How does your Low Voltage (LV) network cope with high levels of EV Charging?

Since the mid-2010s, New Zealand (NZ) has seen a dramatic increase in the number of electric vehicles (EVs) joining the vehicle fleet. This trend is set to continue as EVs approach price parity with fossil-fuelled vehicles and as consumers seek to mitigate their carbon footprint.

In concert with increasing numbers of EVs, more models with larger battery capacities are being made available, to allay consumer concerns around EV range. Chargers with higher power ratings are also becoming increasingly common at home, to reduce charging times. The combination of these factors, indicate the potential for significant demand growth and an increased risk of congestion in residential low voltage networks, where the majority of charging takes place.

Challenges Electricity Distribution Businesses (EDBs) face around supporting EV Charging

EDBs are facing challenges assessing whether existing network infrastructure is fit for purpose in the face of growing EV charging demand. Now more than ever, guidance is required to enable EDBs to assess network adequacy, by considering:

- When, where and what level of network infrastructure reinforcement might be required?
- What charging behaviours might be encouraged to improve demand diversity?
- What After Diversity Maximum Demand values should be adopted for future residential developments in the face of increasing EV loads?

Modelling future scenarios is one method to provide guidance in the face of uncertainty.

EV Hosting Capability Service

The EPECentre has developed a steady state, probabilistic methodology to assess the impact of increasing EV charging in LV networks.

The methodology features:

- A probabilistic approach to encompass a diversity of base loads, EV uptake and charging behaviours,
- NZ-centric inputs e.g. representative EV fleet data, a NZ sourced journey database and local base demand data,
- A flexible scenario builder that can be reconfigured according to EDB preferences, for example to explore the effects of characteristics such as charging behaviour,
- EV State of Charge monitoring to provide realistic scenarios,
- An optimised fast power flow solver to support the large number of scenarios simulated,
- Results generated over the course of a week to capture the time dependence of loads and charging behaviours.

Example of the randomised scenario

An example of the randomised scenario generation process undertaken to generate a probabilistic simulation landscape is presented in Figure 1.

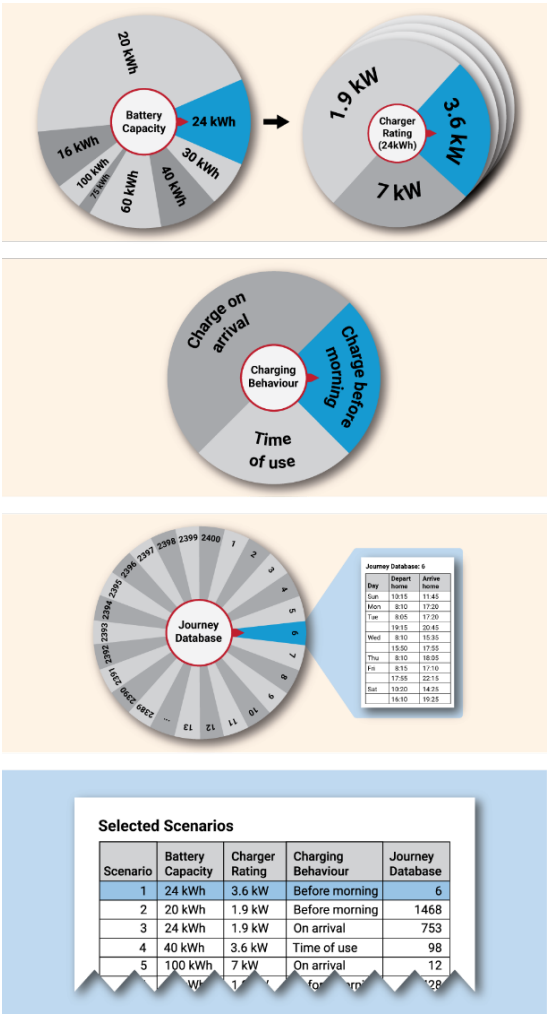

Figure 1

What do you need to get started?

For the EPECentre to assess your networks' capability to host increasing levels of EV charging, the simulations require topological detail of your low voltage network, including:

- distribution transformers,
- conductor connections and impedances,
- ICP connection points.

An example simulation unit, called a sub-network, consisting of a distribution transformer and the connections downstream is shown in Figure 2.

While complete network information is ideal, if all the information is not available, reasonable approximations can be agreed. Customisation of the tool may be possible to meet your specific requirements.

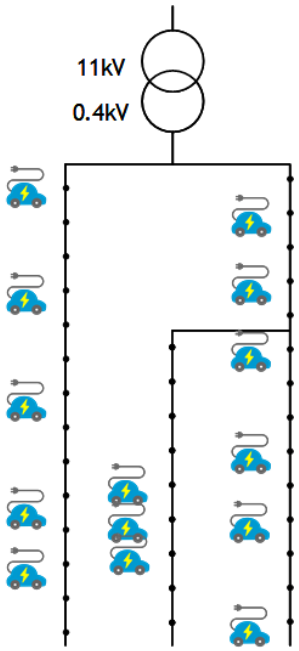

Figure 2

Network Results

Probabilistic EV hosting simulation results are presented in terms of the likelihood of congestion violations at different levels of EV uptake. Comprehensive results are made available in an Excel spreadsheet, including:

- Transformer loading and a summary of the voltage and current violations for each sub-network,
- Key distribution results for the voltages and currents for each individual conductor segment.

Results are ranked to highlight sub-networks and conductors most susceptible to congestion. Results are also presented in graphical form to summarise the trends around network performance at increasing levels of EV uptake. Study findings will be summarised and presented as a report.