana Luiza Santos de Sa, a transport researcher and PhD student at the University of Melbourne, is working at the forefront of this challenge.

Daniel Kroh is pursuing a joint PhD to explore the fundamentals of organic semiconductors at the University of Bayreuth, Germany, and the University of Melbourne.

Through his research project, Ronald Theoman Leon, a PhD student in Chemical Engineering and Materials Science, is attempting to decipher an ancient scientific phenomenon called electrostatic energy, or triboelectricity.

Engagement

MEI's engagement program aims to educate, inform, and connect the energy community across academia, government, and industry.

MEI*network*, MEI's flagship engagement program, offers targeted educational opportunities for participants from academia and industry, while our seminars, lectures and workshops inform and stimulate broader collaboration and debate.

MEI*network*23

The MEI*network* program provides opportunities for education, professional development and engagement among key research and industry stakeholders. Offered annually since 2018, it has become the centrepiece of MEI's events and engagement program.

The main components of the program include:

*   the MEI*network* Seminar Series, which offers a deep dive into the supply and value chain of a primary energy vector;

*   the Energy Systems Short Course, held mid-year as an intensive course for energy sector professionals and graduate students from the University of Melbourne; and

*   the MEI Symposium, which has become a platform for national and international researchers to share their latest findings on technologies, systems, and opportunities for a clean energy transition.

The success of the MEI*network* program is made possible by the generous support of our industry and government partners. We work closely with our partners to develop a program that reflects current trends and challenges in the energy sector.

The following activities took place in 2023 as part of the MEI*network*23 program.

MEI*network* Seminar Series

The aim of the MEI*network* Seminar Series is to give participants a sound understanding of the current technical and economic factors that underpin the Australian energy system. Knowledge of these market factors is critical in determining the changes required to move towards a clean energy system.

Each year, the focus is turned to one of our primary energy vectors, cycling through the major topics of electricity, natural gas, and energy commodities.

In 2023, the focus was turned to the topic of energy commodities.

*   MEI*network*23 Seminar #1: Crude oil and product supply chains, *Presented by Nicholas James, Viva Energy, 9 May 2023*

*   MEI*network*23 Seminar #2: Uranium mining and refining, *Presented by Neilesh Syna, ANSTO, 8 June 2023*

*   MEI*network*23 Seminar #3: Energy commodity trading, *Presented by Keith Handbury, Shell, 6 July 2023*

*   MEI*network*23 Seminar #4: New energy commodities and critical minerals, *Presented by A/Prof Mohan Yellishetty, Monash University, 10 August 2023*

*   MEI*network*23 Seminar #5: Fiscal policy to support future energy commodity exports, *Presented by Prof Ross Garnaut, University of Melbourne, 7 September 2023*

Energy Systems Short Course

The Energy Systems Short Course teaches skills in analysing the financial, technical, and environmental performance of energy projects. The course centres on practical, hands on, modelling exercises. Participants develop their own spreadsheet models, and learn how to answer questions such as: *Is a proposed wind farm or gas turbine a good investment? What is the probability that it will earn a commercial rate of return? What is the best financing structure for the project?*

The 2023 Short Course was taught by Dr John Burgess, a University of Melbourne Honorary Professorial Fellow, with the assistance of Jonathan Anderson, a Senior Engineer working in the energy sector. Among the attendees were graduate students from the University of Melbourne and professionals from MEI's industry partners.

Engagement

MEI Symposium 23

The annual MEI Symposium showcases the multi-disciplinary energy research taking place across the University of Melbourne and beyond. It provides a space for collaboration, as well as an opportunity to celebrate the past year's accomplishments.

At MEI Symposium 23, we were pleased to host Professor Graham (Gus) Nathan, Research Director of the Heavy Industry Low-carbon Transition CRC (HILT CRC) and the University of Adelaide, as our keynote plenary speaker, alongside presenters from across the University of Melbourne and interstate.

In a keynote address on 'Prospective Pathways to Decarbonise Heavy Industry from Australian Ores', Professor Nathan explored how to accelerate the transition to net-zero for the difficult-to-abate sectors of iron/steel, alumina, and cement, considering both the path and the goal.

A packed schedule of speakers represented disciplines from across the University of Melbourne, as well as from industry and interstate. Parallel sessions throughout the day covered MEI's four Research Programs: Energy Systems, Energy Materials, Power Generation and Transport, and Heavy Industry and Resources.

In total, more than 60 people presented their research during the Symposium. Students and Post-Doctoral Research Fellows competed for a total of $8,000 in prizes for Best Presentation and Best Poster in four categories, following the themes of the four MEI Research Programs. MEI congratulates the following winners in each of the four categories:

Energy Systems

Best Poster: Eshan Karunarathne, *Constructing low voltage network models using smart meter data*

Best Presentation: Jing Zhu, *Making EVs and the grid work together: New challenges and opportunities*

Power Generation and Transport

Best Poster: Joel Mortimer, *Use of water injection to control autoignition and knock in a heavy duty, hydrogen fuelled, reciprocating engine*

Best Presentation: Tom Jelly, *High-fidelity computational studies of roughness effects on high pressure turbine performance*

Heavy Industry and Resources

Best Poster: Qiang Ge, *Cryogenic hydrogen experiment and study*

Best Presentation: Zhenbiao Zhou, *Comparing powertrains for heavy duty long haul trucks and their implications for liquid hydrogen*

Energy Materials

Best Poster: Yuchen (Jimmy) Sun, *C60 as a versatile electron contact material for crystalline silicon solar cells*

Best Presentation: Shi Tang, *High efficiency perovskite solar cells for space applications*

Public seminars, lectures, and workshops

MEI hosted several other seminars, lectures, and workshops throughout 2023 as part of its education and engagement program. Some of these events included:

AEMO Quarterly Dynamics webinars

In partnership with the Australian Energy Market Operator (AEMO), MEI hosted the AEMO Quarterly Energy Dynamics seminars series, sparking discussion on the findings of AEMO's Quarterly Energy Dynamics report. The report covers dynamics, trends and outcomes in Australia's electricity and gas markets. MEI has become a key dissemination point for the findings of the quarterly report via the seminars, which are presented by Kevin Ly, Group Manager for Reform Development and Insights at AEMO.

Net Zero Australia: Launch of Final Results and Mobilisation Report

19 April 2023 and 12 July 2023

The Melbourne Energy Institute co-hosted the public release of the final results from *Net Zero Australia*, a groundbreaking multi-year study into how Australia might achieve a net zero economy, conducted in partnership by the University of Melbourne, The University of Queensland, Princeton University and international management consultancy Nous Group.

Launched in 2020, the Net Zero Australia study aims to provide rigorous and independent analysis of how Australia can achieve net zero emissions for both our domestic and export economies. Interim modelling results released in August 2022 showed that achieving net zero will be an immense challenge, but it also creates a once-in-a-generation nation-building opportunity. The final findings from the study were made public for the first time at an event in April 2023, and provided a detailed breakdown of possible scenarios and sensitivities, sector by sector, and comprehensive mapping of the transition to net zero emissions.

Following the release of the final results, the Net Zero Australia partnership released its Mobilisation Report, *How to make net zero happen,* at a public event at the University of Melbourne on 12 July 2023. A recording of the event, the report, the event presentation, and press release can be downloaded from the Net Zero Australia website.

Public lecture: Offshore HVDC grids – A European perspective

25 May 2023

MEI hosted Dr Hakan Ergun, Research Expert from KU Leuven in Belgium, who presented the '*Offshore HVDC grids – A European perspective'* public seminar.

During this seminar, Dr Ergun discussed the most important challenges with respect to the realisation of HVDC grids, and highlighted a number of possible solutions to perform efficient system planning. Special attention was given to the interplay between the market and the network design and new operational concepts for HVDC grids.

Dr Alan Finkel: POWERING UP - Unleashing the clean energy supply chain

19 June 2024

MEI hosted the launch of Dr Alan Finkel's new book '*POWERING UP: Unleashing the Clean Energy Supply Chain*'.

The former Chief Scientist shared his compelling insights and expertise, and made the case for Australia leading the way in the global transition to clean energy.

The clean energy transition is humanity's biggest ever economic challenge. During his book launch, Dr Finkel explored how to remove the barriers that prevent nations transforming from petrostate to electrostate. He discussed the entire supply chain, from raw materials through power infrastructure, the workforce, transportation and household customers, and revealed the outlines of a new geo-economic order, explaining in persuasive, practical terms how we can get there.

Engagement

Accelerating energy decarbonisation using numerical simulations

20 July 2023

MEI hosted a lecture by global combustion and fluid mechanics expert, Dr Bénédicte Cuenot, on *'Accelerating energy decarbonisation using numerical simulations'.*

The transition to energy sources with zero net greenhouse gas emissions has become a top priority worldwide. Depending on the sector and its specific needs in terms of energy flexibility, availability, cost and power, various solutions are currently being proposed by the research and industrial communities. In many cases, combustion is used to release controllable quantities of energy to the final application. In this context, reliable and efficient numerical simulations are essential to study the technical viability of these solutions as a complement to experimentation, or even before any actual testing.

In this lecture, Dr Bénédicte Cuenot discussed the current methods and models for the numerical simulation of turbulent combustion in low-emission systems, including the application to several projects currently being studied.

Energy Futures public forum: Dialling down the gas

30 August 2023

The Victorian Government's decision to ban gas connections in new homes and government buildings from 2024 has brought the transition from gas to electricity firmly into the spotlight, raising several important questions, not least among them being: is this the end of the gas-fired wok?

On 30 August 2023, MEI and Grattan Institute hosted the public forum, *'Energy Futures Public Forum: Dialling Down the Gas'* that addressed this question and others, including:

- What are the economic and greenhouse gas costs and benefits of the switch?
- Which households face the most significant barriers to electrify and how do we ensure that lower-income households are not left behind with soaring gas bills?
- What support is there for diverse dwelling types and ownership structures?
- What measures need to be taken to address the complexities of gas distribution network stranding and who bears the responsibility and cost?

The expert panel included Alison Reeve, Energy and Climate Change Deputy Program Director at the Grattan Institute, Dr. Sangeetha Chandrashekeran, Senior Research Fellow Australian Research Council Centre of Excellence for Children and Families Over the Lifecourse, and Damian Sullivan, Principal of Climate Change and Energy at the Brotherhood of St. Laurence. The panel discussion and audience Q&A was moderated by Professor Pierluigi Mancarella, MEI's Energy Systems Program Leader.

With approximately five million Australian households currently reliant on the gas network, this change is just one of the many that may be required for Australia to achieve its emissions targets.

Public lecture: Renewing the social contract for interacting with the grid

16 November 2023

MEI hosted a [public lecture](#) by Dr. Niraj (Nij) Lal, Principal at AEMO and Visiting Fellow at the Australian National University, and Professor Pierluigi Mancarella, MEI's Energy Systems Program Leader.

Rooftop solar panels have transformed Australia's energy mix, supplying up to close to 100 percent of electricity demand in South Australia and a quarter of the east coast's demand. This change is reshaping the energy market and grid, with solar curtailment and emergency backstop measures having financial implications for solar owners, non-owners, and grid operators.

As more Australian households adopt distributed energy resources (DER), particularly in the form of rooftop solar PV and soon batteries and electric vehicles (EVs) too, our "social contract" for connecting to and interacting with the grid must evolve. The outdated 19th-century model no longer fits, and we require a new agreement that is fair for both solar (and battery and EV) owners and non-owners.

At this event, Nij discussed his recent DER Bill of Rights and Responsibilities paper, which aimed to support sector reform by outlining fairness principles and proposing a framework for grid connectivity. Drawing on powerful analogies, Nij explained that while individuals could unconstrainedly self-consume the energy they produced, selling energy to the grid should come with certain responsibilities.

Pierluigi then presented insights from the ARENA-funded Project EDGE, which successfully demonstrated how a DER marketplace could be developed to interact with the wholesale energy market and without breaching local network limits. In doing so, it was critical to understand the concept of fairness and its broader impact on the community when distribution companies set time-varying export or import limits for DER at the customer's connection point.

Public lecture: the electric vehicle - past, present or future?

22 November 2023

MEI held a public lecture on *'Electric vehicle integration'* by Professor Lluc Canals Casals, Professor at the Project and Construction Engineering Department, Universitat Politècnica de Catalunya (BarcelonaTECH).

Electric vehicle technology has been around for over 140 years. Despite numerous attempts to compete with traditional internal combustion engine vehicles, it's clear the era of electric vehicles has arrived, with the shift primarily driven by sustainability.

As electrification gains momentum, historically separate sectors, such as transport, electricity, construction and communications are converging. Transportation is increasingly reliant on the electricity grid, and understanding how this transition impacts the grid, whether as a challenge or opportunity, depends on our understanding and management of the transformation.

In this lecture, Professor Lluc Canals Casals explored strategies for electric vehicle integration and discussed whether a technology from two centuries ago could be the solution for the challenges of the next century. Discussion was moderated by Professor Nando Ochoa, Professor of Smart Grids and Power Systems at the University of Melbourne.

Public lecture: Can the Inflation Reduction Act put the United States on the path to net zero?

18 December 2023

MEI hosted Professor Jesse D. Jenkins of Princeton University, who presented his lecture on *'Can the Inflation Reduction Act put the United States on the path to net zero?'*

The leader of the [REPEAT Project](#) shared the project's latest findings and identify progress and remaining gaps on the path to net zero.

For the first time, the full financial weight of the United States federal government is aligned behind the transition to clean energy. A pair of budget (Inflation Reduction Act) and infrastructure (Infrastructure Investment and Jobs Act) laws enacted by the last Congress will deploy more than half a trillion dollars of public funding over the next decade to put clean energy on sale and shift the USA away from fossil fuels. But will it be enough to put the United States on track for net-zero or to meet the nation's 2030 climate goals?

Engagement

Popular articles

The following lists a selection of articles authored by MEI researchers and Fellows. The articles appeared in *Pursuit*, the University of Melbourne's academic research publication, and *The Conversation*, a news platform that publishes stories written by academics and researchers.

Harvesting big energy from small movement

Pursuit, 27 January 2023

By Dr Peter Sherrell and Professor Amanda Ellis, *University of Melbourne*.

A new material designed to harvest up to 400 times more energy from movement than currently possible has potential applications in biomedicine and geospatial monitoring.

Why you don't want 'phantom energy' on a spacecraft

Pursuit, 8 May 2023

By Ronald T. Leon, Dr Peter C. Sherrell, Professor Amanda V. Ellis, *University of Melbourne.*

Measuring and removing unexpected 'phantom' levels of electricity from energy harvesting devices has been challenging – until now.

Keen to get off gas in your home, but struggling to make the switch? Research shows you're not alone

The Conversation, 24 July 2023

By Sangeetha Chandrashekeran and Julia de Bruyn, *University of Melbourne.*

Victoria has a plan for the state to electrify, but how do we make the transition fair and equitable for everyone? New research suggests a way forward.

Decarbonising transport for our health

Pursuit, 15 November 2023

By Professor Mark Stevenson, Dr Rebecca Patrick, Avita Streatfield and Clare Walter, *University of Melbourne*.

Transforming Australia's carbon-intensive road transport system can also solve one of our most significant public health challenges.

Communications

Using various communications channels, MEI contributes to the national energy debate by presenting a range of views on relevant and critical industry issues.

energy@melbourne: MEI's monthly e-newsletter

MEI's monthly external newsletter, energy@melbourne, is our key communication tool. The e-newsletter has a subscriber list of over 5,500 individuals from industry, government, academia, and the wider community. All public engagement initiatives are promoted through this newsletter, as are MEI researchers' projects and successes, and other relevant industry news.

Media

The MEI Director and Program Leaders are often called on by media to provide expert commentary relating to the Australia's energy sector. In 2023, a total of 14 interviews were given by members of the Melbourne Energy Institute. Many of these interviews were syndicated across multiple publications Australia wide.

Interviews given by Net Zero Australia Steering Committee members Professor Michael Brear and Professor Robin Batterham were published extensively, and the NZAu project results were quoted by multiple media outlets. In total, there were over 1800 mentions of the NZAu project in the media in 2023.

The following provides a snapshot of some of the interviews and media articles featuring MEI and the Net Zero Australia Project.

Battle of the billionaires: Cannon-Brookes and Forrest clash over Australia's energy future, Sydney Morning Herald, 28 January 2023, *Interview with Professor Pierluigi Mancarella*

Gas power a critical safety net in energy transition set to cost 'trillions', study finds, ABC, 19 April 2023, *Interview with Professor Michael Brear*

Australia must triple electricity grid, ABC, 19 April 2023, *Interview with Professor Michael Brear*

Net zero means doubling gas-fired power: study, The Australian Financial Review, 19 April 2023, *Interview with Professor Michael Brear*

Nuclear power plant costs need sharp fall to help Australia reach net zero target, a study finds, The Australian, 19 April 2023, *Interview with Professor Robin Batterham*

Race is on for the world to reach net zero emissions, SBS News, 23 September 2023, *Interview with Professor Michael Brear*

Social media

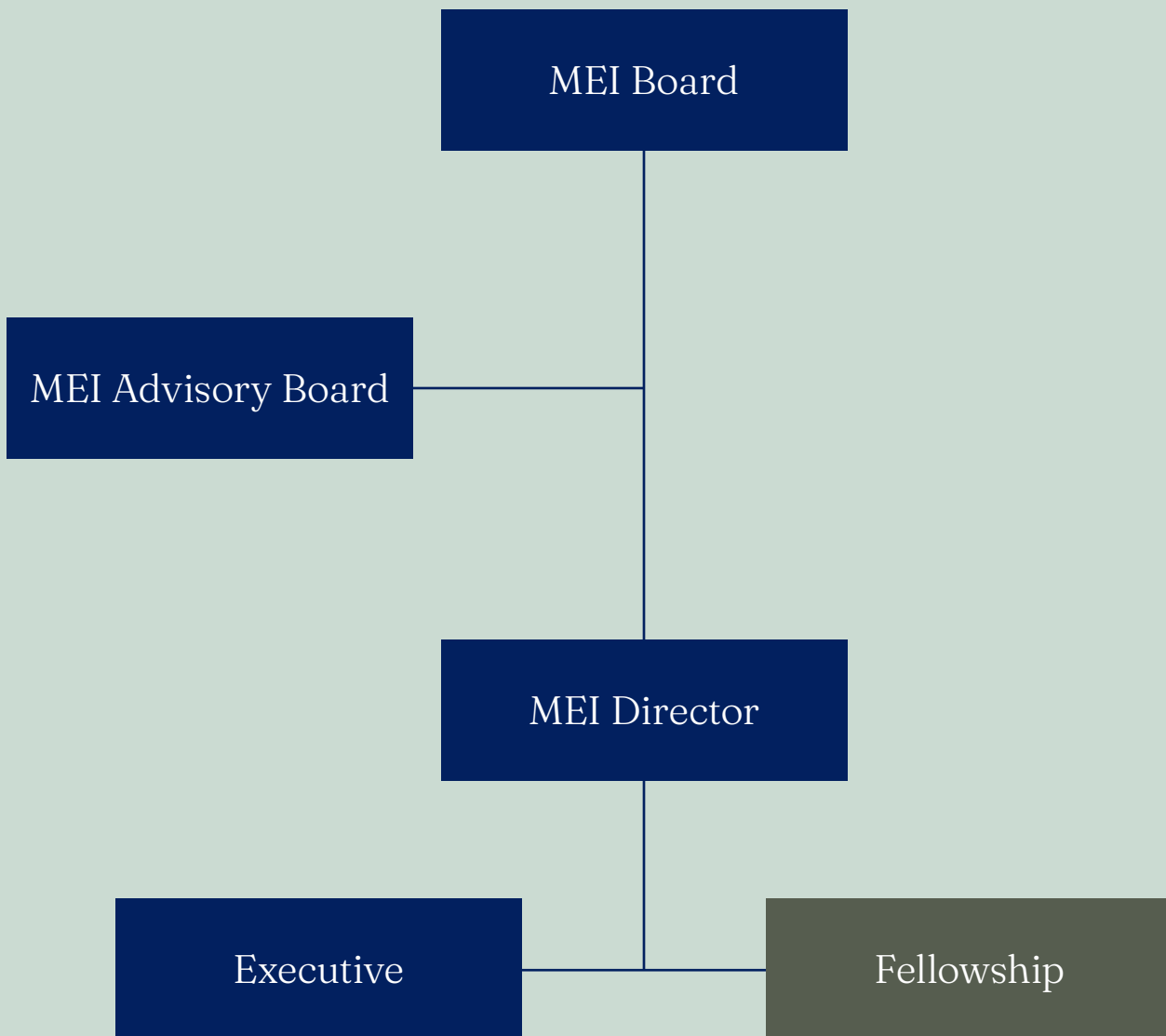MEI invites conversation on research topics and encourages participation in public seminars through social media, in particular Twitter and LinkedIn.
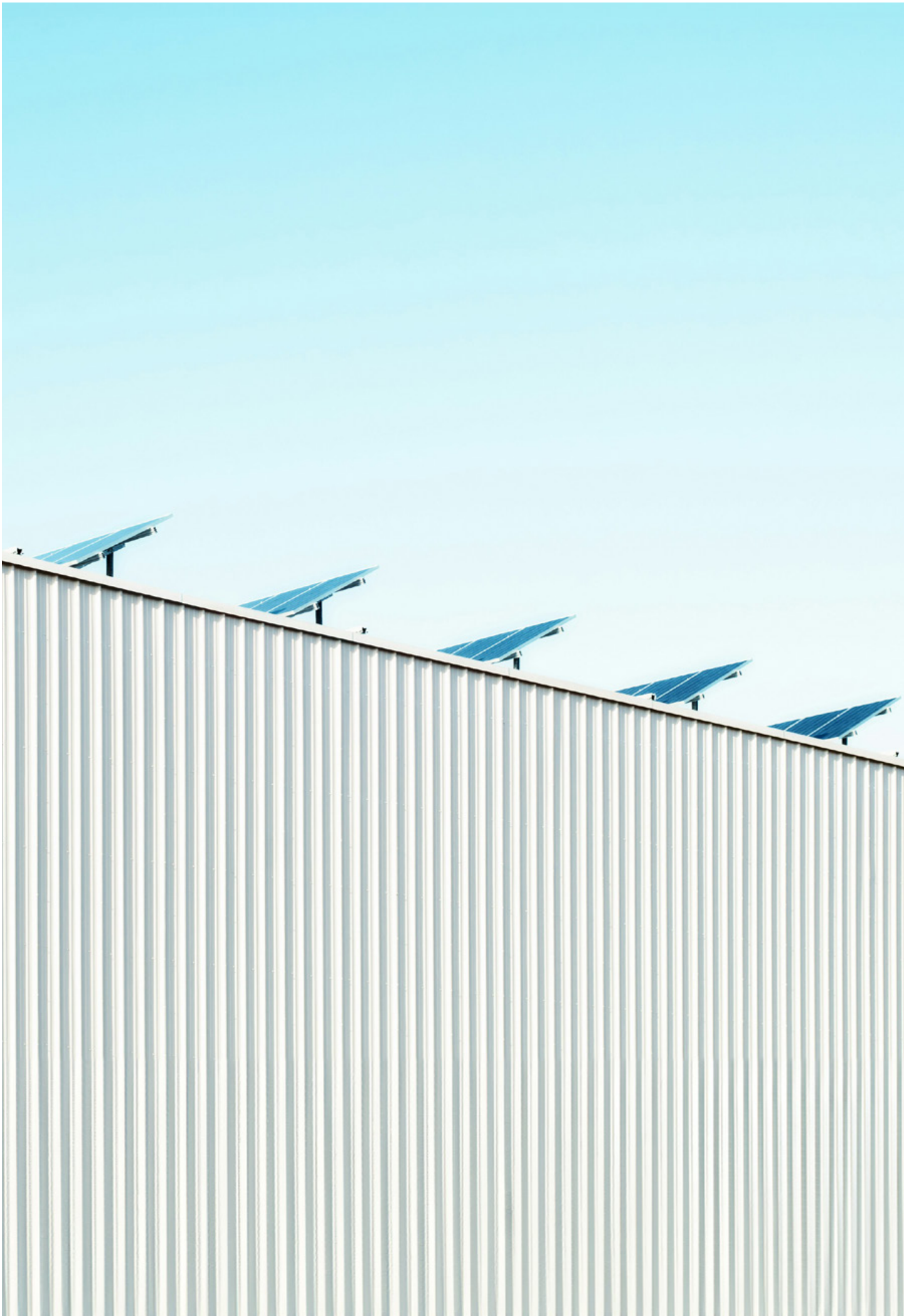
Governance

The Melbourne Energy Institute reports to the MEI Board for operational matters. The Institute Director, team of professional staff and the Executive Committee work together to operate MEI, and the Advisory Board and Fellows provide strategic advice.

```
                          ┌─────────────────┐
                          │   MEI Board     │
                          └────────┬────────┘
                                   │
  ┌──────────────────────┐         │
  │ MEI Advisory Board    ├─────────┤
  └──────────────────────┘         │
                                   │
                          ┌────────┴────────┐
                          │  MEI Director   │
                          └────────┬────────┘
                                   │
          ┌──────────────────┬─────┴──────────────┐
  ┌───────┴────────┐                    ┌──────────┴───────┐
  │   Executive    │                    │    Fellowship    │
  └────────────────┘                    └──────────────────┘
```

MEI Board

Professor Mark Hargreaves, *Pro Vice-Chancellor (Research Partnerships and Infrastructure) (Chair)*

Professor Andy Martin, *Associate Dean, Research, Faculty of Science*

Professor Frank Vetere, *Deputy Dean (Engagement), Faculty of Engineering and Information Technology*

Advisory Board

Mr Andrew Stock, *Councillor, Climate Council (Chair)*

Mr Michael Bielinski, *CEO Siemens Energy*

Ms Mel Cutler, *Director Sustainability and ESG, Bupa*

Ms Sally Farrier, *Company Director*

Mr Tony Wood, *Energy Program Director, Grattan Institute*

Executive Committee

Professor Michael Brear, *Director, Melbourne Energy Institute (Chair)*

Professor Lu Aye, *Professor, Department of Infrastructure Engineering*

Dr James Bullock, *Senior Research and ARC Decra Fellow, Electrical and Electronic Engineering*

Dr Shiaohuey Chow, *Senior Lecturer, Department of Infrastructure Engineering*

Dr Chris Goodes, *Enterprise Professor – Sustainable Resources, Faculty of Engineering and Information Technology*

Professor Ralf Haese, *Professor in Environmental Geochemistry, Geography, Earth and Atmospheric Sciences*

Ms Anita La Rosa, *Institute Manager, Melbourne Energy Institute*

Professor Pierluigi Mancarella, *MEI Program Leader Energy Systems, and Chair Professor of Electrical Power Systems*

Professor Kathryn Mumford, *MEI Program Leader Hydrogen and Clean Fuels, and Head of Department, Chemical Engineering*

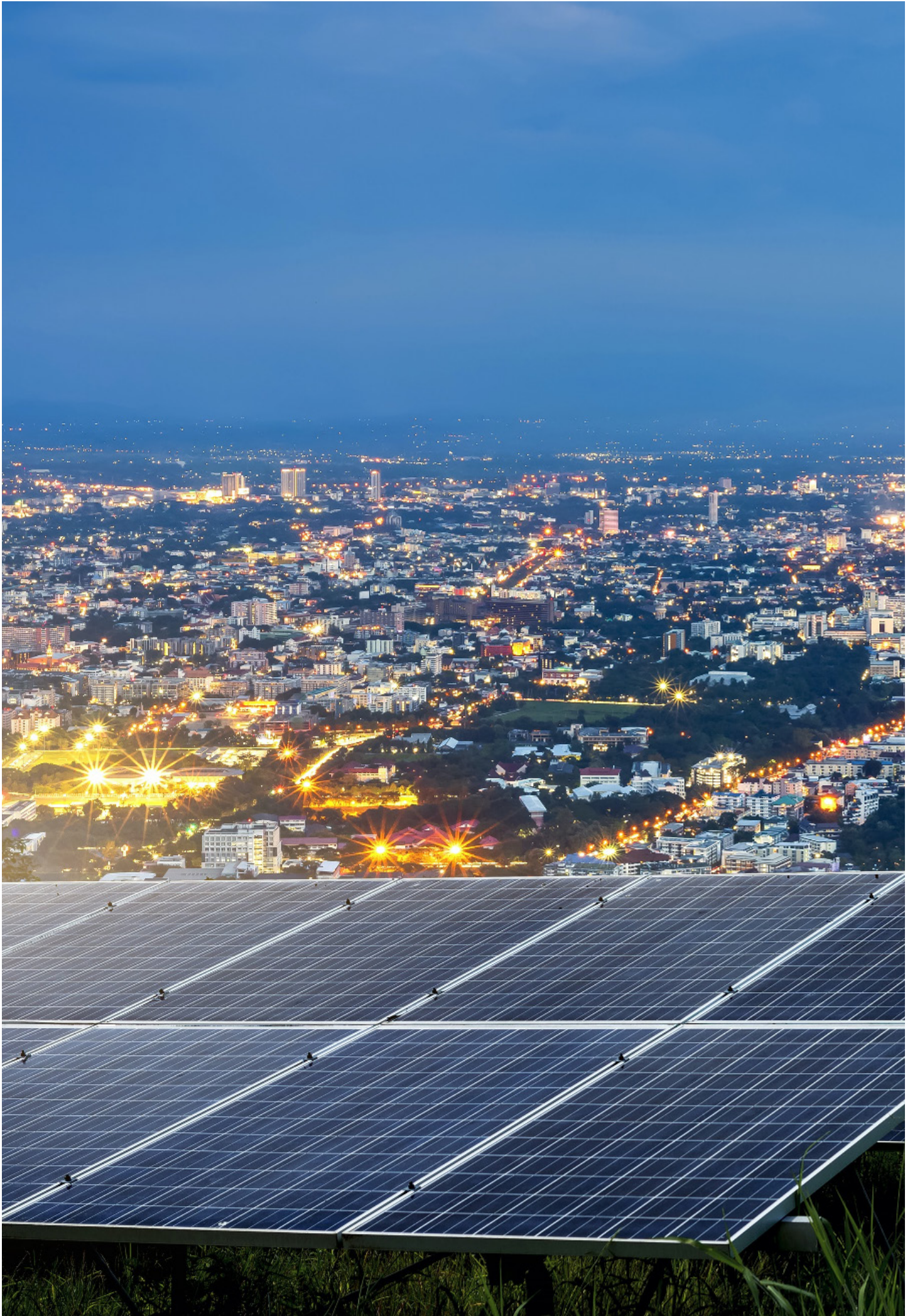**Dr Adrian Panow,** *Director Major Projects, Melbourne Energy Institute*

Professor Richard Sandberg, *MEI Program Leader Power Generation and Transport, and Chair of Computational Mechanics*

Dr Wallace Wong, *MEI Program Leader Energy Materials, and Senior Lecturer in the School of Chemistry*

Financial summary

Internal Income	$
Core funding from Deputy Vice-Chancellor (Research)	1,029,100
Other income	214,836
Total Income	**1,243,936**
Expenditure	
Institute staff salaries	628,558
Administration and general costs	12,000
Events and communication	12,000
Research project support salaries	230,128
Research project seed funding	70,000
Partnership development	66,054
Total Expenditure	**1,018,739**
External Income	
ARC	-
Industry – direct contract and leveraged	11,338,000
Government	4,908,000
Philanthropy	300,000
Total External Income	**16,546,000**

Contact us

RFQ10346