Electric Highway Tasmania, Hobart EHT Fast Charger Network Project
LESSONS LEARNT REPORT 2

Project Details

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EXECUTIVE SUMMARY

"Making predictions is hard, especially about the future."
In a fast changing area such as EV uptake, with relatively long lead times to develop new sites and obtain equipment, it is important to be prepared for the likely rate of growth of demand. Early estimates of use (kWh per EV per month) provide some basis for making tentative statewide forecasts of demand for additional charger capacity.

KEY LEARNINGS

Lesson learnt No.2: Demand and Capacity

Category: Forecasting

Objective: The objective of the Project is to address blackspots by improving the availability of public BEV Fast Charging Stations which will support BEV uptake by the public and businesses, including fleets.

Detail:

Electric Highway Tasmania (EHT) currently operate thirteen sites in Tasmania with sixteen under development and others under consideration. Our first sites have operated since August 2020.

We are beginning to develop a data set that enables some context to be established for better estimating real world use of DC fast chargers in Tasmania. This report provides some early insights from this data.

Forecasting use is important in planning the number, size and location of chargers required, as well as the 'ultimate' charging capacity required so as not to overbuild capacity. There is a significant lead time from first identifying a possible site in an area until it is built, in our experience, approximately three years on average. Upgrades to existing sites can generally be achieved within a year.

EHT has worked to develop the Tasmanian network in three stages:

1. **Ensuring initial 'skeleton' coverage** (2018-2021) with approx. 150km spacing between fast chargers on major routes. We intentionally located only where there were no existing chargers, essentially leaving the main Midlands Highway to others who had announced or moved early on this route. (completed Feb 2021)
2. **Filling in low demand regions** (2021-2023) and reducing spacing to about 50 km max on most routes in the state, including most minor routes. This will allow shorter range EVs to get around the state, provide more flexibility to all EVs, and provide more communities with infrastructure that would attract visitors that otherwise may not stop. This stage will essentially be complete by the end of 2023, albeit with a few remaining gaps.
3. **Adding capacity as demand grows** (2023 onward) This will primarily be by growing existing sites but will also include some additional sites to fill a few gaps or add to convenience. We have three existing sites which will be expanded by the end of 2023 in response to strong demand and increasing frequency of queuing. Most sites remain well below commercially sustainable levels of use for the next few years.

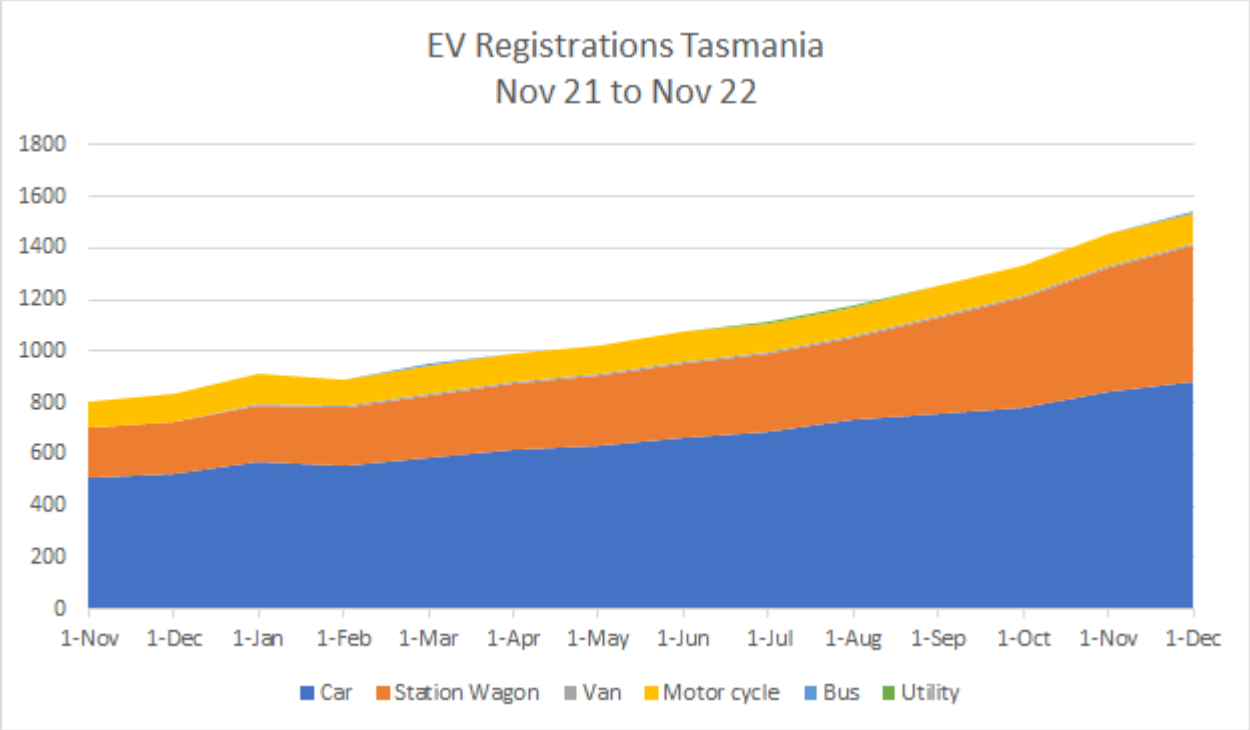
Throughout these three stages, EHT has tried to anticipate the market by installing capacity before demand has been established to increase the confidence of prospective EV purchasers that they can go anywhere in Tasmania with adequate EV fast charging capacity. In general, until recent months, this has ensured sufficient capacity at our sites so that queuing has been minimal, less than 5% on average over the year at all sites.

This changed rather dramatically since November 2022 when use across the network grew strongly and three of our sites became 'excessively' busy. Given the alignment with the strong growth in EV uptake during the period, we do not believe this is purely a seasonal peak. Additional chargers have been ordered to expand these sites.

We are beginning to have sufficient data from our sites to enable us to estimate the capacity required as EV ownership grows with a little more confidence. We have both a range of charger capacities, (24kW, 50kW and 75 kW) and relatively good coverage statewide to show the distribution of demand. This paper presents the statewide analysis as an indication of the likely expected demand in the long term.

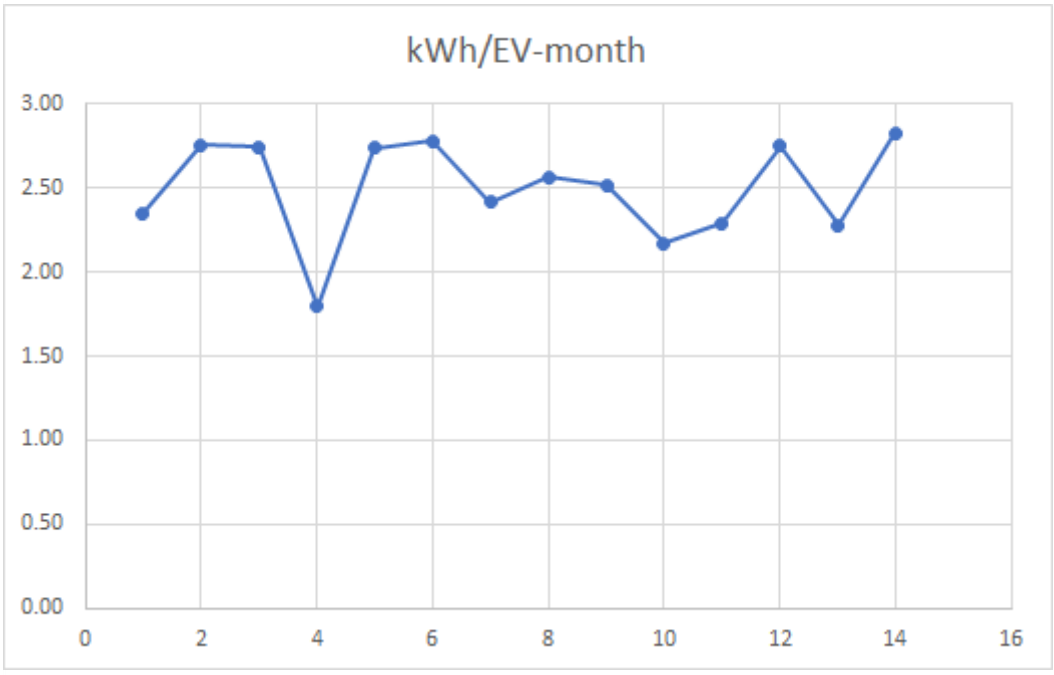
Data used

The Tasmanian Government provides data on number of registered EVs (excluding PHEVs) by major category: https://www.transport.tas.gov.au/licensing/general_information/statistics The EV data has only been collated and published since November 2021 so the history is still a bit short.



Using these statistics, we track Tasmanian EV numbers in relevant categories (not trucks, buses and motorcycles) against kWh delivered by our DC charger network to EVs with Tasmanian post codes. Only about 85% of EHT charging transactions reveal postcodes but that ratio remains reasonably steady so the trend is valid.

The monthly trend is quite steady as shown in the graph below. This is despite the number of EVs doubling over the year and the number of sites operated by EHT increasing from six to thirteen. Note that consumption by months is 'normalised' for the number of days so the dip in Feb (marked as '4') is not due to it being a shorter month. The seasonal variation roughly tracks intra-state tourism activity in the state.



The average electricity delivered to EVs on our network is about 1.4% of the estimated total electricity used by the EV fleet, assuming the distance travelled is about the same as the average Tasmania private passenger vehicle (40 km/day) and energy use is 0.15 kWh/km. Allowing an additional 15% for EVs whose state of origin is not identified by our chargers, this would increase to about 1.6%.

EHT has about 35% of the fast charger capacity in Tasmania but does not occupy the most travelled routes, so this suggests that that DC fast charging in Tasmania from all sources provides between 5% and 7% of the electricity used by Tasmanian EVs, consistent with our expectations.

Some charging away from home is provided by the large number of public AC chargers, possibly a similar amount of energy but probably less. The rest of EV energy used – at least 90% – is at home (or at fleet base).

These statistics are for Tasmanian EVs. Over the year, in the absence of COVID restrictions on interstate travel, interstate post codes account for about 40% of charging activity on the EHT network. We believe it may be higher for EHT than other providers because of our strong presence in tourism regions of the state.

Interstate use is strongly seasonal, but the trend shows interstate growth in our network is a bit stronger than Tasmanian growth. Confidence in this is low given the irregularities introduced by COVID in years past. However, it seems that interstate EV drivers have discovered that Tasmania is a great place for EV tourism, contributing significantly to DC fast charge demand in the state.

Longer term projections

This is a short period of record, so long term projections must be seen as tentative. Projecting forward, there are many factors that will affect the capacity of chargers required to meet the total demand. The number of charging bays required will depend on factors such as:

1. **Battery size** – Larger battery EVs will require proportionately less charging away from home (or fleet base) and use of public DC fast chargers per EV will trend down over time.
2. **Charging capacity and average charging rates** – Faster chargers (and faster charging EVs) will require fewer bays to deliver the same energy. We find that average charging rates are about 70% of the 'nameplate' capacity given that EHT has relatively conservative charging power. This ratio declines as charger maximum capacities increase.
3. **Utilisation** (hours per bay per day) – We expect average utilisation of charging bays to be four hours per day in a mature environment. On peak days this would be up to 12 hours per bay. Above four hours per day average, queuing will be excessive too often. Below four hours per day, the price would have to be higher than at present to be viable, unless the cost of installation and maintenance of EV fast chargers falls substantially.
4. **Alternatives to fast charging** (on-street charging, overnight accommodation providers, destination charging) – Low powered AC charging is generally cheaper to provide, friendlier to the grid and better matches overnight charging needs so should be encouraged and is likely to play a significant long-term role, reducing DC fast charger use.
5. **Vehicle type** – Our data and usage estimates are so far mostly for private light passenger vehicles; consumption will be heavier for utes, vans, light trucks or heavily used commercial vehicles (eg taxis), towing boats and caravans – not to mention heavy vehicles such as buses and large trucks.

Our expectation is that the percentage of public fast charging will not exceed 5% in the long run and may fall to as low as 2% in Tasmania.

We expect chargers to average about 90 kW charge rate as future 800V EV architectures make 200kW peak charging without cable/connector cooling practical. A charge rate of 200kW provides about 300 km in 20 minutes, which in the Tasmanian context is ample for almost all users.

The assumed average of 90kW is 45% of the nameplate capacity of a 200kW charger. Not all chargers in the state will be 200kW capacity and not all EVs will support such high charge rates.

How many charging bays are enough?

The total number of bays required for a 100% EV fleet of light passenger vehicles and light goods vehicles in Tasmania can be estimated based on the following assumptions:

Electricity use:

- Number of vehicles 500,000 (currently 480,000 light passenger and light goods vehicles)
- Average distance travelled 15,000 km per year (currently 14,600 but expected to go up as the marginal cost of travel is much less for EVs)
- Energy use of 200 Wh/km (current average closer to 160 Wh/km but expect to see higher average as more larger vehicles (utes, van, small trucks) are included in the mix
- Total electricity required = 500,000 x 15,000 x 0.2 = 1,500,000,000 kWh per year

Share in fast chargers:

- At 5% = 75,000,000 kWh per year
- At 2% = 30,000,000 kWh per year

Delivery capacity per bay per year

- Average use of four hours per bay per day
- Average delivery, 90kW

- Total energy per bay = 4 x 90 x 365 = 131,400 kWh/year

Number of bays required for Tasmanian vehicles

- At 5% 75,000,000 ÷ 131,400 = 570 or about 1 bay per 900 EVs
- At 2% 30,000,000 ÷ 131,400 = 228 or about 1 bay per 2,200 EVs

Now all we must do is accurately predict the rate of uptake of EVs and where they need to charge!

Caveats:

- These estimates assume perfect allocation of capacity to where demand arises which is highly unlikely.
- These estimates assume all stations operate economically, with moderate levels of queuing. In practice, many stations may be established that prove to be not profitable but that may remain open if losses are bearable to the owner. Others may regularly queue.
- If the cost of establishing and operating a fast charger is significantly reduced, the break even number of hours per day will be lower, allowing sites to operate with fewer than four average hours per day per bay. This may particularly apply where a single bay is installed in areas of modest demand with a limited power supply but low installation costs.
- The estimated number of bays does not include interstate vehicles. These may add up to 25% to the demand in peak seasons in the long term.

Taking all these factors into account, the total number of fast charging bays installed is likely to be of the order of double that estimated above, that is about 500 to 1,000 bays statewide to meet the needs of a 100% electric vehicle fleet.

And how many charging sites?

Sites with multiple charging bays reduce the likelihood of queuing, reduce wait times when queuing does occur, and make it easy to see when a charger becomes free. Queuing theory shows an increasing benefit with scale, but equally a declining rate of improvement as the number of bays increases. There are also often economies of scale for both capital and operating costs in sites with larger numbers of charging bays.

Offsetting this, a few large sites may offer less convenience to users than having more sites which are convenient for different users. In our estimation all but the most infrequently used sites should have at least two bays, and given the geographic characteristics of Tasmania, benefits of further scale at any site are reduced once a site has about eight bays.

Taking an average of about four bays per site, we expect that there may be about 125 to 250 commercially viable sites with EV fast chargers in Tasmania

To put this in perspective, by about the end of 2023 there will be 80 EV fast charging bays in service in Tasmania at about 60 sites, albeit on average with about one third of the charging power assumed in the calculation above. That suggests that:

- One quarter to one half of all *sites* ever required in Tasmania will have been established within the next year;
- Charger capacity is approaching 5% of the low estimate and 2% of the high estimate likely for a 100% EV fleet. The fleet will not be 100% electric until the late 2030s.

At this point the above is a rather ‘heroic’ extrapolation that must be treated with caution. However, each year that passes allows this to be refined. If other charge point operators share data on total energy delivered to Tasmanian drivers, a clearer picture will emerge each year of the likely need for charging infrastructure in the long run.

The estimates above of charging bays required will be considered extremely low by those commenting in social media that think we need one fast charger per 10-20 EVs.

> *The EV per charging point ratio remained relatively flat over the 2015-2021 period at under 10 EVs per charging point in China, Korea, and the Netherlands. This reflects charging infrastructure deployment that matches the speed of EV stock growth. In the United States, the number of EVs on roads outpaced the number of public charging points, with about 18 EVs per charging point in 2021. A similar trend is observed in Norway, where there were only a handful of EVs per charging unit in the early 2010s versus around 29 by 2021.*
>
> https://www.iea.org/reports/global-ev-outlook-2022/trends-in-charging-infrastructure

Some further caveats

The estimate above does not include heavy vehicles which will require their own higher power and high clearance drive through sites and are expected to be catered for separately.

Some very high use vehicles may have their own special arrangements. For example, taxis are likely to have wireless charging at taxi ranks and not use general purpose EV fast chargers much.

The assumptions and estimates used above are specific to Tasmania and are not representative of conditions in other Australian states. For larger Australian cities and for many countries overseas, dwellings often do not have private off-street parking, and EV owners depend to a much greater extent on public fast chargers. In those situations, the fleet average of charging delivered by public fast chargers is likely to be an order of magnitude higher than in Tasmania (say 20% to 50%) and require correspondingly many more EV fast chargers (and serve fewer EVs per charger).

Management response: In a rapidly evolving industry with limited precedents, it is important to try to establish some benchmarks against which to calibrate forward planning and help maintain a sense of perspective. At the same time early conclusions must be treated with care. Frequent critical review is required to ensure that forward planning does not become tied to false certainties.

Implications for future projects: Ideally, make explicit some of the foundation assumptions used in project design so they can be assessed, and reality checked by participants who will be developing their own benchmarks and expectations.

Conclusion: It is an exciting time to be in this business!