eea | Electricity Engineers' Association

Professional Development

Annual Power Engineering Exchange

APEX | 2023

TRANSITIONING TO DECARBONISATION

22ND NOVEMBER 2023

8.30am to 6:00pm

CONNETICS, 11 ISLINGTON AVENUE,
CHRISTCHURCH

AGENDA AND ABOUT THE PRESENTERS

About the EEA

The Electricity Engineers' Association (EEA) is a key industry coordination organisation providing a voice for the electricity supply industry and ensuring the industry is engaged, informed and active in engineering, technical and health and safety issues affecting companies, individual engineers and other stakeholders. **Being a part of the EEA is about being linked in to the wider electricity supply industry.**

Our Members

For over 85 years, the EEA has been committed to providing the New Zealand electricity supply industry with expertise, advice and information on technical, engineering and safety issues.

To do this we work with and represent over 50 Corporate Member organisations and more than 400 individual professional members. These include chief executives, senior engineering/technical managers, engineering and field staff, health and safety managers working in network, generation and electricity retail companies, contractors, consultants and equipment suppliers.

EEA Scholarships

The EEA has supported over seventy students into engineering careers by awarding annual scholarships to undergraduates specialising in electricity generation, power systems or electricity utilisation at Auckland and Canterbury Universities and, from 2013, Auckland University of Technology.

EEA Awards

The Best Conference Paper Award—Student Category recognises the excellence of student engineers who have demonstrated a high level of technical competence and communication skills.

Young Engineers can apply for further awards as they develop in their role, such as the Young Engineer of the Year Award or the Professional Development Award.

Annual Power Engineering Exchange (APEX) Summit

APEX is a conference for graduate engineers, of any discipline, in the electricity supply industry and a great opportunity to share experiences while learning from the presentations of others. Networking at events such as the APEX Summit is an excellent way to start relationships and gain exposure to the industry.

APEX is also a must-attend for students willing to meet graduates working in the industry, and to hear about some real world projects they are involved in.

Joining The EEA

Are you a full-time student undertaking an engineering qualification relevant to the New Zealand power industry? If so, as an **EEA STUDENT MEMBER**, your benefits would include:

- Free student membership
- Free attendance to the APEX Summit
- Free attendance at student events and guest lectures organised by EEA
- Notification about scholarships, awards and networking events
- Access to EEA guides and safety rules (free or discounted)
- Online access to EEA Electricity Industry Update and Safety Rules Newsletters

If you have recently graduated with a tertiary engineering qualification relevant to the New Zealand electricity supply industry in the preceding 12 months, you are eligible for an EEA Graduate membership.

As an **EEA GRADUATE MEMBER**, your benefits would include:

- Free graduate membership for two financial years (1 April – 31 March)
- Use of the post-nominal 'GradM.EEANZ'
- One free attendance to the EEA Annual Conference
- Free attendance to the APEX Forum
- Discounted registrations for attending professional development events and courses
- Access to EEA guides and safety rules (free or discounted)
- Subscription to EEA mail alerts (awards, networking events, accident and incident reports)
- Online access and mail subscription to EEA Electricity Industry Update and Safety Rules Newsletters

ABOUT THE PRESENTERS

8.30am **Registration, Arrival Tea and Coffee**

8.55am **Welcome from Luke Reisima, Meridian Energy: APEX Chair**

9.00am **Hanna Cheng, Transpower**

Hanna is a Graduate Power Systems Engineer at Transpower currently working in the HVDC Operational Engineering team in Wellington.

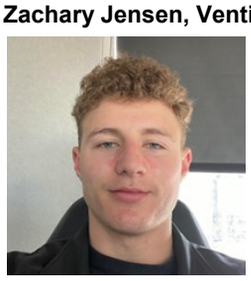
Prior to this, Hanna also worked in the Power Systems Development team in the System Operator during her graduate rotations. Hanna completed her studies in 2022, with a BE (Hons) in Electrical and Electronics Engineering with a minor in Power Engineering from the University of Canterbury.

The Challenges of a Changing Generation Portfolio and an Introduction into Grid-forming Inverters

New Zealand's target of 100% renewable generation by 2030 is driving pivotal changes in its generation portfolio. This commitment places a growing emphasis on renewable energy sources and the integration of emerging technologies. Historically, New Zealand was reliant on large rotating synchronous generation such as hydroelectricity. However, there has been a steady uptake of inverter-based renewable energy such as wind and solar. This aligns with the 2030 target, but also introduces challenges to grid stability, reliability, and resilience.

Grid-forming inverter technology has recently emerged as a promising solution to address the challenges associated with the changing generation portfolio. Unlike the current grid-following (GFL) inverters that rely on the grid voltage and frequency, grid-forming inverters can independently manage and regulate the grid. This technology includes features such as voltage and frequency control, black-start capabilities, and the ability to operate in islanded microgrids during grid disturbances. As New Zealand strives to achieve its decarbonisation targets, the implementation of grid-forming inverters holds the potential to enable inverter-based renewables while maintaining grid stability and reliability.

9.25am **Zachary Jensen, Ventia**



Zachary Jensen is a Graduate Engineer at Ventia, working in the electricity and gas division, where he works on various projects in the high-voltage industry. He is commonly involved with the delivery of innovative projects including 3D modelling, surveying, and drone operations.

His role also extends into engineering analysis and technical support for Ventia's field operations. Zachary graduated from the University of Canterbury in 2022 with an Honors Degree in Electrical and Electronic Engineering .

Effective Disaster Recovery Planning and Resource Management

On February 14, 2023, Cyclone Gabrielle hit the Hawke's Bay and Gisborne region, causing severe flooding and damage to Transpower's Redclyffe Substation, an essential link to Unison's distribution network. This resulted in the substation tripping, disconnecting 103MW of power and over 75,000 homes. Ventia's Central Region team was the first to arrive at Redclyffe Substation to assess the damage and begin restoring power. Power was restored to most customers within 8 days, however, the full rebuild lasted 7 months.

Ventia's experience during the Redclyffe response highlighted the importance of effective disaster recovery planning and resource management. With climate change increasing the likelihood of similar events, resilience and response to these events is extremely important. This presentation focuses on Ventia's response to the Napier floods and its purpose is to communicate our journey and the key lessons learned, including:

The first response,

- assessment of the damaged substation,
- initial restoration and pressures to restore power,
- long term rebuild and fatigue management,

Ventia's review of what succeeded and failed, how this could be improved for future events.

9.50am **Ella Gilroy, Meridian Energy**

Ella Gilroy is a Graduate Mechanical Engineer in the Meridian Energy Generation team. She joined Meridian in 2022 after completing her Bachelor of Engineering at the University of Canterbury.

Since joining Meridian, she has worked on a variety of tactical and strategic projects across the hydro generation assets.

Watt's the solution? Investment within a changing energy landscape

As New Zealand transitions to 'Net Zero 2050', how do generation companies choose to invest in their existing plant to meet the rapidly increasing demand following unprecedented electrification? Hydro generation has historically provided reliable base load generation while various other forms of generation are used to meet peaks during periods of high demand. However, as these peaks in demand grow, and newer forms of generation are brought online, can we modify how our existing hydro units are operated to flex to these new demands? Or do we invest in new plant that is efficient, or plant that has a wide operating range? How is a generation strategy developed with ageing plant kept in mind? This paper explores potential opportunities for capacity gains from plant modernisation, including generation output higher than the unit rated capacity, increasing consented flows, changes to outage scheduling, operating plant as peaking units, and refurbishment or replacement of existing plant. The mechanical impact of varying the existing plant operation is considered alongside the unique challenge of managing the flow-on effects of operational changes through the Waitaki chain.

10.15am **Aratrika Ghosh, Transpower**

Aratrika has recently joined Transpower as a Graduate Power system Engineer since Feb'23. She is currently pursuing a PhD degree at the University of Auckland. She is currently placed in the System Operator-Power System Development Team placement at Transpower where she is working on the EMT modelling in PSCAD for the New Zealand Grid.

She has previously been placed in Power system Dynamics team rotation in Grid Development at Transpower where she worked on voltage and reactive power stability along with harmonics studies in some of the NZ North Island area buses and reactive power-voltage droop calculation for the STATCOMS in the NZ Grid in Power factory Modelling Software.

Preparation for Electromagnetic Transients (EMT) Studies for New Zealand

The world energy market is transitioning toward more renewable based systems to help address the challenges of climate change and reduce reliance on fossil fuels. New Zealand has committed to 100% electricity from renewable sources by the year 2030. This ambitious goal will rely heavily on the utilization of inverter-based resources, (IBRs).

The accelerating uptake of IBRs is having a significant impact on the power system behaviour. To address some of the control stability issues identified in other jurisdictions related to IBRs, we need to undertake detailed modelling of the control system in EMT (Electromagnetic Transient) using simulations like EMTDC (Electromagnetic Transients including DC). These simulation techniques calculate instantaneous values and can duplicate the responses of the power system at all frequencies. Fault ride through assessment of IBRs in weak grid connections is a particular use of EMT models.

This case study covers the development of an EMT model of the Power System around the Hawke's Bay including nearby generators. I will also discuss how EMT modelling can be used to study the behaviour of the power system when subjected to fault conditions such as balanced and unbalanced fault studies.

10.40am **Morning Tea**

11.00am **Brian Luo, ElectroNet**

Brian works at ElectroNet as an Engineer within the Electrical Safety team for the past two years.

He graduated University of Canterbury with a BE (Hons) in Mechatronics Engineering.

Earth testing application

Since the government passed the Zero Carbon amendment to the Climate Change Response Act in 2019, the power industry has seen an overwhelming number of renewable energy prospects enter the market. While this provides plenty of optimism for New Zealand to reach its carbon goals, a significant amount of work will also be required to turn these prospects into functioning assets. Leaning into emerging technologies and innovation will be key for delivering these renewable energy prospects.

One such innovation is the ElectroNet earth testing application. Earthing systems ensure the safety of people, protection of equipment, and operational security of assets. To validate the integrity of the earthing system, earth testing must be conducted on a routine basis. In the past, earth testing was carried out with pen and paper. The development of the earth testing application has enabled ElectroNet to carry out more thorough testing and deliver conclusions to clients in real time. The earth testing application represents an example of improving the processes in place to help meet the demands of today's fast-moving landscape**.**

11.25am **Sanjay Mepani, Counties Energy**

My name is Sanjay Mepani. I have worked in the electrical industry for about 3 years now. Currently I am employed by Counties Energy as a Technology Engineer, where I assist with the development of standards and strategies that relate to the creation, operation and maintenance of Counties Energy DSO.

I have a Bachelor of Engineering Technology degree from Manukau Institute of Technology. In my current role I have been involved with testing of non-network solution such as use of 2nd life EV battery to provide voltage support, also been involved in performing load flow analysis to determine the impact of uptake of DERs on CE network. Previously I have worked as a Network Connections Engineer at The Lines Company where I was responsible for developing quality engineering design for EV charging requests, residential and industrial customers.

An innovative approach to non-network upgrade solutions

Counties Energy is pioneering a non-network solution to harness the untapped potential of retired electric vehicle (EV) batteries. Our aim is to repurpose these batteries for second-life use as stationary grid-scale Low Voltage (LV) and portable energy storage solutions. This approach supports New Zealand's decarbonization goals and addresses the increasing adoption of EVs, which leads to a growing supply of retiring battery packs.

As EV charging, solar PV, wind power, and other Distributed Energy Resources (DERs) strain existing distribution networks, Counties Energy sees a unique opportunity. Our innovative solution can alleviate network constraints where traditional investments are impractical due to economic and non-economic factors.

Our second-life EV batteries, currently undergoing lab trials, have demonstrated their potential for peak management, buffering high-powered DC charging stations, and addressing power quality issues. We plan to advance to field trials to gain practical insights.

Counties Energy's vision extends beyond stationary storage; we aim to create a fully portable and scalable solution. This technology promises enhanced grid support services, a substitute for diesel generation, and off-grid applications. We're committed to providing a sustainable, forward-thinking alternative to traditional energy solutions.

11.50am **Antony Mirfin, Aurora Energy**

Anthony is a Network Planning Analyst at Aurora Energy, and is an Energy Studies PhD candidate at the University of Otago. His roles at Aurora include demand forecasting and analysis related to non-network solutions, load management, and network visibility.

Anthony has carried out research on the impact of housing insulation levels on New Zealand's future energy demand, with both energy and health implications. His current research focuses on developing predictive models of energy use in buildings, with applications to large-scale insulation retrofit financing.

Passionate about the wider energy sector, he has a special interest in the demand-side – when and where energy is used and how this can be managed for better outcomes for the whole system.

Aurora Energy Decarbonisation Scenarios

In May 2021, He Pou a Rangi the Climate Change Commission released 'Ināia tonu nei: a low emissions future for Aotearoa', outlining the paths New Zealand can take to meet its climate targets. Electrifying demand traditionally met by fossil fuels (e.g. transport, industrial heat) has been identified as a key step for achieving the required emissions reductions. The resulting major increase in electricity demand would have significant implications for transmission and distribution networks.

Aurora Energy, in collaboration with ANSA, have developed their Decarbonisation Scenarios to understand the impact on their network under a range of different futures. The scenarios cover a range of possible future energy mixes (e.g. high electrification vs. biomass + hydrogen), and how well these loads are managed (e.g. time-of-use and demand flexibility). For each scenario, we forecast the peak electrical load and annual energy demand through the network out to 2050, and explore what this could mean for Aurora and its customers. From this analysis, we can identify the steps Aurora needs to take now and in the coming years to ensure the transition is affordable and equitable.

12.15pm **Kristen Ong, Connetics**

Kristen is a Graduate Design Engineer who works in the Underground Reticulation team at Connetics in Christchurch. She has also worked for the Substations team as part of her graduate program rotations. Kristen has been working full time as a Graduate Design Engineer since early 2023 after completing a Bachelor of Electrical and Electronic Engineering with Honours at the University of Canterbury.

The projects Kristen has been involved in with the Substations team mainly included secondary design for major distribution zone substations. The projects Kristen has been involved in with the Underground Reticulation team includes low voltage network reinforcement, street lighting upgrades, and EV charger connections.

(EV)olution, Trends and Insights on New EV Charger Connections

Electric Vehicles (EVs) and EV chargers have become increasingly vital tools in New Zealand's pursuit to build a decarbonised economy. With growing consumer confidence in EV technologies and escalating petrol prices, an expanding number of New Zealanders are incorporating EVs into their daily lives. As EV adoption surges, the installation of more charging stations has become imperative to cater to the rising demand.

Connetics has observed a notable uptick in EV charger connection projects on the Canterbury Low Voltage (LV) network. Fulfilling these growing number of project deadlines has it challenges and requires a substantial amount of resources. Examples of challenges associated with these new EV charger connections include tight spaces, the presence of numerous existing underground services, and reinforcing an aging network. Therefore, determining the optimal location and charger type we install has become a critical aspect of the solution. From housing complexes and commercial zones to key arterial routes, the placement and type of EV charging stations must now be guided by human behaviour, rather than reactive necessity.

12.40pm **Lunch**

Aleida Powell / Mitchel Davis, Deta

1.15pm

Aleida is a Project engineer at DETA Consulting. She graduated with first-class honours in Energy Management in 2021 and a Masters in Energy Science and Technology in 2023, both from the University of Otago.

In her role at DETA Consulting, Aleida has worked on a wide range of projects, including decarbonisation feasibility studies for industrial production facilities, sustainability roadmaps for commercial clients and decarbonisation modelling projects for electricity distribution companies.

She most recently completed a 4 month secondment to Alpine Energy where she worked as a Planning Engineer. What Aleida enjoys most about her role is the diversity of projects she has been involved in which all have a tangible impact towards reducing emissions in New Zealand..

Mitchell is a Project Engineer at DETA Consulting. He graduated with first-class honours in Mechanical Engineering from the University of Canterbury.

His internship at Meridian started his interest in Energy. Mitchell's current position allows him to gain insight from many energy-intensive clients around New Zealand. He has worked on various projects including, electricity demand forecasting, carbon foot printing, project management & process heat electrification.

Mitchell enjoys the client-facing nature of consultancy and is passionate about assisting businesses energy transition so they can meet their decarbonisation goals.

Painting by Numbers: a 2050 Picture of Electricity Demand

Electricity has a vital role to play in enabling Aotearoa's transition to net zero emissions in 2050. This transition presents a challenge for both consumers and suppliers due to the unprecedented growth in electricity demand, and the associated infrastructure and system level changes required. It also presents an opportunity for the acceleration of this transition through the provision of digestible data and forecasts that inform the nature and direction of changes needed.

DETA's knowledge of biomass availability for process heat users has been incorporated into Regional Energy Transition Accelerators (RETA's), which describe pathways of what potential electrification may look like for different regions. More recently, DETA's work with individual EDB's has explored how customers changing demands will influence future infrastructure requirements, due to the uptake in electric vehicles, embedded generation, and changing time of use profiles.

This work represents a collaborative approach where suppliers, end-users, and DETA are painting a picture of future energy demand. This collaboration involved sharing between previously unconnected industries, working across geographically distinct regions, and the use of information and tools from both academic and professional disciplines. It is this collaboration that is one of the key enablers for Aotearoa's transition to a low emissions future.

1.40pm **Rohit Singh, Transpower**

Rohit is a Graduate Real Time Systems Engineer at Transpower. He graduated in 2022 from Auckland University of Technology with a Bachelor of Mechatronics (Hons).

Rohit has been in the SCADA team for 11 months starting with an internship and moving to graduate programme.

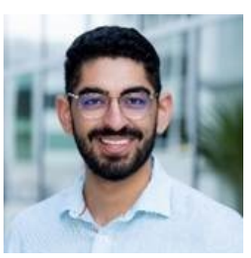
Transpower's Digital Substation

As we pursue our carbon zero goals, Transpower foresees significant increases in the integration of process heat, industry electrification, solar and wind generation. We know we need to build additional substations to effectively manage and align with initiatives such as the Emissions Reduction Plan (ERP) and Government Investment in Decarbonising Industry (GIDI). Whakamana I Te Mauri Hiko, suggests one substation annually for 25 years, putting pressure on build timeframes.

Digital substations (DSS) play a key role in Transpower's strategy to facilitate growth in load and generation while simultaneously reducing costs and accelerating commissioning. DSS, reduces copper wiring with fibre optic cables and shifts analogue communications to digital. Minimising trenching, improving safety, enhancing efficiency, and reducing our control rooms' carbon footprint. We've facilitated offsite testing and pre-commissioning, as the control rooms will be portable, resulting in the shift from traditional substation designs.

DSS incorporates IEC 61850 GOOSE and Sampled Values for all process functions. This feature enables remote automated testing for protection and control devices. MMS and Merging Units further optimise grid performance and data management, making it a pivotal solution for power distribution in the carbon-zero era.

2.05pm **Digvijay Singh, Ergo Consulting**



Digvijay is a Graduate Engineer at Ergo Consulting and has been part of the Civil & Structural since February 2022. He enjoys the challenge of combining practical construction with conceptual design.

Digvijay has been exposed to a range of design works involving the collaboration of electrical and civil engineering, including new substation construction, modifications to existing switchroom buildings, new switchroom design, firewall design, and cable stand designs. Having focused entirely on the power industry since graduating from the University of Auckland in 2021 has allowed Digvijay to grow his knowledge and experience in this division.

Let's Get Serious with Sustainable Substation Structures

Climate change is one of the largest challenges facing the world. Understanding our carbon impact is challenging, as quantifying our impacts is relatively new and little literature exists specific to New Zealand. The electricity industry is facing increased demands as part of the transition to electrification. New Zealand has also set a goal of becoming carbon neutral by 2050.

To support this future development, significant infrastructure is required for the rising demand. In 2020, the energy industry accounted for approximately 40% of the total emissions in New Zealand, with 8.5% of this estimated to derive from construction related activities. In our industry the opportunity to construct more sustainable infrastructure is potentially minimised. This presentation will illustrate our conclusions from the comparison of alternative configurations of a Switchroom design in relation to equivalent carbon emissions and discuss possibilities of producing more sustainable structures.

Decisions early in the project can have significant impacts to emissions, so working together at a multi-disciplinary level can greatly influence our decarbonisation efforts.

2.30pm **Hamish Weir, Beca**

Hamish is a Power Systems Engineer in the Beca Power team. Since graduating from the University of Canterbury in 2021.

He has been mostly involved in design of high voltage substations, though he has augmented this with work across various other fields such as system modelling and renewable design. Hamish is passionate about developing his skills and knowledge to help to solve the problems that the electricity industry faces.

Runback Scheme Principles and Applications

The modern electrical power grid faces increasingly complex challenges, including the integration of renewable energy sources and the need for enhanced resilience in the face of disruptions. Runback schemes, a critical aspect of power system protection and control, play a pivotal role in maintaining system stability and reliability.

This presentation delves into the key principles, applications, and technical/financial advantages of runback schemes within electrical power systems. It will explore:

- How these schemes provide a safeguard against system instability by enabling controlled disconnection of generators during emergency situations, grid disturbances, or cascading failures.
- Using runback schemes to reduce the cost of connection of non-dispatchable generation into existing transmission and distribution assets.
- The integration of runback schemes with advanced grid control technologies, such as smart grids and microgrids, emphasizing their potential to enhance grid resilience and adaptability.

Attendees can expect to gain insights into the future of power system protection and control, underlining the role of runback schemes in securing the stability and sustainability of electrical power networks.

2.55pm **Afternoon Tea**

***** Cast your vote for the Best Presentation and People's Choice Award *****

3.20pm **Panel Discussion**

Session Facilitator: Emma Lloyd, Connetics / EEA Executive member

"You have the opportunity to create a next generation network group for EEA – how would you design the group to best cater for the needs of younger members and encourage their active participation in EEA?"

4.20pm **Awards Results** — Joint EEA / CIGRE Best APEX Presentation Award **and** People's Choice Award

Closing Comments — **Luke Reisima**, APEX Chair

4.40pm **Social Function**

6.00pm **Close of APEX 2023**

The EEA would like to formally acknowledge and thank our sponsors for their support:

Venue and organisational support:

Presentation Prize Co-Sponsor:

Best APEX Presentation Award 2022

In 2022, twelve young engineers presented under the theme 'Technology Led Changes'. **Logan Cane**, Mitton ElectroNet, won the Best APEX Presentation Award for his presentation on 'Stop Using Your Imagination: How LiDAR Technology is Changing the Way We Design Substations'.

People's Choice Award 2022

The audience was also invited to vote for their best presenter. **Emma Lloyd,** Connetics won the People's Choice Award with her presentation on 'Why are engineers integrating new technology into solar array designs? '

POWER YOUR CAREER

JOIN THE EEA

YOUNG ENGINEER OF THE YEAR AWARD

Increasingly our young engineers are playing a significant role in shaping the future of our industry. The EEA wishes to recognise their contribution to our industry and is asking companies and individuals to identify and nominate from within their business, candidates for the EEA Young Engineer of the Year Award. The 2019 award winner will represent New Zealand at the IEC Young Professionals Programme in Shanghai, China in October 2019.

The award will be presented to a young engineer who is judged to have demonstrated great achievement and leadership within the electricity supply industry, community and stakeholders.

The entrant must be aged under 35 as at 31 December 2020, and have a tertiary-level engineering or technology qualification and be an individual member of the EEA or staff member of a Corporate Member.

EEA SCHOLARSHIPS

The Electricity Engineers' Association (EEA) is proud to support every year a number of students into engineering careers, help them raise their profile and **recognise the young talents that will contribute to the future of our electricity supply industry**.

We award five undergraduate scholarships annually, in partnership with the University of Canterbury (x2), the University of Auckland (x2) and the Auckland University of Technology (x1). The scholarships are tenable for a period of one year, for a value of NZ$4,500 each.

This initiative is part of the EEA's commitment to the future development of engineers and engineering education in New Zealand and to the ongoing professional development of its members in all sectors of the industry.

STUDENT & GRADUATE

PROFESSIONAL DEVELOPMENT
FUTURE ENGINEERS AND LEADERS

Engineering Excellence—Electricity Engineers' Association | EEA

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