Electricity distribution network & the future of transport

Energy Centre summer school in energy economics
University of Auckland
14-16 February 2022

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Transport - questionnaire

Write your answer in the chat please

1. What share of light passenger vehicles will be electric in 2030?
2. What share of buses will be electric in 2030?
Outline

• Who we are & what we do

• Energy systems modelling at Vector

• A glance at the transport transition

• Things to think about
Vector at a glance

- Electricity network customers: >569,000 (~30% of NZ)
- Network Length (19,144km): 
  - Overhead: 8,284km
  - Underground: 10,860km
- Peak demand: 1,715MW
- Energy distributed: 8,395 GWh
- Network assets:
  - GXP: 15
  - Zone substations: 112
  - Distributer substations: ~22,000
  - Poles: ~120,000
The changing energy system

Many of the changes are expected in the medium and low voltage systems.

Source: IEEE

Digitalised & data-driven
Resilient & flexible
Customer-centric & affordable
The role of electrification

Expect to see electrification across sectors & services. But transportation is a big one!

Electrification

As electricity generation becomes progressively cleaner, electrification of areas previously dominated by fossil fuels emerges as a crucial economy-wide tool for reducing emissions.

This takes place through technologies like electric cars, buses and trucks on the roads, heat pumps in buildings, and electric furnaces for steel production.

Key question: What does this mean for the network?
Energy systems modelling at Vector

- Traditional data analytics
  - E.g. Covid impacts on energy consumption

- Medium-term forecasting
  - E.g. Feeder/substation level energy consumption using machine learning techniques

- Long term demand scenarios
  - Peak demand, using granular, bottom-up simulation modelling
Long Term Scenario Modelling: Peak demand

Our approach
- Customer centric
- Bottom-up
- MSM level spatial resolution
- Linear, deterministic, simulation tool

Key strengths
- Granular customer base
- Data driven

Key insights
- Fuel switching
- Customer characteristics and behavioural changes
- New tech potential
Long Term Scenario Modelling: Peak demand

Impact of Main Growth Drivers by MSM in 2032

- Customer Growth
- Efficiency Gains
- EV Uptake
- Solar & Battery Uptake
- Gas to Electricity Conversion

[Maps showing various scenarios and growth drivers across different regions]
Long Term Scenario Modelling: Peak demand
Auckland peak demand growth

AUCKLAND EV COUNT

- Actual
- Model - CCC
- Transpower
- MOT - Fast
- MOT - Base
- MOT - Slow
- Global EV Outlook Sustainable Development
- Global EV Outlook Stated Policies
- AKL Council Climate Target

VECTOR WINTER PEAK DEMAND AT 2032

- Present
- Customer Growth
- Energy Efficiency Gains
- EV Uptake
- Solar & Battery Uptake
- Gas Fuel Substitution
- Base
- DERMS - HW Control
- DERMS - EV Control
- DERMS - Battery Control
- Potential

- Decrease
- Increase

AMP

2017 2022 2027 2032 2037 2042 2047

EV Count

2017 2022 2027 2032 2037 2042 2047

VECTOR WINTER PEAK DEMAND AT 2052

- Present
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Present

2017 2022 2027 2032 2037 2042 2047

MWh

2017 2022 2027 2032 2037 2042 2047

MVW
Depending on charging technology, connecting one EV is equivalent to an additional one to 20 new homes on the electricity network.

It is not the battery size, but the capacity of the charger, which defines power line capacity and investment requirements.
Vector’s EV Trial on smart charging

Smart charging algorithms are effective in peak load management, without compromising customer satisfaction.

Webinar on this tomorrow 10am!

https://www.esig.energy/event/webinar-ev-smart-charging-trial/
Key question: What will the transport sector transition look like?

Climate Change Commission (CCC) – Transport in the demonstration path:

- Travelling less/shorter distances: -3% per person by 2030
- Using low-emissions options*: 6% (2019) -> 11% (2030) -> 14% (2035)
  - Cycling: 0.6% (2019) -> 1.5% (2030)
  - Public transport: 3.5% -> 7.7% (nearly triples in Auckland by 2030)
- Household light vehicle travel: -9% by 2030
- Changing how most vehicles are powered

*walking, cycling, public transport, and emerging options such as e-scooters

It's about more than EVs!
CCC: Uptake of light EVs* in the demonstration path

- 17% (42%) of light passenger vehicles in 2030 (2035)
- Electric buses
  - 53% (2030), 80% (2035) of vehicle numbers
- Electric trucks
  - 42% (95%) of medium trucks imported in 2030 (2035) (15% of fleet in 2035)
  - 18% (73%) of heavy trucks imported in 2030 (2035) (5% of fleet in 2035)
- Aviation
  - Short-haul conversions begin 2030
  - 5% of fuel displaced by 2035
- Ferries: same as heavy trucks

Note: Buses and trucks make ~2% of total fleet but almost 20% of road transport emissions!
Charging with very high capacity chargers

High capacity chargers will likely become common.

- AC, home charging / trickle charging
  - ~2.2 kW – eq. 1 house added

- AC, home / office / public, “fast charging”
  - ~7-22 kW – eq. 3-9 houses

- DC, public, “rapid charging” or “super-fast charging”
  - ~50-350 kW – eq. 20-140 houses

- Ferries: ~1-3 MW chargers!

<table>
<thead>
<tr>
<th>Type of EV</th>
<th>Passenger Vehicle</th>
<th>Large EV</th>
<th>Light Commercial</th>
<th>Trucks &amp; Busses</th>
<th>Trucks &amp; Busses</th>
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</thead>
<tbody>
<tr>
<td>Average Battery Size (right)</td>
<td>50 kWh</td>
<td>75 kWh</td>
<td>100 kWh</td>
<td>200 kWh</td>
<td>300 kWh</td>
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<tr>
<td></td>
<td>Power Output (Below)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 kW</td>
<td>53 min</td>
<td>1 h 20 min</td>
<td>1 h 48 min</td>
<td>3 h 35 min</td>
<td>5 h 23 min</td>
</tr>
<tr>
<td>90 kW</td>
<td>30 min</td>
<td>45 min</td>
<td>1 h</td>
<td>2h</td>
<td>3 h</td>
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<tr>
<td>120 kW</td>
<td>22 min</td>
<td>33 min</td>
<td>44 min</td>
<td>1 h 30 min</td>
<td>2 h 14 min</td>
</tr>
<tr>
<td>150 kW</td>
<td>18 min</td>
<td>27 min</td>
<td>36 min</td>
<td>1 h 12 min</td>
<td>1 h 48 min</td>
</tr>
<tr>
<td>180 kW</td>
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<td>22 min</td>
<td>30 min</td>
<td>1 h</td>
<td>1 h 30 min</td>
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<tr>
<td>240 kW</td>
<td>11 min</td>
<td>16 min</td>
<td>22 min</td>
<td>44 min</td>
<td>1 h 7 min</td>
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<tr>
<td>300 kW</td>
<td>8 min</td>
<td>13 min</td>
<td>17 min</td>
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<td>7 min</td>
<td>11 min</td>
<td>15 min</td>
<td>30 min</td>
<td>46 min</td>
</tr>
</tbody>
</table>

Source: https://blog.evbox.com/level-3-charging-speed
Why coordinating EV charging matters

Figure 18: Split of long-term peak-driven supply costs for residential consumers

This chart shows that:
- the biggest benefit of peak management comes from avoiding distribution network costs, especially within the high voltage (including sub-transmission) part of those networks

Source: Concept Consulting, 2021.

What does “getting it right” look like?

And what does that mean for the network?
Things to think about

• Charging for all fleet types
• Speed of uptake: Where should infrastructure go in first?
  • Locations, capacities: Peak times & available capacity differ by location
• Pricing: Can pricing solve future capacity constraints? (dynamic & locational)
• Business models: Role of regulator to ensure competitive outcomes
• Coordination among all parties involved: existing and new!

Let’s talk – any questions or comments?
Thank you!

Contact: Kiti.Suomalainen@vector.co.nz