Ara Ake & Electricity Distribution Business New Zealand Decarbonisation Challenge Problem Statements

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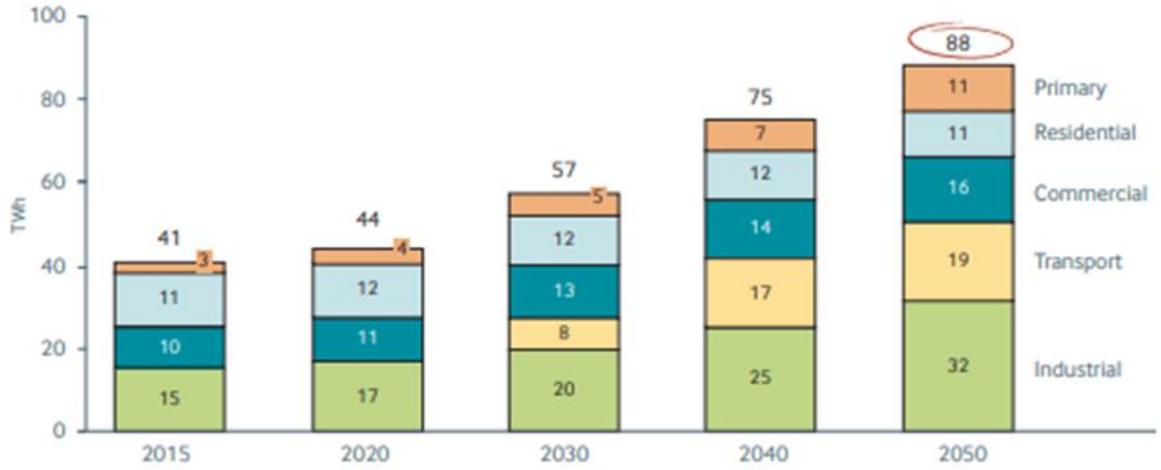
Ara Ake
Future Energy Development

1. Overview

New Zealand is on a decarbonisation journey with a target of reaching 100% renewable electricity by 2030 and carbon neutrality by 2050.

With this journey comes inherent and significant uncertainty. It is estimated that NZ's electricity consumption will more than double by 2050, predominantly driven by the decarbonisation of industrial heat and the transition of transport.

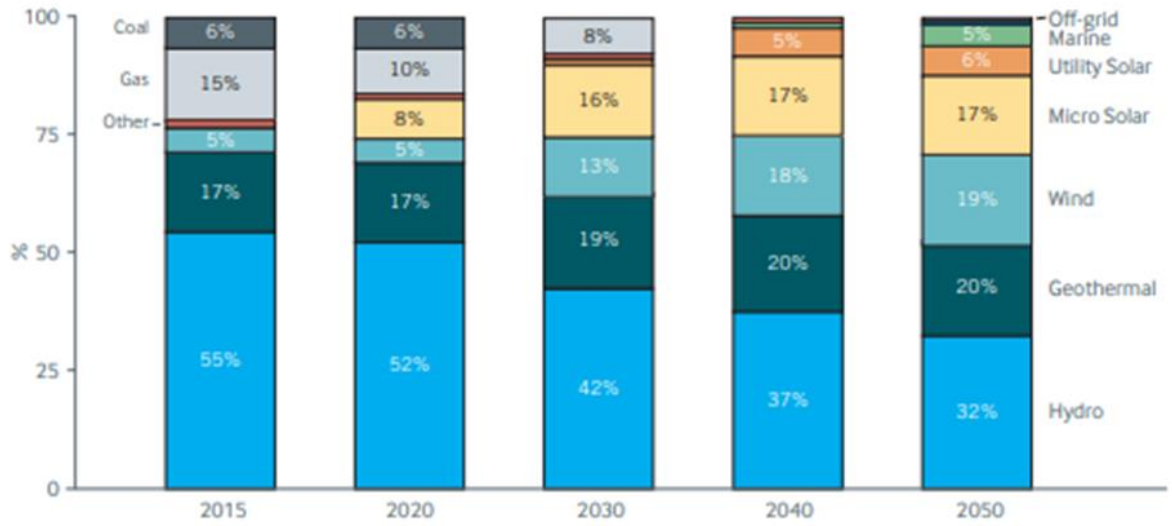
Table 1: Estimated Growth in Delivered Electricity Demand by Sector, 2015 - 2050



Source: Te Mauri Hiko Energy Futures Transpower White Paper 2018

This transition will see a significant shift in the composition of NZ's electricity supply portfolio and the distribution of generation assets.

Table 2: Composition of New Zealand's Electricity Supply Portfolio by Generation Type, 2015 – 2050



Source: Te Mauri Hiko Energy Futures Transpower White Paper 2018

The 29 Electricity Distribution Businesses (EDB) of New Zealand are a key enabler of this transition and are directly impacted by the inherent uncertainty of the journey. They face the challenge of investing, managing, and operating their network to support New Zealand towards these sustainability goals, while continuing to deliver a fit for purpose, safe, secure, and, very importantly, equitable electricity distribution service.

The goal of the EDB Energy Decarbonisation Challenge (the "Challenge") is to find innovative solutions to EDB decarbonisation problems as New Zealand transitions to a decarbonised energy future.

Ara Ake has been working with 11 EDBs in New Zealand, including facilitating a workshop to collaboratively agree and articulate the top decarbonisation challenges facing the EDBs. The top two decarbonisation challenges are detailed in the report below and are the focus of the Challenge:

1. Distributed Energy Resources and Network Asset Management
2. EDB Service Affordability in a Decarbonised Future

2. Problem 1 - Distributed Energy Resources and Network Asset Management

2.1 Problem Overview

The EDB's of Aotearoa are challenged with how to effectively and efficiently plan, design, operate, maintain, and resource going forward to optimise network investment decisions in a way that robustly and efficiently includes the impact and inherent uncertainty of decarbonisation demand increases, flexibility services, and distributed energy resources (DER).

DER is defined as: Controllable devices (solar, wind, battery, EV chargers, hot water etc), used to generate, store and manage energy.

EDBs have identified there is a shortage in both the quantity and quality of skills, resources, experience, and tools within the industry as a whole and specifically within their organisations, to support the impact of New Zealand's decarbonisation journey on EDBs. This leads to:

- poor customer experience,
- difficulty in accurately forecasting load constraints,
- network reliability and security challenges,
- low staff morale,
- suboptimal investment decisions, and
- potential to slow the uptake of decarbonisation technologies.

2.2 Problem Statement

This problem manifests in several ways across the business and has been specifically investigated in the following three areas:

Asset Management

A. A shortage of skills, resources, experience, and tools to effectively and efficiently integrate the impact and inherent uncertainty of DER solutions into core EDB asset management, planning, systems, and operations, leads to risk of degradation of reliability, affordability, power quality, security, and ultimately, customer experience and impacts the robustness and timeliness of network investment decisions.

Network Demand Forecasting

B. A shortage of skills, resources, experience, and tools to forecast and visualise the demand and supply-side impact of decarbonisation on network assets (e.g., load and constraint forecasting including capacity, voltage, power quality, reliability and security), in a timely and accurate manner, leads to staff burnout, inaccurate network forecasts, and impacts on the optimisation and timing of future network investment decisions, potentially slowing the uptake of decarbonisation technologies.

DER Connection Requests

C. A shortage of skills, resources, experience, and tools to complete a prompt and quality assessment of a DER connection request (e.g., solar applications) to identify any potential network constraints/impacts leads to overwork of staff, frustration and delays for customers, and slows the uptake of decarbonisation technologies.

2.3 Problem Details

What is the problem that needs to be solved?

How to effectively and proactively integrate DERs, flexibility services, and decarbonisation-driven demand growth into EDB asset management planning and processes, including:

- Load and network constraint forecasting/heat maps (including capacity, voltage, power quality, reliability, security)
- Asset planning for DER – visualisation of capital investment vs operating expenditure
- Accurate identification of current and future network gaps
- Active vs reactive network management
- Visibility into the low-voltage network & increase in demand
- New connection assessment – bidirectional flow
- DER/distributed generation (DG) connection assessment
- Translating data into actionable insights.

Who is impacted?

External:

- **The DER customer:** connection application delays
- **EDB customers as a whole:** network reliability, quality, and affordability
- **Flexibility service providers:** difficulty in value stacking service offerings
- **New Zealand as a whole.**: challenges in reaching decarbonisation goals.

Internal:

- **The engineering team:** challenges assessing network constraints and designing high-quality and timely solutions
- **Field crew:** challenged in building the physical assets to meet DER needs and timing
- **Communications & Customer team:** challenged in handling and responding to customer queries and follow ups in a reasonable timeframe
- **Leadership and Board:** challenged with the confidence to make robust and optimal investment decisions and identify key risk factors.

Why is it a problem?

- Reliability, affordability, power quality, and security issues impact on customer experience
- Impacts the customers' ability to realise the value of their investment in DER
- Impacts the robustness of EDB investment decisions – risking being more subjective than an objective fact-based data-driven assessment
- Stresses team capacity to keep up with business as usual and shifting the landscape
- Staff frustration, performance, burnout, and turnover
- Risk of further regulation
- Ultimately impacts the ability to deliver on decarbonisation goals.

How is the problem observed?

- Negative impacts on network reliability, power quality, security, affordability, and ultimately, customer experience drives increased call volumes, fault, and maintenance call outs
- Delays in DER connection process
- Suboptimal investment decisions.

Where is the problem observed?

- At the customer end/customer connection point
- Data collection, capture, and insights
- Manual processes, human error, and competency challenges
- Asset management planning
- Investment decisions.

When was the problem first observed/will be observed?

- First surfaced with grid-scale solar connections/large DER connection assessment
- DG 1 – distributed generation under 10kW (predominantly residential)
- DG 2 – distributed generation over 10kW
- Challenges integrating software into traditional/manual systems and solutions.

3. Problem Statement 2 - EDB Service Affordability in a Decarbonised Future

3.1 Problem Overview

The EDBs of New Zealand are challenged with how to invest to enable decarbonisation while maintaining affordability for consumers, particularly for those in energy hardship, as inequity is growing between those who can afford to invest in energy savings and those that cannot.

3.2 Problem Statement

As a result of decarbonisation, electricity demand in New Zealand is forecast to increase, requiring EDB investment to support this growth. This investment is expected to increase lines charges for all customers that are connected, however, customers that have the resources and capability to invest in DERs, smart appliances, and demand-side management tools will have their costs reduced, shifting more of the burden of the EDB charges onto those customers who can least afford it, thereby increasing energy hardship in New Zealand.

3.3 Problem Details

What is the problem that needs to be solved?

- Decarbonisation is resulting in a growing wealth gap and widening the inequality between those who can afford to invest in energy saving and those who cannot
- Optimisation of load management to minimise increased network investment.

Who is impacted?

- General customers – the majority could end up paying for minority benefit – contributing to a further widening of the wealth gap
- Energy-hardship customers
    - Unlikely to afford appliances that will reduce energy consumption
    - More likely to be in rental accommodation, therefore less able to invest in technology
    - Less likely to be actively engaged in demand-management tools
    - Find it difficult to pay energy bills
- Local community – societal, health, and education challenges with increased hardship
- EDB shareholders – as it becomes an increasing political/regulatory issue
- New Zealand – impact on energy trilemma (equity, security and environmental sustainability) could slow decarbonisation.

Why is it a problem?

- Does not result in a just transition to a low-emissions energy future
- Increases negative impact on community and support services
- Further increases the risk of intergenerational hardship.

How is the problem observed?

- Overdue energy accounts increase
- Community support services are stretched further
- Negative media coverage
- Increase in political intervention in market
- Constrained network investment, due to price-quality regulations and input methodologies set by New Zealand's Commerce Commission.

Where is the problem observed?

- Spending capability of consumers
- Increasing number of new builds have DER capability, whereas older houses and rentals are less likely to
- Electric vehicle (EV) and DER uptake greater in affluent suburbs/areas.

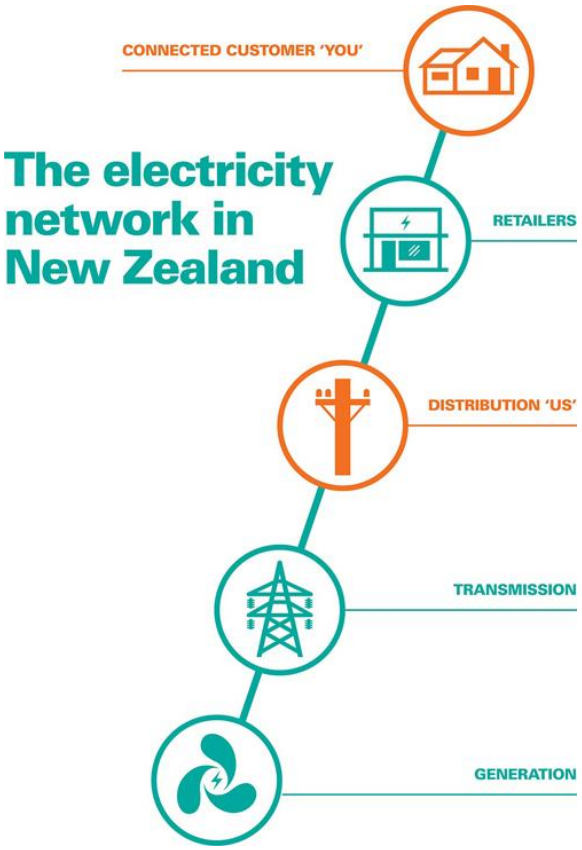
When was the problem first observed/will be observed?

- Early indications are coming through with the government subsidy for the purchase of EVs – as uptake predominantly in the wealthier suburbs.

4. Appendix 1 - Overview of the New Zealand Electricity Sector and Electricity Distribution Businesses

Below is a short overview of the New Zealand Electricity Sector and Electricity Distribution Businesses.

Broadly speaking, the industry can be broken down into four main components – generation, transmission, distribution and retail.



Generation

Electricity in New Zealand is generated by five major companies, with the government being a major shareholder for in three of those companies. Over 80 percent of New Zealand's electricity comes from renewable sources.

Transmission

State-owned enterprise Transpower owns and operates the New Zealand national electricity transmission system, which supplies electricity to lines companies using high-capacity, high-voltage transmission lines.

Distribution

Twenty-seven EDBs distribute electricity throughout New Zealand. EDBs connect to the national grid and distribute the electricity to consumers through their local networks. New Zealand EDBs are a mix

of community-trust owned and equity owned, they employ more than 10,000 people, deliver electricity to more than two million homes and businesses, and have spent or invested $8 billion in the past five years.

Retail

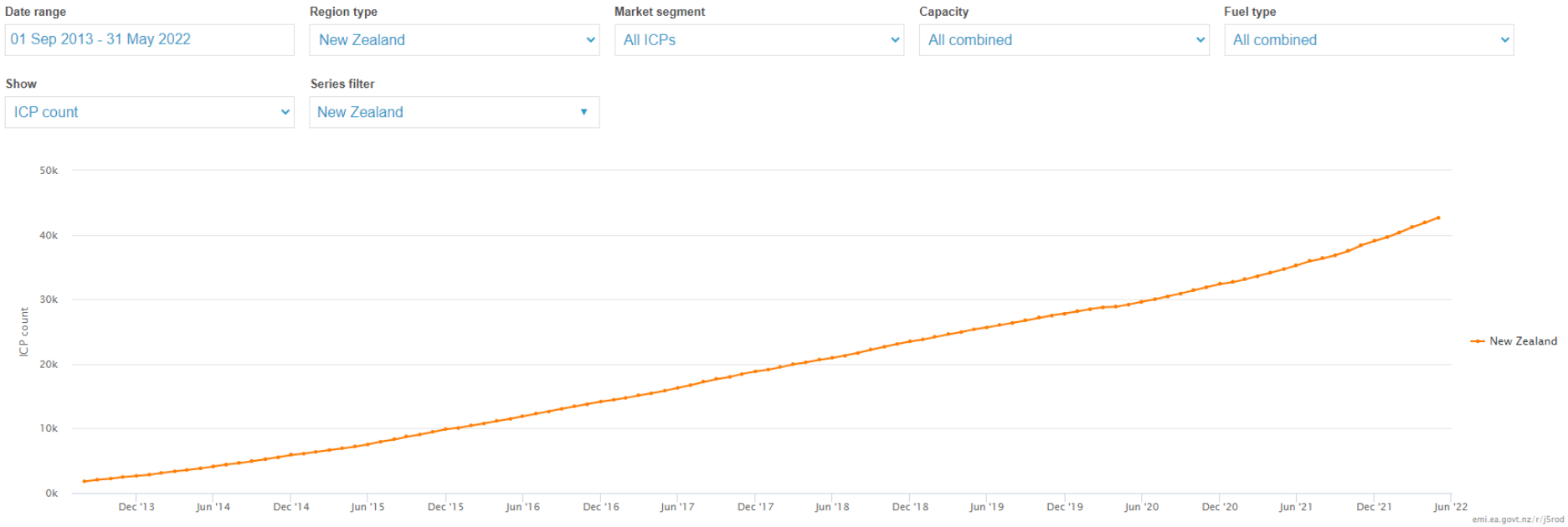
There are over 40 electricity retailers in New Zealand, however, the four largest retailers hold a market share of over 80%. Electricity retailer invoices to customers include the cost of the electricity consumed, as well as national transmission and local distribution costs.

Electricity Distribution Business Map

Below is a map of the location of the 29 EDBs in New Zealand.

Distributed Generation Installation Trend

Below is a graph of the uptake of distributed generation in New Zealand in the past 10 years, through to 31 May 2022.



NZ Electricity Sector Further Information Links

Further data and analysis on New Zealand's Electricity Sector, can be found at the links below:

https://www.transpower.co.nz/resources/te-mauri-hiko-energy-futures

https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-publications-and-technical-papers/energy-in-new-zealand/

https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-modelling/

Electricity Market Information Website

https://www.eeca.govt.nz/insights/data-tools

https://www.ena.org.nz/