OERC SYMPOSIUM

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TRANSPOWER



OERC SYMPOSIUM PROGRAMME

DAY 1 | Morning

9:00 – 9:15 am	**Welcome/Mihi**
9:15 – 10:15 am	**Keynote** Keynote Speaker 1: **Dr Thomas Longden** (Western Sydney University) *Energy Equity and Energy Security – The Importance of Preventing a Two-Speed Energy Transition*
10:15 – 10:45 am	**Morning Tea**
10:45 am – 12:00 pm	**SESSION ONE**
10:45 – 11:00	**Essential household energy services during electricity outages: evidence from Te Tairāwhiti, Aotearoa New Zealand** Kimberley O'Sullivan, Lydia Le Gros, Cheyenne Locke, Breeann Cairns, Rewiti Ropiha, Shirley Keown, Lief Keown, Pauline Norris, Janet Stephenson *University of Otago and Tūranga Health*
11:00 – 11:15	**People, Place and Networks: Reciprocal Learning and the importance of Community Energy in the Future Energy System** Hinerangi Pere *Orion*
11:15 – 11:30	**Indoor conditions and energy use in New Zealand homes: Highlights from HEEP2** Vicki White *BRANZ*
11:30 – 11:45	**Developing a Home Energy Course for the community** Rachel Hart *EPECentre, University of Canterbury*
11:45 – 12:00	**Quantifying solar rooftop shading losses from neighbouring medium and high-density developments** Sharee McNab, Tulaulelei Overhoff *EPECentre, University of Canterbury*
12:00 – 12:30 pm	**Poster Session**
12:30 – 1:15 pm	**Lunch**



OERC SYMPOSIUM PROGRAMME

DAY 1 | Afternoon

1:15 – 2:20 pm	SESSION TWO
1:15 – 1:35	**Leading interdisciplinary conversations: Reflections on the first 20 years of the OERC** Janet Stephenson *Centre for Sustainability Research, University of Otago*
1:35 – 1:50	**Where the Digital and Energy Transitions Meet: Understanding ICT and AI Emissions at the University of Otago** Sophia Penner *University of Otago*
1:50 – 2:05	**From Fragmented Data to Energy Intelligence: Anthill's Mission to Make Sense of NZ's Energy System** Rafferty Parker *Anthill Ltd*
2:05 – 2:20	**Social acceptance of geothermal development in New Zealand: Building a social and institutional baseline** Yoshifumi Imamura and Smrithi Talwar *Earth Sciences New Zealand*
2:20 – 2:30 pm	**Break**
2:30 – 3:30 pm	**SESSION THREE**
2:30 – 2:45	**The impact of price comparison tolls on electricity retailer choices** Peter Gibbard and Kevin Remmy *Department of Economics, University of Otago*
2:45 – 3:00	**The invisible grid: behind-the-meter and substation trading under Multiple Trading Relationships in Aotearoa New Zealand** Brad Mudgway *Victoria University of Wellington*
3:00 – 3:15	**Comparative study of decentralised control of hot water cylinder within New Zealand low-voltage distribution feeders.** Max de Groot *University of Otago*
3:15 – 3:30	**Evaluating a Third Terminal for New Zealand's HVDC Link: A Pathway to Future Multi-Terminal HVDC Networks** Josh Schipper *University of Canterbury*
3:30 – 4:00 pm	**Afternoon Tea**
4:00 – 5:00 pm	**SESSION FOUR**
4:00 – 4:15	**Modelling New Zealand's Electricity Transition: Life cycle emissions, system security and prices** Maoxing Liu, Jen Purdie, Michael Jack *University of Otago*
4:15 – 4:30	**Life Cycle Assessment of Residential Space and Water Heating Technologies Considering Temporal Electricity Emissions and Grid Infrastructure Impacts** Patricio Gallardo, Sharee McNab, Hamish Avery *Electric Power Engineering Centre - University of Canterbury*
4:30 – 4:45	**Improving condensation measurements for energy-efficient heat exchangers using a multi-camera wind-tunnel platform** Kirill Misiiuk, Lucas Olsen, Sam Lowrey *University of Otago*
4:45 – 5:00	**China's Green Technology Dominance and the Political Economy of the Global Energy Transition** Jack Buchan *PhD Student Politics Programme University of Otago*
5:00 pm	**Day 1 Close**
6:00 pm	**Symposium Dinner** Staff Club



OERC SYMPOSIUM PROGRAMME

DAY 2 | Morning

9:00 · 9:15 am		**Welcome/Mihi**
9:15 – 10:15 am		**Keynote** Keynote Speaker 2: **Dr Andrew Sykes** (Transpower) *Powering prosperity: Te Kanapu, New Zealand's first grid blueprint*
10:15 – 10:45 am		**Morning Tea**
10:45 am – 12:00 pm		**SESSION FIVE**
10:45 – 11:00	💻	**Decarbonising Industrial Heat in New Zealand: A Techno-Economic Assessment of Electrification and Biomass-based Pathways** Tillman Tenzler *Hamburg University of Technology / University of Otago - Physics Department*
11:00 – 11:15	💻	**Powering Prosperity at Scale: A Scenario Analysis of New Zealand's 600% Renewable Energy Vision** Rafferty Parker, Daniel Gnoth *Anthill Ltd, New Zealand*
11:15 – 11:30		**Open-source power system modelling for Aotearoa New Zealand: from current operation to energy transition planning** Vicente Sepúlveda-Figueroa, Rebecca Peer, Jannik Haas *SERG, University of Canterbury*
11:30 – 11:45		**Energy Return On Investment for optimising energy resilience** Solis Norton[1] and Tim Crownshaw[2] *[1]Whirika Consulting Ltd and [2]EECA*
11:45 – 12:00		**From renewable electricity to decentralised H2O2: Techno-economic screening of flexible power-to-chemicals production** Gregor Riha[1 2], Hannah Aster[2], Johannes Lindorfer[2], Jannik Haas[1] *[1] Sustainable Energy Research Group (SERG), University of Canterbury, Ōtautahi Christchurch, Aotearoa New Zealand [2] Energieinstitut an der Johannes Kepler Universität Linz, Austria*
12:00 – 1:00 pm		**Lunch**



OERC SYMPOSIUM PROGRAMME

DAY 2 | Afternoon

1:00 – 2:00 pm		**Keynote** Keynote Speaker 3: **Sam Elder** (Climate Navigator) *Towards a new energy democracy – a collective vision to guide Aotearoa's energy transition*
2:00 – 3:00 pm		**Community Energy Network Panel** Chaired by Gareth Cartwright
3:00 – 3:30 pm		**Afternoon Tea**
3:30 – 4:30 pm		**SESSION SIX**
3:30 – 3:45		**Who Controls the Energy Transition? Community Energy, Prosperity and Technological Autonomy** Jennifer Campion *University of Waikato*
3:45 – 4:00		**Elevating Indigenous Voices in the Just Energy Transition** Dr Sea Rotmann *SEA - Sustainable Energy Advice Ltd / HTR Task by Users TCP*
4:00 – 4:15		**Energy Abundance, for whom?** Josh Ellison *Rewiring Aotearoa*
4:15 – 4:30		**Electricity use findings from the Māori and Public Housing Renewable Energy Fund (MPHREF)** Phoebe Taptiklis *Motu Economic and Public Policy Research*
4:30 – 4:50 pm		**Presentation of student prizes**
4:50 – 5:00 pm		**Symposium close**



PRESENTATION ABSTRACTS

KEYNOTE ABSTRACTS

Energy Equity and Energy Security – The Importance of Preventing a Two-Speed Energy Transition

Dr Thomas Longden

Western Sydney University

While the energy transition is well underway, we are increasingly seeing a multi-speed transition that has justice and equity implications for regions, communities and socio-economic groups. In Australia, many more household technologies (such as solar PV and batteries) are being installed in more prosperous postcodes. When focusing on the Cheaper Home Batteries program we found that there were 912 more battery installs in each major city postcode with high socio-economic status and a history of high solar installations. This corresponds with 3.6% more households having installed a battery and an additional 36MWh of capacity installed in each of these more prosperous postcodes. An announced re-design of the program has coincided with a higher rate of battery installations and larger batteries being installed. At the same time, electricity pricing is changing and prepayment for electricity operates in remote Indigenous communities. Despite claims that implementing time-of-use tariffs will change the way that people use electricity, real-world deployments have shown little shifting of electricity use without technological assistance. I will conclude by focusing on the insights provided by interviewing energy experts and their assessments of whether households would be better/worse off under time-of-use tariffs. Experts specified that socio-technical factors shaped by work schedules, care responsibilities, housing characteristics, and energy literacy impacted the likelihood of being worse/better off. While having solar and a battery is a game changer enabling greater agency over energy use, most of the remaining households have limited flexibility and are likely to be worse off with time varying pricing.

Powering prosperity: Te Kanapu, New Zealand's first grid blueprint

Dr Andrew Sykes

Transpower

Te Kanapu, Transpower's future grid blueprint, looks beyond today's planning horizons to explore how Aotearoa New Zealand can power a prosperous, low-emissions future. Using five scenarios for a growing and thriving economy in 2050, the programme tests what electricity demand, generation choices and network capability could mean for people, business, and the environment. This presentation will share insights from Transpower's recently published work showing that enabling a geographically and technologically diverse generation mix through transmission and distribution networks can help deliver more affordable, reliable, and sustainable outcomes. It will also outline how the grid blueprint is moving from scenarios and insights to the first set of low-regrets transmission investments, aimed at enabling growth at least cost while maintaining resilience and security. Dr Andrew Sykes will discuss what this means for long-term sector coordination, investment confidence, and the choices needed to power prosperity across New Zealand for communities, industry, and future generations.

Towards a new energy democracy – a collective vision to guide Aotearoa's energy transition

Sam Elder

Climate Navigator

Sam will share a bold vision for a more localised and democratised energy system which puts power back in the hands of people and communities AND creates new value opportunities for the energy sector. She will outline why this is a critical opportunity for Aotearoa, explore learnings from here and overseas, seeds of change, barriers holding us back, and potential next steps as we navigate towards a better energy future, together.



DAY 1 — SESSION ONE

Essential household energy services during electricity outages: evidence from Te Tairāwhiti, Aotearoa New Zealand

Kimberley O'Sullivan, Lydia Le Gros, Cheyenne Locke, Breeann Cairns, Rewiti Ropiha, Shirley Keown, Lief Keown, Pauline Norris, Janet Stephenson

University of Otago and Tūranga Health

Electricity outages are an increasingly important energy resilience challenge, particularly as climate-related disruptions place greater pressure on electricity systems. However, relatively little is known about how outages affect households' ability to maintain essential energy services and manage day-to-day needs at home. This study, Pahekeheke o te Pūngao, examined electricity outage experiences and energy insecurity in Te Tairāwhiti, Aotearoa New Zealand.
A cross-sectional mixed-methods survey was conducted with 64 community-recruited adults. Participants provided information on household energy use, affordability, outage experiences, and health and wellbeing, alongside qualitative accounts of managing energy hardship.

Energy insecurity was common, with half of households reporting that electricity costs were difficult to afford and more than half reporting trade-offs between energy and other household expenses. Weather-related outages were reported by 59% of households, with most experiencing multiple outages annually. Outages disrupted essential household functions including refrigeration, communication, medication storage, thermal comfort, and use of electrically powered medical equipment.

Findings highlight the importance of reliable electricity supply for maintaining household resilience and wellbeing. They demonstrate that resilience planning must extend beyond infrastructure restoration to consider the minimum energy services households require during outages. Understanding these requirements can help inform preparedness planning, consumer protection, and future investment in household and community energy resilience.

People, Place and Networks: Reciprocal Learning and the importance of Community Energy in the Future Energy System

Hinerangi Pere

Orion

The transition toward an increasingly electrified and distributed energy system raises questions that extend beyond technology and infrastructure. As household energy practices, technologies and expectations evolve, electricity networks, policymakers, communities and the wider energy sector must collectively consider how future energy needs will be understood and how the benefits and challenges of transition will be distributed. Within this context, community energy and place-based approaches provide an important space for learning about the relationship between people, place and the energy system.
We will reflect on the emerging journey of community energy within the Waitaha region, drawing from the experiences of learning alongside communities with initiatives such as the Community Energy Activator, the Community Energy Wellbeing Collective and the important role of place-based community energy activities and solutions. Community energy initiatives provide an evolving environment for testing how relationships between communities, households, electricity networks and the wider energy sector can support new ways of understanding and responding to the emerging future energy needs and our energy future.

Indoor conditions and energy use in New Zealand homes: Highlights from HEEP2

Vicki White

BRANZ

The Household Energy End-use Project 2 (HEEP2) is New Zealand's most comprehensive study of household energy use and indoor environmental conditions since the original HEEP research conducted between 1999 and 2005. Drawing on data from householder surveys, building and appliance assessments, retailer energy records and high-resolution in-home monitoring, HEEP2 provides an up-to-date evidence base on how New Zealand homes perform, how occupants use energy and the indoor environments they experience.

This presentation will focus on new insights into household energy use, while providing a brief overview of key findings relating to indoor temperatures and moisture.

Results show that winter indoor temperatures have improved since the original HEEP study, but many bedrooms remain below recommended healthy temperatures, particularly overnight. At the same time, summer overheating is emerging as a growing issue, with many homes experiencing elevated evening and night-time temperatures during warmer months.

The moisture analysis shows that while elevated relative humidity was common, particularly in bedrooms, a key finding was that moisture problems are often driven as much by cold indoor temperatures and underheating as by excessive moisture generation.

Energy use findings suggest that overall household energy consumption has changed relatively little over the past two decades, but how energy is used has shifted substantially. Heat pumps now dominate residential space heating, electricity plays a much larger role in delivering heating services, and changes in appliance ownership and efficiency have altered household energy demand patterns. The presentation will explore how energy use varies across New Zealand households, including differences by region, dwelling characteristics and household demographics, as well as the contribution of major end uses such as space heating, hot water, lighting and plug loads.

Together, these findings provide a uniquely detailed picture of residential energy use and housing performance in Aotearoa New Zealand and highlight opportunities for improving energy efficiency, thermal comfort, housing quality and occupant wellbeing.

Developing a Home Energy Course for the community

Rachel Hart

EPECentre, University of Canterbury

Reaching net-zero greenhouse gas emissions by 2050 will require a combined effort from the government, businesses, communities, and residents.

A free-of-charge adult education course for Ōtautahi Christchurch residents was developed by the EPECentre, and the first cohort ran over three evenings in June 2026. The first two sessions covered energy basics and residential energy technologies, and the third session looked at householders' energy profile and potential for PV and batteries. An energy use tool was built which allows individuals to upload their household energy data from their home smart meter and to estimate the impact of installing energy technologies such as solar, batteries and electric vehicles on power bills. The EPECentre team subsequently attended two community expos to speak with residents about home energy and to raise awareness of the home energy tool and course.

By converting current research and knowledge into an easy-to-understand format, the intention of the course was to empower the community by increasing knowledge and understanding of home energy use and available technologies. This assists attendees to make informed decisions about the technology that best suits their needs and gives them greater confidence when discussing energy options with technology suppliers.

The development of the course will be reported, along with learnings and next steps.

Quantifying solar rooftop shading losses from neighbouring medium and high-density developments

Sharee McNab, Tulaulelei Overhoff

EPECentre, University of Canterbury

Rooftop solar photovoltaic (PV) systems are globally the most widely adopted household energy generation technology, but to maximise return on investment depends on unshaded solar access. In New Zealand, the Enabling Housing Supply Act 2021 and the National Policy Statement on Urban Development allows residential buildings of three to six storeys to be built in established suburbs, without notification. Existing solar systems are left vulnerable to shadowing with no solar access protection as housing access is prioritised. A comparison of the treatment of solar access for other jurisdictions is explored. Quantifying the impact of solar shading requires access to 3D models that are typically the domain of solar professionals and designers. A simple, browser-based tool is reported here, that is driven by a building outline traced in Google Earth and a few household inputs, to quantify shading effects. The building profile is converted into per-panel horizon profiles and solar generation is simulated with the European Commission's PVGIS service, making this analysis accessible to anyone.

A case study is reported for a Napier household beside a proposed six-storey development found that the building would reduce the annual generation of three arrays by 7.1 to 8.8%, or 701 to 872 kWh per year, with about 73% of the reduction between May and August. A northeast-facing array loses under 2% despite a similar horizon. The losses would pass British and Australian solar access guidelines, which average over the year or count remaining sunlit hours.

The tool gives developers, councils and homeowners an easy-to-use, transparent, repeatable estimate to inform decisions that weigh housing supply against existing solar generation.

DAY 1 — SESSION TWO

Leading interdisciplinary conversations: Reflections on the first 20 years of the OERC

Janet Stephenson
Centre for Sustainability Research, University of Otago

The Otago Energy Research Centre was established a little over 20 years ago to bring together academics who had an interest in energy-related research from all disciplinary perspectives. It was one of the first such interdisciplinary groups at Otago University, and paved the way for many similarly interdisciplinary centres, themes and networks. I reflect on OERC's journey over those years, which has included learning how to communicate across diverse disciplines, how to develop strong associations with stakeholders in the energy sector, and the importance of health, inclusivity and equity in energy research. Looking to the climate-disrupted future, I discuss how energy will continue to play an outsized role in resilience, wellbeing and the economy, and the continued relevance of the OERC over the next 20 years.

Where the Digital and Energy Transitions Meet: Understanding ICT and AI Emissions at the University of Otago

Sophia Penner
University of Otago

The global energy transition is unfolding alongside rapid growth in digital services and artificial intelligence, creating a difficult tension: we are working to decarbonise national electricity grids at the same time as demand for energy-intensive computing seems to be ever-increasing. All the while, the greenhouse gas emissions associated with information and communication technology (ICT) remain largely invisible in most organisation's reporting. This presentation will argue that making the energy and emissions impacts of digital technologies visible enables organisations to make informed decisions about how digital growth can best support the transition to a low-carbon future. Drawing on lessons learned from the development of a pilot ICT emissions assessment at the University of Otago, it will explore why these emissions are difficult to measure, where current data and reporting gaps lie, and how clearer evidence can support better institutional decisions. The presentation will also consider how sustainability can be embedded more deliberately into digital strategy, technology procurement, AI adoption, and energy planning, rather than treated as a separate reporting exercise. Overall, it will offer a practical perspective on how organisations can make the energy and emissions impacts of their growing digital footprint more visible, use that evidence to guide digital strategy decisions, and consider whether rising computing demand can help unlock clean-energy investment and even accelerate, rather than undermine, the transition to a sustainable energy future.

From Fragmented Data to Energy Intelligence: Anthill's Mission to Make Sense of NZ's Energy System

Rafferty Parker
Anthill Ltd

New Zealand's energy sector publishes a wealth of open data. The wholesale market, distribution and transmission networks, and government agencies all provide information essential to understanding the energy transition. Some arrives through APIs at 5 minute intervals; some is buried in tables at the back of PDFs published once per year.

Answering questions about the energy system often requires combining these sources. Their differing formats, definitions, conventions and locations make this a substantial engineering task.

Over the past few years, Anthill has been extracting, storing, cleaning, and connecting these datasets in one centralised location. Their Energy Intelligence Platform combines AI with purpose-built analytical tools that allow users to explore complex questions in plain English.

Rafferty will provide a brief overview of the platform, outline its architecture, and demonstrate the types of analyses it enables.

Social acceptance of geothermal development in New Zealand: Building a social and institutional baseline

Yoshifumi Imamura and Smrithi Talwar
Earth Sciences New Zealand

This study uses a geothermal system in the Taupō Volcanic Zone (TVZ) as a case study to establish a social and institutional baseline for assessing social acceptance of geothermal development in New Zealand. Based on publicly available information, it examines the area's socio-economic characteristics, historical and cultural context, regulatory and institutional settings, and previous research on social acceptance.

The review shows that social acceptance cannot be understood simply as support for or opposition to geothermal development. It depends on the stage and scale of development, anticipated effects, and the processes through which decisions are made. For wider community stakeholders, important factors include information transparency, environmental and health and safety effects, distribution of benefits and burdens, trust in institutions and project proponents, and protection of valued geothermal environments. Mana whenua have distinct status, rights and interests under Te Tiriti o Waitangi and related institutional arrangements, requiring early and meaningful involvement in decision-making.

The baseline provides a foundation for future stakeholder engagement and for examining how geothermal development can contribute to New Zealand's energy transition while recognising community interests, environmental values and mana whenua rights and interests.

DAY 1 — SESSION THREE

The Impact of Price Comparison Tools on Electricity Retailer Choices

Peter Gibbard and Kevin Remmy
Department of Economics, University of Otago

We estimate a structural model of electricity retailer choices accommodating various sources of consumer inertia, including inattention, limited information, switching costs, and product differentiation. The model disentangles the relative importance of different frictions. We estimate our model using individual-level data of all retailer switches and queries on an electricity price comparison website in New Zealand, Powerswitch. We find that price comparison tools strongly impact market structure and consumer surplus. However, mandating all consumers search for alternatives has stronger effects on market structure and consumer surplus gains. Our results help policymakers design policies that improve consumer choices and effective competition in retail markets.

The invisible grid: behind-the-meter and substation trading under Multiple Trading Relationships in Aotearoa New Zealand

Brad Mudgway
Victoria University of Wellington

New Zealand's distributed energy is growing fast but largely out of sight. Distributed solar has grown from 6 MW in 2013 to 878 MW in 2025, and battery co-adoption is rising. Much of this energy is consumed behind the meter, so it never appears in settlement data, national energy balances or transmission planning inputs. Meanwhile, the market's single-retailer-per-ICP model prevents households and communities from trading the value of their solar, batteries EVs and other emerging P2P technologies.

This policy-focused research examines how behind-the-meter and substation-level trading could be enabled through Multiple Trading Relationships (MTR). Using Electricity Authority registry data, irradiance-calibrated yield estimates and adoption scenarios to 2040, preliminary analysis estimates that 169–229 GWh of residential solar was self-consumed invisibly in 2025. Total behind-the-meter energy, including vehicle-to-home and community schemes, could reach about 683 GWh by 2030 and 1,829 GWh by 2040, around 4% of national demand. The same assets could provide roughly 500 MW of dispatchable peak capacity by 2032 through batteries and vehicle-to-grid, but only if aggregators, community schemes and peer-to-peer traders can legally settle at a shared connection point and that value is priced correctly in the market.

The research argues that MTR is the foundational market reform on which other distributed energy opportunities depend, and that it must be paired with production-side metering, a national behind-the-meter energy reporting balance, and network tariff reform prior to DPP5 to address growing cross-subsidies between solar and non-solar households. It considers how local trading at substation level could share benefits with households that cannot install their own systems, linking the transition to equity as well as efficiency.

Evaluating a Third Terminal for New Zealand's HVDC Link: A Pathway to Future Multi-Terminal HVDC Networks

Josh Schipper
University of Canterbury

New Zealand’s High Voltage Direct Current (HVDC) inter-island link is a critical component of the national electricity system, enabling large-scale power transfer between the South and North Islands. As future electricity demand grows, and more energy storage is needed for renewable generation integration, greater transmission capacity along the length of New Zealand becomes a necessity. This study investigates the feasibility and potential benefits of HVDC options, particularly a third terminal to the existing HVDC scheme near Christchurch,as a step toward future multi-terminal HVDC operation.

The work examines the application of Modular Multilevel Converter (MMC) technology alongside the existing Line Commutated Converter (LCC) infrastructure, creating a hybrid HVDC configuration capable of supplying power directly to the Upper South Island (USI). A transmission network study was conducted using a New Zealand power system model for power-flow and contingency analysis. The performance of a third-terminal HVDC connection was compared against a conventional transmission reinforcement option involving an additional 220 kV circuit into Christchurch from the Waitaki region. Results indicate that the HVDC tap can provide substantial increases in transfer capability and demand support to the Upper South Island while reducing the need for major AC network reinforcements. The analysis shows that HVDC terminal can provide transmission capacity to the USI 50% greater than its name plate rating.

Comparative study of decentralised control of hot water cylinder within New Zealand low-voltage distribution feeders

Max de Groot
University of Otago

Increasing electrification and distributed generation are increasing thermal and voltage pressures on low-voltage (LV) distribution feeders. Hot water cylinders (HWCs) can provide demand flexibility to reduce this pressure by shifting electrical demand in time. Decentralised control can coordinate this flexibility with limited communication requirements.

This study compares price-, household-current, and household-voltage-based HWC control under consistent feeder conditions and across control penetrations from 0 to 100%. Performance was assessed using feeder demand, household voltage, energy consumption, and electricity cost. Control variants were introduced to reduce synchronisation.

For 60% penetration, the randomised price controller produced the largest reduction in 95th-percentile feeder power of 12.8%. This fell to 4.3% at 100% penetration due to rebound peaks caused by synchronised device responses. In contrast, the probabilistic voltage controller scaled more effectively, reducing 95th percentile feeder power by 14.6% at 100% penetration.

Overall, HWC control can provide useful demand flexibility, but increasing control penetration does not necessarily produce proportional network benefit. Performance depends on both how well the control signal represents feeder conditions and how much diversity is maintained between individual device responses.

DAY 1 — SESSION FOUR

Modelling New Zealand's Electricity Transition: Life cycle emissions, system security and prices

Maoxing Liu, Jen Purdie, Michael Jack
University of Otago

Decarbonising New Zealand's transport and heat sectors through electrification will increase electricity demand and require new generation, storage, and network infrastructure. Although renewable sources supplied 92% of electricity in the June 2026 quarter, renewable share alone does not capture progress. The transition must also balance environmental and economic outcomes with supply security.

To move beyond the renewable generation share as the primary measure of progress, we first develop a whole-system assessment framework that captures both operational emissions and embodied emissions from future generation and construction of network infrastructure. Building on this environmental assessment, we compare an accelerated 100% renewable pathway (reaching 100% renewable electricity by 2035), with a gas-dominated thermal pathway over the next 30 years, evaluating trade-offs across life-cycle emissions, wholesale electricity prices, and security of supply.

Results identify shifting priorities over the next three decades. Before 2035, retiring fossil fuels remains the main opportunity to reduce electricity system emissions. Phasing out coal by 2035 and gas by 2045 reduces cumulative life-cycle emissions by approximately 30% relative to keeping these in the electricity system. Emissions from large-scale renewable construction create new peaks in annual emissions in the next few decades, and so using lower-carbon materials could reduce cumulative whole-system emissions by a further 7%. An accelerated 100% Renewable pathway produces 76.6% lower emissions and a 56.4% lower average electricity price than the gas-dominated Thermal pathway, but records 5 times as many weeks with electricity shortages exceeding one hour over the 30-year modelling period.

These findings show that powering New Zealand's future electricity system requires rapid fossil-fuel retirement and earlier decarbonisation of construction materials and manufacturing processes to limit both operational and embodied emissions. Achieving 100% renewable electricity will also require cost-effective generation and network expansion to manage electricity prices, alongside a diversified portfolio of storage and demand response to maintain supply security.

Life Cycle Assessment of Residential Space and Water Heating Technologies Considering Temporal Electricity Emissions and Grid Infrastructure Impacts

Patricio Gallardo, Sharee McNab, Hamish Avery
Electric Power Engineering Centre - University of Canterbury

Residential space and water heating (SWH) is an important component of household energy demand (approximately 47% of residential electricity consumption). This study unpacks which heating technologies are most environmentally benign in terms of cumulative energy demand and greenhouse gas (GHG) emissions for different New Zealand contexts

(including climate, dwelling type, size, and insulation). An integrated life-cycle assessment framework was developed to investigate the operational and embodied energy use and emissions associated with residential SWH technologies and their interaction with the electricity system in New Zealand. The analysis considers three aspects of SWH technology selection and deployment. First, the trade-offs between resistive and heat-pump-based technologies are evaluated as a function of dwelling size, building envelope characteristics, and climate zone. Second, the influence of alternative future electricity-system pathways on SWH operational emissions is investigated, with particular emphasis on hydrological resource availability and its implications for generation dispatch and temporal electricity emission intensity. Third, the national-scale implications of substituting energy-efficient SWH technologies and improved demand flexibility from thermal storage. Estimates of national electricity demand reduction and peak flattening are used to calculate the benefit of avoided electricity-system infrastructure - generation, transmission, and distribution. A long-run marginal cost-based approach is used to estimate the avoided distribution infrastructure.
Replacing resistive water heating with heat-pump water heating reduces household operational electricity consumption by 24–69% and GHG emissions by 16–64%. Replacing 20% of New Zealand's resistive water heaters with heat-pump water heaters reduces the required grid capacity and peak, resulting in a lower emissions electricity grid, which reduced the space and water heating electricity emissions by 7–9%. Shifting 20% of SWH demand to off-peak periods reduces peak electricity demand by 117–168 MW. The results demonstrate that the lifecycle implications of SWH technologies depend on the interaction between technology characteristics, household characteristics and associated thermal demand, electricity-system conditions, and demand flexibility.

Improving condensation measurements for energy-efficient heat exchangers using a multi-camera wind-tunnel platform

Kirill Misiiuk, Lucas Olsen, Sam Lowrey

University of Otago

Condensation on cooled surfaces plays a central role in refrigeration and heat-exchange technologies, where effective condensate management is important for maintaining high heat-transfer performance and energy efficiency. However, its experimental characterisation is commonly based on measurements obtained from limited, single-view regions of interest. Such approaches implicitly assume spatially uniform condensation behaviour, an assumption that is increasingly questionable under realistic flow and thermal conditions relevant to practical heat exchangers.

In this work, we present a dedicated wind-tunnel platform designed to extend the spatial and temporal coverage of condensation measurements on cooled surfaces. The system combines controlled airflow and vapour conditions with a thermally regulated substrate and a synchronised multi-camera imaging arrangement, enabling simultaneous observation of condensation dynamics at nine distinct locations across the same surface. Machine-learning-based image analysis is used to automate droplet detection and quantify condensation behaviour across the resulting datasets. While the sample size remains limited (40 × 40 mm), this approach provides a substantial improvement over conventional single-point or single-view measurements. The configuration allows direct comparison of local droplet growth, coalescence, and shedding processes under identical macroscopic operating conditions.

Representative experiments demonstrate pronounced spatial variability in droplet statistics and temporal evolution across the surface, even when global flow and thermal parameters are held constant. Differences in local droplet size distributions, surface coverage, and shedding frequency highlight the limitations of assuming a single “representative” measurement region. The results illustrate how conventional single-view measurements can obscure important condensation features that are relevant to condensate removal, flooding onset, and heat-transfer performance.

By explicitly extending spatial coverage, the presented platform provides a robust experimental framework for improving the fidelity of condensation measurements under conditions relevant to refrigeration systems using natural refrigerants. More representative experimental datasets can support the validation of heat-transfer models and the development of advanced condensing surfaces, ultimately contributing to more efficient refrigeration and thermal-energy systems.

China's Green Technology Dominance and the Political Economy of the Global Energy Transition

Jack Buchan

PhD Student Politics Programme University of Otago

Globally, the energy transition is unfolding amid growing pressures from climate change, energy insecurity, and rising energy demand, including from artificial intelligence. At the same time, China increasingly supplies the technologies enabling this transition, dominating production and supply chains of many key green technologies.

China's position presents states with both opportunities and risks. Its production capacity provides access to renewable technologies at a cost and scale other states struggle to match, enabling cheaper and faster energy transitions.

However, reliance on these capabilities also creates strategic dependencies and potential vulnerabilities to disruption or coercion.

Drawing on ongoing doctoral research, this presentation explores the changing global political economy of the energy transition, particularly the growing importance of geopolitical competition and international economic dependence. It then introduces a framework for understanding how China's position in green technology production shapes the energy transition pathways of states, particularly through its effects on affordability, decarbonisation speed, and strategic autonomy.

DAY 2 — SESSION FIVE

Decarbonising Industrial Heat in New Zealand: A Techno-Economic Assessment of Electrification and Biomass-based Pathways

Tillman Tenzler

Hamburg University of Technology / University of Otago - Physics Department

Heat for industrial and commercial sectors in New Zealand (NZ) is mainly provided by burning fossil fuels. An insecure supply of natural gas, a ban on coal boilers and an increasing cost of emission certificates (NZU) pressure businesses and sites to transition to renewable energy carriers. The most promising options for NZ are electrification via heat pumps and the utilisation of residual biomass resources as a fuel. Existing national energy system models simplify heat pump (HP) representation using fixed coefficients of performance (COP) or completely excluding high temperature heat pumps (HTHP) that can provide heat at temperatures above 100 °C.

This talk presents a system dynamics model of NZ's industrial and commercial heat demand below 300 °C. It covers the commercial, dairy, food, pulp & paper and wood product manufacturing sectors. The model is initialised with 2024 as a base year and simulates until 2050. Equipment reaching its end of life during the simulation is replaced by the compatible technology with the lowest levelised cost of heat. Industrial HP are limited by the availability of waste heat streams. Their COP is modelled on the basis of a range of process applications for each sector. Biomass prices respond dynamically to regional supply and demand.

HP could technically supply 90 % of the modelled heat demand. Under the modelled baseline assumptions, they supply 58 % of the total heat demand by 2050. Biomass boilers (BB) account for 17 % of total heat demand. This transition leads to an emission reduction of 63 % between 2024 and 2050.

The uptake of HP and BB is limited by cost rather than technical feasibility. This is most prominent for HTHP and BB in the commercial sector, as their investment costs are large.

With the coal ban in place, natural gas is the main fossil fuel competitor to electrification and biomass. Under the lowest modelled NZU cost, it supplies 19 % of the nationwide demand in 2050. The regional ratios between electricity, biomass and natural gas prices decide on the resulting technology split. Only NZ's North Island features a natural gas network. This leads to the South Island completely phasing out fossil fuels, as Diesel and liquefied petroleum gas (LPG) are not cost competitive. Repealing the coal ban leads to emissions increasing by 12 % by 2050. Increasing the NZU price and capital subsidies mainly displace the remaining natural gas.

Powering Prosperity at Scale: A Scenario Analysis of New Zealand's 600% Renewable Energy Vision

Rafferty Parker, Daniel Gnoth

Anthill Ltd, New Zealand

New Zealand generated 45.4 TWh of electricity in 2025, mostly from renewable sources, yet it uses less than a tenth of its realistic renewable potential. Using the Anthill Energy Intelligence platform, this paper tests the Kākāriki Renewables "600%" vision of 272 TWh a year by 2050, six times today's generation, against two lower-growth electrification pathways. The model draws on Electricity Authority metered generation, ERA5 wind and solar data for 47 sites, and datasets from MBIE, EECA, the Commerce Commission, Stats NZ and Transpower.

The 600% system is led by solar: 101 GW of solar, 18 GW of wind and 5 GW of geothermal, with 49 GW of electrolysers. The electrolysers absorb more than half of all generation and replace gas as the main way of balancing the system. The pathway needs about NZ$438B of capital, close to one year of GDP, and around 5 GW of new generation a year, many times the current pace.

Delivered electricity prices fall in all pathways. Under the 600% pathway they drop from 38 c/kWh today to about 15 c/kWh by 2050. By then network charges (9.5 c/kWh) outweigh generation costs (5 c/kWh), so network pricing reform does more for consumers than cheaper generation.

The economic case depends on where the extra energy goes. Cheaper energy for domestic industry and displaced fuel imports are the most secure benefits. Hydrogen exports, worth about NZ$14B a year in revenue, are the largest new stream but also the least certain. They depend on offtake contracts and on electrolysers buying power close to wholesale cost.

This points to regional energy precincts, where electrolysers, data centres and process heat sit beside the generation that serves them and connect directly to the high-voltage grid. That approach is directly relevant to Transpower's Te Kanapu Grid Blueprint.

The physics is achievable. Moving the national conversation from scarcity to abundance lets New Zealanders ask which international investment fits their values and way of life, who owns these precincts, and how the returns are shared between communities, iwi, workers and overseas capital.

Open-source power system modelling for Aotearoa New Zealand: from current operation to energy transition planning

Vicente Sepúlveda-Figueroa, Rebecca Peer, Jannik Haas

SERG, University of Canterbury

Open-source energy-system models can support transparent analysis of Aotearoa New Zealand's rapidly changing electricity system. This work presents the development of a PyPSA-based modelling framework within the SERG Energy Observatory, combining harmonised power-system data with reproducible operational and planning analyses. A 2025 representation of the New Zealand power system is used to investigate short-term operational sensitivities to additional solar PV and battery storage, assessing changes in renewable curtailment, thermal generation, emissions and system flexibility. The framework provides a foundation for subsequent capacity-expansion modelling and analysis of future energy-transition pathways.

Energy Return On Investment for optimising energy resilience

Solis Norton[1] and Tim Crownshaw

Whirika Consulting Ltd[1] and EECA[2]

New Zealand's energy transition requires whole-of-system assessment of energy carrier* ability to deliver Net Energy to society, after accounting for energy invested in their production and transport. Whirika Consulting and EECA have developed Energy Return on Investment (EROI) models tailored to the New Zealand context, establishing this physics-based approach as a compliment to conventional economic analysis.

Building on the harmonised EROI methods of Murphy et al. (2022), the framework incorporates thermal-equivalence adjustment, Point-Of-Use system boundaries, and Bayesian analysis of uncertainty arising from natural variability and epistemic limitations. Expert input from industry in New Zealand and leading international researchers was instrumental in model development and validation.

Two groups of Point-Of-Use EROI values emerged. Geothermal co-generation, solar photovoltaic, wind, wood chips, and electricity generated from imported coal formed the higher-EROI group. White and torrefied wood pellets and e-SAF formed the lower group, while diesel and lignite lay between these groups. Uncertainty distributions usually overlapped within groups.

The framework offers a consistent, transparent, and adaptable basis for comparing and optimising energy carriers. Applied collaboratively alongside economic analysis, it can identify opportunities to improve thermodynamic performance and inform strategic energy planning. For example, it is valuable support for decisions such as industrial fuel switching or electricity network investment, while making analytical uncertainty explicit to decision-makers.
* Energy carrier: A substance or system that stores, moves, and delivers energy, but does not produce energy.

From renewable electricity to decentralised H2O2: Techno-economic screening of flexible power-to-chemicals production

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Powering prosperity through the energy transition requires renewable electricity to reach the industrial chemicals that businesses and communities depend on. Hydrogen peroxide (H2O2), essential for pulp and paper, water treatment and

electronics, is still produced in centralised fossil-based plants and transported over long distances. Decentralised electrochemical production from renewable electricity could supply it on-site, but its viability depends strongly on location-specific variables. Building on earlier GIS-based siting work, this contribution extends to a techno-economic screening framework developed within the Horizon Europe project Power2Hype. It links industrial demand with renewable availability, electricity prices and grid carbon intensity to assess levelised production cost and carbon footprint. The framework will be applied to representative cases in Germany, Spain and Belgium to show how an identical electrolyser performs differently across sites, with implications for business competitiveness, environmental performance and secure local supply for people.

DAY 2 — SESSION SIX

Who Controls the Energy Transition? Community Energy, Prosperity and Technological Autonomy

Jennifer Campion
University of Waikato

The energy transition is increasingly promoted as a pathway to local prosperity. Across New Zealand and internationally, community energy initiatives, distributed renewable generation, and Indigenous investments in clean-energy infrastructure are expected to create economic opportunities, strengthen resilience, and enable greater participation in energy governance. Underpinning many of these initiatives is a widely held assumption: that ownership of renewable-energy assets will allow communities to exercise greater control over their energy futures.

This paper argues that ownership alone may be insufficient to deliver that promise. As energy systems become increasingly digitalised, renewable-energy infrastructure is embedded within wider technological ecosystems comprising software, data platforms, technical standards, specialist expertise, and ongoing support networks. Consequently, communities may own renewable-energy assets while having limited influence over the technologies that govern their operation, maintenance, optimisation, and future development.

Drawing on scholarship on community energy, energy democracy, and socio-technical transitions, the paper develops a framework distinguishing between ownership, access, control, and autonomy. It argues that discussions of prosperity in the energy transition have focused primarily on asset ownership and economic return, while paying comparatively less attention to the capacity of communities to shape the technological systems upon which they depend. This distinction is becoming increasingly important as digital technologies, smart-grid infrastructure, battery storage systems, and data-driven energy management become central features of contemporary energy networks.

The paper proposes technological autonomy as an important but underexplored dimension of a prosperous energy transition. Technological autonomy does not imply self-sufficiency. Rather, it refers to the capacity of communities to participate meaningfully in decisions about the technologies that underpin their economic, social, and environmental futures. A transition that delivers prosperity for people, business, and the environment requires more than investment in renewable-energy infrastructure. It also requires attention to local capability, governance, and the conditions under which communities can exercise meaningful influence over the technological systems that shape their future.

Keywords: community energy; technological autonomy; energy transition; energy democracy; prosperity; digital energy systems; governance; just transition.

Elevating Indigenous Voices in the Just Energy Transition

Dr Sea Rotmann
SEA - Sustainable Energy Advice Ltd / HTR Task by Users TCP

In the face of an accelerating climate crisis and shifting geopolitical power balances, the world is pursuing a "green transition" in which electrification is central. Electrification demands Critical Raw Materials (CRMs), including Rare Earth Elements (REEs), a large share of which lie beneath Indigenous lands. Although the UN affirms Indigenous peoples' right to "own, use, develop and control" their traditional lands, these rights are routinely overruled, including on "national security" grounds. The newly discovered Per Geijer deposit in Northern Sweden - Europe's largest known REEs find - sits at the centre of these tensions. A peer-reviewed paper co-authored by two Users TCP by IEA research collaborations examines three competing narratives (which map to the “energy trilemma”) surrounding the proposed new mine: the "green transition," "national security," and "energy justice" narratives. Focusing on cumulative threats to the Gabna reindeer-herding community, we explore the power imbalances that determine which stories are heard in energy transition decision-making, and which are marginalised. We argue that recognition, restorative, and intergenerational justice principles need to be brought to the centre of transition planning. Recommendations from Indigenous hui participants (including leaders from the U.S. and Aotearoa) include mapping the cumulative impacts of green-transition

projects, combining Indigenous and Western scientific knowledge, and strengthening legal and policy mechanisms to protect Indigenous rights. Doing this is imperative to ensure that energy transitions are both environmentally and socially just, whilst also considering geopolitical implications.

Energy Abundance, for whom?

Josh Ellison
Rewiring Aotearoa

We now seemingly have cross-party agreement on the idea of “energy abundance” with that language used by ACT, Greens, Labour, Opportunity, and National. But before this energy abundance term becomes a meaningless cliche echoed by all and practiced by none, we should call a spade a spade and think about who this energy abundance is actually for, then how we might deliver on it.

An abundance of expensive energy, abundance for energy companies, is not necessarily an abundance for New Zealanders. In a similar way, an abundance of energy infrastructure is often actually the exact opposite of abundance for consumers. This is not an argument against having an abundance of energy, it’s an argument for where that abundance is, and who it's for.

As a small nation that can struggle to compete economically on the modern global stage, we have made it far harder for ourselves by building an energy system that fails our people and businesses. We are currently a nation in service to our energy system, when we should be a nation served by our energy system. That’s why it was built, that is the point of energy systems in the first place.

Electricity use findings from the Māori and Public Housing Renewable Energy Fund (MPHREF)

Phoebe Taptiklis
Motu Economic and Public Policy Research

In 2021 the government made NZ$28 million available for renewable energy projects. Half (14 million) went to Kāinga Ora and the other half was made available in a contestable fund for owners of Māori housing. More than 450 applications for renewable energy projects were received, and 45 were funded. Ninety percent of the funded projects were for rooftop solar, for which inverter and electricity consumption data has been collected from a sample of 358 households. The Electricity Authority mandates retailers to maintain 24 months of historical consumption data for every account, and this allows for a study design which can assess how rooftop solar impacted each household’s electricity consumption comparing the electricity use after to the pre-intervention use. By incorporating inverter data, we analyse two primary outcomes: Change in grid consumption, and change in total electricity use, before and after solar installation. Using a fixed effects regression model, fixed on house and date, we found that households, on average, used 5.23 fewer kWh per day from the grid when considered across the whole year. When the analysis was restricted to the heating season (May – October) this increased to 4.31 fewer kWh per day. In terms of total electricity use (grid consumption plus the use of self-generated electricity) we found that households, on average, over the whole year used 2.03 kWh more electricity per day after the solar panels were installed, and this increased to 3.79 kWh more electricity per day over the heating season. This means that even in winter households were using, on average around 8 kWh of self-generated electricity use per day. Furthermore households (which did not pay the capital costs of the systems) saved around $1500 on electricity bills (normalised to a net present value of Q2, 2026) with a further $450 in rebates, leading to almost $2000 less in electricity costs per household per year. We estimate that MPHREF households are now injecting 4000 MWh of electricity into the grid annually, as well as keeping their homes warmer in winter.



POSTER ABSTRACTS

Empirical Modelling of a Refrigerative Dehumidifier Using Low-GWP Refrigerants

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Refrigerative dehumidifiers are beneficial in humidity control in residential, commercial and industrial applications. It is estimated that 19% of homes in the United States, and 25% of New Zealand homes make use of one. The environmental impact that a dehumidifier has is dependent on which refrigerant it makes use of. Around 10% of global greenhouse gas emissions are from heating, ventilation, air-conditioning and cooling (HVAC&R), therefore development of systems that utilise low global warming potential (GWP) refrigerants is essential for reducing these emissions. The Kigali Amendment mandates the phase-down of hydrofluorocarbons such as R134a, which is commonly used in domestic refrigerative dehumidifiers and has a high GWP of 1430. Refrigerants with low-GWP such as R1234yf (GWP ≈ 4) and R290 (GWP ≈ 3) are possible candidates for replacement across many applications. Empirical modelling provides a means of predicting dehumidifier performance while incorporating the behaviour of individual system components. This work develops an empirical model of a domestic-scale refrigerative dehumidifier and evaluates its ability to represent system performance using R134a, R1234yf, and R290. The model combines empirical compressor sub-models for isentropic efficiency, volumetric efficiency, and fractional heat loss with refrigerant- and air-side heat transfer models. The model was calibrated using experimental data from an ungeared dehumidifier system at 20°C and 25°C, 70% relative humidity. The calibrated model was then compared with experimental measurements across a range of airflow rates and for both ungeared and geared configurations, across the three different refrigerants. The model reproduced the general trends in suction pressure, discharge pressure, compressor electrical power, and moisture extraction rate across the tested conditions. Compressor power was predicted within 5% for all three refrigerants. However, moisture extraction was consistently overpredicted, particularly at low airflow rates and the higher ambient temperature. These results demonstrate the feasibility of combining empirical compressor and system sub-models to represent dehumidifier performance across multiple refrigerants. The overprediction of moisture extraction indicates that assumptions of uniform heat and mass transfer across the evaporator and condenser heat exchangers should be investigated further. Future model development will focus on direct characterisation of the heat exchangers and airflow distribution to improve prediction accuracy across the range of operating conditions.

2D CFD Modelling and Validation of 3D-Printed Centrifugal Fans

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2D CFD Modelling and Validation of 3D-Printed Centrifugal Fans Marcus Read1, Ava Cane1,2, S Wakes3, S Lowrey1,4 1Department of Physics, University of Otago, New Zealand 2ENSIP, Poitiers, France 3Department of Mathematics and Statistics, University of Otago, New Zealand 4Dodd-Walls Centre for Photonic and Quantum Technologies, New Zealand *Correspondence: sam.lowrey@otago.ac.nz

Centrifugal fans are critical components in applications ranging from electronics cooling to aviation and building ventilation. Together all types of fans account for almost 1% of global energy usage. However, optimizing their designs computationally often demands resource-intensive 3D simulations. This study develops and validates a rapid computational screening workflow for centrifugal fans by coupling 2D steady-state Computational Fluid Dynamics (CFD) with a physical test bench.

We characterized two 3D-printed backward-curved impeller configurations (N=6 and N=26 blades) at rotational speeds from 2,000 to 5,000 RPM. This consisted of the development of a 2D steady state numerical model in Ansys fluent. The model was run at a range of operating conditions and the data was subsequently validated against an ASHRAE-compliant test bench. The 2D models achieved satisfactory qualitative agreement with experimental data, successfully showing the trends seen in the experimental data. The 2D simulations consistently overestimated the pressure rise due to the inherent omission of spanwise effects and 3D loss mechanisms.

Ultimately, this workflow provides a computationally inexpensive, rapid-prototyping framework for early-stage centrifugal fan optimization. Further work could focus on developing a 3D steady state simulation to account for the 3D loss mechanisms and quantifying a correction factor that would allow the use of 2D simulations as a predictive tool.

Development of a Micro-patterned Epoxy Plate Heat Exchanger for Reduced Pressure Drop

Charlie Hurley Sam Lowrey

Otago University

Heating, ventilation, and air conditioning (HVAC) accounts for approximately 20% of global electricity use and ~8% of greenhouse gas emissions. Condensing heat exchangers are central to this technology, and condensate build-up during operation can significantly reduce their efficiency.

Natural surfaces such as rice leaves and butterfly wings use microscale patterns to repel water and shed droplets quickly. Previous work showed that the micro-ribbed texture produced by 3D printing has a similar effect, reducing air-side pressure drop in condensing plate heat exchangers (PHEs). The inverse of this texture, a micro-waveform structure, shows even greater hydrophobicity.

In this work, a scalable method was developed for fabricating epoxy heat exchanger plates using 3D-printed polylactic acid (PLA) moulds. Each plate has one smooth surface and one surface with a 200 μm pitch micro-waveform. Eighty plates were assembled into a PHE and tested in controlled psychrometric chambers in two orientations, with hot, humid air flowing over either the smooth or the micro-waveform surfaces. Because both sides are made of the same material, this setup isolates the effect of the microstructure.

Compared with the smooth surface, the micro-waveform surface reduced hot-side pressure drop by 4–24% and increased condensation rate by 1.3–6.4%. In the medium and high temperature tests, its dehumidification performance factor (DPF) was 18.6% and 24.7% higher, respectively.

This poster presents the fabrication method and performance results, demonstrating how bio-inspired micro-waveform surfaces can improve the energy efficiency of condensing heat exchangers and dehumidifiers. Future work on other waveform pitches, frosting conditions, and other heat exchanger types and materials is also outlined.

Leveraging fine-tuned LLMs for electricity load prediction with multi-modal data

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Accurate short-term electricity load forecasting is essential for power grid operation and reliability. However, many existing forecasting methods mainly rely on historical load and structured exogenous variables, with limited use of unstructured information such as news. To bridge this gap, this paper proposes a load prediction framework, MMWP-LLM, which integrates multi-modal data inputs. The model is fine-tuned using LoRA based on two base LLMs, including DeepSeek-R1 and QWEN3, and combines the prediction results through weighted fusion. Additionally, an optimized prompt design is employed to efficiently integrate multi-modal information, such as historical load, weather, holidays, and news. The results based on an open-source load dataset show that MMWP-LLM outperforms six traditional prediction models and two standalone fine-tuned large language models, demonstrating higher prediction accuracy and stability. Compared to the optimal traditional model, it reduces MAE, RMSE and MAPE by 15.30%, 13.07% and 14.82%, respectively. This confirms its efficacy in short-term electricity load prediction and illustrates the substantial potential of large language models in energy prediction applications.

“Powering 96,000 Homes” or Fragmenting Habitat? Media Framing, Stakeholder Voices and Representations of Nature in Aotearoa New Zealand’s Renewable Energy Transition (2024–2026)

Nguyen Vuong

University of Otago

As Aotearoa New Zealand expands renewable energy infrastructure to support decarbonisation, news coverage can shape how the benefits and ecological costs of development are understood. This study examines how New Zealand daily newspapers frame renewable energy developments, whose perspectives shape coverage, and how nature and biodiversity are represented through language. Articles published between January 2024 and October 2026 were retrieved from ProQuest Australia & New Zealand Newsstream. All eligible articles were analysed to identify recurring issue frames and the stakeholders most often positioned as primary definers. A chronological subsample was then examined in greater depth, focusing on noun phrases, agency attribution and the language used to describe nature. Preliminary findings suggest that coverage frequently foregrounds regulatory processes and the scale and economic benefits of renewable energy projects. Developers and government representatives appear prominently in defining these debates, while conservation groups and mana whenua receive less visibility as primary definers. Initial ecolinguistic analysis also suggests that nature is often described through measurable resources, land use and consenting

constraints, although some coverage foregrounds ecological relationships and impacts. These emerging patterns raise questions about whose priorities shape public understandings of the energy transition and how ecological concerns are positioned alongside economic and regulatory considerations. By examining both stakeholder representation and the language used to describe nature, this study explores how news coverage negotiates the relationship between renewable energy development, biodiversity, and mana whenua perspectives. It contributes to wider discussions about an energy transition that supports prosperity for people, business, and the environment.

Fast EV Charging Stations in Medium-Voltage (MV) Networks

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The transition to a net-zero electricity system and green technologies is accelerating renewable energy integration, transport electrification, and deployment of distributed energy resources to reduce dependence on fossil fuels. While these developments support decarbonisation objectives, they also create technical and operational challenges such as voltage imbalance, reverse power flow, network congestion, coordination difficulties and uncertainty. There is a growing trend for Electricity Distribution Businesses to investigate cost-effective flexibility and non-network solutions, such as demand response, energy storage, and flexible EV charging to manage network constraints as an alternative to costly infrastructure upgrades or network reinforcement.

Electric vehicles (EV) have shown significant growth over the past decade, resulting in a substantial increase in charging demand. To support widespread EV adoption and provide a refuelling experience similar to internal combustion engines, the charging time of EV batteries must be significantly reduced. To achieve this, ultra-fast charging stations are becoming increasingly important, consisting of multiple ultra-fast chargers in the multi-megawatt power range and can charge the EV battery at a rate comparable to conventional gasoline refuelling. Such a high and instantaneous power demand creates significant impacts on network performance and stability, such as peak loading, voltage imbalance and distorted power quality.

This research, which has recently commenced under the Applied Doctoral Scheme (ADS) in collaboration with Aurora Energy as the industry partner, aims to understand how the integration of ultra-fast charging infrastructure into the medium voltage grid affects network performance and to evaluate potential non-network mitigation strategies that support future network requirements.

This poster outlines the research motivation, objectives, and the proposed methodology, while providing an opportunity to obtain feedback from the research community and industry stakeholders.

Keywords Fast EV Charging, Distribution Networks, Network Flexibility, DER Integration, Medium-Voltage Networks

