Origin EV Smart Charging Trial

Lessons Learnt Report

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Acknowledgement and Disclaimer

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Contents

ARENA Summary

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1. Executive summary

Origin has successfully augmented charging behaviour with trial participants conducted over two experiments. The key learnings below relate to the ongoing Smart Charging Trial that Origin Energy is managing with its participants.

2. Introduction

Origin's smart charging trial seeks to collect charging and usage data to provide insights into EV charging behaviours and examine responses to smart charging. The trial will provide insights required to inform the design of tariffs and retail propositions for smart charging to encourage the charging of EVs by customers in a way that will be beneficial to both EV owners as well as the electricity system.

The trial commenced in August 2020 and involves:

1. Installing and connecting at least 150 smart chargers onto Origin's Virtual Power Plant (Figure 1).
2. Capturing data on EV charging patterns. Data will be captured during a baseline period of unmanaged charging followed by a period of smart charging with different incentives and price signals.
3. Capturing data on how much energy usage can be shifted through smart charging.
4. Longitudinal study on drivers to explore customer perceptions, motivations and experience in smart charging and driving.

Figure 1: Illustration of connection of EV chargers onto Origin's Virtual Power Plant to facilitate smart charging
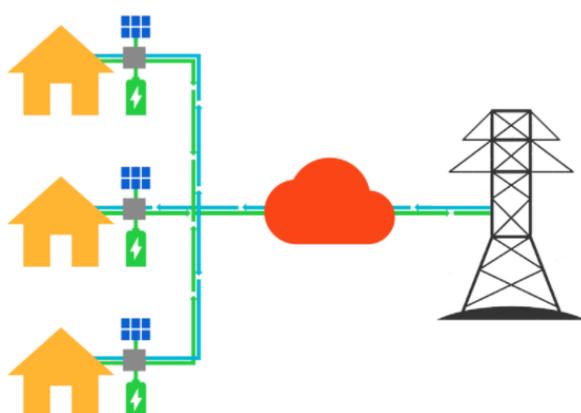
Origin's VPP will provide charging instructions to:

- Maximise consumption of renewables
- Minimise wholesale energy costs
- Comply with user preference for priority charging

Progress to date includes:

- Completion of Experiment 1
- Extension of Experiment 2

3. Key Learnings & Observations

Lesson Learnt No. 1: Lead time for installations increased due to COVID-19 lockdowns and commercial installations of chargers

Category: Logistical/Social

Objective: N/A - Observation

Detail: We found through the trial that the impact of COVID-19 continued to disrupt installation of chargers as lockdowns occurred in various states. As noted in our interim report, charging behaviour was also impacted by various lockdowns requirements across different states.

Origin further noted that commercial charger installs required a significant level of technical knowledge when compared to residential installs. Businesses were often concerned about load management on their site, particularly if a site already had high existing load. Further, we found that we had to navigate the decisions around adding extra chargers and the impacts this would have on infrastructure upgrades to business premises.

Conclusion: Commercial charging require large lead times due to corporate processes, sign offs and multiple people involved in making decisions. These lead times have a flow on affect with installers, employees and business being impacted by COVID, either through lockdowns, business policies or individual circumstances.

Lesson Learnt No. 2: Participants were willing to augment their charging behaviour for incentives (Experiment 1 – Incentivised charging)

Category: Economic/Social

Objective: Determine whether participants were willing to change their charging behaviour through incentives.

Detail: Preliminary data suggests that participants responded favourably to Experiment 1. Experiment 1 consisted of Origin implementing a variable reward to test a monetary incentive-based approach to smart charging.

The variable component consisted of a 10c per kWh reward for charging between the times of 10am – 3pm and 9pm – 5am. Charging outside of these pre-defined periods did not yield a reward. Rewards would accumulate and be provided to participants on a monthly basis as a credit on their energy bill.

When using the smart charger, feedback from participants was that they valued the visuals and functionality through the Origin app. We found there were a mix of power users where participants wanted full control of their charger (e.g., configuring the exact amperage at different times) and participants who just wanted something simple and automated.

Compared to baseline charging data *(Figure 2)*, we found that participants responded strongly to the incentive. As can be seen in *Figure 3*, charging outside of peak periods (3pm-9pm) increased from 70% during baseline periods to 90% during the first experiment. It was noted that participants shifted their charging to the 10am – 3pm period where charging increased by 6% and the midnight period where charging further increased by 17% suggesting that overnight charging was more flexible in their circumstance.

Figure 2: Baseline Residential charging behaviour
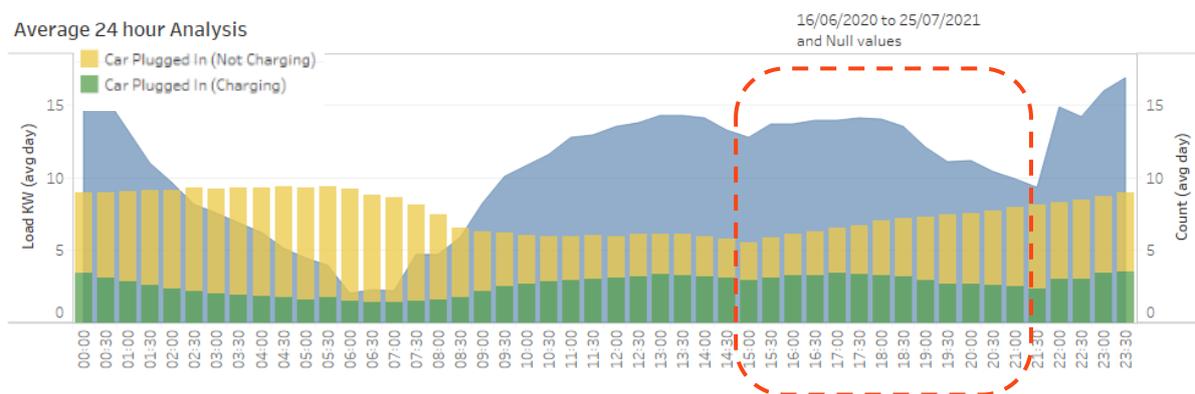
Figure 3: Experiment 1 Residential charging behaviour
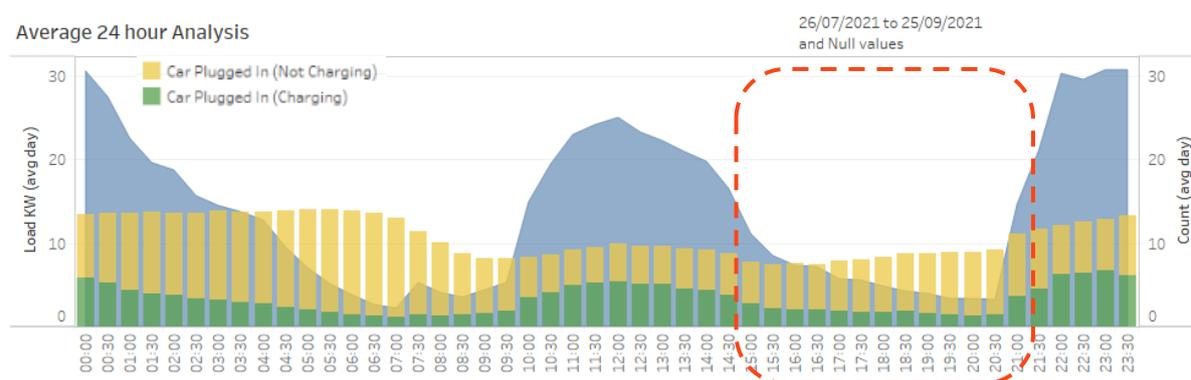
Average 24 hour Analysis — 26/07/2021 to 25/09/2021 and Null values

		Early Morning	**Solar Sponge**	**Peak**	**Overnight**
		5am to 10am	10am to 3pm	3pm to 9pm	9pm to 5am
Baseline	No incentives	7%	25%	30%	38%
Experiment 1	Incentives	4%	31%	10%	55%

This is a significant result as it indicates a participant's willingness to augment charging behaviour in response to a monetary incentive.

Interestingly, after the experiment and incentives had ended, participants continued to charge at the previously incentivised periods suggesting charging behaviour can be changed and be made habitual. Origin did not test how long the charging habits would last for in the absence of incentives.

Implications for future projects: Engaged participants have self-selected to be involved in the Smart Charging trial. Once EV's become more mass market, and less engaged customers are charging, the effectiveness of monetary incentives would need to be revisited. This can also be used to inform and determine tariff structures going forward.

Conclusion: Providing financial incentives to participants reduced charging consumption at peak times by 20%.

Lesson Learnt No. 3: Participants were willing to allow Origin to control their chargers for incentives (Experiment 2 – Origin managed charging)

Category: Economic/Social

Objective: Determine whether participants would change their charging behaviour by letting Origin take control of their EV charger driven by incentives.

Detail: Experiment 2 consisted of Origin controlling charging for a small window rather than relying on participants to control their charging.

Origin implemented a fixed and variable reward mechanism to incentivise control.

The fixed component consisted of a 25c per day reward if participants allowed Origin to curtail their charging between 3pm and 9pm. Furthermore, participants would also receive a variable component of 10c per kWh reward for charging between the times of 10am – 3pm and 9pm – 5am to further shape charging habits.

Noting that participants that may want to override this, Origin provided functionality in the Origin mobile app to override any settings *(Figure 4)*. We found that participants valued this feature as it provided flexibility and control when needed.

Figure 4: Smart charging override prompt on the Origin app
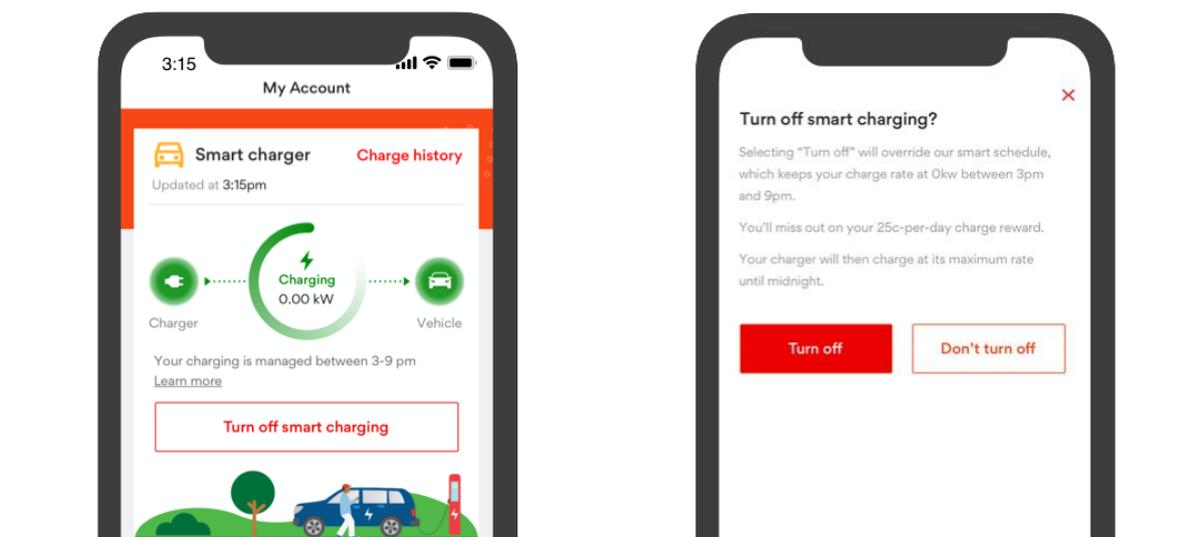
Figure 5: Experiment 2 Residential charging behaviour
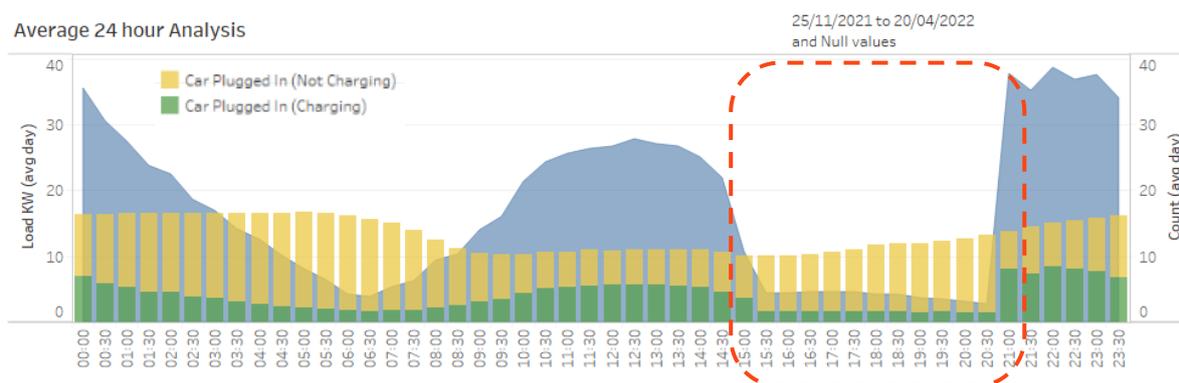
		Early Morning	Solar Sponge	Peak	Overnight
		5am to 10am	10am to 3pm	3pm to 9pm	9pm to 5am
Baseline	No incentives	7%	25%	30%	38%
Experiment 1	Incentives	4%	31%	10%	55%
Experiment 2	Incentives with control	9%	30%	6%	55%

Compared to baseline charging data *(Figure 2)*, Origin found that participants responded strongly to the incentives. Charging during the peak periods reduced by 24% when compared to baseline charging patterns and 4% compared to experiment 1 *(Figure 5)*. It was noted that participants further shifted their charging to the 10am – 3pm period where charging increased by 5% compared to baseline and a decrease of 1% compared to Experiment 1. Lastly, we noted changes in the overnight period where charging further increased by 17% compared to baseline and no change compared to experiment 1.

Although this approached provided only a 4% benefit when compared to Experiment 1, this is also a significant result as it indicates participants responded well to controlled charging in comparison to an incentive-based mechanism. This observed behaviour could be explained by the convenience factor of having to "plug and forget" for the participants rather than having to think daily about charging (and not charging) in specific time periods.

Implications for future projects: Although reducing peak consumption appears to be small (4%) when compared to just using pricing incentives – control of EV chargers will play a larger role in providing firmness of curtailment especially when less engaged customers adopt EVs.

Conclusion: Control of EV charging decreased charging from peak periods by an additional 4% compared to incentivised charging.

Lesson Learnt No. 4: Demand response peak events have all been within the Origin controlled curtailment window

Category: Economic

Objective: Determine whether network peak events required further intervention by the participant/retailer

Detail: A paper arrangement was set up between Origin and Powercor to take note of peak events (tabled below).

Network Patch	Date	Time
Citipower, Powercor, United Energy	Sunday 13th February 2022	4pm – 8pm local time
Citipower, Powercor, United Energy	Monday 14th February 2022	4pm – 8pm local time
Citipower, Powercor, United Energy	Monday 31st January 2022	4pm – 8pm local time
Citipower, Powercor, United Energy	Monday 24th January 2022	4pm – 8pm local time
Citipower, Powercor, United Energy	Friday 31st December 2021	4pm – 8pm local time
Citipower, Powercor, United Energy	Wednesday 30th November 2021	4pm – 8pm local time

Peak events had the potential to increase the price for charging, which was invisible to the customer. We note that based on the timing of these events, the experiments that Origin was conducting was already incentivising participants to charge outside of the peak period. No additional communication or further incentivisation was required due to strong participation in charging curtailment.

Implications for future projects: Although peak events were managed with one network on paper, standards to help with scalability and interoperability between networks, aggregators, retailers for practical implementation should be considered.

Conclusion: Peak events did not require additional engagement with the customer as it all fell within periods where Origin was curtailing EV charging.

4. Key Terms

Term	Description
ARENA	Australian Renewable Energy Agency
EV	Electric Vehicle
kWh	Kilowatt hour
Origin	Origin Energy
VPP	Virtual Power Plant