Electricity Distribution in a Distributed Energy Future

Duncan Head
GM Insights & Information
Overview of traditional NZ Energy Sector

Source: Electricity Authority
Regulation is applied to lines companies

Unregulated

Regulated under specific rules for Transpower

Regulated - 15/29 EDBs under price and quality regs

Nb: 86% of retail market held by big 5 'gentailers'

Source: electricity authority Dec-19

Source: Electricity Authority
VECTOR’S ELECTRICITY DISTRIBUTION

- Electricity network customers: >569,000 (~30% NZ)
- Network Length (18,708km)
  - Overhead: 8,182km
  - Underground: 10,526km
- Peak demand: 1,821 MW
- Energy distributed: 8,802 GWh
- Network assets:
  - GXP: 15
  - Zone Substations: 112
  - Distribution substations: ~22,000TXs
  - Poles: ~120,000

Source: Vector Electricity Information Disclosure 2019
~27% of your energy bill is for distribution

Source: Electricity Authority
Being an EDB used to be easy because everything was simple, the same and predictable.
“The pace of change has never been this fast, yet it will never be this slow again”

Justin Trudeau
Prime Minister Canada
The pace of technology adoption is accelerating

Fig 3 in World Economic Forum (2017), The Future of Electricity New Technologies Transforming the Grid Edge
The future requires a resilient, flexible and affordable distribution network.
The future requires a resilient, flexible and affordable distribution network.
The Energy Transition will require a complete rethink of all parts of the energy system including today’s market structures, business models, rules and regulations.
The Future of Energy for Vector

- Consumer choice
- Resilient & affordable energy networks
- Innovation
- Clean energy options
What are some of the main ways the energy transition is changing Distribution planning, investment and operation?
#1. Need to design and build the network from the end user up
How system operator sees Auckland

15 points of connection to the Grid (GXP)
How EDBs traditionally focused on the network

~112 High Voltage supply points (Zone Substations)
How EDBs now have to operate, plan and manage the network

22,000+ ‘LV networks’
Flipping planning from top-down to bottom-up

Change is being driven at the customer level

The LV network is critical to the energy transition and where all the activity will be

If not understood and managed, the cost of getting this wrong is enormous for consumers
#2. The need to invest in ‘capability’ and the digitalisation of the network
Electricity network investment and peak load

Design network to meet peak load

Investment driven by peak load, not energy consumption

Safety margin

Morning peak  Mid-morning slump  Evening peak  After eleven

Capacity (kW)
Analogy to filing a bucket with water

Pipe size (i.e. peak capacity [W]) not volume of bucket (i.e. energy consumption [kW]) defines network sizing and investments

Different pipe capacity (size)

Flow rate: 100 litre/min

Flow rate: 10 litre/min

Different flow rate & fill time

Same consumption (volume)
Wind and solar don’t reduce network investment

Wind and solar provide a lot of energy over the year
Wind and solar contribute little during peak demand
Need network infrastructure to be designed to meet peak load

Changing demand-side
Electrification of heat and transport

New energy technologies have higher loads than electric household appliances

un-friendly network charging of electric vehicles could lead to significant investment requirements
But higher energy use often increases income
Reshaping the network load curve

Active demand management on DERs

Storage

Network investment savings or deferral

Battery charging

Battery discharging

DERs and Storage are non-wire alternatives to traditional network assets
#3. Invest in shorter life or portable solutions that can buy time
Summary

- LV network is critical to the energy transition
- Build everything from end user up
- Uncertainty is the new normal – need flexibility of investments
- Digitalisation of network
- Rise of the DSO