Electricity Engineers' Association

Professional Development

Annual Power Engineering Exchange

APEX | 2024

POWERING THE FUTURE

26TH NOVEMBER 2024

8.30am to 6:00pm

BLACK AND GOLD

4 TARANAKI STREET, WELLINGTON

Site Visit | 27th November

Transpower: Haywards Substation

Meridian: West Wind

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**

8.50am **Welcome from Nicki Sutherland, EEA Chief Executive and Harsharan Singh, Ventia: APEX Chair**

9.00am **Leon Liang, WEL Networks**

Leon is a graduate network innovation and performance (NIP) engineer from WEL Networks. He is a part of the NIP team, in which he focuses on design aspects of the projects that are being undertaken.

This involves working on planning, designing, project delivery and installations.

Leon is new to NZ power industry and joined WEL in Dec 2023 since completing BE (Honours) in Engineering at University of Canterbury.

Enhancing and Reinforcing LV Network visibility: Transformer Smart Meter

WEL Networks has around 6000 transformers and serves over 100,000 customers in the Waikato region. About 70% of these customers have a WEL smart meter installed, giving visibility to approximately 4700 transformers. Since 2022, these smart meters collect near real-time data on voltage, current, active power, and reactive power, with real-time alarm functions enabled in 2023. The WEL smart meter uses mesh radio communication which relies on the meters communicating with each other to reach an access point that links to the headend server. T he mesh performance is effective in urban areas but less so in rural areas due to lower meter density. To improve this, WEL's Network Innovation & performance (NIP) team, and metering team are enhancing mesh performance and capability in these regions.

One of the methods of improving mesh capability is the installation of smart meters at strategic transformers across the network. Over the last few years, WEL has been installing transformer smart meters and has a continuing project underway to install 45 transformer smart meters this year.

9.25am **Nathan Miller, Ergo Consulting**

Nathan is a graduate electrical engineer at Ergo Consulting, who escaped the busy streets of Auckland to live in Christchurch in 2021. After a couple years of working in the building services sector, he made the pivot to the power industry as a substation designer.

Nathan's work mainly focuses on the secondary design of substations, with tastings of cable thermal modelling, LV AC systems, and network analysis. If he isn't in the office, Nathan spends his days hiking and rolling d20s, preferably at the same time.

Industrial Decarbonisation via Electrification – The Cost of Information

The RETA (Regional Energy Transition Accelerator) programme, run by the Energy Efficiency & Conservation Authority (EECA) aims to accelerate the decarbonisation of New Zealand's industrial industry through electrification or transition to biomass. When electrifying, many industrial customers struggle with the lack of information surrounding the cost and timelines of such a change. The RETA programme aims to investigate these hurdles, along with any other barriers, to support and encourage industrial customers to be less reliant on fossil fuels.

Given the size of many industrial sites, electrification requires a thorough investigation of existing assets, from the customer connection point all the way back to Transpower's Grid Exit Point. Historical and forecast data from customers, distribution companies, and Transpower are woven together to give a better understanding of the impact electrification would have to each contributor's assets. The quality and availability of this data can greatly sway the projected cost and potential timelines for this electrification. With these findings, industrial customers and those in the HV sector can better forecast what steps need to be taken to facilitate decarbonisation, and ensure our electrical grid stays resilient for the years to come.

9.50am **Nicholas Davies, Beca**

Nicholas is an Electrical Engineer who joined the Beca Power team as a Graduate Power Systems Engineer at the beginning of 2024.

This year Nicholas has been developing his technical skill base through exposure to a variety of projects with a focus on Primary Power Engineering, while also gaining experience with Secondary and Protection Engineering roles.

Harmonics & Keeping the Grid in Tune: Reducing a Dissonant Crescendo within the Renewable Future

As renewable energy generation increases in New Zealand, so too do harmonics; a threat to the quality of power in our networks. This presentation explores the critical issue of growing harmonics within New Zealand's power grid and the specific challenges that the power industry may face in managing this problem. It will cover what harmonics are and why they arise from renewable inverter-based generators such as solar and wind farms, the problems they cause ranging from inefficiencies in power consumption to equipment overheating and failure, the increased costs they pose for both industry and consumers, and how the industry will approach the mitigation of harmonics. It will also highlight the implications of potential new regulations. With generators (and their harmonics) on the rise to meet a 60-80% increase in electricity demand by 2050, existing limited regulations are likely to be increased as has been the case in other countries. This poses the following questions:

What methods of mitigation are effective and affordable? Who is liable for added costs of mitigation incurred from new regulations? How retroactively can new regulations be applied to generators already producing harmonics? What methods of monitoring harmonic output and overall grid contribution are available and what is their accuracy? What approaches to grid injection substation design can ensure future-proofing against uncertain future requirements?

10.15am **Zach Landon-Lane, Connetics**

Zach is a Graduate Design Engineer at Connetics, currently working in the electricity industry in Christchurch. He completed his studies at Ara in 2023 and graduated with an Electrical Engineering Technology Degree.

Since joining Connetics Zach has worked across design and project management teams and has worked on numerous projects for EDBs as well as private network customers.

Christchurch Red Zone Regeneration Project

The 2011 earthquake significantly impacted Christchurch's landscape, resulting in widespread destruction and forcing many residents to leave their homes. Rendering much of the residential area with irreparable infrastructure damage, this became known as the "Red Zone". Over the following years, the city embarked on a journey of rebuilding, today, efforts are underway to revitalise this area through the "Red Zone Regeneration Project," which aims to breathe life back into the region and enhance the city's natural environment.

The City to Sea Lighting Pathway is an innovative project that Connetics is designing as part of this project. This pathway seeks to connect the city centre with New Brighton Beach and improve public access to new developments within the red zone. Connetics is also examining the redesign of the existing high-voltage (HV) infrastructure, assessing what remains and determining the necessary upgrades to support these future developments. Unfortunately, the area has been left in a challenging state, leading to various issues, with theft becoming a significant concern due to reduced public presence.

10.40am **Morning Tea**

11.00am **Abigail Field, ElectroNet**

Abigail is an Engineer within the ElectroNet Power System Analysis Team. Abigail's work primarily focuses on New Zealand and Australian Grid Connection and Model Validation studies. She has modelling experience with a range of generation types, such as inverter-based energy systems, and geothermal and hydro-power plants.

Abigail has been involved in the power industry since graduating from the University of Canterbury in 2022. Abigail completed a minor in Power Systems Engineering alongside her degree in Electrical and Electronic Engineering.

Hybrid Solar and BESS Plants - To DC or not to DC?

New Zealand utilises non-renewable forms of generation to ensure electricity security. As New Zealand transitions towards a more renewable power system, the integration of inverter-based technologies such as solar and wind generation is increasing. However, the variability of solar and wind prevents these generation types from reliably responding to grid frequency events.

Inverter-based hybrid generation schemes, comprised of solar or wind and Battery Energy Storage Systems (BESS), are a possible solution. These systems deliver clean base-load generation and offer energy storage capabilities, enabling rapid response to frequency events. Depending on how the solar and BESS systems are connected, hybrid plants can either be AC-coupled or DC-coupled. The configuration of the hybrid plant impacts key modelling differences, including total instantaneous capacity, number of required inverters, and plant behaviour.

11.25am **Christy Tom and Henry Bui, PowerNet**

Christy obtained his Bachelor of Electrical and Electronic Engineering from Cochin University of Science and Technology, India, and a Graduate Diploma in Power Strand from Wintec, New Zealand. He has been a Graduate Electrical Engineer with the Asset Management Team at PowerNet in Invercargill since February 2023.

In his role, Christy develops project scopes, prepares data for information disclosures and annual reports, conducts congestion studies, and approves distribution generation applications. He also performs network load flow analyses, approves new connection applications from customers, assists with earthing queries, and monitors smart meters to investigate faults and address customer complaints.

Henry obtained his Bachelor of Electrical and Electronic Engineering with Honours at the University of University of Canterbury. He has been a Graduate Electrical Engineer with the Asset Management Team at PowerNet in Invercargill since November 2023.

In his role, Henry undertakes outage studies, identifies suspected faults as part of pre-emptive fault management, and conducts contingency analysis for integrating new generation into the distribution network. He also builds models to calculate conductor ratings for all conductors in the PowerNet network and contributes to various work scopes in the Asset Management Plan (AMP), including feeder refurbishment, distribution transformer replacement, and power supply quality upgrades.

Proactive Fault Detection with Smart Meters: Enhancing Public Safety and Network Reliability at PowerNet

At PowerNet, we prioritise a "safety always" culture, ensuring the safety of our people, contractors, and the public. A key part of this commitment is addressing the risks of broken neutral conductors, which can cause electrical fires, equipment damage, or electric shocks. Traditionally, we relied on manual inspections and public reports to identify broken neutrals, which were slow and risked undetected issues.

In 2021, we adopted a proactive approach by leveraging SmartCo smart meters, covering 90% of our Southland customers. Collaborating with SmartCo, we use Hiko Energy Insights to integrate advanced data for network management. Hiko aids in identifying power quality issues, improving customer connections, optimising asset utilisation, and detecting faults like broken neutrals. Over the past year, this integration has enabled us to detect and resolve 17 broken neutral instances before any safety incidents occurred.

11.50am **Mitchell Davis, Orion**

Mitchell has worked in the energy industry since graduating as a Mechanical Engineer from the University of Canterbury. His previous role at DETA Consulting focused on delivering carbon reduction, particularly with industrial clients through project delivery, energy audits, and demand flexibility assessments. Mitchell joined Orion in July 2024 as the Flexibility and Markets Development Lead. In this role, he leads projects focused on demand flexibility, including Resi-Flex and hot water flexibility trials.

These projects have involved partnering with electricity retailers and key industry stakeholders to test demand flexibility and provide insights to build the flexibility value stack in New Zealand.

Flexibility at Orion: EDBs Role in Demand-Side Flexibility

As New Zealand's electricity system evolves, demand-side flexibility becomes crucial for achieving future goals. According to the BCG report, The Future is Electric, the country will need 2 GW of demand flexibility by 2030 to realise $10 billion in benefits by 2050. Orion and its project partners actively participate in this transformation by implementing demand-side flexibility projects. This presentation will explore Orion's role in current and future demand flexibility efforts, which will be key to enabling New Zealand's energy sector to decarbonise. Key topics include: The importance of industry collaboration in enabling demand-side flexibility at scale; Overview of Orion's existing demand-side flexibility, providing over 70 MW of peak demand response through initiatives such as hot water control, upper South Island load management and major customer control period charges; Current projects aimed at enhancing future flexibility, including Resi-Flex and hot water control trials and the various benefits consumers get from the ability to participate in demand-side flexibility.; Insights gained from the Lincoln flexibility trial.; The evolving role of distributors in managing and leveraging demand flexibility and the future projects Orion would like to complete to develop the flexibility market in New Zealand.

12.15pm **William Thomas, Meridian Energy**

William has been working with Meridian Energy as a Graduate Electrical Engineer for the past two years following the completion of a Bachelor of Electrical and Electronic Engineering with Honours at the University of Canterbury. He is commonly working on the delivery of asset management projects, providing technical resources for design, installation and commissioning of generation secondary systems.

His past projects have included the end-of-life replacement of battery backup systems and local service transformers, supporting the deployment of ICT infrastructure on generation sites and analysis of generation trends and capability. William enjoys the hands-on nature of asset management engineering and getting onsite amongst the action.

Developing Secondary System Upgrades: A Case Study of the Waitaki 110V DC Distribution Upgrade

As the New Zealand energy sector transitions into greater electrification, existing hydro-electricity generation is pushed to extend its service life and invest into large refurbishments of primary plant. To prepare for this transition, the secondary services for generators need to be brought up to modern design standards, balancing reliability, capacity and complexity. But when these existing systems have been incrementally modified by immediate needs of the past, integrating an upgrade presents a significant design and installation challenge.

This presentation examines the upgrade of the 110V DC Distribution System at the Waitaki Power Station, which included the segregation of supplies into two separate systems. It will explore: How the project was delivered to satisfy the future demands of the Waitaki station.; The constraints against modifications of the existing 110V DC system due to disrupting generation, power supply capacity and installation environment.; Issues that impeded the projects development, how these were remediated and how they could have been prevented.; The importance of planned secondary system design for electricity generation and its failure behaviour.

Lunch

1.15pm **Lydia Smith, Transpower**

Lydia has worked as a HVDC and Power Electronics Engineer at Transpower since January 2024. Prior to this role, Lydia started the Transpower graduate programme in February 2023, including placements in the HVDC and Power Electronics Service Delivery Management team, and Project Management in Auckland. Lydia graduated in December 2022 from the University of Canterbury with a Bachelor of Electrical and Electronic Engineering with First Class Honours and a minor in Power Engineering.

Rules aren't made to be broken, but let's test the status quo

Three 200 MVA interconnector transformers connect the Haywards 220 kV and 110 kV buses. To energise these transformers, one of the three 220 kV buses must be cleared, and the transformer energised from Bunnythorpe. All switching carries inherent risk, and excessive complexity further exacerbates the risk. Redefining the switching requirements could result in significant efficiency gains, and risk reduction for personnel and plant.

Transpower's HVDC Bipole operating policy requires this procedure to minimise the inrush current. Significant inrush current can result in voltage disturbances, causing inverter commutation faults, and the potential tripping of Pole 2. This requirement was implemented following an event prior to 2006 and has not been reviewed since.

Following the installation of a new HVDC control system, decommissioning Pole 1, installing Pole 3 and a STATCOM, the HVDC team concluded that the risk to the system has reduced, and that this requirement should be reviewed. Initial investigation begun with modelling; however, the best understanding of the risk came from in-service energisation tests.

1.40pm **Matt Crawley, Marlborough Lines**

Matt is a graduate Electrical Engineer with a year of experience in the power distribution sector. As a graduate engineer at Marlborough Lines Ltd, he has worked in multiple teams throughout the company to gain an in-depth understanding of how an Electricity Distribution Business operates.

He is known for his Excel skills and data analysis, and for creating a development strategy for remote areas of the power distribution network.

Single Wire Earth Return

"Single Wire Earth Return (SWER) networks are used throughout New Zealand as an effective means of reticulation in remote areas. SWER is however severely capacity limited due to safety concerns around Earth Potential Rise (EPR) resulting from its method of operation. This restricts development of areas powered by a SWER network. Most of Marlborough Lines (MLL)'s SWER network was built in the 1970's and will be due for replacement in the next decade. In the intervening 50 years, remote areas of Marlborough have become popular bach locations with the number and size of settlements increasing.

SWER may have been sufficient when constructed, but with network growth predicted to continue in remote areas a method was needed of identifying where upgrades to either single- or three-phase are required. An investigation compiled and then used various SWER network metrics to calculate an Upgrade Need Index (UNI).

In addition to each SWER network's characteristics, load data, and suitability of its surrounding landscape for residential or commercial development; the investigation also considered the implications of the Climate Change Commission's 2021 report. The resultant UNI will assist MLL to determine which of its SWER networks should be upgraded to support network growth in the future."

2.05pm **Vatsal Gajjar, Powerco**

Vatsal is Graduate engineer who has a Bachelor of Electrical/Electronics Engineering from Auckland University of Technology.

Has been at Powerco for over a year, rotating into different teams and developing skills as an engineer.

Aeolian Vibration Trial

Overhead conductors play a critical role in the electricity network, enabling the efficient transport of electrical energy to customers. For New Zealand's Electricity Distribution Businesses (EDBs), conductor renewal represents a significant capital investment. EDBs face the challenge of renewing conductors before they reach the end of their reliable, sustainable, and economically viable lifespan.

Cyclic conductor motion under laminar wind flow is a constant concern for transmission networks. This issue, known as aeolian vibration, is well-studied and engineered against in those contexts. However, in the distribution industry, aeolian vibration is a less-explored phenomenon. Mitigation efforts are often based on common knowledge, typically applied in cases of long spans, flat terrain, or lines crossing over water bodies. Aeolian vibration is of particular concern where the conductor is attached at tied or clamped points along the line.

Powerco's Overhead Asset team has initiated a trial using vibration recorders and weather stations to analyze the conditions that lead to aeolian vibration. This approach will enable us to better engineer solutions to protect conductors from this issue. This presentation will detail the trial process, our findings to date, and the steps planned for the future.

2.30pm **Arno Knight, Ventia**

Arno is a Graduate Engineer in Ventia's Southern Substation and Lines Team. He works on an array of projects from geospatial analysis to 3D modelling and drone operations. He passionate about using new technologies to modernise the power industry.

Arno graduated from the University of Canterbury in 2022 with a BE(Hons) in Electrical and Electronic Engineering.

Building Resilience through technology

To have a truly resilient electrical grid, an accurate picture of the system's condition is essential. Ventia uses an array of technologies to map, model and assess the condition of New Zealand's network to ensure a resilient and reliable grid. This allows for a more accurate prediction of an asset's lifespan and streamlines the process of construction and maintenance across New Zealand's grid.

Ventia primarily use UAVs, LiDAR and geospatial technologies to monitor and create 3D models of their sites. This presentation will discuss how this is used to: Update Transpower's asset catalogue,; Assess the condition of assets,

Manage risk of landslides, vegetation growth, and flooding,; Plan access to remote sites for maintenance and projects,; Create safe work zones, reducing the risk of harm to workers and equipment.

Asset data not only assists Ventia's complex construction and maintenance work but has also proved vital in recovering from natural disasters and emergencies. It helps rebounding from unforeseen events by accurately identifying problems and allows our team to respond safely. The technology is now accessible across the electricity industry and will increase the resilience and safety of the national grid.

2.55pm **Afternoon Tea** *** Cast your vote for the People's Choice Award ***

3.20pm **Panel Discussion**

Session Facilitator: Emma Lloyd, Connetics / EEA Executive member

Topic: Powering the Future

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

Closing Comments — **Harsharan Singh, Ventia**, APEX Chair

4.40pm **Social Function**

6.00pm **Close of APEX 2024**

APEX2024 SPONSORS

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

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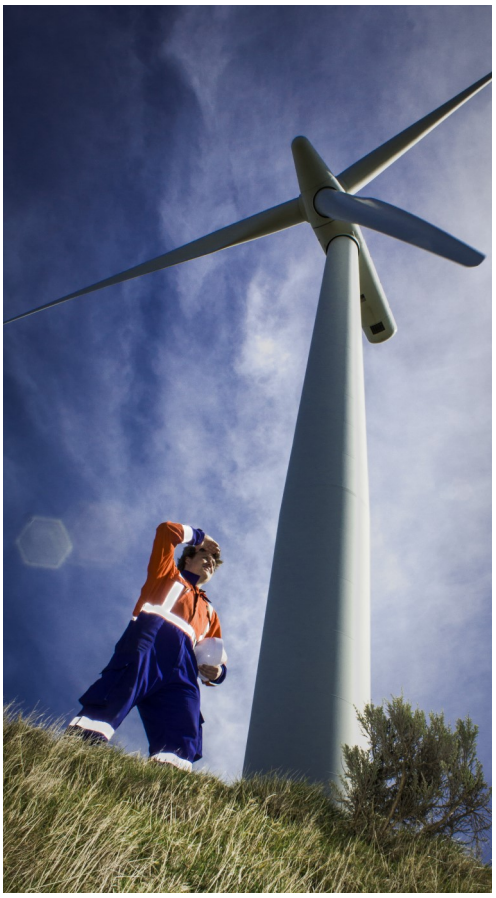

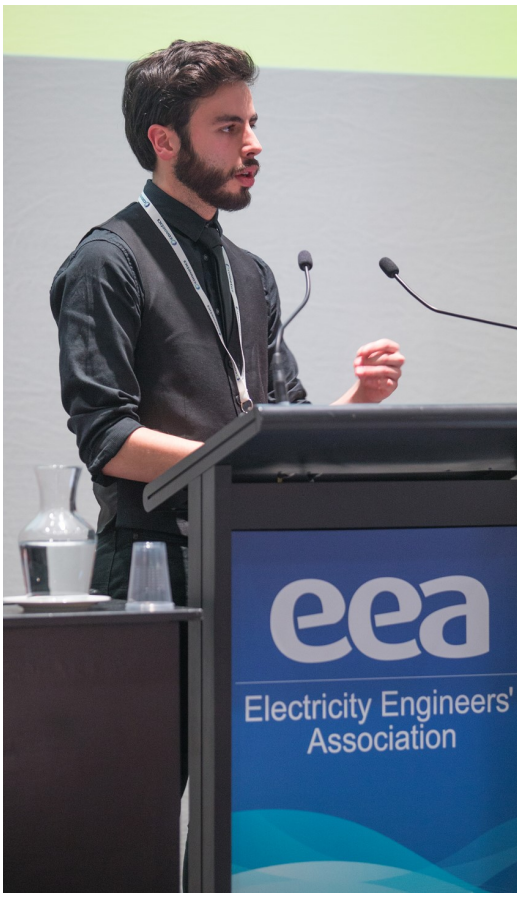

YOUNG ENGINEER OF THE YEAR AWARD

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 2024 award winner represented New Zealand at the IEC Young Professionals Programme held in Edinburgh, United Kingdom over 21 to 25 October 2024. The IEC Meetings in 2025 will be held in Kyoto, Japan over 15 to 19 September.

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 31st December 2025, 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

NOTES

Engineering Excellence—Electricity Engineers' Association | EEA

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