The University of Queensland
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THE UQ TESLASCOPE RESEARCH PROJECT

INSIGHTS REPORT 1

Thara Philip

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THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

CREATE CHANGE

Contact
Thara Philip
t.philip@uq.edu.au

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The UQ Teslascope Project Team

Thara Philip

HDR Scholar/Lead Researcher

Dr Kai Li Lim

St Baker Fellow in E-Mobility

External Advisor

Dr Jake Whitehead

The UQ Teslascope project was established by Dr Jake Whitehead in his former role as the Tritium E-Mobility Fellow at The University of Queensland.
Dr Whitehead continues to act as an external advisor on this project and is one of Thara Philip's PhD supervisors.

Project Overview

The UQ Teslascope project is an innovative research program that was launched at The University of Queensland in 2021. This project primarily aims to understand the driving and charging patterns of electric vehicles in Australia and across the globe, and analyse the scope of using electric vehicles as batteries-on-wheels.

UQ partnered with the analytics platform Teslascope to recruit Tesla users at a global level. Teslascope collects data from consenting Tesla owners and this data is shared with the research team at UQ.

Recruitment of participants for the first stage of the project began in November 2021. 409 participants from Australia, New Zealand, North America, Europe and the UK participated in the first phase of this project.

This project is funded by Advance Queensland and iMOVE Cooperative Research Australia. The UQ research team is greatly appreciative of the participants who made this unique and important research possible.

Australian researchers to study how Tesla car batteries can power grid

Queensland researchers examine ability of EVs to support grid

Researchers at the University of Queensland will conduct an international trial to assess if the spare battery capacity in electric vehicles could be used to accelerate the rollout of renewable energy, support the electricity network, and potentially power homes in the future.

UQ seeks 500 Tesla owners to gauge how EVs could act as grid batteries

THE FIFTH ESTATE

INFRASTRUCTURE & TRANSPORT

Batteries on wheels: UQ launches international vehicle-to-grid study

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Please note, a detailed research paper outlining the full results of this study is forthcoming. This report provides initial insights into the findings of this study. The full research paper will be on the UQ Charge-EV Project website once published: https://aibe.uq.edu.au/research/energy/electric-vehicle

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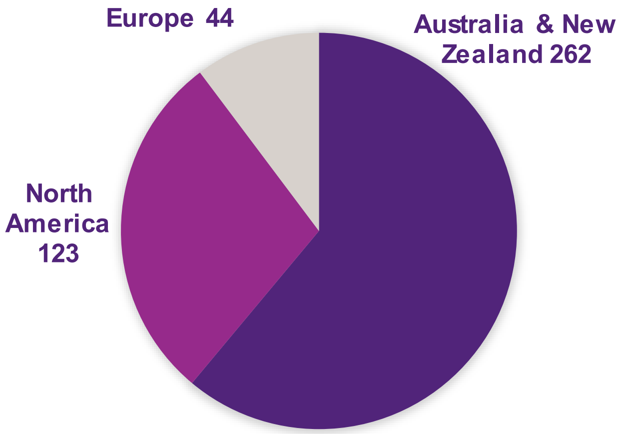
Data Insights



The UQ Teslascope project had 409 electric vehicle owners (429 electric vehicles) from across 15 countries as participants.

Figure 1. Distribution of cars by region

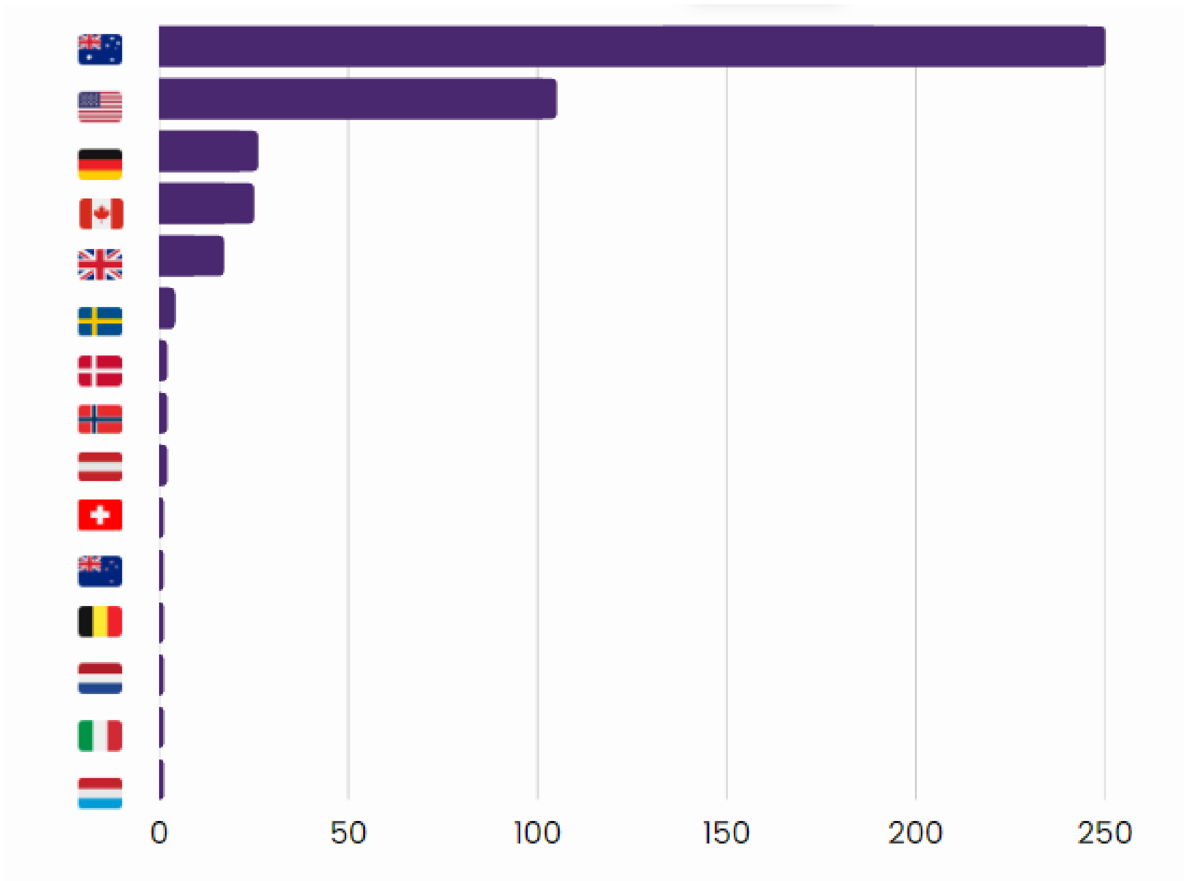
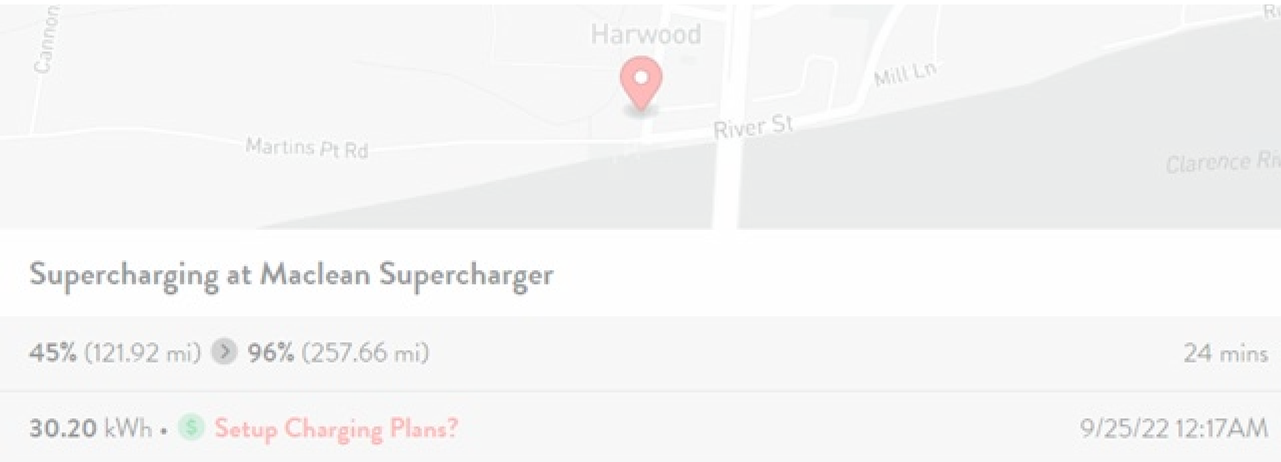


Figure 2. Number of participants by country

	Data Highlights
377	Days
17 Nov 2021- 29 Nov 2022	Date range
200,337	Number of driving events
2,949,895	Kilometres driven
69,579	Number of charging events
9,359	Number of fast charging events
977,168	Energy consumption in kilo watt-hours (kWh)

Table 1. Data highlights



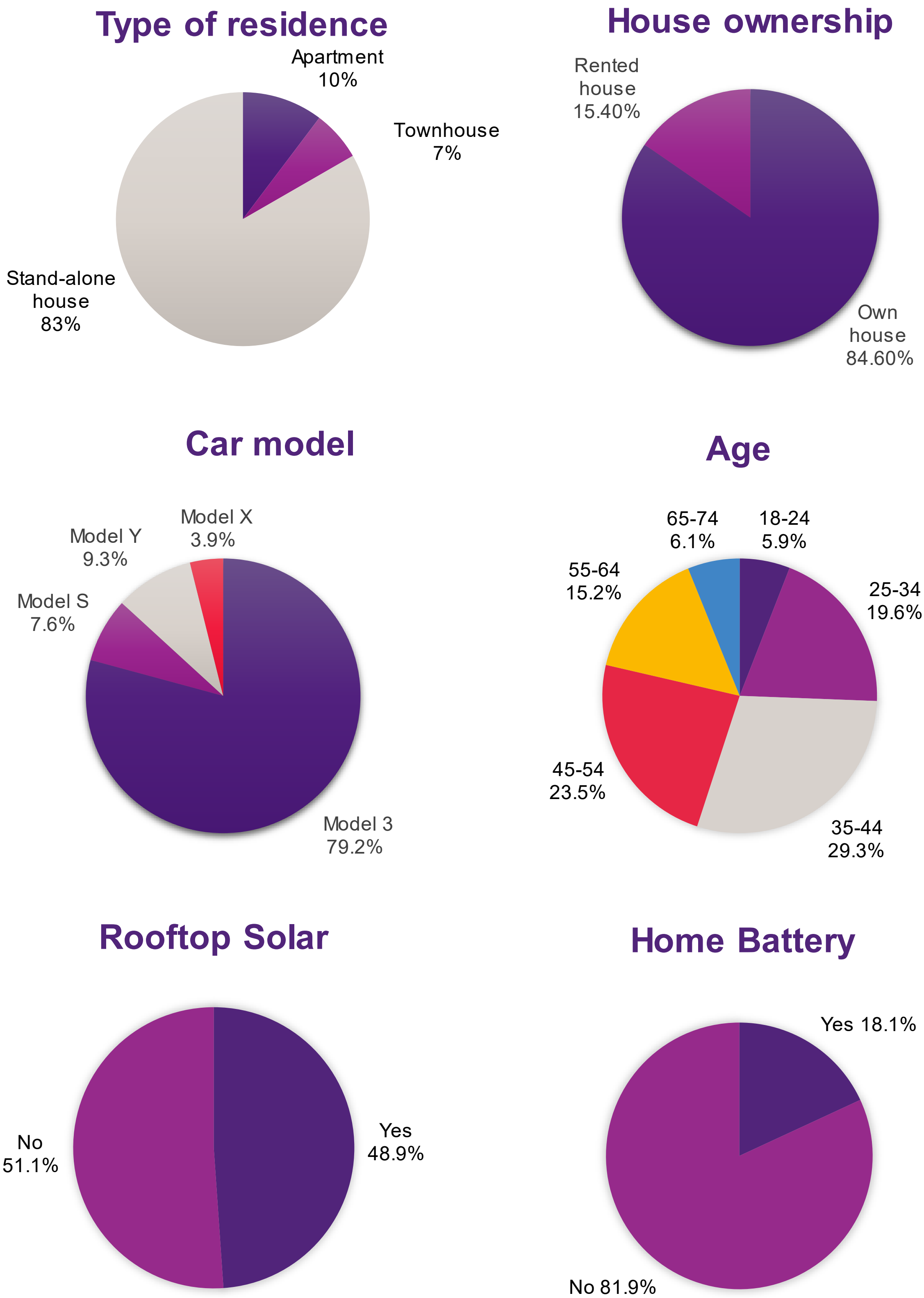


Figure 3 . Participant characteristics

Driving Locations

Figure 4. Driving locations in Australia

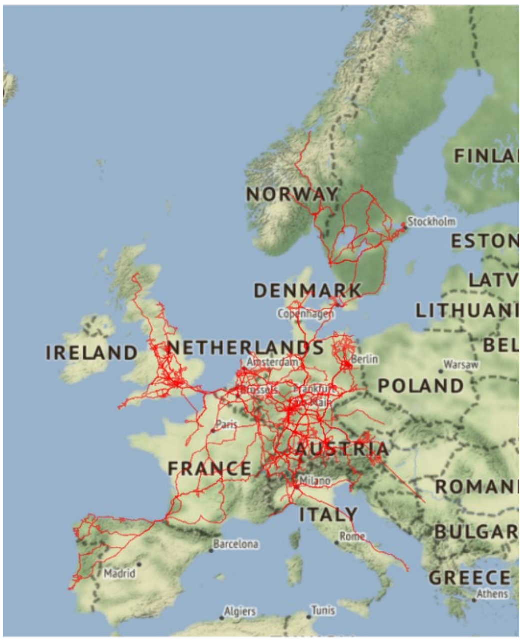


Figure 5. Driving locations in Europe

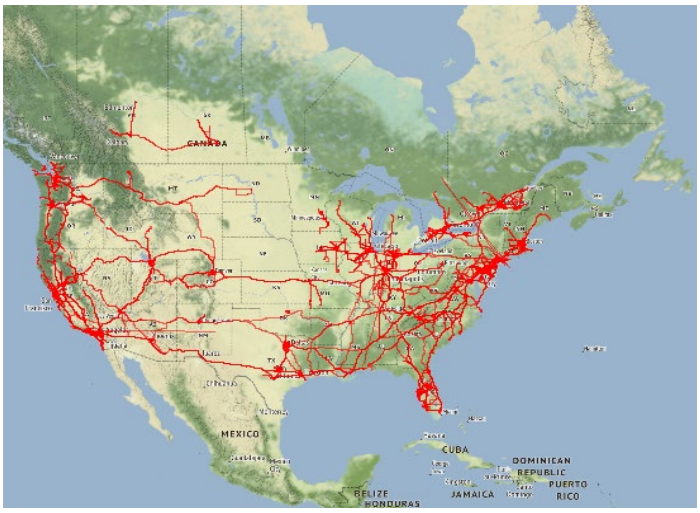


Figure 6. Driving locations in North America

Driving Patterns

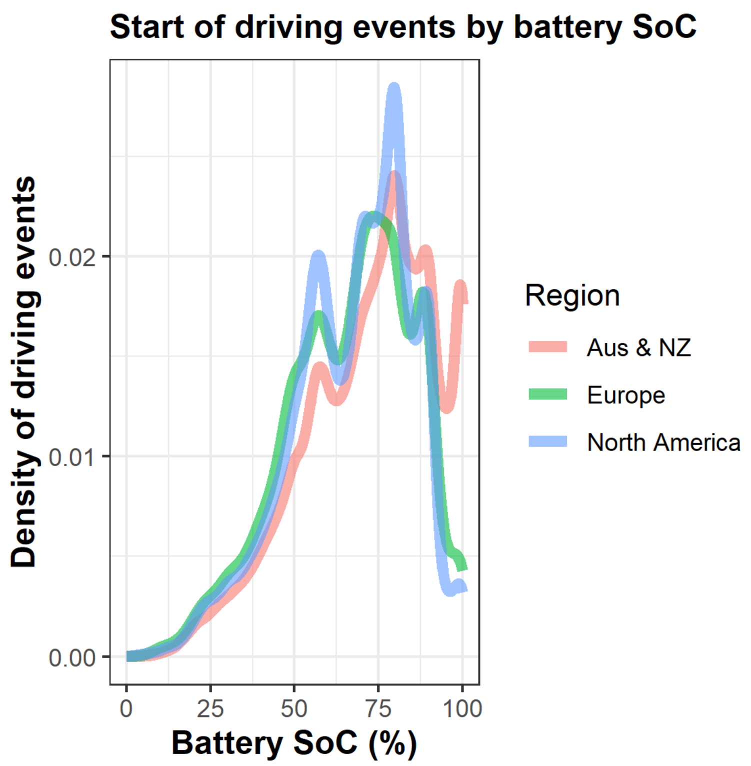


Figure 7. Density of driving events by battery SoC

As shown in Figure 7, a high number of driving events start with battery State-of-Charge (SoC) at 50 to 80 percent in all the three regions.

A very high number of individual trips* cover less than 50 km.

*Trip: A single driving event with the vehicle in drive, reverse or hold and with no more than fifteen minutes of being parked with no driver in car.

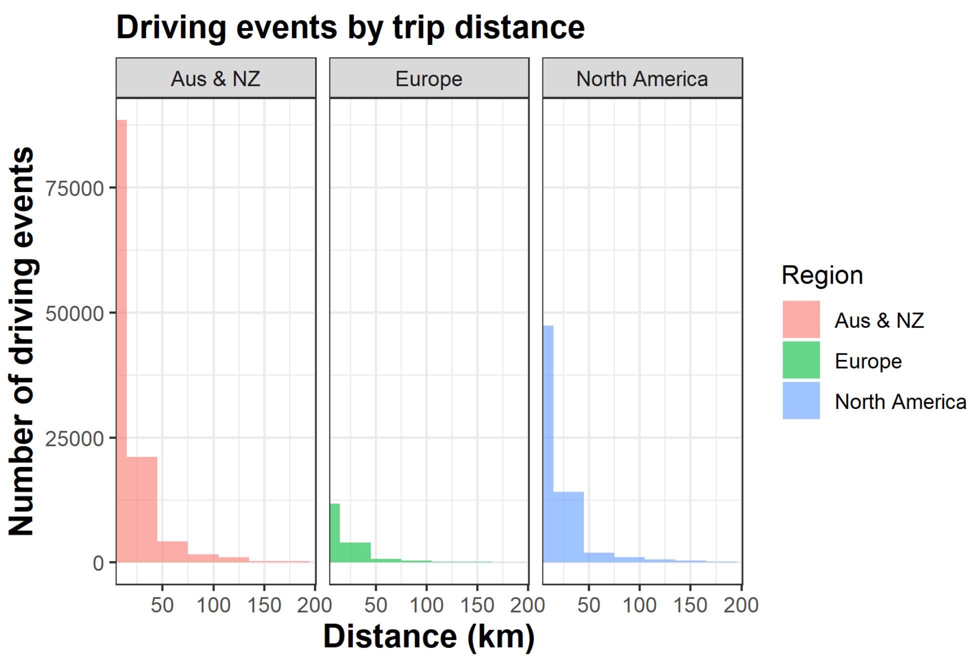


Figure 8. Density of driving events by trip distance

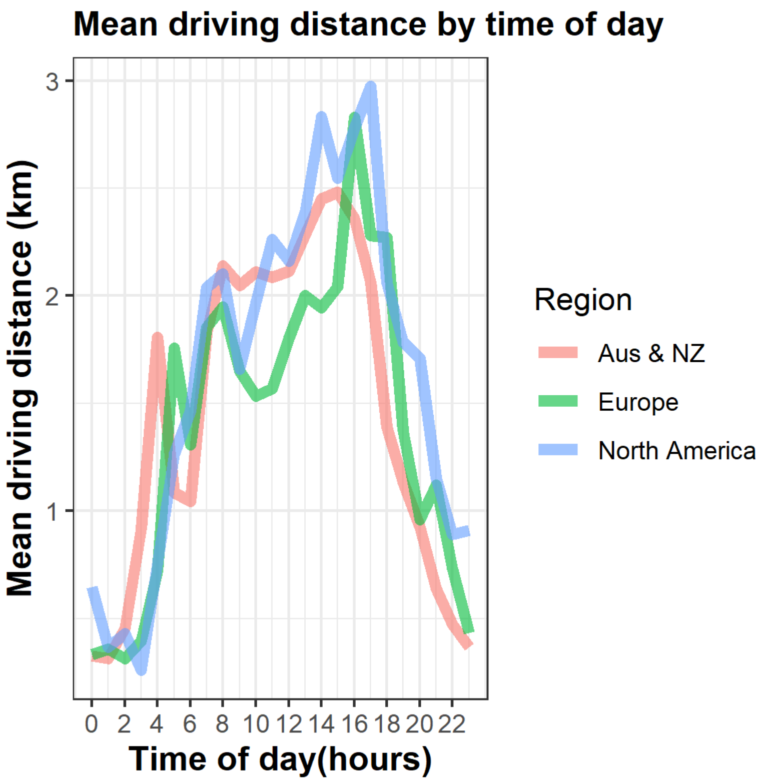


Figure 9. Mean driving distance by time of day

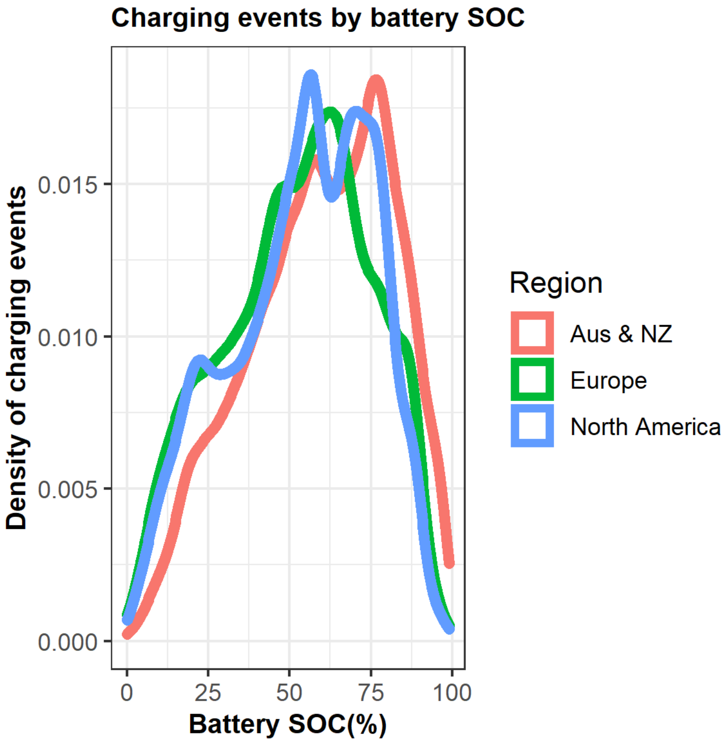
The average driving distance per vehicle per day for all three regions are given in Table 2.

As this is based on a limited number of vehicles participating in the research program, wider sampling would be required to further confirm these values. Nevertheless, these estimates tend to align with other reported mean driving distances for various regions.

Region	Mean daily distance (km)
Australia & New Zealand	30.25
North America	34.89
Europe	29.33

Table 2. Mean daily driving distance by region

Charging Patterns



The majority of EV charging events start when battery SoC is between 50 to 80 percent.

Figure 10. Density of charging events by battery SoC

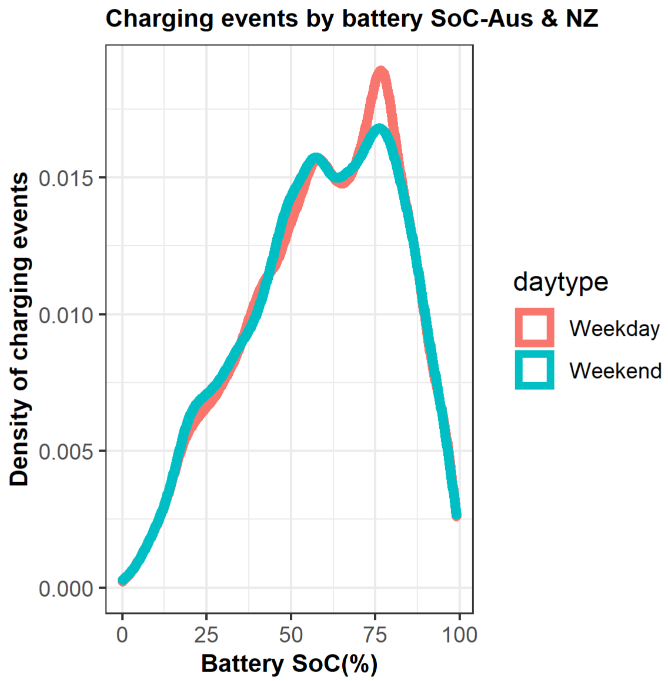


Figure 11. Density of charging events by battery SoC-Australia & New Zealand

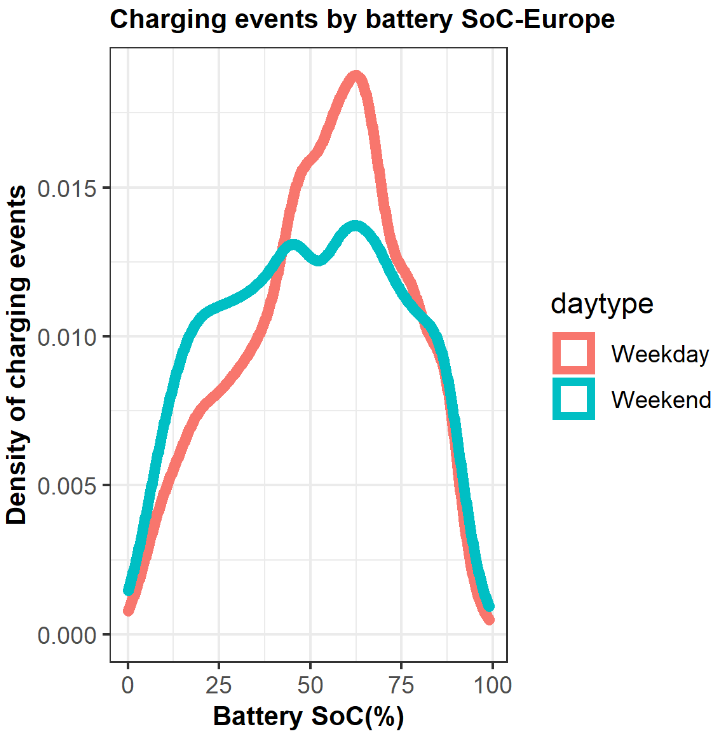


Figure 12. Density of charging events by battery SoC- Europe

For all three regions, it is observed that more top-up charges occur during weekdays.

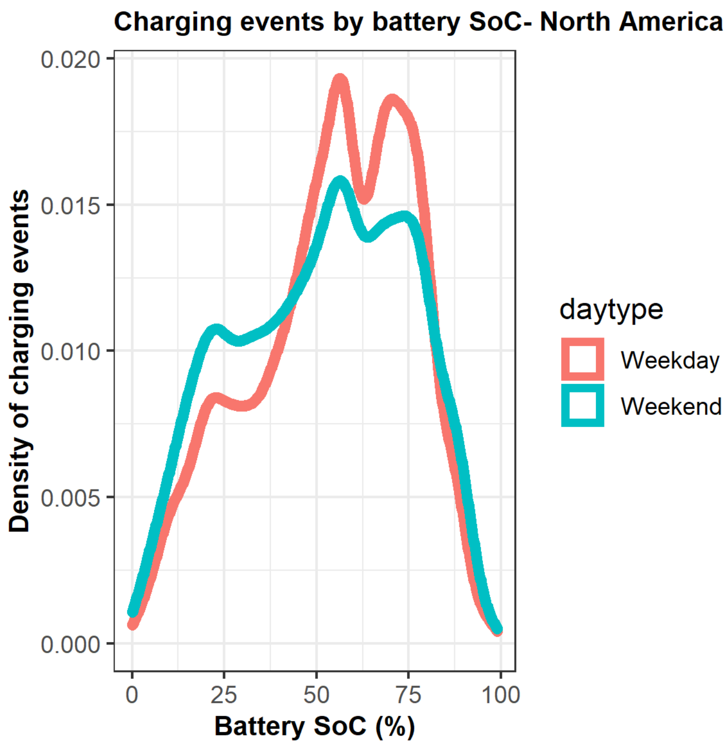


Figure 13. Density of charging events by battery SoC- North America

Energy Consumption During Charging

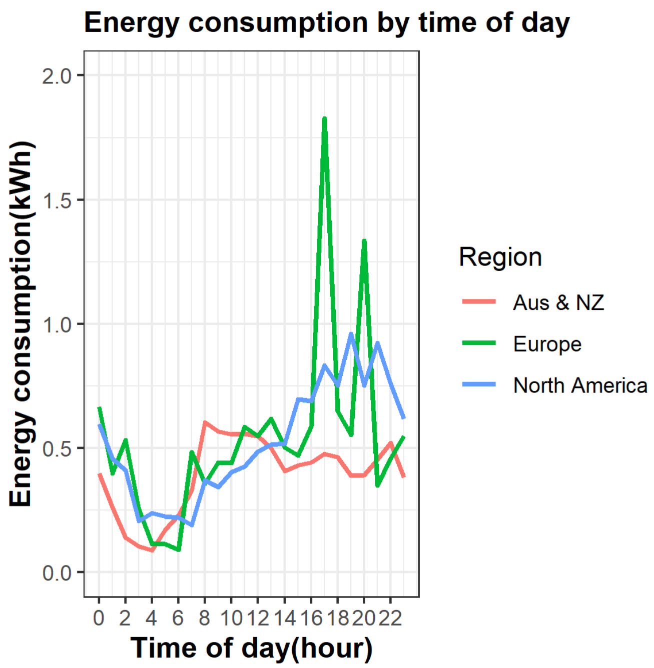


Figure 14. Mean energy consumption per vehicle by time of day

Region	Mean daily energy consumption (kWh)
Australia & New Zealand	9.59
North America	12.79
Europe	12.96

Table 3. Mean daily energy consumption

For Australia & New Zealand and North America, energy consumption patterns are similar on weekends and weekdays.

Energy consumption during daytime is observed to be higher during weekends for all the three regions.

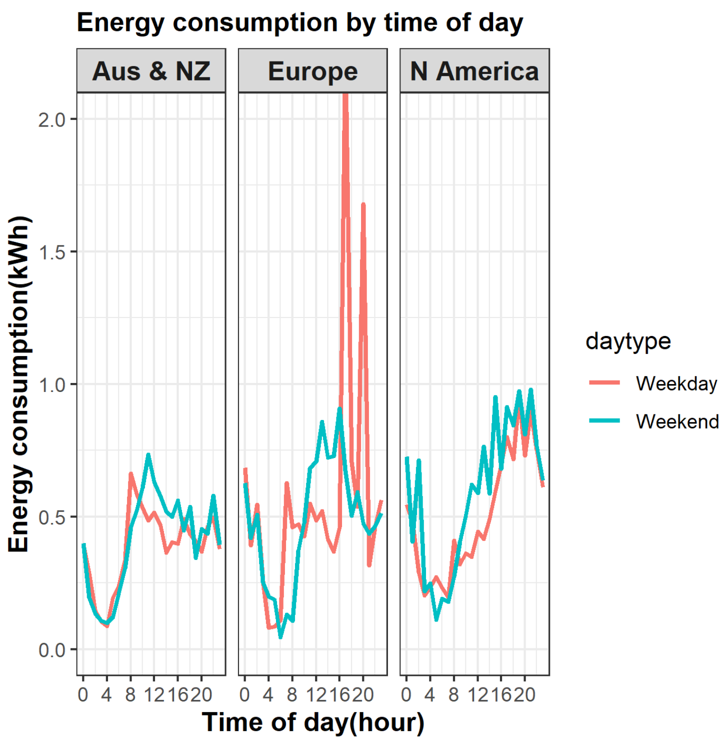
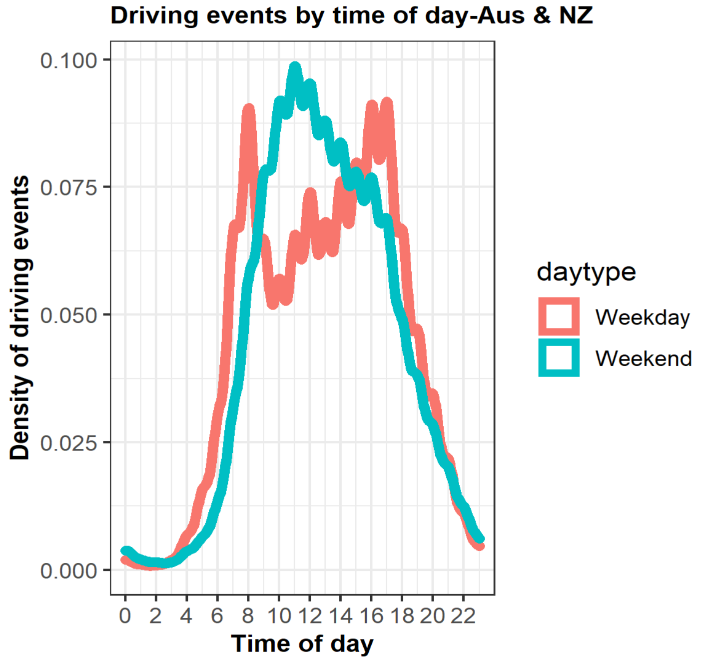
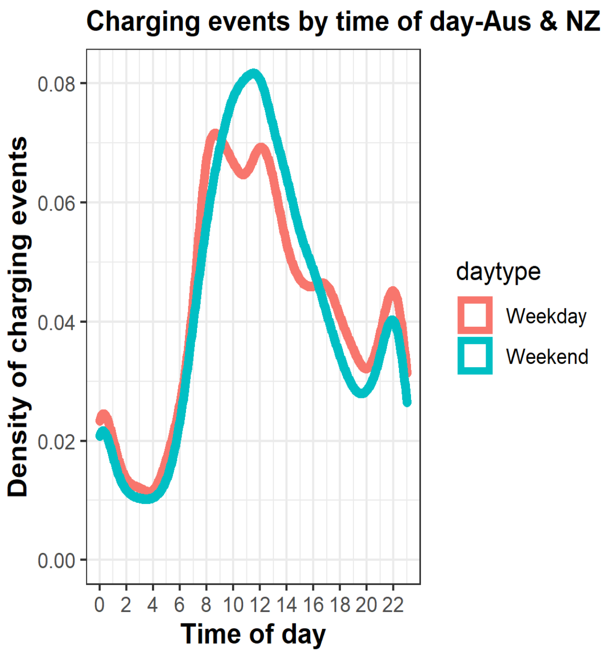


Figure 15. Mean energy consumption per vehicle by time of day

When Are Electric Vehicles Being Driven And Charged?

Australia & New Zealand





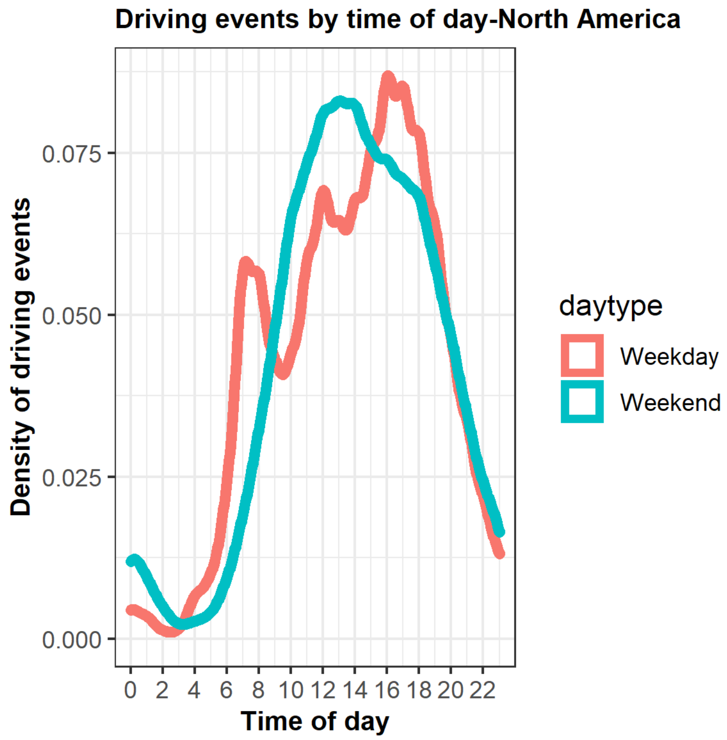
For Australia & New Zealand, a morning and evening peak driving period is observed on weekdays and a mid-day peak driving period on weekends.

Majority charging events happen during the daytime. As seen in Figure 14, mean energy consumption for charging is high during daytime and early night.

This potentially points to the high-power charge events happening during the night to benefit from the night tariff rates while using low power charging during the daytime to take advantage of solar.

Figure 16. Driving and charging events by time of day-Australia & New Zealand

North America



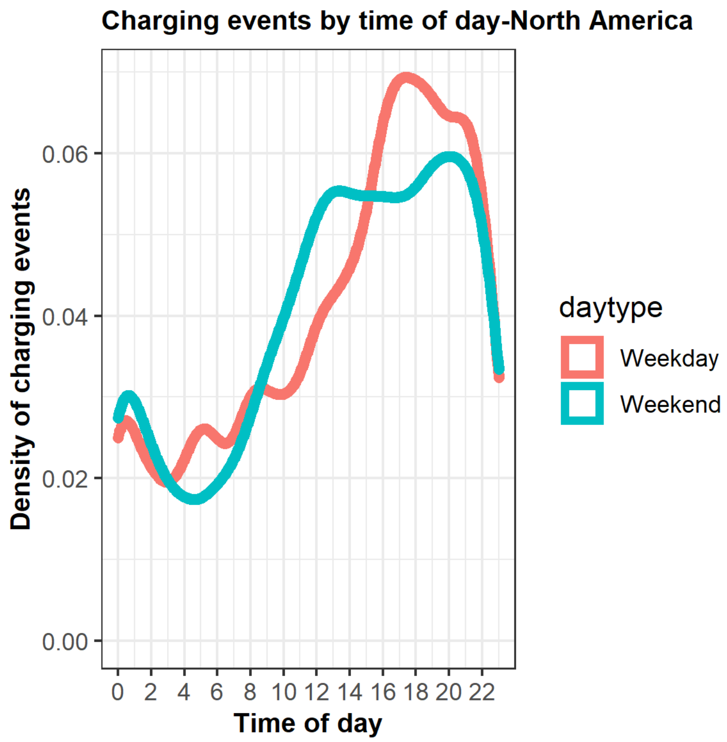


Figure 17. Driving and charging events by time of day - North America

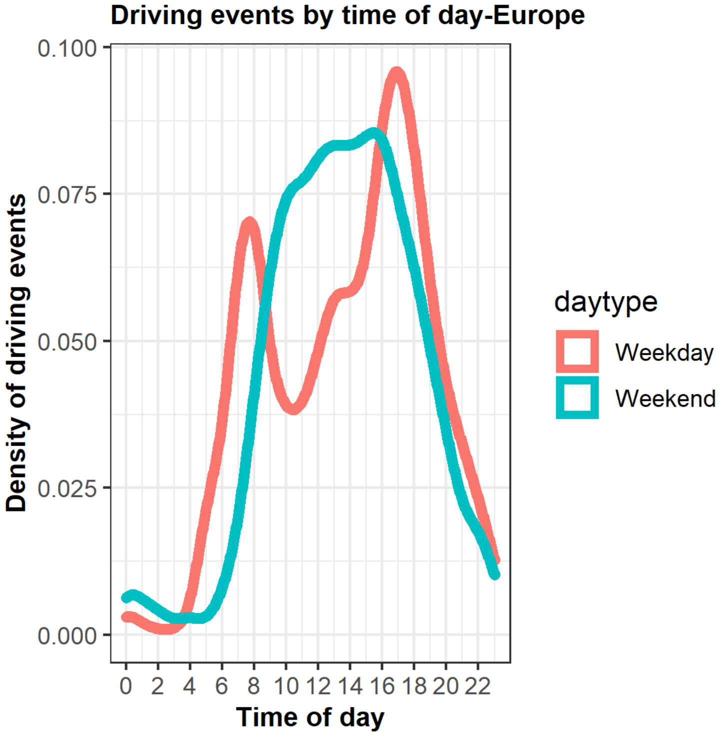
For North America, driving events peak during mid-day on weekends.

Driving events during morning and evening peak times are higher on weekdays compared to weekends.

An evening charging peak is observed, particularly on weekdays.

Energy consumption for charging is high during evenings and night time, as seen in Figure 14.

Europe



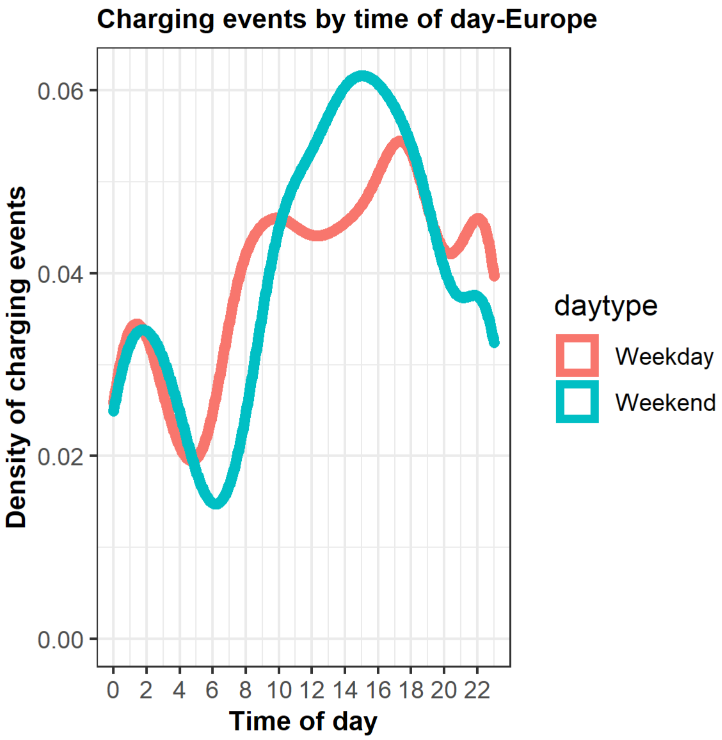


Figure 18. Driving and charging events by time of day - Europe

For Europe, majority driving events are observed during mid-day on weekends and peak hours on weekdays.

A high number of charging events occur during daytime including peak hours.

Energy consumption for charging is higher during evening peak hours* on weekdays as seen in Figure 14.

*The results of this study using a low sample size of less than 50 may not represent the general EV population of Europe.

Scope Of Smart Charging

For Australia & New Zealand and North America, it is observed that the majority of charging events occur during daytime and night, outside of peak hours. For Europe, an evening charging peak is observed on weekdays. Additionally, charging patterns are mostly similar during weekdays and weekends. Most vehicles are parked during the daytime, although more vehicles are driven during the daytime on weekends. Overall, these trends look positive in terms of demand management and smart charging possibilities, although some regions perform better than others.

There may be potential for the successful rollout of smart charging programs, with varying levels of behaviour change requirements.

The next phase of this project aims to uncover the level of behaviour change required, and design incentives to bring about these behaviour changes amongst electric vehicle drivers.

Acknowledgments

On behalf of the research team, we would like to express our heartfelt appreciation to all the individuals and organisations who have contributed to the successful completion of this research to date.

First and foremost, we would like to express our sincere appreciation to the research participants who generously shared their time, experiences, and perspectives with us. Their invaluable contributions have provided important insights and evidence, enriching the quality and relevance of our findings.

We would also like to thank our research partner Teslascope and Mr Tyler Corsair who provided essential support and resources throughout the project.

We extend our deepest appreciation to the research funders Advance Queensland and iMOVE CRC whose generous support has made this project possible. Their investment in our work has enabled us to undertake rigorous research, develop innovative methodologies, and disseminate our findings widely. We are grateful for their commitment to advancing knowledge.

Last but most importantly, we would like to thank our advisors for their support in undertaking this research.