# EQL Networks and Electric Vehicles

Part of Energy Queensland

July 2021

# Network Problem statement

How will connection of customer electric vehicles influence energy use on the Queensland electricity networks?

How do we optimise EV charging for both customers and the network?

## Focus on residential “home” charging. Why?

- Fast or ultra-fast charging systems are generally captured under the Customer Connection Process (due to the nature of the network support they require).
- The LV (low voltage) network is liable to the largest immediate impact of EV charging.

# Getting Perspective

High level framing

| | |
|---|---|
| <u>Energy use</u> | |
| Average daily energy use in a home: | 9 – 20kWh |
| EV electricity use (average daily commute of 40km): | 8 – 10kWh* |
| | |
| <u>Network demand (typical appliance instantaneous electrical load)</u> | |
| Electric Element hot water system: | 1.8 - 3.6kW |
| Large split system air conditioner: | 2kW (approximately) |
| Ducted air conditioning system: | 5kW |
| | |
| EV charge on a 10A/15A socket: | 2.4/3.6kW |
| EV charge with EVSE: | up to 22kW |

* Source: Qld Gov't: "The Future is Electric", average 1kWh per 5-6km

# Data gathering

EV SmartCharge Queensland – 197 EV customers.

Classifying EV customers

- Contact details (address, type of house)
- Type of EV (make, model and manufacture data)
- Charging (max. charge rate, tariff, type of charger, phases connected)
- Retailer
- Solar and/or Battery ownership
- Primary purpose (private or commercial)

Grouped by

- EV type (BEV Large, BEV Small, PHEV)
- Regional or Metro.
- Solar/Battery.

Longitudinal study to assess changes in EV charging behaviour over time.

# Data Gathering (cont'd)

## Driving and Charging Data Captured by FleetCarma C2 Device – ProPlus Tier

### Trip logs

- Vehicle make, model, and year
- Odometer
- Trip start-time
- Trip end-time
- Total distance traveled (miles)
- Trip start-time battery state-of-charge
- Trip end-time battery state-of-charge
- Trip energy consumption (kWh)
- Trip fuel consumption (gal)
- Total electric distance traveled (mile)
- Auxiliary load (kWh))
- Ambient temperature (F)

### Charge logs

- Vehicle make, model, and year
- Charging location by geofence classification
- Charging start-time
- Charging end-time
- Charging energy consumption (kWh in 15-minute intervals)
- Charging energy consumption in aggregate by time period
- Charging power (kW)
- Charging start-time battery state-of-charge
- Charging end-time battery state-of-charge
- Ambient temperature (F)

**Event-based charge and trip logs including 15-minute interval charging data can be provided monthly via utility-hosted and secure FTP site**

# Use cases to satisfy

Energy used whilst charging

Home -v- Public (impact of housing type e.g. apartment dwellers).
Demand profile (impact of charger type/connection for network diversity).
Type of EV.
Energy losses (at time of charge and battery deterioration over time).

When does charging occur

Time of day: solar soak option, peak demand management.

Influencers on charging behaviour

Battery state of charge (minimum and maximum)
Seasonal impacts
Tariffs
Length of ownership (more trips, longer trips, eased range anxiety, etc…)

Input to Forecasting and Network Planning

# Initial Findings

June 2021: average across all EV categories approx. 8kWh per day plug-in charging of average 40km daily.

Home charging – average vehicle profiles (residential only, January – June 2021):

- 59% of all charging kWh are privately charged (not public)
  - BEV Large; highest energy and demand between 1-2am (4.6kW max), return spike at 4-5am, and a returning evening peak at around 8pm (kWh and demand).
  - BEV Small; similar profile to BEV large until 5.30am but daytime energy peak (not demand), and a returning evening peak at around 8pm (kWh and demand).
  - PHEV; similar demand characteristics to BEV Small, but flatter daytime charging, with kWh slightly lower overall. A fully charged PHEV is going to manage the daily commute just like any BEV.

Charging (January – June 2021)

- 10.5% of EV owners let their battery discharge to 20% or below, before recharging.
- 25% of charging occurs when the battery is at least 80% SoC (significant “top-up” charging).
- 39% of BEV charging sessions end at 80% SoC, 21% to full (battery protection).
- Almost 39% do not exercise any direct control when their EV charges (e.g. timers, tariffs, soft controls).
- Charging losses are just over 10% but when SoC reaches 90% losses jump to almost 20%.

# Thank you

Questions?