Chargefox Electric Vehicle Charging Network Project

2018/ARP125

Project results and lessons learnt

Lead organisation:	Chargefox		
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Executive Summary

Chargefox's Electric Vehicle (EV) Charging Network Project commenced in October 2018 and is due to be completed mid-2020. The Project will deliver 22 ultra-rapid EV Charging Sites across Australia in order to make EV ownership more attractive and feasible. This project was made possible by the funding from ARENA as part of ARENA's Advancing Renewables Programme. To date, Chargefox has commissioned 12 of these Charging Sites and a further four are constructed and awaiting power connection. This report documents lessons learned by the Chargefox's team over the past quarter. The lessons learned presented here include an innovative dynamic connection arrangement with electricity networks, a new approach to commissioning, and a new streamlined approach to project delivery. All of these have improved our ability to deliver ultra-rapid EV charging quickly and to budget.

Project Overview

Project summary

The Project is the development and construction of at least 22 Charging Sites along major driving routes between Brisbane and Adelaide along the coast of Eastern Australia, in and around Perth in Western Australia, and in Tasmania, at approximately 200km apart. Each Charging Site will hold at least two (2) DC Charging Stations of a minimum charging capacity of 150kW each at the conclusion of the Project. Due to the additional stage 2 funding from the Victorian Government, the Melbourne site will hold a total of four (4) ultra-rapid Charging Stations and two (2) 50kW DC charging stations. In addition, four (4) other regional Victorian sites, will also have two (2) 50kW DC chargers added to them, allowing four cars to charge simultaneously at those sites. Other higher traffic sites on the network may include additional Charging Stations at lower capacity. The Project will allow all EV models currently available for sale in Australia to charge through its stations.

Project scope

The objectives for the Project will be achieved through the following Outcomes:

- creating an EV charger management platform designed and built in Australia, which helps EV drivers find chargers and business owners manage their chargers;
- developing, constructing and operating at least 22 Charging Sites, comprising at least 2 DC Charging Stations at each site, using ultra-rapid EV chargers to dramatically reduce charging times for drivers. The stations will be accessible to all EV models currently available for sale in Australia;
- installing solar PV and a battery to provide the electricity needs for all the Charging Stations for at least one Charging Site;
- providing accessibility to Charging Stations to at least 75% of the Australian population; and
- reducing range anxiety for prospective purchasers of EVs in Australia through the creation of a network of Charging Sites along major driving routes.

Outcomes

To date, the following has been achieved against the agreed Outcomes:

- Chargefox has delivered the charger management platform and freely-accessible app on iOS and Android, and we have over 1,300 plugs on the network.
- Of the 22 Charging Sites, we have commissioned and opened 12, and a further four are constructed awaiting power connection.
- Solar PV and battery was installed at the Euroa Charging Station. Solar PV and batteries are being included in other sites as appropriate.

Conclusion and next steps

Chargefox will continue to build the remaining sites to completion.

Lessons Learnt

Lessons Learnt: Dynamic connections

Knowledge Category:	Technical
Knowledge Type:	Network connections
Technology Type:	Electrical Vehicles
State/Territory:	New South Wales

Key learning

We can use electricity network infrastructure much more efficiency, and improve our site-finding process, through the use of dynamic connections. A dynamic connection measures the capacity available at a network asset at a moment in time, taking into account the size of the asset and the power being drawn by other customers connected to that asset, and allows the EV chargers to use the balance of power remaining.

This is beneficial for the network, because it means the asset is being used much more efficiently and as a result defers the need for network augmentation.

Implications for future projects

Dynamic connections make a greater range of potential EV charging sites feasible without needing a high voltage upgrade, which tends to be expensive. They also have the potential to reduce the time needed to deliver a site. The benefits are much wider than EV charging – any large, variable load that is able to implement the control strategy to the satisfaction of the network should be able to use this approach.

Knowledge gap

The first knowledge gap was regulatory, in that it required agreement with the network; in this case, Essential Energy in NSW. Essential Energy agreed to trial the dynamic connection for 12 months subject to a number of safety and monitoring requirements. To our knowledge, this is the first time Essential Energy has agreed to and approved a dynamic connection configuration. The pilot will give the network confidence in the concept which will influence other networks. Because it means assets can be better utilised, there are clear benefits for networks.

The second knowledge gap was the technical solution. It uses a meter to measure the total load on the network asset, and the available power is then calculated. This result is then fed to the chargers and Chargefox's servers. The chargers are controlled so that they may not exceed the maximum available power. Chargefox in partnership with JET Charge developed this technical solution including building a full operating test system to demonstrate the concept.

Background

Objectives or project requirements

The power connection is one of the most significant technical challenges in an ultra-rapid EV charging site, due to the high power requirements. It is a major constraint to site selection and can be very expensive and with long lead times. Ideally, a site has power available without needing to augment the network, but sites like this are difficult to find.

Using a dynamic connection takes advantage of network assets that are subject to variable loads, and makes what power is available at any one time to the chargers. For example, a network transformer may have 50% capacity available for the vast majority of the year, excepting hot summer days when air conditioning loads reach high peaks. Dynamic connections allow that capacity to be used for most of the year, and dial chargers down for the short periods when a lot of power is being used by other customers.

Process undertaken

Through our electrical designer, we engaged with Essential Energy to first test their interest in the concept, and then to understand what they would need in order to approve a dynamic connection. This informed the technical solution which was developed by Chargefox on the software side, and JET Charge on the hardware side. We developed and constructed a working demonstration using a 50 kW DC charger to prove the concept.

Essential Energy's approval of the connection configuration set out their requirements for implementation. This is now being implemented at our Gundagai site and we expect to have it fully operational shortly.

Supporting information (optional)

N/A

Lessons Learnt: Remote commissioning

Knowledge Category:	Technical
Knowledge Type:	Construction
Technology Type:	Electrical Vehicles
State/Territory:	All of Australia

Key learning

We can deliver projects more efficiently by implementing remote commissioning with our charging hardware suppliers. Remote commissioning is when the charger manufacturer's commissioning staff don't attend on site, and instead oversee the process as it is completed by appropriately experienced and trained electricians.

Implications for future projects

We take a flexible and lean approach to project construction, which often leaves little time for delay or error. A particular cause of delay that is often outside our control is the connection of power supply to our sites. Additionally, we have previously needed to book busy commissioning teams in advance. A last minute delay to power connection can therefore cause flow-on delays. Our ability to remote commission gives us greater flexibility to complete projects on time and has a side-effect of upskilling our installation teams so they can do even better work for us in future.

Remote commissioning is of significant additional benefit when delivering projects during the COVID-19 pandemic, as it avoids the need for interstate travel and reduces the number of people working on site.

Now that we have remotely commissioned one site, at Ballarat, we have already discussed ways to improve the process for future sites. For examples, better use of live-streaming video cameras and audio will make it easier for remote personnel.

Knowledge gap

Remote commissioning was not possible previously as procedures and training resources had not been established, and there was limited experience installing unfamiliar equipment. The charger manufacturer developed these resources which were then negotiated in terms of on site practicalities. We brought in electricians who had built sites for us previously and who had already experienced the commissioning process.

Background

Objectives or project requirements

As we have rolled out this project, it became very clear that we needed a more flexible approach to commissioning that gave Chargefox's delivery team greater control of the process. This was particularly the case as our Charging Sites are located all around the country, and we are sometimes commissioning multiple sites concurrently.

Process undertaken

The charger manufacturer established processes including pre-commissioning checklists, online training modules for installation staff, and lists of equipment needed on site. During commissioning, on site and remote staff used live video streaming to undertake commissioning and documented all the commissioning tests as they were completed. After commissioning was complete, all staff involved participated in a debrief to discuss improvements for subsequent sites.

Supporting information (optional)

N/A

Lessons Learnt: Streamlining project delivery

Knowledge Category:	Logistical
Knowledge Type:	Construction
Technology Type:	Electrical Vehicles
State/Territory:	All of Australia

Key learning

We can more efficiently and flexibly deliver multiple sites concurrently by consolidating our delivery team and streamlining site design, equipment specifications, logistics and construction. We have achieved this by building a strong team to deliver multiple sites and ensuring we can easily switch focus between sites as needed across all stages of design and construction.

Implications for future projects

Our ability to deliver sites efficiently and flexibly has stepped up significantly since project commencement and we will continue to improve as we deliver each site. For example:

- *We can easily divert resources to different sites, as needed*
- *Hardware can be procured in advance, kept in storage and deployed to whichever site is ready for it*
- *Logistics can be simplified and made cheaper by scheduling pick-ups and deliveries to multiple sites at once – often in different States*
- *Our project budgets and construction schedules are synchronised better than ever*

Knowledge gap

Engaging design and construction services on a site-by-site basis has benefits but can also slow projects down, for several reasons. Firstly, it usually involves more tightly scoped contracts which limits the ability to direct resources to areas where the most progress is possible. Another major reason is that aspects of design, such as switchboard design, are done per-site which means that specific pieces of hardware are tied to particular sites.

With a very busy work program involving sites being constructed concurrently, we identified the need to change our approach and engage design and construction services on a different basis. We were only able to do this after we had delivered sufficient sites such that we were able to assemble the right people who possessed the right skills, accreditations and experience across different jurisdictions, and would be able to work together flexibly and collaboratively.

Background

Objectives or project requirements

We needed to alter our approach to project delivery so that we could deliver sites to an ambitious project schedule, whilst maintaining control of our budgets. For this, we needed to partner with

organisations with a national presence and/or had experience and knowledge to deliver to the required standards, which vary between different States and electricity networks.

Process undertaken

Based on our experience with our earlier sites, we were able to identify and engage the right people to form a project delivery team. Our approach to working together has been transparent and frank, resulting in high levels of trust. The proof of this approach is in our results – we have been building and commissioning sites at great frequency since taking this approach in the second half of 2019.

Supporting information (optional)

N/A.

Lessons Learnt: Ultra-Rapid Usage Analysis

Knowledge Category:	Technical
Knowledge Type:	Technology
Technology Type:	Electrical Vehicle Chargers
State/Territory:	All of Australia

Key learning

Usage of ultra-rapid charging stations is growing over time, as of new sites are constructed and the sale of electric vehicles grows in the market. Sessions on charging stations on those sites, across both 50kW and 350kW chargers, are normalising around a time duration rather than an energy consumption amount. Drivers are charging for 20-30 minutes and consuming 10-20kWh energy, meaning sessions are top-up, rather than fill-up. 350kW chargers get used about 50% more than 50kW chargers on the same site.

Implications for future projects

Ongoing analysis around usage can assist in planning for expansion of existing sites and planning of new ultra-rapid sites. Duration and power analysis, along with utilisation information, allows for infrastructure to be more focussed on actual usage. This could theoretically lead to lowering of costs for future site construction, or at least more focussed spend.

In addition, understanding usage patterns also allows for the driver experience to be improved around their interaction with the chargers. The digital experience in particular can be customised to follow usage styles, encouraging drivers to support each other and move on at appropriate times.

Knowledge gap

At the beginning of the project, the only information available around usage of ultra-rapid chargers came from European and US markets that were still nascent. No information at all was available for Australian drivers and their habits around domestic usage.

Background

Objectives or project requirements

Our goal here was to measure usage patterns of charging stations on ultra-rapid sites to understand how Australian drivers in particular might use them.

Process undertaken

The systems developed by Chargefox record detailed information of all charging sessions, including location, duration and energy consumption. As usage of the network has grown, we've been able to analyse that data to see patterns emerging on usage.

Supporting information (optional)

N/A.