

AGL Electric Vehicle Orchestration Trial

Lessons Learnt Report 1
May 2021



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This Project received funding from ARENA as part of ARENA's Advancing Renewables Program.

The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

1. Executive Summary

AGL's Electric Vehicle Orchestration Trial has received funding from ARENA as part of ARENA's Advancing Renewables Program. The trial comprises three streams:

- A trial of orchestrated residential EV smart charging comprising 200 participants who will have their charging controlled via a smart charger installed in their homes.
- A trial of two emerging charging technologies:
 - Vehicle to grid (V2G) – 50 participants who will have vehicle charging and discharging controlled via a V2G charger installed in their homes.
 - Vehicle API charging control – 50 participants who will have their vehicle charging controlled remotely via an API supplied by the vehicle manufacturer.
- A control group of 100 customers on a time-of-use (TOU) tariff to assess the effectiveness of a tariffication incentive against that of firm charging control.

The project is currently in the recruit and build phase, with 82 smart charger participants recruited and 28 chargers installed, plus 25 vehicle API participants recruited. Work on developing the necessary aggregation software is well advanced.

Due to delays in the availability of V2G chargers, the V2G stream of the project has not yet commenced.

2. Introduction

The AGL Electric Vehicle Orchestration Trial project commenced in November 2020 with the execution of a funding agreement between ARENA and AGL, and formal public announcements by the Minister for Energy and Emissions Reduction, ARENA and AGL. The project received funding from ARENA as part of ARENA's Advancing Renewables Program.

The trial comprises three streams:

- A trial of orchestrated residential EV smart charging to assess the value of controlled charging as a distributed energy resource – 200 participants who will have their charging controlled via a smart charger installed in their homes.
- A trial of two emerging charging technologies:
 - Vehicle to grid charging – 50 participants who will have vehicle charging and discharging controlled via a V2G charger installed in their homes.
 - Vehicle API charging control – 50 participants who will have their vehicle charging controlled remotely via an API supplied by the vehicle manufacturer.
- A control group of 100 customers on a time-of-use (TOU) tariff whose performance will be compared with the participants on controlled charging to assess the effectiveness of a tariffication incentive against that of firm charging control.

The project comprises three phases:

Phase 1: Recruit and Build – recruitment of all trial participants, installation of charging hardware in homes, and development of the aggregation platform to manage and control charging. This phase takes place during calendar year 2021.

Phase 2: Operate – test and understand the feasibility and value of smart charging as a distributed energy resource; trial the emerging vehicle API and vehicle-to-grid technologies; assess the experiences and perceptions of participants regarding EV charging orchestration; in conjunction with the Distribution Network Service Provider (DNSP) partners in the project, understand the positive and negative impacts of EV orchestration on the distribution network. This phase takes place during calendar year 2022.

Phase 3: Close-out – transition customers from the trial, analyse any remaining data and publish the final project report. This phase takes place in the first half of 2023.

3. Aggregation Software Development

3.1. Smart Charging

To control the smart chargers installed in participant's homes and to give participants visibility and control of what is happening with their charging, a charging aggregation platform is being developed for the smart charging stream. The platform comprises three main elements:

- A smartphone app that allows customers to:
 - see their current charging status
 - see what charging control is planned over the next few days
 - be notified of up-coming ad-hoc charging control events
 - override controlled charging when needed.
- EV charger aggregation software that:
 - manages the database of individual chargers in the field
 - sends control and programming commands to the chargers
 - manages the data behind the customer app, including notifications
 - groups chargers into blocks of controlled load that can be dispatched individually or together
 - manages the collection of data from the chargers
 - provides an interface for setting up charging schedules and ad-hoc charging control.
- A second software platform that collects data from the charger aggregation software and provides visibility and analysis tools to allow EV charging to be viewed together with other distributed energy resources being operated by AGL.

The first two elements of the platform are being developed by Chargefox for this project, as extensions to the software and app that they already have for the management of public chargers. The third element is being developed by AGL as an extension to an existing platform called NEO that is used for the management of distributed energy resources such as residential batteries.

Detailed development of these elements commenced in January 2021. At the time of writing, the development program is about 50% complete. The currently anticipated completion date for this part of the project is July 2021.

3.2. Vehicle API

The software to manage the control of charging via the vehicle API is similar in concept to that being used for smart charging except that the software does not communicate with smart chargers; rather it communicates directly with individual vehicles via an API provided by the vehicle manufacturer for this purpose. The vehicle then manages its own charging no matter what charger it is connected to, be it a

smart charger, a “dumb” charger or even just an extension lead plugged into a general purpose outlet. This technique potentially provides a powerful and low-cost way of controlling vehicle charging that we aim to understand and explore further during the trial.

For this part of the project AGL, has elected to use an existing platform developed by US company Flexcharging Inc. Flexcharging has extensive experience managing vehicle API control, which is quite challenging as, at this early stage of development, vehicle manufacturers are tending to alter their API functionality regularly. There are some minimal modifications to the Flexcharging platform being made in order to meet all of the trial requirements.

The overall architecture of the vehicle API platform is similar to that of the smart charging platform above:

- 1) A smart phone app to allow the customer visibility and control of their charging.
- 2) An aggregation platform that manages the data and control aspects of the trial and communicates with the vehicles via the vehicle manufacturer API. (AGL will be using Tesla vehicles for this part of the project as Tesla have a well-developed API in operation globally, including in Australia.)
- 3) A data interface to the AGL NEO software for data management and analytics.

This development is largely complete, including data transfer from the Flexcharging platform to NEO.

3.3. Vehicle-to-Grid

Development of the vehicle-to-grid aggregation software has not yet commenced. Pending the availability of chargers and resolution of some technical questions around the optimal method of communicating with these chargers, we expect this development to commence in Q3 2021.

3.4. Lessons Learnt

Detailed investigation into vehicle-to-grid technology since the commencement of the project has revealed that the technology is still at a very early stage, perhaps earlier than is widely thought. Trials held overseas to date are small in scale, using essentially pre-production hardware and rudimentary software systems, and there are not yet any rollouts of the technology beyond these trials. V2G chargers are not yet being sold as commercially available product.

The integration/interfacing of V2G chargers with control and aggregation software is not yet standardised – the Open Charge Point Protocol (OCPP) V2.0 standard promises to do this in the future but is not yet a reality. Consequently, a number of technical questions remain regarding the optimum way to interface with and control V2G chargers, and it will be necessary for the project to resolve these before moving ahead with development of the aggregation platform for the trial.

4. Customer Recruitment

4.1. Participant Offer

The participant offer is particularly attractive and is expected to drive interest in the trial:

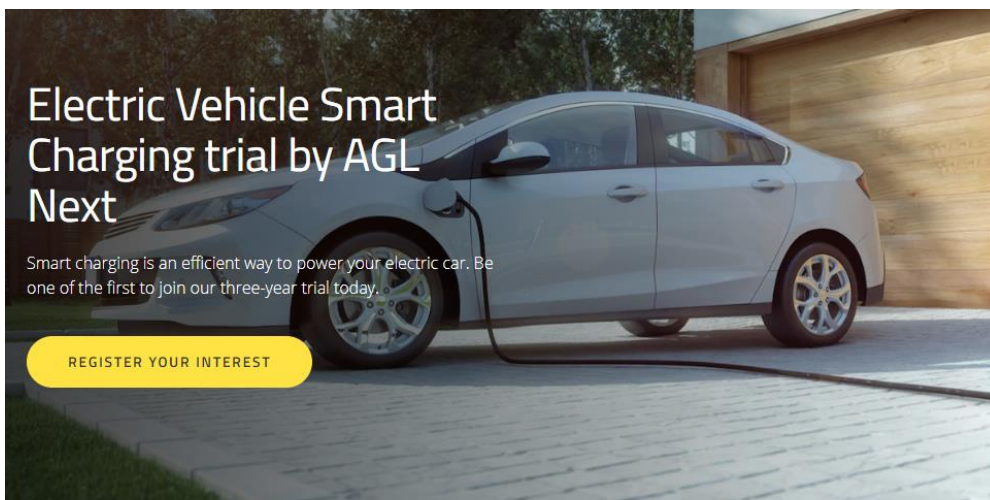
- Smart charging – free smart charger and installation (for a “standard” install), bill credit and carbon neutral energy plan.
- Vehicle API – bill credit and carbon neutral energy plan.
- V2G charging – discounted charger, bill credit and carbon neutral energy plan.

4.2. Smart Charging

To take advantage of media publicity surrounding the project launch in November 2020, AGL implemented a project landing webpage including an expression of interest form that could be completed by intending participants¹. A total of 280 registrations were received through this method prior to formal recruitment commencing.

Following development of the necessary sales support and fulfilment back-office software, AGL started customer recruitment for the smart charging stream on 9 March 2021 with our recruitment agent commencing outbound contact with potential participants who had registered interest in the trial.

¹ <https://www.agl.com.au/get-connected/electric-vehicles/smart-charging-trial>



About the trial

If every electric car driver comes home from work and starts charging at the same time, while the grid is already at peak demand, it's just going to add to the pressure. To cope with that, we may need a bigger grid, which would be expensive - and could mean higher electricity bills for everyone. But what if we could just get smarter about when we charge our cars?

Introducing smart charging

Smart charging means we can communicate with your charger, or car, to start charging when the demand for electricity is lower - like overnight or in the middle of the day. And since most cars are plugged in for longer than they actually need to charge, we can be flexible with charging times.

Figure 1 - Part of the trial landing page

The recruitment agent has worked full-time on recruitment for the trial since that time.

The initial expressions received from the time of the trial announcement have been augmented with further expressions of interest resulting from targeted EDM campaigns to AGL EV tariff customers and EV owners via a number of EV manufacturers.

At the time of writing the recruitment and installation program is on track with 82 participants signed up to the smart charging stream and 28 chargers installed. Conversion rate from expressions of interest to charger installation is around 50%, with the main reasons why the customer did not proceed being:

- Customer is living in multi-unit development where it is not possible to install the charger on the customer's property.
- Installation complexity, for example trenching, leading to a high installation cost.

Recruitment will continue until all 200 participants are recruited and have their chargers installed.

4.3. Vehicle API

The vehicle API control concept relies upon vehicle manufacturers having a suitable API available to be used by a third party to control the vehicle charging. Globally this is becoming more common, however in Australia the relatively low number of EV models on the market, and the relative immaturity of the EV market generally, has meant that there are very few options available at present.

In scoping the project during 2020, AGL identified Tesla as the sole EV manufacturer operating in the Australian market that had this capability available locally. A small number of other vehicle manufacturers selling EVs in Australia had the capability available in international markets but not locally, and some others who had the capability internationally were not yet selling EVs in Australia.

Consequently, the recruitment effort for this stream has focussed on Tesla owners, from whom we had received a large number of expressions of interest. Recruitment for this stream has only just commenced, however the response has been very positive for those customers who already have a charger installed with 25 participants had signed up at the time of writing. At this stage we don't anticipate any concerns filling the target of 50 vehicles for this stream.

4.4. Vehicle-to-Grid

Recruitment for the vehicle-to-grid stream is presently on hold until we have a clearer view of charger availability.

Eligibility for this stream is limited to Nissan Leaf owners, the Leaf being the only V2G-capable battery EV on the market at present. This part of the trial has created quite a lot of interest amongst Leaf owners with many of registrations of interest from this group. These customers are being contacted and advised of the delay in the supply of chargers – if they are happy to wait then they are held on a specific V2G list for later contact. Those not able to wait for their charger are being transferred to the smart charging stream.

4.5. Lessons Learnt

The delay between the announcement of the project in November 2020 and commencement of recruitment in March 2021 was less than ideal from a customer journey perspective. This delay was necessary to allow the development of software to enable the sales process, however it meant that customers who had expressed interest were not contacted for some months. Nevertheless, very few customers dropped off the list due to changed circumstances and the recruitment process has proceeded reasonably well since it commenced.

5. Charger Supply Chains

5.1. Smart Chargers

The smart charger stream of the trial is not designed to be a technology trial of the chargers themselves; rather it is a trial of the value and customer impact of smart charging orchestration. To ensure the project meets this objective, charger selection for this stream has erred on the side of reliability and low technology/supply-side risk so that the principal purpose of the stream is not impacted by delays in charger supply or technical issues with the chargers themselves.

AGL has selected the Schneider EVLink Wallbox charger for the initial stages of the trial. This charger is a relatively low risk selection because:

- The charger has been in production for several years and has an established supply chain.
- The charger has the necessary certifications for the Australian market.
- Inventory of this charger is already held in Australia by the charger supplier for this project, JET Charge, through an established supply line with the manufacturer, Schneider.
- AGL has had previous experience controlling this charger, having used it in an earlier small-scale trial of residential smart charging² and through having multiple units installed in the AGL corporate car park in Melbourne (which are useful for testing).
- The aggregation software provider for this part of the project, Chargefox, has had previous experience controlling and monitoring this charger and has some aspects of the required interface already built.

This selection has proven to be a good one as charger installation has commenced on schedule without any delays in charger availability or supply.

AGL is currently assessing a different model charger to potentially take over from the Schneider EVLink Wallbox at a later stage of the trial. This model offers additional functionality in a smaller footprint with a lower cost and will therefore be very attractive for a wider-scale rollout. At the time of writing, this charger is going through approval testing at an independent test laboratory. Once this has been achieved, AGL will undertake further functional testing and interface testing in conjunction with Chargefox before introducing the charger into the installation program.

5.2. Vehicle-to-Grid Chargers

In contrast to the smart charging stream, the vehicle-to-grid (V2G) stream of the trial is all about the introduction and trialling of new technology. In that respect, issues with the new technology being introduced are to be expected and indeed embraced and solved during the course of the trial.

² AGL ARENA Demand Response Trial – refer <https://arena.gov.au/projects/agl-demand-response/>

AGL's original plan was to commence installation of chargers for the V2G stream in June 2021. The charger proposed to be used is the Wallbox Quasar, being supplied in Australia through JET Charge. This is one of only two residential V2G chargers currently available for trial purposes on the global market to our knowledge.

As V2G chargers include a grid-connected inverter, they must comply with the Australian Standard for grid connected inverters, Australian Standard 4777.2. Some aspects of this standard are different to the globally used international standards, meaning that additional testing, and possibly product modification, is required. The timeframes to achieve this with the Quasar have now extended from what was initially forecast.

At the time of writing, we expect the V2G chargers to be available in Q3 2021. If this timeframe is achieved, any adverse impact on the trial program will be minimal.

6. Charger Installation

6.1. Smart Chargers

AGL has partnered with JET Charge for the supply and installation of the smart chargers. The installation program commenced on target with the first installation completed on 31 March 2021. At the time of writing 28 chargers have been installed.



Figure 2 – First of the trial smart chargers installed at a home in Melbourne

AGL has implemented an end-to-end process to manage the installation of chargers covering handover from the recruitment team through to the completion of the installation. This process uses the Emvisage field services management software to provide a cross-organisational platform to manage the installation. As both AGL and JET Charge were already users of Emvisage this has been relatively simple to implement with only small modifications required to the Emvisage platform.

One issue that has been noted in the early stages of the installation program is a percentage of dwellings with a low current capacity (eg 40A single phase) available at the main switch. (The 7.4kW single phase chargers draw 32A unless limited to a lower value.) In these cases, the options are a relatively costly upgrade to the consumers mains or limiting the charge rate of the charger. The second

option is generally the one chosen. The extent to which this becomes a significant issue will be recorded as the installations proceed.

There have also been a small number of customers with detached garages for whom an installation involving trenching was not economic. This was anticipated.

Early customer feedback on the recruitment and installation process has been very positive. This will be reported in more detail in the next Lessons Learnt report once more installations have been completed and a larger sample size of survey responses is available.

6.2. Vehicle-to-Grid Chargers

There have been no vehicle-to-grid charger installations to date.

6.3. Lessons Learnt

Current capacity limitations at the main switch in some homes will limit the vehicle charge rate to a level below the maximum capacity of the charger. The extent to which this becomes significant will be monitored as the trial proceeds.

7. DNSP Engagement

7.1. Trial Establishment

AGL had been in dialog with a group of Distribution Network Service Providers (DNSPs) since the development of the trial concept in early 2020. A number of meetings were held with this group to explain the trial scope and objectives, and to gauge interest from the DNSPs in participating in the trial through the Technical Reference Group.

The DNSPs that elected to participate are:

United Energy
AusNet Services
Jemena
SA Power Networks
Ausgrid
Endeavour Energy
Energy Queensland (Energex and Ergon)

7.2. Technical Reference Group

The Technical Reference Group provides a forum where AGL and the partner DNSPs can socialise, discuss and guide the distribution network aspects of the trial. The Technical Reference Group is the main channel through which the distribution network activities for the trial are coordinated and information disseminated.

The objectives of the Technical Reference Group are to:

- Provide an interface between the DNSPs and AGL to ensure that key network issues are identified and addressed during the trial.
- Help design the test program for assessing distribution network impacts and orchestration value.
- Encourage discussion between the DNSPs themselves.
- Monitor and assess results.
- Allow adjustments in approach to be made throughout the trial.
- Disseminate information learnt during the trial between AGL and the partner DNSPs.
- Provide the opportunity to contribute to the ARENA knowledge sharing reports.

The Technical Reference Group has met once in the reporting period, on 3 March 2021. Apart from a status update on the trial, the main purpose of this meeting was to discuss the test cases that the various DNSPs would like to explore during the trial. The timing of this meeting was important as

detailed design of the trial aggregation software had just commenced and it was important to ensure that the software could execute all of the test cases that could be envisaged.

All of the represented DNSPs were active participants in the meeting. The meeting identified a number of test cases that had not previously been recognised by AGL and are now being built into the aggregation software development.

The next Technical Reference Group meeting is planned to occur in late May/early June 2021.