



THE UNIVERSITY OF  
MELBOURNE

# Annual Report 2017

—  
**Melbourne  
Energy  
Institute**



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Enquiries for reprinting information contained in this publication should be made through the Editor, Melbourne Energy Institute, The University of Melbourne Victoria 3010

E: [mei-info@unimelb.edu.au](mailto:mei-info@unimelb.edu.au)

W: [energy.unimelb.edu.au](http://energy.unimelb.edu.au)

T: +61 3 8344 3519

Subscribe to the MEI newsletter at  
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### **Editors**

Susannah Powell

Anita La Rosa

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# Message from the Director

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## The year 2017 was an exceedingly busy one in the world of energy

In 2017 we had the Finkel Review and passage of *almost all* of its recommendations through the COAG Energy Council, multiple Commonwealth and State inquiries and several energy policies proposed, withdrawn and some even implemented. Thinking more globally, we had worrying reforms to energy regulation in the United States and strong, continued growth in China and the region. Technology also continued its march, with renewables and unconventional oil and gas all having major impacts.

The Melbourne Energy Institute did its best to engage constructively with all of this throughout the year. We also quietly got on with the more usual aspects of academic life – learning, teaching and researching to the best of our collective ability. Looking back on 2017, I think that we can be proud of our achievements during this exceptional year, and I hope that this *Annual Report* is testament to this.

One particular initiative stands out for special mention. MEI was one of only two organisations commissioned by the *Independent Review into the Future Security of the National Electricity Market* (the Finkel Review). We consider that the Finkel Review was a deeply considered and comprehensive examination of the complex interplay between electricity system security, costs and environmental performance. We remain proud to have supported it with our analysis led by our Chair of Power Systems Engineering, Professor Pierluigi Mancarella, and we continue to work with industry and government on its implementation.

I also take this opportunity to thank many people who contributed to MEI in 2017. I first thank Sara Bice, who as a wonderful Deputy Director shared the load of running MEI whilst growing our *Energy, Community and the Region* program. Sadly for MEI, Sara and her family relocated to China over the summer of 2017/18, and we wish her all the best for this new chapter in her career. I also thank Susannah Powell, MEI Manager, for her support during an extraordinarily busy year. The MEI Advisory Board, particularly Andrew Stock as Chair, as well as our Fellowship and our Executive, all continued to provide wonderful support, for which I am truly thankful.

All of us welcomed Christmas of 2017 and a much deserved summer holiday. Let us continue into 2018 with the hopes of another fine cohort of graduates, new insights and evidence-based energy policy.



**Professor Michael Brear**  
**Director, Melbourne Energy Institute**

# The Melbourne Energy Institute

## The Melbourne Energy Institute (MEI) engages with the University's energy sector partners in industry and government

Since the Institute was launched in 2010, it has delivered influential, interdisciplinary research on the challenges of transitioning towards a low carbon energy system.

### The University of Melbourne and MEI

The University of Melbourne undertakes world-leading research in many disciplines. It has the largest research expenditure of any Australian university, and the largest cohort of research students in Australia. Our researchers work with the community, industry and government on some of the world's most pressing challenges.

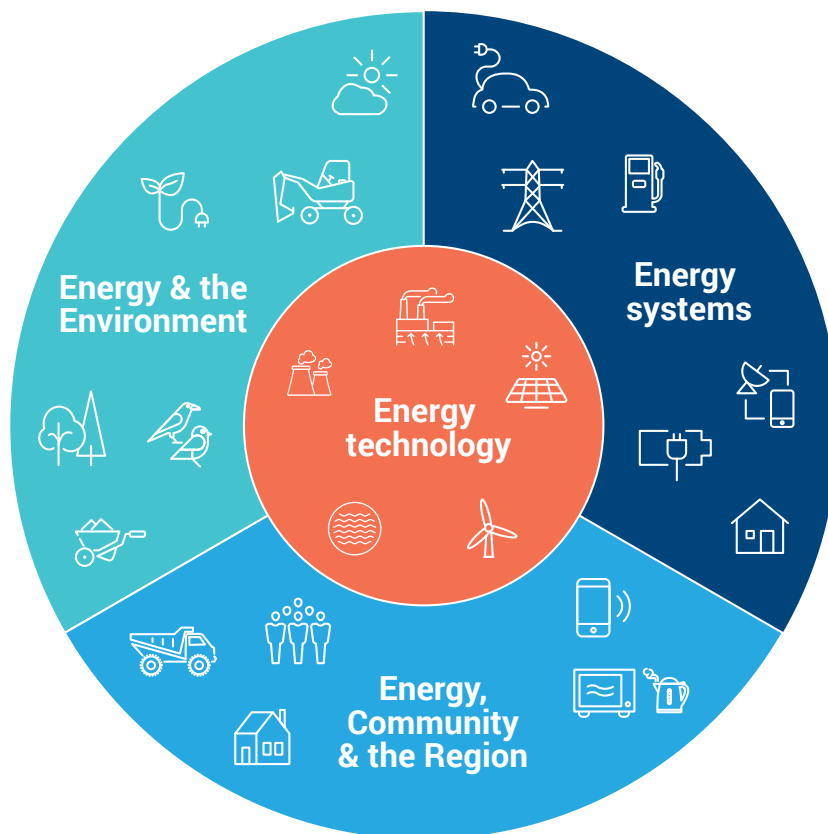
MEI has over 300 specialists across Architecture, Economics, Engineering, Health, Law, Planning, Science and Social Science. They include a former Chief Scientist of Australia, several recipients of Australia Day Honours, several Fellows of Learned Academies and numerous Fellows of Professional Societies.

MEI staff work together in four programs:

1. Energy Systems
2. Energy Technology
3. Energy, Community and the Region
4. The Environment and Energy Resources

### Working with MEI

MEI works closely with industry and government. Our current partners include the Asian Development Bank (ADB), the Australian Energy Market Operator (AEMO), AusNet Services, BHP, Billcap, Commonwealth and State Governments, CO2CRC, CSIRO, the Department of Defence, Ford, GE, Mitsubishi Heavy Industries, Powershop and Toyota. Collaborative research and knowledge transfer are central to MEI's work, and we welcome new partners.



# Highlights of 2017

## Power system security assessment of the future national electricity market

MEI was commissioned by the Independent Review into the Future Security of the National Electricity Market (the Finkel Review) to undertake a power system security analysis in early 2017.

This work was led by our Chair of Electrical Power Systems, Professor Pierluigi Mancarella, and focused on an aspect of power system security called frequency response adequacy. This involved assessing whether a given generation portfolio can maintain a system frequency of around 50Hz without disruption to energy supply.

The University's report to the Finkel Review had two main findings:

1. Without implementation of appropriate operational measures, the NEM will experience increasing issues of frequency control in all modelled scenarios.

2. There is significant potential to use several operational measures and electricity market designs to ensure frequency response adequacy in renewable-rich power systems.

Our report then showed how a number of technologies and services can provide so-called Fast Frequency Response (FFR), and therefore legitimately play a role in supporting frequency response adequacy. This includes demand response, energy storage of several forms and the so-called synthetic inertia in newer wind turbines, amongst others. Means of increasing the system inertia, such as synchronous condensers, could also assist in providing this support.

This deeply technical analysis by the University supported the Finkel Review's own recommendations, and we continue to work with industry and government on the Finkel Review's implementation.

### Primary frequency response and inertia requirements for secure operation

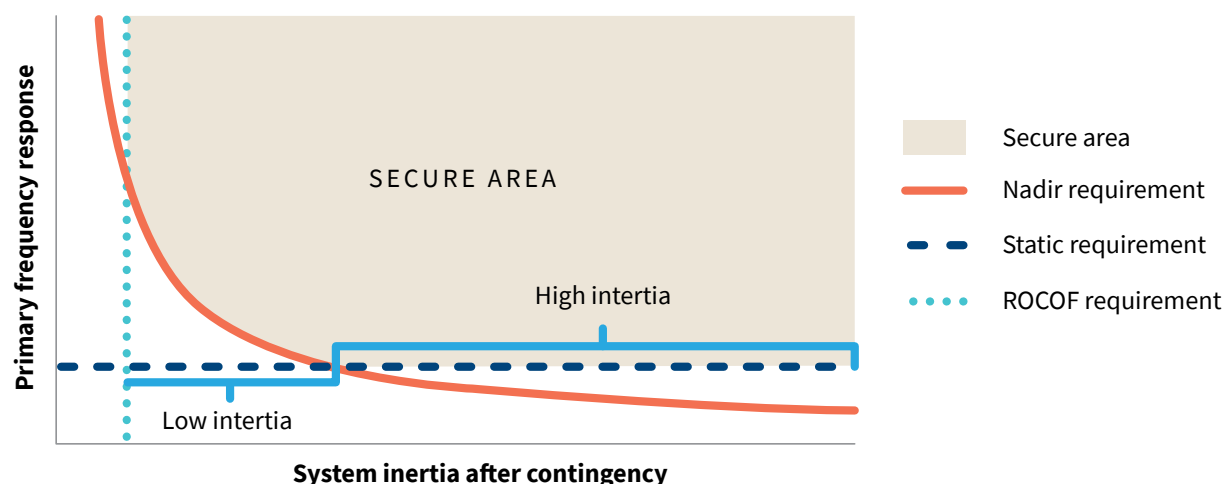


Figure 1: Frequency response security map showing the secure area of operation for different levels of primary frequency response (PFR) and system inertia. Source: Mancarella, P., 2017, Power System Security assessment of the future National Electricity Market, Melbourne Energy Institute, University of Melbourne (pg. 9)

## The role of pumped hydro storage in Australia's energy transition

In 2017, MEI, EnergyAustralia and ARUP released a report that examined the feasibility of sea-water pumped hydro energy storage at Cultana in South Australia.

This work was funded by the Australian Renewable Energy Agency (ARENA), and represented the culmination of several years of work by MEI on pumped hydro energy storage.

Pumped hydro energy storage is not a new technology. Indeed, it is by far the largest form of energy storage used in electricity systems globally. However, the use of sea-water pumped hydro energy storage is much less common. In 2010, MEI published a book by one of our affiliates, Professor Peter Seligman, titled *Australian Sustainable Energy – by the numbers*. That book examined many different decarbonisation options, including what future role pumped hydro might play.

Professor Seligman's book appears to be the first of several Australian studies that considered the role of pumped hydro storage. Notable, subsequent projects now in development include Snowy Hydro's *Snowy 2.0 Project*, Hydro Tasmania's *Battery of the Nation*, as well as the *Cultana Pumped Hydro Project*.

For this Cultana project, MEI undertook wholesale market modelling of the pumped hydro plant, determining its optimal power and storage capacities and associated financial performance. This required maximisation of wholesale market revenue, not only through buying and selling energy, but also by providing several support services for the South Australian energy system.

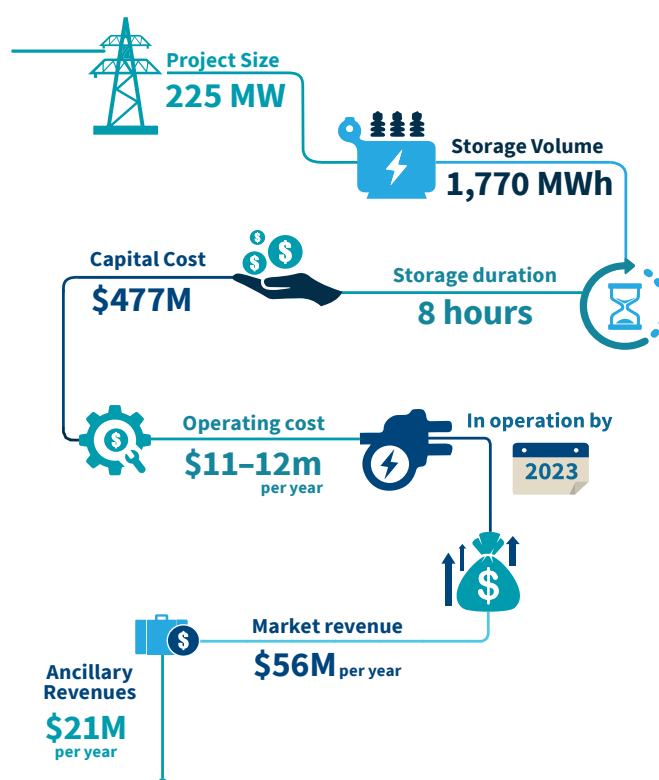


Figure 2 - Key outputs of the Cultana pumped hydro energy storage study. Source: ARENA, ARUP, EnergyAustralia, University of Melbourne, 2017, *Cultana Pumped Hydro Project, Knowledge Sharing Report* (pg. 5)



## Fuel pricing and consumption research – Maintaining competition in the Australian fuel marketplace

**During 2017, Associate Professor David Byrne conducted research using Big Data to identify anti-competitive conduct by fuel retailers in Australia. Associate Professor Byrne is the Director of Capability Building at the Centre for Market Design (CMD).**

The CMD has several applied research projects which are directly influencing the public, by enabling improved choices for Australian consumers.

An example of this is Associate Professor Byrne's fuel consumption research, which is having impact through in depth analysis of large datasets on fuel pricing and consumption. The research, conducted in partnership with Associate Professor Nicolas de Roos from the University of Sydney, focuses on maintaining competition in the Australian fuel marketplace. The study utilised Big Data spanning a 15-year time frame and state-of-the-art methods in econometrics, to uncover a tacitly colluding cartel in Australian retail petrol markets.

It is an evolving project, which is now allowing the Centre to work closely with the NSW government in evaluating the impact of providing real time petrol price data to consumers. This analysis is intended to increase price transparency and competition, and benefit Australian communities through better informed competition policy.

Associate Professor Byrne's research into using Big Data to expose tacit collusion between petrol companies is the first study to demonstrate how firms – in this case, petrol retailers – initiate and sustain such tacit collusion, which leads to higher consumer prices. This work has since been recognised internationally, and is informing new collusion detection strategies in Australia, the United States and Canada. More broadly, Associate Professor Byrne's work has shown how Big Data can be used to promote competition in retail markets.

This research will continue to feature prominently within the MEI and the Australian media in the context of current energy market power and pricing debates.





## Creating healthy cities one step at a time

**A recent series published in The Lancet, led by the University of Melbourne and featuring authors from leading global academic institutions, quantifies for the first time the health outcomes that could be gained through changes to urban design and the transport system.**

Major global health challenges are being confronted in the 21st century, prompting calls to re-think approaches to disease prevention. Worldwide, the majority of people already live in cities and by 2050, it is estimated that 75% of the world's 10 billion people will have cities as an important social determinant of health. City planning that reduces non-communicable diseases and road trauma, while managing rapid urbanisation, is part of the solution.

The 3-part Lancet Series “Urban Design, Transport and Health” explores how integrated multisector city planning, including urban design and transport planning, can be used as an important and currently underused force for health and wellbeing within the framework of the United Nations’ Sustainable Development Goals in both high-income countries, and low-income and middle-income countries. The three papers unravelled the complexity of urban design, the transport system and population health, and provide a paradigm shift in our approach to responding to the growing burden of chronic disease in our cities. The Series was led by

Professor Mark Stevenson, an epidemiologist and Professor of Urban Transport and Public Health at the University of Melbourne, and an executive committee member of MEI.

The research was launched by the United Nations in New York in late 2016, where the authors addressed a meeting of the UN's Sustainable Development Solutions Network. Central to the research is the promotion of “compact cities” in which people live in higher density neighbourhoods closer to local shops, public transport, services and jobs, and complemented by increased infrastructure for walking and cycling instead of relying on cars. The series offers key recommendations that urban and transport planners and policymakers could implement to improve the health of urban populations.

Partner organisations include international collaborators from the University of Sao Paulo, Pontifical Catholic University of Parana, Federal University of Parana (Brazil), University of Utah, Harvard School of Public Health, University of Washington, Washington University at St Louis, University of California San Diego (USA), University of British Columbia (Canada), London School of Hygiene and Tropical Medicine, London School of Economics, University of Cambridge (UK), Indian Institute of Technology (India), and Beijing University of Technology (China). Australian collaborators include researchers from the Australian Catholic University, Queensland University of Technology, University of Western Australia, Swinburne University of Technology and Monash University.



# The Melbourne Energy Institute research programs

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## Energy Systems

Leader: Professor Pierluigi Mancarella

**Our Energy Systems program considers how systems of different energy technologies behave. This considers wholesale and retail energy markets, energy networks and system planning.**

### Capabilities

- Distributed energy resources, smart grids and integrated, multi-energy systems
- Demand modelling using randomised control trials, big data and machine learning
- Retail energy markets and consumer behaviour
- Risk and resilience assessment of future energy systems
- Wholesale energy market design and operations, and renewable energy integration

### Impact

- Modelling work commissioned for the Finkel Review
- AEMO Expert Advisory Panel membership
- AEMO demand forecasting using AMI data and machine learning approaches
- Modelling of electricity consumer behaviour for Billcap, Click Energy and Simply Energy

### Key Personnel

Associate Professor David Byrne  
Professor Michael Brear  
Associate Professor Robert Crawford  
Professor Rob Evans  
Professor Ross Garnaut  
Dr Dominique Hes  
Professor Terry Jones  
Professor Chris Leckie  
Professor Pierluigi Mancarella  
Professor Chris Manzie  
Dr Leslie Martin  
Professor Nando Ochoa



## Energy Technology

Leader: Professor Richard Sandberg

**Our Energy Technology program brings together researchers who investigate different energy technologies. This examines several forms of renewable and low emission power plant for stationary and mobile applications, as well as energy storage and fuels.**

### Capabilities

- Carbon capture and storage (CCS)
- Conventional and alternative fuels and emissions chemistry
- Gas turbine, reciprocating engine, hybrid and electric powertrain dynamics and optimisation
- Wind turbines/farms, solar PV and energy storage dynamics and optimisation
- Low drag vehicles for land, sea and air
- Materials for advanced photovoltaics, displays, lighting, and high temperature applications

### Impact

- Energy efficient lighting for CSIRO and partners
- Propulsion, engines and fuels for Ford (Australia, Europe and USA), DST Group, MHI and Toyota
- Improved aircraft engine aerodynamics for General Electric
- High temperature materials for the Australian Defence Force
- Modelling of real-world, solar PV performance across Australia with AEMO

### Key Personnel

Professor Robin Batterham  
 Professor Michael Brear  
 Professor George Franks  
 Dr David Jones  
 Professor Sandra Kentish  
 Professor Dan Li  
 Professor Chris Manzie  
 Professor Paul Mulvaney  
 Dr Guillermo Narsilio  
 Professor Richard Sandberg  
 Professor Geoff Stevens  
 Professor Paul Webley  
 Professor Rachel Webster





## Energy, Community and the Region

Leader: Dr Reihana Mohideen

**Our Energy, Community and the Region program examines how individuals, communities and states rely on and interact with energy technologies and energy systems. Examination of equity and national development are features of this work.**

### Capabilities

- Delivering social, environmental, gender and human rights impact assessments
- Modelling and evaluating consumer behaviour, energy services and energy markets
- Analysing big data, including social media and historic economic data
- Analysing emerging energy technology trends, including access and uptake in Asia

### Impact

- Providing recommendations to local and state governments concerning energy transitions
- Commissioned work for the Asian Development Bank on the energy transition in Asia and implications for social inclusion and gender equality
- Advising Australian and other governments on community energy models and research programs to improve stakeholder engagement in infrastructure and services
- Engaging with industry, academic institutions, governments and civil society to establish a 'knowledge hub' on the energy transition in Asia

### Key Personnel

Dr Adam Bumpus  
 Dr David Byrne  
 Dr Sangeetha Chandra-Shekeran  
 Professor Ross Garnaut  
 Professor Lee Godden  
 Professor Fiona Haines  
 Dr Leslie Martin  
 Dr Reihana Mohideen



## Environment and Energy Resources

Leader: Dr Robyn Schofield

The Environment and Energy Resources program examines the manifold interactions between our energy systems and our environment. This program looks closely at energy resource extraction, carbon dioxide sources and sinks as well as atmospheric and geo-chemistry.

### Capabilities

- Air quality and health impacts
- Environmental chemistry and fluid dynamics
- Geology and geochemistry of oil, gas and other basin resources including carbon storage
- Modelling of the carbon cycle and climate change
- Resource economics
- Resource law

### Impact

- Deepen our understanding of geological carbon storage for BHP
- Determine anthropogenic trace gas distribution and residence time to inform UNFCCC processes
- Model the consequences of nations' energy policies to inform governments and UNFCCC
- Measuring and forecasting air pollutants in cities to inform urban design and policy development

### Key Personnel

Professor Peter Cook  
 Professor Michael Crommelin  
 Professor John Freebairn  
 Professor Lee Godden  
 Professor Ralf Haese  
 Professor Stephan Matthai  
 Associate Professor  
 Malte Meinhausen  
 Professor Jason Monty  
 Professor Peter Rayner  
 Professor Mike Sandiford  
 Dr Robyn Schofield  
 Professor Mark Stevenson  
 Professor Doreen Thomas

# Selected Major Initiatives

## Energy Transition Hub: An Australian-German innovation partnership

**Germany has a strong established service and manufacturing sector and has arguably gained more experiences related to the Energiewende (energy transition) than any other country. Australia has vast and diverse energy, mineral and land resources that are essential for a global zero-carbon energy system.**

The Energy Transition Hub establishes a forum for Australia and Germany to learn from each other, generate mutual benefit through the global energy transition, and strengthen the bilateral relationship.

The Energy Transition Hub is a broad initiative led by the University of Melbourne and the Australian National University on the Australian side, and the Potsdam Institute for Climate Impact Research (PIK), University of Münster, and Mercator Research Institute on Global Commons and Climate Change (MCC) on the German side. Additional partners include Murdoch University, RMIT, Monash University.

The Australian Secretariat of the Energy Transition Hub is located in the Australian-German Climate & Energy College, an initiative founded by the Melbourne Sustainable Society Institute and the Melbourne Energy Institute, with Cienna Turpie as the Hub's Manager. The Hub's initial funding agreements were signed in mid-2017, with funding received from the Department of Foreign Affairs and Trade (DFAT) in Australia and the German Federal Ministry of Education and Research (BMBF). The official launch of the Hub is scheduled for later 2018.

The ultimate objective of the Hub is to open research and dialogue on the opportunities of a zero-carbon economy for both countries. With the right mix of technology investment and policy signals, Australia could position itself as the energy superpower and low-cost competitive investment location, also for energy-intensive industries, in a net zero emissions future.

The Energy Transition Hub focuses on four key themes, including: Socio-economic aspects of the energy transition; Scientific and technical aspects of low-carbon energy; Achieving the objectives of the Paris Agreement; and Opportunities for extractive and manufacturing industries. Under each of these themes, there are a number of projects led by experts in the field. The Hub works with businesses, governments, research organisations and civil society to ensure relevant outcomes. Three Australian showcase projects were initiated by the Energy Transition Hub in its first six months, nine working groups were formed and a major project initiated on the German side.



## Research partnership with Mitsubishi Heavy Industries

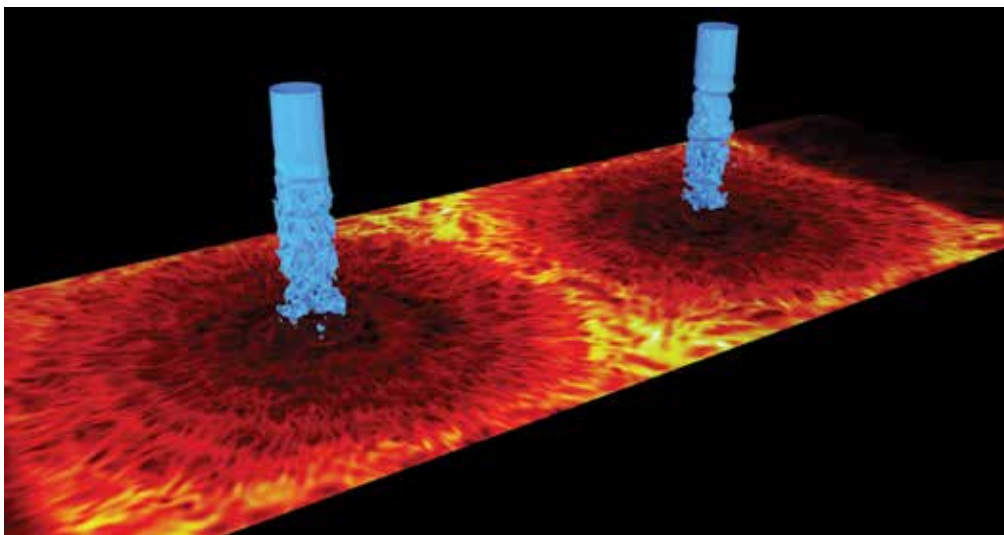
**The University has recently entered into a research partnership with technology giant Mitsubishi Heavy Industries (MHI), global designer and manufacturer of energy technologies. We are collaborating with MHI's Open Innovation Centre to conduct fundamental and applied research, mainly on gas turbine and IC engine technologies.**

Mechanical Engineering's Professor Richard Sandberg and his team has world leading expertise in high-fidelity simulations to elucidate novel physical phenomena and to generate data that is then used for model development using an innovative machine-learning strategy. These models can be used by MHI's designers to obtain more accurate predictions, resulting in the development of more efficient and reliable products.

The partnership with MHI began in 2016 with a pilot study on developing improved models for the prediction of turbulence and heat flux for a so-called jet-in-cross flow arrangement, a key technology required for turbine cooling. Following the successful completion of the pilot study, a follow-on project on impingement cooling was started in 2017. As part

of that project, high-fidelity simulation techniques have been used to understand how the arrangement of impinging cooling jets can be optimised to achieve the desired cooling efficiency with less coolant, thereby increasing the efficiency of gas turbines for power generation. Much of the simulation work has been completed by Postdoc Dr Javier Otero who is now working on translating the data to superior design tools for MHI designers.

The collaboration with MHI will be extended through 2018 to also consider the effect that surface roughness has on turbulent flow, in particular on the drag and heat flux, and on advanced control systems. These are other areas where the University of Melbourne has world leading expertise.



*Figure 5: Image of high-fidelity simulation of multiple impinging jets. Blue contours show cooling jets, and the red surface visualises the temperature field on the surface to be cooled, with yellow denoting the hottest areas Source: Professor Richard Sandberg, Dr Javier Otero*



## Energy transition transforming women's lives

**Developing Asia has suffered some of the most damaging early manifestations of climate change. This, coupled with rising energy demand, is driving an energy transition towards low-carbon solutions. This energy transition is integral to the sustainable development goals of the United Nations and is vital for improving the lives of billions of people around the world.**

Dr Reihana Mohideen has worked on improving energy access and social inclusion in India, Bangladesh, Bhutan, Maldives, Nepal and Sri Lanka. Women in these countries traditionally manage the household chores of food processing and collecting fuel and water, which is back-breaking and time-consuming work. Access to modern energy can dramatically cut this workload. Dr Mohideen, a senior research fellow at the Melbourne Energy Institute, is developing frameworks and decision making tools to ensure the energy systems implemented benefit and empower women and by extension, their communities. For some communities, transformation comes with expansion of a country's existing electricity grid. For more isolated or less populated communities, options may be limited to stand-alone solar, wind and micro-hydro systems, sometimes backed with diesel generators.

In developing countries, just 365 kilowatt hours a year per household – the Tier 3 minimum energy of the World Bank's multi-tier approach to providing sustainable energy access – is enough to power lighting and televisions, charge mobile phones and computers, pump water, provide mechanised food processing, basic refrigeration, washing machines and rice cookers. This level of access to modern energy reduces the amount of back-breaking manual labour women do and creates opportunities for economic empowerment. The less time women spend on household chores, the more time they can spend on income-raising activities.

Local clinics in electrified communities can also stay open for longer hours, and provide better diagnostics and services. Indeed, international data shows a clear decline in maternal mortality rates when energy consumption



increases from very low to moderate levels. Cooking with electricity instead of firewood or cow dung also makes the air in homes healthier. The World Health Organisation estimates that over 4 million people die prematurely every year due to indoor air pollution related to cooking with solid fuels such as these. Exposure is particularly high among women and young children, who spend the most time near the domestic hearth.

Dr Mohideen has partnered with the Asian Development Bank, government agencies and utilities in various Asian countries. She has designed templates, specifications, and a modified reference energy system to help them consider the implications of energy technology and system innovations for women.

The next stage of the study is to pilot a smart reference energy system in a rural community in India. Beginning in July-August 2018, the objective of the study is to develop an energy system that integrates gender equality and social inclusion (GESI) criteria. The pilot will be monitored for a minimum of 2 years to further refine the GESI mainstreamed model and to demonstrate overall success of its design.

## Peter Cook Centre for CCS Research

**The Peter Cook Centre for CCS Research celebrated its 5th anniversary in a busy 2017 and it continues its strong engagement with industry and government. Of particular note is our GeoCquest project.**

The Peter Cook Centre for CCS Research at the University of Melbourne is leading a global research partnership with BHP and other eminent institutions as a sponsor to support the long-term storage of carbon dioxide in geological reservoirs. The research collaboration commenced in 2017 and addresses fundamental questions relating to the role of small-scale geological heterogeneity on multiphase flow and carbon trapping in sedimentary rocks.

The University of Melbourne, together with the University of Cambridge (UK) and Stanford University (USA) and will share more than \$3 million and work alongside BHP to improve technologies and our understanding of carbon storage in rock formations. This is a key component of carbon capture and storage (CCS) technology that is needed to meet the world's commitments under the COP 21 Paris agreement and to limit warming to below 2 degrees celsius.

The partnership is an opportunity to develop CO<sub>2</sub>-reducing technologies in close collaboration with one of the world's largest resource companies. Two research groups within the Peter Cook Centre for CCS Research at the University of Melbourne – led by Professor Ralf Haese from the Faculty of Science and Professor Stephan Matthai from the Melbourne School of Engineering - will contribute to the project.

The Peter Cook Centre also continues as a vibrant hub of broader activity on CCS. The Australian National CCS Research Conference was hosted in June together with the Global CCS Institute in the new and award-winning Arts West Building. Over 100 delegates presented and debated their research results. Highlights of the conference included the opening of the conference by Mrs. Samantha McCulloch, energy analyst working at the International Energy Agency, presentations showing technical details of the storage complex of the three Australian CCS Flagship sites and another 23 oral and 20 poster presentations.



A one-week intensive course on geological carbon storage was also given by Dr George Carman to professionals and post-graduate students in July. Dr Carman is a highly experienced petroleum geologist who also served as the Subsurface Storage Director for the Victorian CarbonNet project. The course covered a large range of technical and scientific aspects pertinent to geological carbon storage.

Finally, we were honoured to host Professor Sally Benson as a Distinguished Guest Lecturer for one week in October. Professor Benson is an eminent scientist and engineer who is currently Director of the Global Climate and Energy Project (GCEP) and co-Director of the Precourt Institute for Energy at Stanford University (USA). In her role as Distinguished Guest Lecturer, Professor Benson presented her latest research, briefed government delegates on low-emission technology developments in the USA and gave public lectures highlighting the importance of CCS in a low emission future.

# Public engagement

## SEMINAR SERIES

### Energy Futures – what will Australia’s energy future look like?

MEI’s contribution to our national energy debate continued in 2017 with our Energy Futures Seminar Series. The seminars provide a forum for academia, community, industry, and government to discuss critical future energy issues. Run in partnership with policy think-tank Grattan

Institute, the Energy Futures Seminar Series presents a range of views on the immediate and long-term impacts of changes in energy policy and the development of novel energy technology solutions. In 2017, the series explored the following relevant and critical industry issues:

#### ENERGY FUTURES SEMINAR #1

##### The future of clean coal?

Our expert panel explored whether clean coal is a crucial step in the transition towards a net zero emissions economy or an expensive and retrograde step.

##### Speakers

**Professor Michael Brear**, Director MEI and Professor of Engineering, University of Melbourne

**Tania Constable**, Chief Executive Officer, CO2CRC

**Tim Buckley**, Director of Energy Finance Studies Australasia, Institute for Energy Economics and Financial Analysis

##### Moderator

**Maxine McKew**, Vice Chancellor’s Fellow, University of Melbourne



*MEI and Grattan’s expert panel discussing the future of clean coal.*

#### ENERGY FUTURES SEMINAR #2

##### Chief Scientist Alan Finkel’s review of the security of the National Electricity Market

This Energy Futures seminar followed the release of the final report of the Finkel Review. Dr Alan Finkel and a panel of experts discussed how Australia can respond to challenges that our electricity system faces. Dr Finkel outlined his blueprint for reform of the National Electricity Market, including recommended changes to policy, governance and market rules. This was followed by a discussion between our panel of experts and questions from the audience.

##### Speakers

**Dr Alan Finkel**, Chief Scientist Australia

**Audrey Zibelman**, Chief Executive Officer, AEMO

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

##### Moderator

**Sabra Lane**, ABC Radio National AM Host

## ENERGY FUTURES SEMINAR #3

### Retail competition in the electricity sector and energy price

This Energy Futures seminar explored findings from the bi-partisan review of the Victorian electricity and gas markets lead by John Thwaites and an independent panel, as well as the Grattan report, “Price shock: Is the retail electricity market failing consumers”. The expert panel debated the Review’s recommendations for a regulated Basic Service Offer, and then held a Q&A with the audience.

#### Speakers

**Professor John Thwaites**, Chairperson, ClimateWorks Australia

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

**Sarah McNamara**, General Manager of Corporate Affairs, Energy Council

#### Moderator

**Sabra Lane**, ABC Radio National AM Host

## ENERGY FUTURES SEMINAR #4

### Can Australia fix its energy mess?

In the final Energy Futures forum for 2017, our expert panel reflected on the current state of the energy market, and how it needs to adapt. The impact of high prices, security issues, uncertainty and the ongoing, intense politicisation of energy and climate change policy were all discussed. The panel also discussed the ACCC’s Preliminary Report on its Electricity Supply and Prices Inquiry, as well as the Energy Security Board’s recommendation for a National Energy Guarantee.

#### Speakers

**Dr Kerry Schott AO**, Chair, Energy Security Board

**Rod Sims**, Chair, Australian Competition and Consumer Commission (ACCC)

**Professor Michael Brear**, Director of MEI and Professor of Engineering, University of Melbourne

#### Moderator

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



## STUDENT AND INDUSTRY FORUMS

### Energy Hack 2017

**Energy Hack is a two-day event that brings experts in industry and policy together with researchers and students from diverse disciplines.**

Energy Hack delegates have access to real time data, are able to experiment with new forecasting and machine learning methods, explore commercial applications of block chain technology, learn about the aspirations that motivate consumers and discover emerging technologies. Importantly, delegates are able to test ideas with business mentors and collaborate with the MEI team.

Over 100 engineers, economists, social scientists and renewable energy professionals attended the Energy Hack 17. MEI is grateful to Energy Hack founding partner Powershop Australia, and event partners The State Government of Victoria, City of Melbourne, CitiPower PowerCor, Deloitte Digital, DB Results, Allens, Zen Energy, Clean Energy Council and Intelligent Energy Systems, whose contributions made the event an outstanding success.



*One of the top three standout teams of the Energy Hack 17, and their Rentaray business model presentation.*

At the heart of the hack were the participants, whose innovations were developed together with the expertise of some incredible mentors from across the energy sector. One participant said, 'It was great to meet others with similar interests and to work with those with a variety of experience and skills.' This diversity of experience enriched the teams and assisted them in generating new approaches to old (and new) problems. A total of 17 teams presented to a panel of expert judges:

- **Michelle Groves** – Chief Executive Officer, Australian Energy Regulator
- **Jo Witters** – Executive General Manager, Office of Innovation, Australian Energy Market Operator
- **Simon Holmes à Court** – Energy Entrepreneur
- **Melissa O'Neill** – General Manager Corporate Affairs, Citipower/Powercor
- **Michael Brear** – Director, Melbourne Energy Institute
- **Sabine Heindl** – Director, Strategic Engagement and Corporate Counsel, Energy Consumers Australia
- **Michael Benveniste** – Head of Commercial and Strategy, Powershop
- **Lauren Solomon** – Chief Executive Officer, Consumer Policy Research Centre

The winning teams presented ideas that delivered benefits to energy consumers through effectively utilising new business models and digital technologies. This reflected the Hack lightning talks' focus on innovation in fin-tech and how this can be developed and employed by the energy sector. Our top three teams were:

1. **xsSPACE** – an 'airbnb model' for solar where a marketplace connects consumers that do not have access to rooftop for a PV installation to roofs that are currently free of solar panels.
2. **Rentaray** – a business model that delivers access to the energy price benefits of solar panels to renters by incentivising landlords to install solar system solutions for their tenants.
3. **PowerTwitch** – automated bill analysis and switching platform that finds the customer the best available deal.

## Public lectures

MEI held the following public lectures, attracting large audiences across government, industry, academia and community:

### The role of large scale battery storage in Australia's energy transition

#### Speakers

**John Jung**, President and Chief Executive Officer, Greensmith Energy

**Professor Ross Garnaut**, Professorial Research Fellow in Economics at the University of Melbourne, Distinguished Fellow of the MEI, Chairman of ZEN Energy

**Chris Murphy**, Strategic Advisor, Powershop

**Terry Jones**, Enterprise Professor, University of Melbourne

#### Moderator

**Dr Leslie Martin**, Centre for Market Design, University of Melbourne

### Australian-American Fulbright Commission mini symposium

#### Speakers

**Professor Benny Freeman**, Richard B. Curran Centennial Chair, Engineering, University of Texas at Austin

**Dr Daniel J. Miller**, Scientist, Joint Centre for Artificial Photosynthesis, Lawrence Berkeley National Laboratory in Berkeley, California

### How are supply issues in the gas market affecting the energy sector?

#### Speakers

**The Hon Mark Butler**, Shadow Minister for Climate Change and Energy

**Rosemary Sinclair**, Chief Executive Officer, Energy Consumers Australia

**Robert D'Alessandro**, Head of Procurement and Supply, Qenos

#### Moderator

**Amandine Denis-Ryan**, Acting Chief Executive Officer and Head of Research, ClimateWorks Australia

### The Future of India's Electricity Sector: moving away from coal?

#### Speakers

**Professor Rangan Banerjee**, Forbes Marshall Chair Professor and Head of the Department of Energy Science and Engineering, Indian Institute of Technology, Bombay

### Outlook on the U.S. energy transition

#### Speakers

**Dr David Mooney**, Center Director of the Strategic Energy Analysis Centre, National Renewable Energy Laboratory

## Professor Ross Garnaut public lecture: Does Finkel solve the trilemma?

### Speakers

**Professor Ross Garnaut**, Professorial Research Fellow in Economics at the University of Melbourne, Distinguished Fellow of the MEI, Chairman of ZEN Energy

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## Climate Wars: Mark Butler in conversation with Ross Garnaut and Sara Bice

### Speakers

**The Hon Mark Butler**, Shadow Minister for Climate Change and Energy

**Professor Ross Garnaut**, Professorial Research Fellow in Economics at the University of Melbourne, Distinguished Fellow of the MEI, Chairman of ZEN Energy

### Moderator

**Dr Sara Bice**, Deputy Director of the MEI, University of Melbourne

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## Moving towards a clean energy future in China: RD&D at NICE

### Speakers

**Dr Wayne Xu**, Chief Technology Officer, National Institute of Clean-and-Low-Carbon Energy

**Dr Anthony Ku**, Director of Advanced Technologies, National Institute of Clean and Low-Carbon Energy

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## Global green shift: China as driver

### Speaker

**Professor John Mathews**, Professor in Management, Macquarie University Graduate School of Management

## The role of pumped hydro storage in Australia's energy transition

### Speakers

**Ivor Frischknecht**, Chief Executive Officer, Australian Renewable Energy Agency

**Catherine Tanna**, Managing Director, EnergyAustralia

### Panel

**Dr Roger Dargaville**, Honorary Fellow, University of Melbourne, and Senior Lecturer in Renewable Energy, Monash University

**Julian Turecek**, Head of Assets, EnergyAustralia

**Dr J. Paul Rasmussen**, Energy Leader, Arup Group

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## The energy transition in Asia: 'leap frogging' development?

### Speaker

**Dr Priyantha D.C. Wijayatunga**, Director, South Asia Energy Division, Asian Development Bank

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## US energy and environmental policy under Trump

### Speaker

**Dr Fereidoon Sioshansi**, President of Menlo Energy Economics, San Francisco



## Supported events

MEI was pleased to support the following industry events:

### Australian Energy Week 2017

MEI was a Knowledge Partner for this important industry event

### STEM graduate opportunities with Teach For Australia

MEI supported Teach For Australia in connecting with students that graduated with a degree in Science, Mathematics or Engineering by the end of 2017. The objective was to provide a pathway for graduates to enter the classroom and have an immediate impact

### 3rd ANZPAC workshop on biofueling management for sustainable shipping

MEI was a Knowledge Partner for this important industry event

### After Hazelwood – Victoria's electricity future

This symposium was developed with support from MEI

### Asia Pacific Solar Research Conference

MEI was a Knowledge Partner for this important industry event

## Submissions made to Commonwealth and State Governments

The following submissions have been made by MEI:

### Senate Environment and Communications References Committee - inquiry into the retirement of coal fired power stations submission

- Authored by Brear, Batterham, Dargaville, Evans, Garnaut, Jeppesen, Mancarella and Mareels
- Professor Pierluigi Mancarella and Professor Michael Brear gave evidence

### Victorian Parliament's Economic, Education, Jobs and Skills Committee - inquiry into community energy projects

- Authored by Alexander, Bice, Biggs, Brear, Crawford, Currie, Dargaville, Hes, Jessup, Keenan, Martin, McConnell
- Dr Sara Bice and Professor Michael Brear gave evidence

### Commonwealth Department of the Environment and Energy discussion paper "Better fuel for cleaner air"

- Authored by Schofield, Walter, Silver, Brear, Rayner and Bush

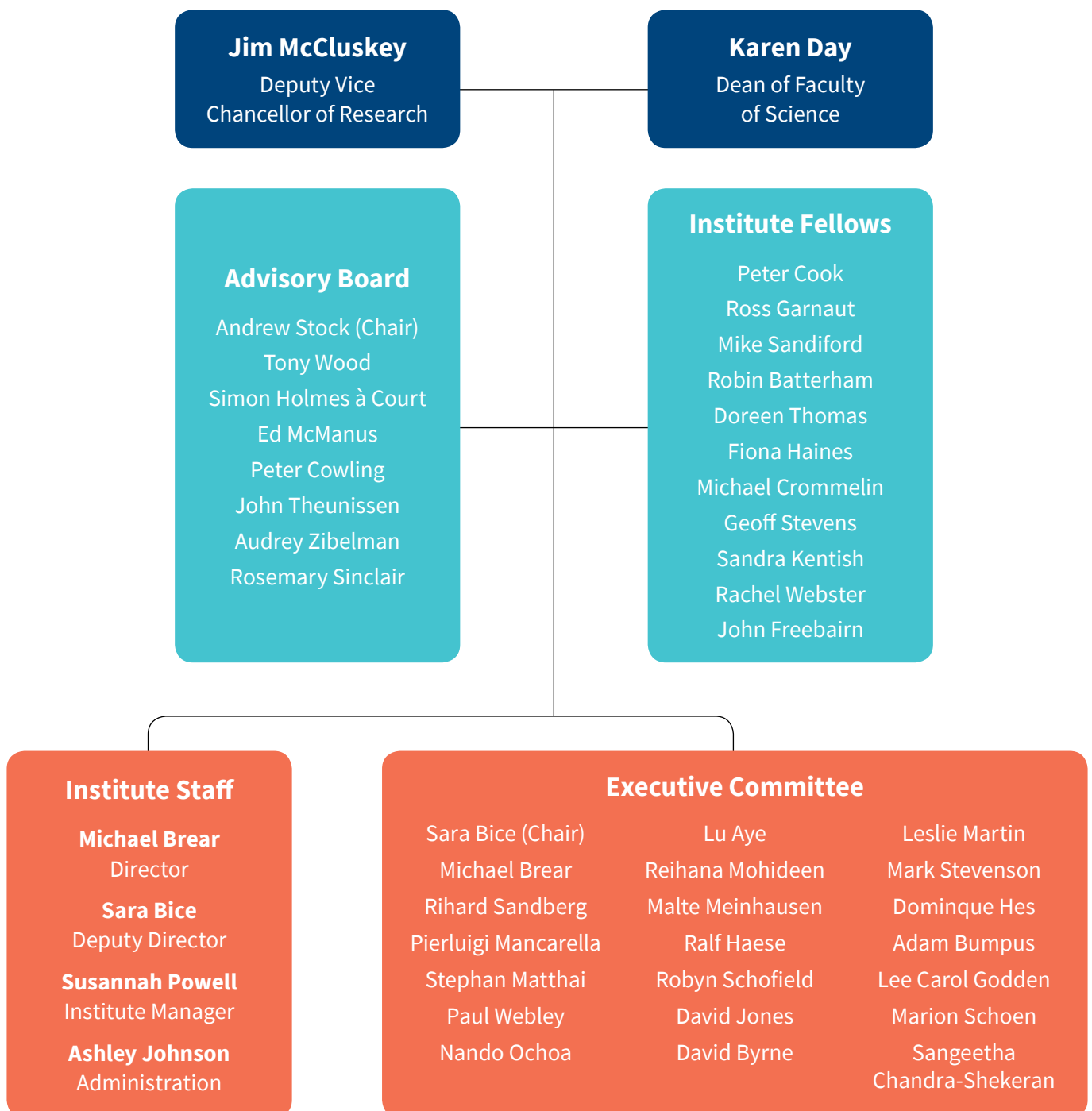
### Power system security assessment of the future National Electricity Market

- Lead author Professor Pierluigi Mancarella

# Governance

The Institute reports to the Deputy Vice Chancellor (Research), Professor Jim McCluskey, for research matters and the Faculty of Science Dean, Professor Karen Day, for operational matters. The Institute Staff and the Executive

Committee operate the Institute, and the Advisory Board and Fellows provide strategic advice. A small team of professional staff support the Director in all Institute activities.



# Financial summary

## Internal Income

Core funding from Deputy Vice-Chancellor (Research)

DVCR Annual MEI Core funding	\$ 1,042,000
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Balance carry forward 2016	\$ (53,813)
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<b>Total Internal Income</b>	<b>\$ 988,187</b>
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## Expenditure

Institute staff salaries	\$ 447,113
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Administration & general costs	\$ 19,000
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Events & communication	\$ 20,905
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Research project support salaries	\$ 127,308
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Research project seed funding	\$ 318,000
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Partnership development	\$ 50,000
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Total Expenditure	\$ 982,326
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<b>Balance</b>	<b>\$ 5,861</b>
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## External Research Income

Industry – direct contract and leveraged	\$ 4,163,000
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Government	\$ 2,282,000
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<b>Total External Income</b>	<b>\$ 6,445,000</b>
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# energy.unimelb.edu.au

**Professor Michael Brear**

Director  
T: +61 3 8344 6722  
E: [mjbrear@unimelb.edu.au](mailto:mjbrear@unimelb.edu.au)

**Susannah Powell**

Institute Manager  
T: +61 3 8344 6538  
E: [powells@unimelb.edu.au](mailto:powells@unimelb.edu.au)

**Anita La Rosa**

Marketing Specialist  
T: +61 39035 8119  
E: [anita.larosa@unimelb.edu.au](mailto:anita.larosa@unimelb.edu.au)

**Ruby Brown**

Communications &  
Administration Officer  
E: [ruby.brown@unimelb.edu.au](mailto:ruby.brown@unimelb.edu.au)

**Further information**

Department of Mechanical Engineering, Building 170  
University of Melbourne, Parkville, Victoria 3010, Australia

E: [mei-info@unimelb.edu.au](mailto:mei-info@unimelb.edu.au)  
T: +61 3 9035 9458