

Driving Change:

Investigating the attitudes, perspectives and behaviours
behind Electric Vehicle Charging Etiquette in Australia

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Driving Change: Investigating the attitudes, perspectives and behaviours of electric vehicle charging etiquette in Australia

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Abbreviations

AEVA – Australian Electric Vehicle Association

BEV – Battery Operated electric vehicle

CFIR 2.0 – Consolidated Framework for Implementation Research 2.0

EV – Electric vehicles

GHG – Greenhouse Gases

ICE – Internal Combustion Engine

IREC – Incoming online research ethics and compliance system

TDF – Theoretical Domains Framework

TPB – Theory of Planned Behaviour

UNSW – The University of New South Wales

Executive Summary

Introduction: The term electric vehicle (EV) charging etiquette has become a popular notion within the EV community as a response to the limited number of available chargers, long waiting times, and unreliable technology. EV drivers need to interact with one another, especially during busy periods, to ensure their vehicle is charged. Charging etiquette has been defined as a set of socially acceptable behaviours that drivers should portray when interacting with other drivers at public charging stations. There are no universal guidelines on what these acceptable behaviours are, resulting in discord and debate among drivers. There is limited research exploring the usefulness of charging etiquette, with a few studies demonstrating that cooperative behaviours can improve the overall usage of charging stations. One novel approach to learning more about the determinants of EV charging is to use implementation science methods to identify and address barriers related to the adoption and adherence of good charging etiquette.

Aim: This report aims to use implementation science methods to examine attitudes, perspectives, and behaviours at public charging stations in Australia and identify factors affecting good charging etiquette, to generate strategies for success.

Methodology: Two studies were conducted to understand how high-income countries and Australia utilise charging infrastructure and engage in charging etiquette.

- Study 1: A scoping review was conducted to better understand the barriers, enablers, and psycho-social determinants of charging infrastructure among high-income countries using the Consolidated Framework for Implementation Research (CFIR 2.0) and the Theory of Planned Behaviour (TPB).
- Study 2: 15 semi-structured interviews in Australia with everyday EV and non-EV drivers and two focus group sessions with experts in the field of EV were conducted. The interview transcripts were thematically analysed using the Theoretical Domains Framework (TDF) to code and develop themes.

Results: Study 1 identified one principal enabler (CFIR: physical infrastructure) and two key barriers (CFIR: Innovation design and innovation complexity) to the usage of public charging stations. Using the TPB, the analysis highlighted the importance of EV drivers' attitudes towards charging behaviours and the beliefs behind their perception of control when engaging in good charging etiquette. The CFIR 2.0 and TPB collectively captured 6 barriers (e.g. Inconsistent across brands, apps and plugs, inconvenient and physical obstacles) and 6 enablers (e.g. layout, comfort, accessibility, attitude) evident in *Appendix A table 2*.

Study 2 found qualitative evidence to support the need for charging etiquette, and identified three domains (Environmental context and resources, Knowledge and Reinforcement) within the TDF that collectively captured **6 individual level barriers (e.g. limited infrastructure, long waiting time, overcrowding) and 11 enablers (e.g. amenities, fines, warnings) to EV charging etiquette**. Additionally, two themes were identified: 'Advancing technology' and 'improving communication' evident in *Appendix A table 3*.

Discussion: Participants defined charging etiquette as being considerate of others. While all participants believed charging etiquette was necessary, many felt the rules needed to be simple, flexible, and adaptable across circumstances, as sometimes abiding by the rules was impractical. Advancing technology to facilitate good charging behaviour and implementing innovations to improve communications were recurrent themes. Recommendations were

made to address the barriers, with implementation strategies that will facilitate the future use of EV charging infrastructure in an Australian context.

Conclusion: Overall, this report demonstrates the importance of EV charging etiquette as a necessary component of public charging infrastructure. Due to the limited number of available public charging stations, EV drivers must interact with each other to guarantee that their vehicles are charged. The findings of this report demonstrate multiple avenues for drivers to learn about electric vehicle charging etiquette and identify potential barriers and enablers that, if addressed using the recommendations provided, can help improve efficient usage of charging infrastructure and adherence to charging etiquette. Australia has an exciting opportunity to learn from the successes and failures of other high-income countries and to avoid the failures by implementing our list of recommendations.



Figure 1: EV charging, source adobe stock (File #: 699990875)

Introduction

Road transportation in Australia is responsible for 60% of transport-related greenhouse gas (GHG) emissions, accounting for 10% of Australia's total emissions as of 2022[3]. Without any intervention to mitigate these consequences, Australia is projected to be the largest contributor to transport emissions by 2030[4]. This is a severe environmental and health issue as GHG absorbs, radiates, and reflects heat to the earth's surface, resulting in rising temperature, rising sea levels, environmental degradation, food and water insecurity, extreme weather events, poor air quality and pollution[5-7]. The health implications of the climate crisis have been detrimental, with more and more humans being exposed to dangerous pollutants, pathogens and suffering from poor nutrition[5, 7]. These environmental health stressors are risk factors for developing various cardiovascular, respiratory, metabolic, and neurological diseases[6-8]. Left unchecked, an increasing proportion of our global population will continue to experience any one of these diseases, placing further burden on our public health care systems. Therefore, immediate action is needed to reduce our transport emissions, which can only be achieved through completely transforming how we produce, expend and travel[9].

Electric vehicles (EVs) are a promising strategy for reducing our carbon emissions as they use rechargeable batteries instead of fossil fuels to power engines and do not produce tailpipe emissions resulting in a lower day-to-day carbon footprint compared to internal combustion engine (ICE) vehicles. EVs are also better performing, more efficient, quieter and have lower maintenance costs[10, 11]. The carbon footprint decreases even more after users charge their EVs with energy generated from renewable sources[12]. Although Australia has been slow to adopt EVs compared to other high-income countries, the demand for EVs has drastically increased by more than 120% since 2022[13]. While this increase is a good thing, it can cause potential problems as the time taken to construct, connect and implement charging infrastructure may not match the increasing demand[14]. The speed of implementing public charging infrastructure may frustrate drivers, especially those who live in apartment buildings and heavily rely on public charging.

EV public charging stations are an essential component to ensuring the continued adoption of EVs as they provide EV drivers with security in knowing that they can charge their EVs any time of day. However, they are restrictive in that they can only charge one or two EVs at a time, take a long time to charge and do not automatically eject the charging plug once charging is finished, resulting in many drivers experiencing long wait times and long trips searching for available chargers [15]. This has led to the poor utilisation of public charging stations where a station is occupied but not used optimally[16]. One study found that despite having an occupancy rate between 40-60% of the time, only 25% was spent charging the vehicle[17, 18]. This suggests that **simply increasing the number of charging stations is not enough to improve usage of charging infrastructure unless we can identify any barriers, enablers, and psychological determinants behind optimal usage.** Australia has implemented numerous public charging stations, however there needs to be more supply to meet the projected demand of EV drivers, especially across state-line journeys[19]. As such, EV drivers will need to work together to share resources until enough infrastructure is available for drivers to use without needing to interact with each other.

EV charging etiquette is needed to regulate mindful and polite interactions between EV drivers at public charging stations. EV charging etiquette is defined as a socially acceptable set of rules that demonstrate the appropriate ways drivers should behave when using a public charging station[17]. There is limited research exploring the effectiveness of charging etiquette on the overall EV driver experience of driving and using public charging stations. A

limited number of studies have shown that cooperative behaviours such as being mindful and considerate of others when using charging station can improve the overall usage of the station [15, 17, 20]. This improvement suggests a relationship between usage of charging station and adherence to charging etiquette where bad charging etiquette may lead to poor utilisation of charging infrastructure. Identifying the barriers, enablers, and psycho-social determinants behind usage of charging stations and adherence to charging etiquette, may prove fruitful for organisations looking to implement charging infrastructure.

Around the world, the lack of clarity and understanding on the acceptable rules of engagement have resulted in conflict and confusion, with many EV drivers preferring to use private home chargers instead of public charging stations [17, 21]. **However, this solution is not a viable option for everyone, for instance, individuals living in apartment buildings have limited off-street parking or no parking space to implement a private home charger[22]. In Australia, more than 2.5 million people or 10.3% of the Australian population live in apartments[23]. More research is needed to clarify these rules of engagement and understand the varying attitudes, perceptions and behaviours that influence public charging station usage and etiquette.** One way of identifying these determinants and behaviours is by using implementation science models, frameworks, and theories.

Implementation Science Frameworks

Changing an individual or a collective's behaviour is no easy feat. It requires an in-depth understanding of the psycho-social and contextual determinants that influence a specific behaviour to occur within a particular setting [24].

Implementation science studies the methods and strategies used to change new behaviours into regularly performed practices[25]. It is a useful evidence-based tool for understanding and resolving potential challenges associated with changing behaviours. It is a planned approach to bridge the gap between research and practice by using theories of behavioural change to inform the design of targeted strategies and guide the implementation process [26]. There are numerous implementation science strategies and frameworks that have been developed to help understand the best way to enact behavioural change (See Appendix B). Using these frameworks is beneficial because it allows for more control over the design of targeted strategies as it assists with replication of success and scale-up of optimal implementation approaches[27].

Multiple behavioural and implementation frameworks are available to gain a comprehensive understanding of EV charging. This study utilises three frameworks below, as they each provide a unique perspective (see Appendix B for more details).

- 1) The Consolidated Framework for Implementation research 2.0 (CFIR 2.0) is a determinant framework that aims to predict or explain potential barriers and facilitators that could influence effectiveness of recommended strategies [28, 29].
- 2) The Theory of Planned Behaviour (TPB) provides insight into the impact of the implementation of evidence-based practices from an individual psychosocial [2, 30].
- 3) The Theoretical Domains Framework (TDF) provides insight into the cognitive, emotional, social and environmental influences on behaviours [24].

Aims

Australia has an exciting opportunity to capitalise on the success and failures of more established global EV markets by implementing evidence-based strategies to improve the utilisation of charging stations and adherence to good charging practices. Implementing these strategies early on may allow Australia to avoid some of the failures and eventually lead the way in innovative approaches to EV adoption.

Therefore, the main objective of this study was to identify barriers, enablers and psycho-social and contextual determinants of public charging stations and charging etiquette using evidence-based implementation science frameworks. We aimed to achieve this by:

- (1) Examining high-income countries with well-established and successful EV markets to identify global barriers, enablers, and psycho-social determinants affecting charging behaviours using the CFIR 2.0 and TPB frameworks. The goal was to draw valuable insights that can be applied to the Australian context and inform our qualitative interviews and focus group sessions.
- (2) Conducting qualitative interviews and focusing group sessions with drivers and EV experts residing in Australia to identify barriers and enablers of charging etiquette using the TDF framework.

For Study 1, the CFIR 2.0 was used to identify the contextual barriers and enablers. The TPB was chosen to gain insight into the individual decision-making processes[2, 28]. For study 2, the TDF was selected because it provided a structured approach for creating interview questions, analysing the data and identifying domains relevant to individual behavioural change[24]. The TDF can also be integrated within the CFIR 2.0 to gain a more comprehensive understanding of behavioural change if need be later down the track[31].

The focus of this report is to provide a comprehensive summary of our findings and to recommend appropriate strategies for stakeholders involved in implementing EV charging infrastructure around Australia. For the purposes of the report, there will be a stronger focus on study 2 interviews and focus group sessions as the information obtained is most relevant to the Australian context and can guide the development and implementation of relevant strategies. Both studies will be written up for academic publication and a suite of public resources informed by our findings are being produced with Art and Design collaborators at the University of New South Wales (UNSW).

Study 1: Scoping Review

A scoping review was conducted to provide an overview of the current state of charging infrastructure in seven of the world's top EV markets (China, Germany, Netherland, Norway, Switzerland, United Kingdom, and the United States). Guided by implementation science frameworks, the aim of the scoping review was to gain a better understanding of the potential enablers, barriers and psycho-social determinants of EV charging and charging etiquette.

Methods

The scoping review comprised of a combination of journal articles and grey literature (policies, guidelines and thesis) from three databases, 'Web of Science', 'Scopus' and 'Google'. After screening 3938 journal articles and 200 grey literature sources, we narrowed the scope down to 57 journal articles and 41 grey literature sources using strict eligibility criteria. Once the relevant information was extracted, the journal articles were coded to either the CFIR 2.0 or the TPB based on if they focused on charging infrastructure or charging etiquette respectively. Charging etiquette rules mentioned in grey literature were extracted and then counted for frequency of appearance.

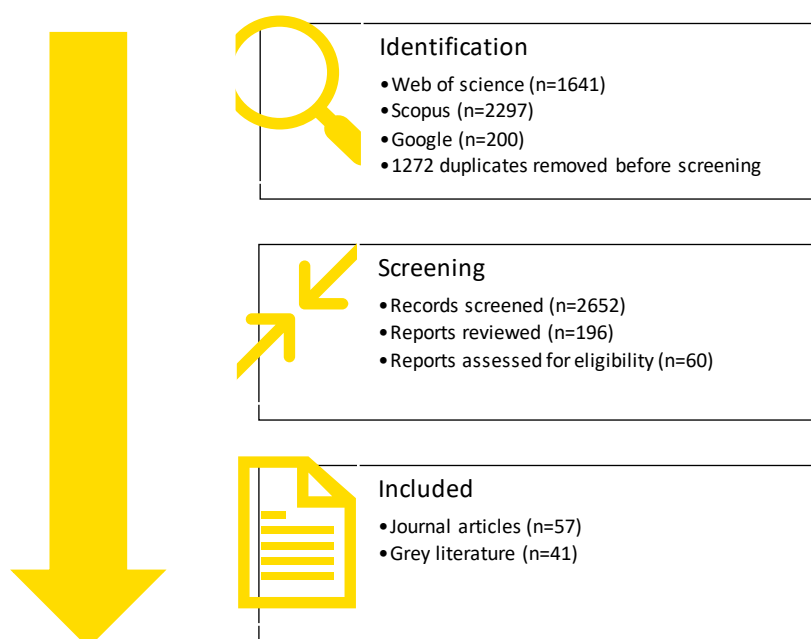


Figure 2: Diagram of how journal articles and grey literature was narrowed down.

When reviewing journal articles, relevant quotes were mapped to one of the five domains of the CFIR 2.0 for coding. For example, "Most BEVs did not use fast charger on a weekly basis. BEV drivers preferred normal charging while the car was parked and use fast chargers on longer trips as a safety net" (**CFIR domain: innovation; construct: innovation design**). Similarly, for coding for the TPB, relevant information was extracted such as "EV drivers are less inclined to move their cars at evening or during the night." This quote would best match the definition for **control beliefs** which are beliefs about the presence or absence of a factors that can improve or decrease performance for a behaviour. In this case, evening/nighttime negatively affected good charging etiquette as drivers would prefer to leave their vehicles overnight to avoid having to move their vehicle late at night.

Table 1 - Example of Coding

Item	Quote	Framework	Domain	Construct
1	<i>"Most BEVs did not use fast charger on a weekly basis. BEV drivers preferred normal charging while the car was parked and use fast chargers on longer trips as a safety net"</i>	CFIR 2.0	Innovation	Innovation design
2	<i>"EV drivers are less inclined to move their cars at evening or during the night."</i>	TPB	Control beliefs	

Analysis

Papers were exported from their databases and uploaded to Covidence for screening and extraction done by both the lead research assistant (AS) and the second research assistant (ZL). Included papers were coded by the lead analyst (AS) based on their corresponding framework. Frequency counts were used throughout the peer-review and grey literature data analysis to provide numerical understanding to the findings.

Results

Only a limited number of papers (grey: n=41; journal: n=11) were identified as being relevant to EV charging etiquette, with most accepted papers (journal: n=52) discussing the impact of charging infrastructure on the driver's experience (see Appendix C table 4 and Appendix D table 5). 38 charging etiquette behaviours were identified from the 41 eligible grey literature sources. The top 9 sources with a frequency count greater than 10 was 'moving your vehicle once your charging session had finished' followed by 'only park in an EV charging bay when you are charging', 'obeying the signage and posted time limits', 'avoiding unplugging another EV without their permission', 'return charger to the correct dock and remove any trip hazards', 'leave a note on your dashboard indicating at what point charging is expected to be completed', 'using apps to find, plan, locate or pay for charging', and 'only charge when necessary' (See Appendix H).

Barriers and enablers of using charging infrastructure.

The results from CFIR 2.0 identified the construct **physical infrastructure** from the inner settings domain as the primary enabler and **innovation design** and **innovation complexity** from the innovation domain as the primary barriers towards appropriate usage of EV charging stations and adherence to EV charging etiquette (See Appendix A table 2).

The physical infrastructure of public charging stations was identified as an enabler towards an EV driver's willingness to charge at that specific location[32-34]. By creating more comfortable and convenient environments for EV drivers, we can reduce the frustration and annoyance associated with long waiting or charging times. This is an important consideration because EV drivers are more likely to travel further to use charging stations with amenities, restaurants, leisure activities and technological features like WI-FI[33, 35-37]. Providing this infrastructure may also have safety implications as EV drivers may be more willing to take breaks during long trips[38]. Public charging appears to be the least frequently used option compared to home and workplace charging[39]. Outside of residential areas, motorways and shopping centres were perceived to be the most popular location for charging vehicles [33, 40]. Hence, including additional amenities for EV drivers may provide them with things to do while their EV is charging or while they are waiting for a spot.

The **complexity** of the charging station was identified as a barrier towards optimal usage of charging stations and adherence to charging etiquette [31]. EV drivers preferred to stay with the same charging operator to avoid having to learn new operations or a different payment system [41]. This suggests that some charging stations are more complicated to use which could lead to increased frustration, dissatisfaction and annoyance. Furthermore, if the instructions on how to use the stations are unclear or the station is too complex to use, incorrect charging behaviours could potentially damage the infrastructure or break charging etiquette rules. This is a possibility as EV drivers have been reported to find it difficult to initially understand which chargers they can use and how it works[41, 42]. There also appears to be no consistent method to pay or app to locate nearby charging stations[17]. EV drivers want a better more concise way of obtaining information related to the availability of charging infrastructure, especially if they are out of service[41]. This was particularly a problem for older generations who disliked relying on their phones or technology to pay[43]. EV drivers also found it difficult to understand how the price was determined and how much their total charging session would cost[41]. This is an important barrier as the cost of charging was often prioritised over distance and availability of spots, with some respondents willing to wait longer for cheaper charging[44].

Likewise, the physical **design** and **layout** of the charging station was identified as a barrier. A couple of studies reported that EV drivers wanted charging stations to provide a similar experience as refuelling at a petrol station[41, 45-47]. Designing charging stations like petrol stations could reduce overcrowding, wait time and improve accessibility to charging stations. However, fast charging is the most similar charging option to refuelling and depending on current battery levels, charging power and speed of charge, it can take at least 20 minutes to recharge a vehicle[48]. Other strategies to improve the physical design included designing charging bays to be located in inconvenient locations to discourage ICE vehicles or EVs from conveniently parking but not charging [2]. Including multiple different speeds of chargers was thought to improve the charging convenience as it provided drivers with options depending on their needs[49]. Fast charging was often preferred during long distance trips while slow charging was preferred when EV drivers would be away from their vehicle for long periods of time such as working, sleeping, running errands or if the price for fast charging was too high [50-52].

Psycho-social determinants of charging etiquette

The TPB identified **control beliefs** and **attitudes towards behaviour** as the primary psycho-social determinants of EV charging etiquette. Control beliefs are *beliefs about the presence or absence of specific factors (environmental, social, psychological etc.) that can influence behaviour*. [2] Similarly, attitudes towards behaviours describes the EV driver's *evaluation of whether engaging in a particular behaviour will result in favourable or unfavourable outcomes*[2].

The TPB revealed that individuals' beliefs about their perception of control over the charging stations was a strong indicator of good or bad charging etiquette. For instance, EV drivers appeared to be willing to move their vehicles at the request of another driver only if the request was made during the day and they were close to, or had reached, their desired charging level. This suggests that the EV driver's perception of control is influenced by the presence of factors like time of day (i.e., being dark) and level of charge (i.e., not charged enough).

Interestingly, EV drivers especially viewed passenger share EVs that were left at public charging bays instead of their company ones as bad etiquette[17]. Three studies reported negative perceptions in EV drivers towards charging stations because of broken or dysfunctional infrastructure[42, 53, 54]. Arriving at a charging station when its broken could

increase frustrations, annoyance and resentment towards the station or other drivers and could lead to potential misuse of infrastructure. A negative perception towards charging stations may have wider implications resulting in drivers choosing not to purchase EVs if they will be dependent on public infrastructure.

Discussion

The aim of this scoping review was to identify prominent barriers, enablers and psycho-social determinants related to optimal usage of charging infrastructure and, subsequently, charging etiquette. Guided by behavioural and implementation science frameworks (CFIR 2.0 and the TPB), a comprehensive literature analysis revealed valuable insights into the factors influencing charging behaviours. Efficient and optimal usage of charging infrastructure can promote good charging practices by reducing the wait time of EV drivers queuing for a spot, minimising congestion and reducing pressure on charging systems. The CFIR 2.0 framework identified two key barriers: innovation design and innovation complexity, and one enabler, physical infrastructure, as instrumental factors influencing charging behaviours. The TPB revealed control beliefs and attitudes towards behaviours as the psycho-social determinants affecting good charging etiquette. Using these frameworks to identify these factors can drive the design of evidence-based strategies to optimise charging etiquette and appropriate use of charging infrastructure.

Barriers and enablers of charging infrastructure

The study revealed that the physical infrastructure of the charging station, such as its location and the surrounding amenities, were significant enablers for using charging stations appropriately. By improving the accessibility and convenience of charging stations, EV drivers are more likely to utilise public charging stations and integrate them into their routine or travel plans. Consistent with the literature, our review found that the location of the charging station played an essential role, as EV drivers preferred charging in locations within walking distance of shopping centres, amenities, and leisure spots[32, 55, 56]. Placing charging infrastructure near these destinations would aid in developing a comfortable and convenient environment for drivers, as it would help reduce any frustration or annoyance associated with long waiting times. Knowing that a charging station is nearby and located conveniently may help alleviate any range anxiety drivers. However, when developing plans to implement charging stations, developers should consider the specific needs of EV drivers - for example, studies show that depending on their travel requirements, EV drivers tend to choose fast chargers for long-distance trips, preferring stations along highways, and slow chargers for long tasks such as while they are working, sleeping or needing to do some errands for a couple of hours [50-52]. Surrounding charging infrastructure with amenities and rest stops along highways could also have safety implications, as EV drivers may be more likely to take a break and top up their vehicle if there is something else they can do to pass the time. Thus, it's crucial when constructing charging stations that developers tailor the physical infrastructure of the charging station and surrounding environment to the needs of the EV drivers.

The **design** and **complexity** of charging stations were identified as prominent barriers against appropriate public charging stations' usage and adherence to good charging practices. An interesting point of discussion that emerged in the scoping review was the desire for charging stations to be built and designed like petrol stations[45, 46, 57]. Studies show that EV drivers are more likely to stop at petrol stations for a shorter duration compared to standard public chargers[48]. EV drivers wanted charging stations to be as quick and easy as refuelling an ICE vehicle. The faster it is to charge the EV the less likely an EV driver will leave their car, decreasing the risk of overstaying and prolonged wait times. This goal might not be achievable

based on current technology as fast chargers typically take around 20 minutes to charge, and regular use can lead to charging inefficiency and battery degradation[48]. There are several characteristics of petrol stations that can be implemented when constructing charging stations, for example:

- 1) ensure that there are multiple designated lanes to allow for multiple vehicles to charge their vehicles;
- 2) increase the number of bays and types of chargers would decrease waiting times, congestion, or overcrowding;
- 3) include multiple charging speeds to help improve charging convenience so that EV drivers can choose the speed that best suits their travel;
- 4) adding a fast charger at an already established petrol station greatly increases coverage for EV drivers and reduce range anxiety[58].

Another important consideration is the strain multiple charging stations would have on the grid, however, using renewable energy, such as solar or wind, as the source should help alleviate the pressure.

Our scoping review also revealed that some EV drivers struggled with the **complexity** and incompatibility of different charging station brands[39]. As such, EV drivers preferred to use the charging stations they were most familiar with to avoid learning new payment systems[41]. Interestingly, petrol stations do not have this issue; despite being owned by various brands the interface of the petrol stations remains similar, with drivers refuelling based on the type of fuel they want and paying either at the station or in the convenience store. Petrol stations are also located on GPS applications like Google Maps and Apple Maps, while the methods of locating a charging station are far from optimal, often requiring the downloading of multiple apps to see different brands of charging stations[58]. Policymakers, stakeholders, and other developers could consider observing petrol stations' design, layout, and simplicity as inspiration for implementing EV chargers.

Psycho-social determinants of charging etiquette.

Control beliefs and **attitudes towards charging behaviours** emerged as critical determinants of charging behaviours. The EV driver's perception of control over external factors may influence whether they use appropriate charging stations and adhere to good charging practices. In theory, EV drivers reported being willing to move their vehicle at the request of another driver; however, when the request came with a cost, EV drivers were less willing to move their vehicles. The lack of universal rules reduced an EV driver's sense of control as there is much uncertainty around what is acceptable and not acceptable behaviour, especially around when it is appropriate to unplug a vehicle[17, 20]. Several papers referred to an additional tool to communicate to other EV users when it was acceptable to unplug their vehicle. The most frequent suggestion was the inclusion of a placard system, which included the contact information of the driver and the charging level or the time the EV owner would be okay with their vehicle being unplugged[17, 20]. Including a system like this can help reduce stress, frustration or anxiety as EV drivers can contact each other to learn about the availability of spots or if a person is comfortable with unplugging. The EV drivers' attitude towards charging etiquette was generally well-received, with individuals who engaged in bad charging etiquette viewed poorly[17, 59]. A positive perspective towards good charging behaviours suggests that EV drivers are open to adhering to charging etiquette. However, studies show that there are many broken or damaged charging stations around shopping centres, schools, and recreational areas after workplace charging[42, 60]. This damage could be caused by numerous factors, such as lack of proper knowledge of using a charging station, lack of

regular maintenance, vandalism or overuse[60]. Promoting positive attitudes toward charging etiquette would be beneficial in fostering adherence to good charging practices. Stakeholders may want to look at implementing strategies to improve the reliability and perception of charging stations.

The findings of this study have several theoretical implications for the field of implementation science. Firstly, the implementation science frameworks CFIR 2.0 and TPB have predominately been used within healthcare or public health settings. By applying these frameworks to settings outside of health, we can gain a deeper understanding of the mechanisms and processes behind behavioural change across various contexts. The use of CFIR 2.0 within the EV charging context provided more insight into the contextual factors influencing optimal charging stations usage and adherence to charging etiquette. This can further inform what we know about behaviour and identify new aspects behind behavioural change that we have yet to consider. Moreover, by integrating implementation science into sustainability and decarbonisation we can gain a more holistic understanding of the contextual factors and determinants that influence human behaviour in this context. A collaborative effort between various stakeholders might be helpful in addressing any limitations or disparities in accessibility of charging spaces.

Through the use of evidence-based frameworks, it is possible to develop evidence-driven actionable recommendations that stakeholders can consider when designing, constructing and installing charging stations, and enhancing charging etiquette. This is especially important because the most prominent barriers were related to design and complexity of charging stations. Improving the development of public charging infrastructure will aid in the adoption of EV and adherence to in the general population [39]. By implementing a user-friendly and optimally designed structure for charging stations, we can avoid the pitfalls of other high-income countries and fast-track our success.

Limitations

This scoping review is not without limitations. We limited our search to the top 7 countries with the largest EV markets which narrowed down the scope of available articles. These countries were chosen because they present a good comparison for the country Australia can become. Like Australia they are high-income countries with numerous funding allocated to improving the EV market. However, this may impact the translatability of the information presented to countries with poor EV markets. Future studies may want to focus on exploring the possibility of improving charging infrastructure and etiquette in low-income countries with poorer resources and limited accessibility to infrastructure. Lastly, there is currently no accepted gold standard method for conducting rigorous grey literature searches which may affect the replicability and reproducibility of this paper. However, it's important to include grey literature because it can provide a current real-world perspective alongside an emerging field of peer-reviewed literature.

Conclusion

The findings of this study demonstrate the importance of the innovation domain and control beliefs in reinforcing good charging behaviours. Improving the design and complexity of charging stations is vital to increasing the reliability and willingness of participants to charge. Furthermore, influencing the individual perception of control over charging may prove instrumental when interacting with other drivers and ensuring that charging infrastructure are used appropriately. The analysis demonstrates the value in using implementation science frameworks to understand the enablers, address the barriers and identify the psychosocial

drivers of change. This information is essential to figuring out how Australia can learn from the successes and failures of other more established EV markets and jump ahead in the long run.



Figure 3: Futuristic Charging Station, source adobestock (file#: 753890499)

Study 2: Qualitative Interviews and Focus Groups

Building on the findings of the scoping review, we wanted to further explore charging etiquette within an Australian context. The main objective of this phase of the study is to examine the attitudes, perspectives, and behaviours of EV drivers at public charging stations within Australia using the Theoretical Domain Framework (TDF) to identify the potential barriers and facilitators of good charging etiquette. To briefly refresh, the TDF provides insight into the contextual determinants of behaviour change (i.e. cognitive, emotional, social and environmental influences)[24]. It is beneficial because it is likely to capture the most significant barriers and enablers related to the implementation of the innovation (i.e. charging etiquette) by identifying all possible contextual influences on behavioural change[61].

Methods

To capture the attitudes, perceptions and behaviours of Australians towards EV charging etiquette we invited members of the general public who drive an EV or ICE to participate in semi-structured interviews (avg 30-min) and professionals to one of two one-hour focus group sessions. Purposeful sampling was used to recruit participants from online EV forums, social media, websites, and newsletters. Ethics approval was received from UNSW IREC (4391) to conduct this study. Participant consent and permission to record was obtained via an online REDCap survey. All questions were guided by the TDF.

EV or ICE driver interviews

Online interviews were conducted from December 2023 to February 2024. Eligible participants included those with regular experience driving either an EV or ICE. The content focused on getting an in-depth understanding of the participants knowledge, expertise, and understanding perceived barriers and enablers towards engaging in good charging etiquette. The semi-structured format provided flexibility to explore the participants' previous experience with electric vehicle charging etiquette.

EV stakeholders focus groups

Online focus group sessions were conducted in January 2024. To join these sessions, participants needed to work or volunteer exclusively for an EV organisation (e.g. Australian Electric Vehicle Association, AEVA). Interviews were offered if participants could not make the scheduled focus group sessions. The content focused on identifying enablers and barriers towards good charging practices and evaluating the feasibility of the consumer interviewees' ideas for improving charging etiquette from an organisational perspective.

Analysis

Individual interviews were transcribed by lead research assistant (AS) using an online software and the focus group sessions' recordings were sent to an external transcription company. All personal and identifying information was removed from the transcripts prior to analysis. A codebook was developed, integrating EV charging etiquette into the definitions of the domains and constructs of the TDF. The lead analyst (AS) cleaned, reviewed, and coded all interview transcripts using NVivo 12, while a second analyst (SL/ZC) coded the focus group

sessions using Microsoft Word. Thematic analysis using the TDF was used to code and identify themes.

Results

In total, 15 participants took part in semi-structured interviews and four EV stakeholders participated across two focus groups (two in each session). The interviews were comprised of 11 males and 4 females, ranging in age from 24 to 71 years residing across 6 states and territories (see Appendix E table 6). 11 participants owned at least one EV with 2 participants intending to purchase one by the end of 2024. 2 participants volunteered at the AEVA and 2 participants worked or had ties to the same car insurance company. Three of the four focus group participants had purchased an EV (see Appendix E table 7).

What is Charging etiquette?

Our analysis revealed a clear definition of how Australian EV drivers perceive charging etiquette and the importance they attribute to it. Charging etiquette was commonly defined as being considerate of others when using public charging stations (see Appendix F in table 8).

"I guess like trying to do the right thing. So, everyone is in the same sort of situation, don't charge more than you need to. Be mindful of the fact that other people want to use the chargers. And leave the charging bay area in a suitable condition. Don't leave cables lying around for someone to trip over. Don't just park there. Like don't use it as your own sort of personal parking spot."- C22

There were varying perspectives on what constituted acceptable behaviours at public charging stations. For example, some participants believed unplugging another vehicle to be wrong while others defended the action based on the circumstances. Others felt comfortable with another person unplugging their vehicle if the situation dictated it.

"I'll do it. If this car been there for half an hour, it's charged and I need to charge. I've got young kids, so if they're screaming and I need to get somewhere. Yeah, I'd unplug it." – C18

While many participants reported having generally positive or neutral experiences at charging stations, several participants reported multiple instances of dealing with drivers engaged in bad charging etiquette. A couple of these participants believed engaging in bad charging behaviours was justified if it was in response to someone who has already broken the rules. Examples included plugging in an EV parked but not charging and lifting the wipers up on the offending vehicle. Other participants resorted to leaving warning cards on windshields or conversing with the offending party when they returned.

"Actual cars parked in EV spots which I'm sure is a common compliant and my technique there is to go and put their windshield wipers up so they know that someone has been very unimpressed by their decision". – C8

All participants agreed that charging etiquette was an important component to having a positive driving experience, with many stating that charging etiquette would be necessary until

enough charging infrastructure is built to support the increasing demand of EV drivers in Australia.

“Etiquette is important to have, otherwise it’s just the wild west, right? And that’s never going to work. There’s only a finite amount of charging stations to go around so you got to have some sort of law and order” – C18

“If there is always somewhere to charge, then you don’t really have to worry about what people are doing at the charging stations” – C1

A common theme was that the etiquette needed to be clear, simple with a flexible set of guidelines that demonstrate what are considered as acceptable behaviours.

Key barriers and enablers to good charging etiquette

The thematic analysis identified ‘Environmental Context and resources’, ‘Reinforcement’ and ‘Knowledge’ as key domains that collectively captured the majority of enablers and barriers towards good charging etiquette across the interviews and focus groups (See Appendix A table 3). ‘Social Influence’, ‘beliefs about consequences’, ‘social professional and identity’ and ‘belief about capabilities’ were identified as having moderately influential role in the adherence to good charging etiquette. Social professional role and identity was rated higher in the focus group sessions due to all of the participants actively working or volunteering in EV related organisations (see appendix G table 9).

The domain of **Environmental context and resources** suggests that the charging environment of a person who needs to perform a specific charging etiquette behaviour is likely to influence whether the person can engage in good charging behaviours.

“I think for me it’s because of the time. It would be more about having other things there, I guess a services station on the main highways and a bakery or a couple of food outlets, toilets, or even a green space for us to run our dogs around because when we do our longer trips, we always take them”. – C14

Findings indicated that the lack of specific facilities and features was identified as a barrier to appropriate charging etiquette, including the low number of charging stations, lack of amenities around stations, and poor signage.

Knowledge referred to the EV drivers’ awareness and perceived understanding of charging etiquette. Lack of knowledge about charging etiquette was considered a barrier to appropriate charging etiquette, as it was thought that drivers may be more likely to break the rules without realising. In the current study, the majority of participants felt they had adequate knowledge of charging etiquette (60% of everyday drivers and 100% of experts rated 7 or higher out of 10 on a charging etiquette scale).

Reinforcement referred to the perceived rewards or punishments associated with engaging or not engaging in the correct charging behaviours. Such perceptions can influence the EV driver’s decision as to whether to adhere to charging etiquette. The expectation of punishment such as warning, fines or penalties for not adhering to charging practices such as ‘not charging over 80% during busy periods’ or ‘charging instead of parking in an EV charging spot’ was seen as an enabler for good charging etiquette.

"I believe that without the stick, you know you're not going to get any change and we've seen how with idle fees there has been almost instant change from people because we do not like being fined." – C12

Two themes that did not fit easily into any single domain of the TDF were '**Advancing Technology**' and '**Improving Communication**'. Using technology and improving communication between drivers and charging infrastructure was seen as pivotal to facilitating good charging behaviours.

Advancing Technology was referred to as a strategy that could be implemented to help facilitate good charging behaviours. Examples included innovations like SMS reminders when charging was complete, reservation systems, or having charging stations visibly monitor and communicate the number of EVs in line waiting for the spot for all drivers to see, were seen as enablers in engaging in good charging etiquette.

"I got a text to say it was all charging was almost up to 80%." – C14

Communication could be improved by increasing the visibility of information between EV drivers and enabling communication by building processes to enable drivers to contact each other, such as through QR codes, website, phone number or app. Allowing EV drivers to know more information, such as how long the wait time will be or if the EV driver charging will let them unplug their vehicle, was seen as an enabler towards engaging in good charging etiquette.

"You can actually have a clock that you can turn manually that says I'm finished with charging at approximately this time. And you put it on your dashboard for everyone to see." – C10

Several strategies were suggested to help improve the dissemination of charging etiquette to the general public. Examples include signage, manuals, workshops/expos, media campaigns, QR codes, part of the app drivers use to pay for the station, short video, myth busting websites, and brochures. Experts recommended focusing on improving points of access to charging etiquette, such as using car dealers, expos, park ranger enforcement and signage as ways to disseminate and enforce charging etiquette.

Discussion

To our knowledge this is the first qualitative study to identify barriers, enablers, and psychosocial determinants of charging etiquette using the TDF framework. Our scoping review informed the foundation of this study, as it provided insight into the potential factors that might influence EV charging in Australia. This study builds upon previous qualitative research by advancing our knowledge on what EV charging and charging etiquette looks like within an Australian context.

Charging etiquette

Participants defined charging etiquette as being considerate of other charging needs which encompassed courtesy, politeness, and unselfish behaviours. Our findings demonstrate a high awareness and knowledge about charging etiquette among the EV community and a low awareness within the non-EV community. Specific scenarios reported by our participants are

consistent with the limited literature that exists, such as observing EV drivers hogging charging stations, charging over 80% during busy periods, cutting in line and unplugging other vehicles [17, 20, 21]. The consensus across participants was that charging etiquette is an important and necessary component of having a positive charging experience. However, many pointed out that it was only necessary because there was insufficient infrastructure available to support the current demand. This suggests that charging etiquette is more of an intermediary solution until there is enough infrastructure available for EV drivers to not need to interact with one another.

Universal guidelines

There were mixed opinions on the necessity of EV charging etiquette guidelines as some participants felt that adequate signage would be enough while others felt more comfortable knowing there was document they could read if needed. Understanding these different schools of thought has wide practical implications, as stakeholders involved in the design, implementation or maintenance of EV charging stations should take into consideration the varying knowledge and confidence levels of drivers when developing resources to support charging etiquette. Regardless of the type of resource (guideline or signage) all participants talked to having clear, simple, and flexible rules that were universal across each charging station and made aware to everyone. Moreover, instead of focusing our efforts on developing one resource for all, stakeholders might want to diversify their approach by releasing tailored resources targeting various demographics. Some participants suggested disseminating the guidelines in the form of audio-visual resources such as through media campaigns, social media posts, websites, optional videos on charging apps or charging stations that give you discounted prices once viewed, and QR codes people could scan if they wanted. While other demographics focused on workshops, conference-like events, and using car dealers as the first point of contact for educating new drivers. Understanding who your target audience is will determine the best way to disseminate charging etiquette rules. A key question that came up during the focus group sessions was who would be responsible for the creation and dissemination of the charging etiquette rules. One group firmly believed the responsibility lies with EV organisations while in the second group believed it was a collaborative and interactive effort between government agencies and EV organisations. EV stakeholders may want to clarify this responsibility to ensure all organisations and agencies are on the same page regarding their roles and responsibilities.

Theoretical domains framework

The TDF has been extensively used to understand the determinant of behaviour change in clinical context but rarely outside this scope. The TDF identified three domains: **'Environmental context and resources'**, **'Knowledge'** and **'Reinforcement'** as collectively capturing majority of the enablers and barriers towards using charging infrastructure appropriately and engaging in good charging etiquette. These findings demonstrate the need for developing targeted strategies to address these domains and promote good charging etiquette.

Environmental context and resource emerged as the most salient domain, capturing how the surrounding environment and current infrastructure available influenced the EV drivers' ability to engage in good charging behaviours. Consistent with the literature and our scoping review, participants expressed concerns about frequency of charging stations, long waiting times, overcrowding at stations, limited amenities, lack of appropriate EV logos on charging bays, poor lighting in evening/night time and minimal signage [20, 32, 62, 63]. The presence of these factors often acted as barrier towards optimally using the charging stations and engaging in

good charging etiquette. Improving the accessibility and availability of charging stations would likely reduce many of these barriers and make it easier for drivers to engage in good charging practices. Stakeholders may want to prioritise creating comfortable and convenient environments for EV drivers to feel safe and more likely to engage in good charging etiquette.

Our findings indicated that limited knowledge about charging etiquette was a barrier towards engaging in good charging practices. Aligning with previous literature, participants believed that misunderstandings and conflict were more likely to occur when only one driver had a limited understanding of what the rules were[17, 20]. When the participants confronted the driver through either conversation or through leaving a note, most drivers apologised while a very small proportion did not seem to care. By the same token, high amount of knowledge about charging etiquette was identified as an enabler, however there were circumstances where knowledgeable EV drivers engaged in bad charging etiquette in response to EV drivers who had broken the charging norms. This suggests that while knowledge is a vital indicator of an individual's ability to engage in good charging practices, a more targeted approach is needed for those who are, or become, aware of good practices and still engage in bad etiquette. An interesting discussion point was the potential discrepancy in knowledge between men and women/children. While the female participants who had an EV felt confident in using charging infrastructure and engaging in etiquette, a couple of male participants reported their wives and children were not as competent in using charging infrastructure or aware of charging etiquette. The latter perspective was in line with existing research, suggesting that men are more likely to be the target audience for the adoption of EVs[42]. Stakeholders should prioritise educational initiatives that focus on raising awareness of EV charging station usage and etiquette within female communities to reduce this gender disparity of knowledge.

The expectation of punishment for not adhering to considerate charging practices such as 'charging over 80% during busy periods' or 'parking but not charging in an EV charging spot' was seen as an enabler for good charging etiquette. Consistent with the literature there appears to be little to no enforcement to punish drivers for blocking other cars or hogging a charging station[20, 64]. Blocking or hogging a charging station can prevent EV drivers from using the stations, so financial penalties might be a good way to discourage bad charging behaviour. However, finding a balance is key as too high penalties may turn drivers from using EV charging stations altogether[20, 64]. For example, many participants suggested the inclusion of incremental idle fees during busy periods to improve availability of charging spots and motivate drivers to behave in accordance with good charging practices. Warnings can also go a long way in discouraging behaviours as one driver reported receiving an email from Tesla after overstaying stating that next time they would be charged idle fees. While another left warning cards on windscreen wipers and never observed the same offender twice. One important consideration is that idle fees, penalties, fines or warnings may not be the best motivators for drivers from wealthier backgrounds as they may just cop the loss as part of the cost of EV charging[17, 20]. To avoid over-penalising EV drivers, harsh penalties should only be imposed in extenuating circumstances such as busy periods or a blatant disregard for other drivers such as parking but not charging an EV or taking longer than 30 minutes to return to their vehicle after charging is complete.

Two interesting categories that did not fit easily into any single domain of the TDF was **'Advancing Technology', and 'Improving Communication'**.

Advancing technology was a recurrent theme across all interviews, as participants suggested various innovations like SMS reminders when charging is complete or providing monitors with a list of EVs waiting for a spot to help remind participants to return to their vehicle on time and

to avoid cutting someone in the queue for a spot. Interestingly, this was a novel concept within the literature as only one article indirectly linked technology advancements to charging etiquette[20]. Constantly improving, maintaining, and updating technology was seen as necessary pathway to improving usage of charging stations and charging etiquette. Including technology that makes it easier for drivers to engage in good charging practices like automatically creating queues without drivers having to log on to an app. Technology could also be used to improve the infrastructure, such as creating universal plugs, providing better avenues for drivers to report dysfunctional chargers, and standardising the necessary features of a charging station to make it easier for drivers to use when they try new charging stations. Including communicative technology where the charging stations talked to the EVs or even a GPS system like those featured in Tesla vehicles was believed to be a strong enabler towards good charging practices, as participants would be less frustrated in trying to find a spot.

Likewise, improving communication between EV drivers was another recurrent theme throughout the interviews and focus group sessions. Including a feasible process that allow EV drivers to potentially contact each other, such as to find out if the driver plugged in is happy for their EV to be temporarily unplugged or how long the driver charging will be, could help improve the overall experience, usage, and ability to engage in good charging practices. Examples given from participants ranged from just leaving their phone number on the windscreen to a laminated signage that states how long the driver would be. Similar examples have been listed throughout the literature with many EV drivers frustrated by the lack of communication especially in dire circumstances such as waiting for long periods of time because they are unable to travel to the next charging station[17, 20]. Standardising a method across charging stations may increase the spread of the practice and improve usage of charging stations.

Limitations

Throughout the project there were several limitations. Most participants that signed up had either purchased an EV or were planning to do within the next year. As such they had spent a great deal of time researching EVs which may not accurately represent the knowledge or perception of the wider population. There was also mainly one researcher who conducted the interviews/focus group sessions, cleaned the transcripts, coded and analysed the transcripts. However, to improve rigor, the research developed a coding guide using the TDF within the EV charging context and obtained feedback from supervisors to establish consensus.

Conclusion

The TDF provided a comprehensive account of the enablers and barriers of adhering to good charging practices and optimally using charging stations. We identified barriers related to the frequency of charging stations, long waiting times, overcrowding, limited amenities, lack of consistent EV logos at charging bays, poor lighting, minimal signage, low knowledge about etiquette and lack of punishment. They also have enablers related to improving communication, advancing technology, and having high knowledge about penalties, fines, warnings, idle fees, and surrounding amenities. Our study offered new insight into these barriers and enablers by relating the findings to the TDF domains and adds value by providing recommendations that can inform the design of targeted strategies to optimise charging etiquette and usage of charging infrastructure. By addressing the key domains and themes mentioned above, organisations responsible for implementing charging infrastructure can help elevate the EV drivers' charging experience and improve the usage and efficiency of charging infrastructure. The methods and lessons learned from this study are transferable to other energy transition technology spaces. Based on these findings, we aim to develop

targeted resources to inform various demographics about current charging etiquette rules. These findings suggest the need for better infrastructure, improved awareness, and knowledge about charging etiquette and strict enforcement. Understanding the barriers, enablers and psycho-social determinants can create a more prosperous, efficient, and sustainable charging ecosystem.



Figure 4: Modern EV at charging station, adobestock (file#: 622443208)

Recommendations

Based on these findings from the two studies, we recommend that stakeholders consider the following evidence-driven strategies targeted at identified barriers to improve the overall charging infrastructure and elevate EV drivers' charging experiences. To see how these recommendations relate to the implementation science framework, see Appendix I.

Study 1:

1. Enhancing EV drivers' perception of control by increasing driver's confidence in correctly using charging infrastructure through clean instructions, demonstration, and guidance around charging etiquette.
2. Provide *real-time updates of multiple brands of charging station availability in one source* (app, monitor, GPS) to allow EV drivers to make informed decisions about where and when to charge.
3. Addressing negative attitudes towards charging infrastructure through *improving the reliability of charging infrastructure*. Create processes for drivers to easily report broken charging infrastructure, schedule regular maintenance of charging infrastructure and have technicians on standby to fix charging stations located in rural areas.
4. Invest in improving design of charging infrastructure to be easy and *consistent across brands and companies*. Governments or EV organisations may choose to create a more *standardised approach to ensure similarity between different companies*.
5. Optimise the physical layout of charging stations by increasing the number of bays and types of charging speeds to make it easier and more convenient for EV drivers to use the charging stations. Stakeholders should investigate the *suitability of charging stations for a wide range of EV drivers*.
6. Building charging stations near amenities, restaurants, rest stops, parks, shopping centres to provide EV drivers with things to do while they charge their vehicles.

Study 2:

1. To improve the environmental context and resource, enhance the *visibility and accessibility of charging stations, make charging more convenient, build more infrastructure* (i.e. limit the distance between them).
2. Developing a *range of targeted resources and media campaigns, provide expos, instructional videos to increase knowledge and awareness of charging etiquette within the general population*.
3. Create and implement signage like council carparks that list acceptable or unacceptable practices for drivers to follow (See Appendix H for example).
4. Utilise technology to help facilitate good charging behaviours such as sending the driver a text message when charging is complete with a warning to collect your vehicle or move your vehicle after 5 to 10 minutes. Implement incremental idle fees. Provide drivers with resources to communicate with each other, whether it's through the charging app or QR code, protect the anonymity of both drivers as some drivers may not feel comfortable sharing their details.
5. Place a stronger focus on the enforcement of charging etiquette, provide warnings, penalties, and fines in a similar manner to those who overstay or park in disabled parking. Provide fines for drivers who fail to move their EV after 15 minutes of charging session being complete or penalise drivers who charge more than 80% during busy period by making them pay a higher rate.

Conclusion

Charging etiquette is defined as a set of socially acceptable rules of engagement between drivers at electric vehicle (EV) charging stations. Currently, there is no universal guide on these rules, resulting in lots of conflict and confusion between drivers as they try to determine acceptable charging behaviours. *Australia needs to catch up in the development of our EV market but is in a unique position to learn from the successes and failures of other, more advanced EV markets worldwide.* Our scoping review used two implementation science frameworks, CFIR 2.0 and TPB, to examine high-income countries with well-established EV markets and identify potential barriers, enablers, and psycho-social determinants that affect charging behaviours. The findings of this review demonstrated the importance of having well-designed charging stations with easy-to-use interfaces located at various convenient locations. The findings of this review were used to inform the basis of our qualitative study, where we conducted interviews and focus group sessions with everyday drivers and EV experts living in Australia. We used the implementation science framework TDF to identify barriers, enablers and psycho-social determinants of charging etiquette within Australia. The findings of the qualitative study demonstrated that environmental context plays a vital role in adhering to charging etiquette and highlighted how knowledge and punishment can help reinforce good charging behaviours. Several recommendations were provided for stakeholders to consider when designing and implementing charging etiquette. To our knowledge, this is the *first implementation-science-based examination of the enablers, barriers, and psycho-social determinants of using charging infrastructure and charging etiquette.*



Figure 5 : Urban, electric vehicle, eco concept, source adobe shock (file# 473289289)

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Appendix

Appendix A – Barriers and Enablers

Table 2- Scoping Review Barriers and Enablers

The barriers and enablers associated with each construct of the CFIR 2.0 and TPB. The (+) indicates an enabler, (-) indicates a barrier, (+/-) indicates both a barrier and enabler.

Scoping Review	
Innovation Design	(+/-) layout of stations (+) standardise the stations
Innovation complexity	(-) inconsistent across brands (-) too many different types of plugs (-) multiple apps to find charging stations
Physical infrastructure	(+) Comfortable and convenient environments (+) Accessibility (+) Access to amenities
Control beliefs	(-) inconvenience, (-) physical obstacles
Attitudes towards behaviours	(+) negative towards bad charging etiquette (-) broken or damaged infrastructure

Table 3: Qualitative study Barriers and Enablers

The barriers and enablers associated with each construct of the TDF and themes. The (+) indicates an enabler, (-) indicates a barrier, (+/-) indicates both a barrier and enabler.

Interviews and Focus groups	
Environmental context and resources	(-) limited available charging stations (-) lack of adequate signage (-) long waiting times (-) limited amenities (-) damaged or unreliable infrastructure (-) cost (-) poor lighting (+) signage (+) shade (+) regular maintenance
Knowledge	(+) Knowledge (+) educate car dealers (+) plan ahead
Reinforcement	(+) Fines, (+) penalties

-
- (+) idle fees
 - (+) warnings
 - (+) Incentives

Advancing technology

- (+) SMS reminder system
- (+) universal app to find all charging stations
- (+) universal plugs
- (+) centralised apps for complaints
- (+) standardising features on stations
- (+/-) Booking system
- (+) Use cameras to spot bad etiquette

Improving communication

- (+) Placard system
 - (+) providing contact details
-

Appendix B – Implementation Science Framework

Consolidated Framework for Implementation Research 2.0 (CFIR 2.0) – (study 1)

The Consolidated Framework for Implementation research 2.0 (CFIR 2.0) is a determinant framework that aims to predict or explain potential barriers and facilitators that could influence effectiveness of recommended strategies [28, 29]. It is made up of 5 major domains known as (1) innovation, (2) outer setting, (3) inner setting, (4) individuals, and (5) implementation process any of which are likely to positively or negatively influence the implementation of optimal charging usage. Within the 5 domains it has 67 underlying constructs that can potentially influence any behaviours on an organisational level. The original version of this model was the highest cited framework within the field of implementation science [28]. As implementation science has progressed, the gaps within the original CFIR have been addressed and updated as the CFIR 2.0. The updated version includes constructs from the theoretical domain's framework (TDF), another framework that provides insight into the impact of the implementation of evidence-based practices from an individual psychosocial and organisational perspective level[31].

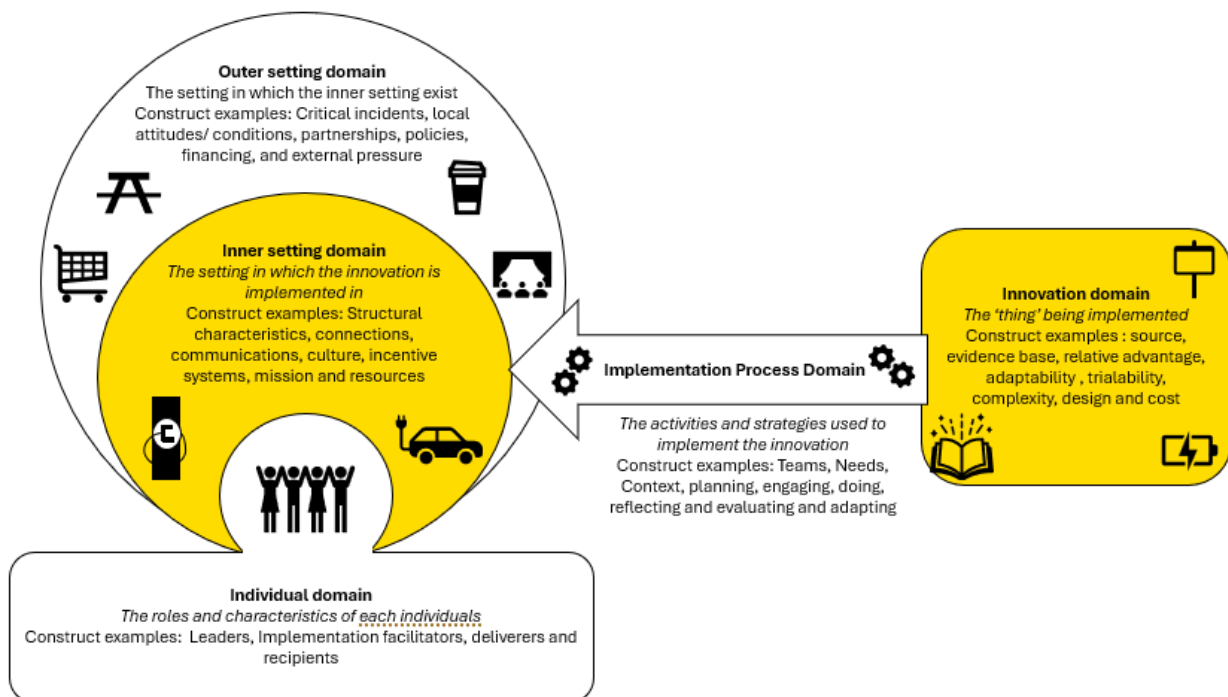


Figure 6: CFIR 2.0 model adapted from [1] demonstrating the factors that can influence the implementation of an innovation.

Theory of Planned Behaviour (TPB) – (study 1)

The theory of planned behaviour (TPB) provides insight into the impact of the implementation of evidence-based practices from an individual psychosocial[2, 30] . It explains individual behavioural change through self-reported behavioural intention predicted by three main constructs (Attitudes towards behaviour, subjective norms and perceived behavioural control) that influence an individual's intention to participate in a certain behaviour[2, 30]. Each construct is influenced by a corresponding belief (behavioural belief, normative belief and control beliefs). The strength of the beliefs directly influences the corresponding construct. As such, the TPB can reliably predict intentions and behaviour using measures that represent the main constructs[30].

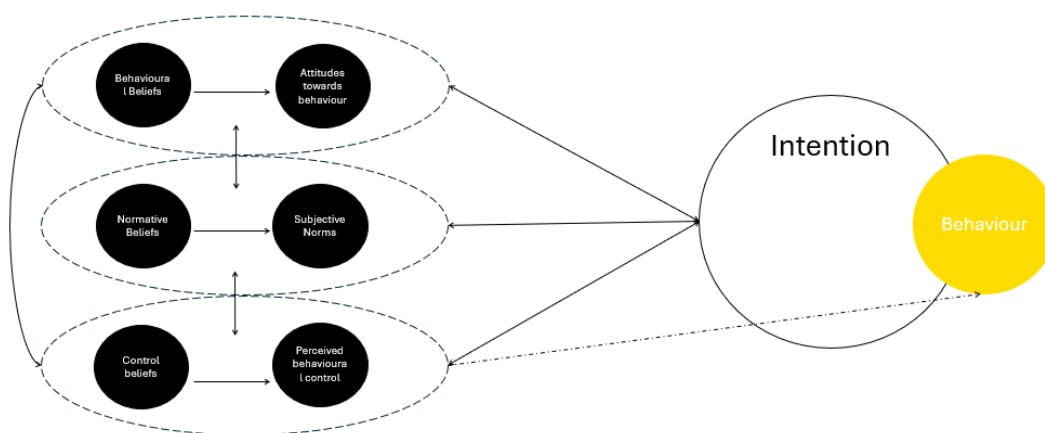


Figure 7: The TPB adapted from[2] demonstrating factors that influence intention and behaviours.

The Theoretical Domains Framework (TDF) – (study 2)

The Theoretical domains Framework (TDF) provides insight into the cognitive, emotional, social and environmental influences on behaviours [24]. It synthesised 33 theories of behavioural change into 14 domains and 84 subconstructs that can be used to identify any potential external influence on a specific behaviour. The TDF has been used widely across a range of healthcare settings however we have adapted the framework to be more relevant to a public charging infrastructure. The TDF in combination with the CFIR can drive the selection of evidence-based strategies known to address key barriers as identified with each framework.

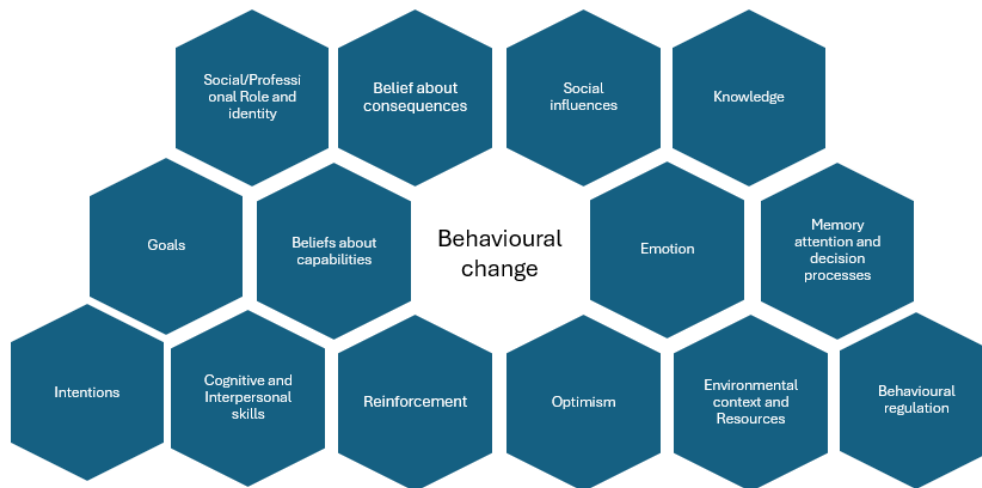


Figure 8: The TDF model demonstrating possible influences on behavioural change.

Appendix C – Peer review sources

Table 4: Scoping Review Characteristic of sources and main findings of journal articles

Description of the characteristics of sources and the main results from each included peer-review related to charging behaviours or etiquette.

First Author	Geography	Type of EV	Type of data collection	Main finding
Everett, [45]	United Kingdom	Plug-in and hybrid vehicles	Questionnaires and interviews	Participants believed that an extensive network of public charging sites was essential to help reduce range anxiety and improve their willingness to have an EV. Charging stations should take no longer than 5-10 minutes to charge and was easy as going to a petrol station.
Wolbertus [65]	Netherlands	EV	Charging data from stations across 5 cities	Data showed that time connected to the charger was much longer than the time spent charging potentially preventing others from being able to use the charging station. The limited residential parking for home-chargers in Amsterdam and Utrecht resulted with a higher public charging station occupancy rate compared to other cities with better parking schemes.

Kim [66]	Netherlands	BEV and PEV	Modelling of charging transaction dataset	People who regularly charge tend to charge for longer, more frequently, and on weekdays at the same charging station. While people who charge irregularly prefer to charge on weekends.
Wolbertus [59]	Netherlands	EV, FEV and PHEV	Data set from charging stations	Negative EV charging hogging behaviours were most evident in overnight charging sessions and by visitors and shared vehicles. Many users only showed charging hogging behaviour on a few occasions.
Nicholas [67]	United States	BEV	Survey	Most users preferred to charge close to home within 5 miles when charging is for free or within 10 miles when they have to pay for charging on their way back home
Vogt [49]	Germany	EVSE	Survey	EV owners preferred to use RFID tags over any other payment methods like SMS and phone. They also preferred to use normal charging speeds while their car is parked and fast charging on long distant trips
Shirmohammadli [68]	Germany	EVs	Traffic data and charging time data	the more attracted motorized individual traffic to a facility, the greater is the potential of this facility for installation of FCS.
Krause [69]	Germany	EV	Survey	People preferred charging stations to be located within walking distance of public shopping locations, eating location, and leisure spots and with at least two charging points.

Xin [70]	China	EV	Charging station data	People preferred to charge between 8 am and 8 pm with increased number of charging times during the work week.
Philipsen [71]	Germany	ICEV and BEVs	Focus groups, Questionnaire	Participants preferred 15-minute charging sessions and for parking spaces close to home to have charging stations.
Wolbertus [72]	Netherlands	EV, PHEV, shared EV vehicles	Fast charger data, survey and state choice experiment	EV drivers in general have a more positive attitude towards fast charging as an alternative when home charging is not available.
Dixon [73]	United Kingdom	EV	Survey	Found that more charging locations reduced the time penalty that EV drivers were expected to endure. Suggestions were made about increasing battery size, charging power and access to charging at more location.
Philipsen [74]	Germany	BEV and ICE,	Interview, choice-based conjoint analysis	The price of charging and range of vehicle battery was considered the most important factors for ICE users. BEV users preferred recharging at freeway chargers oppose to countryside chargers.
Wen [75]	China	EV	Survey	Normal and slow charging had little influence in the EV user's choice of charging station in residential/working areas or in shopping centres.
Ma [76]	China	EV	Survey	Survey indicated that participants found the current EV charging infrastructure as acceptable. The physical facilities of charging stations,

				accessibility of chargers and cost/payment of charging were the most important indicators for users.
Wen [51]	China	electric private cars	Survey	High income families were more willing to charge in residential/work chargers over leisure/entertainment locations. Users who preferred fast charging modes preferred to charge in public charging locations.
Jonas [77]	United States	EV	Data from charging stations	Users preferred to charging closer to their homes and started to charge more during the pandemic. Peak charging sessions occur between 7 and 9 am ending between 5 and 6 pm and extended to between midnight and 2 am during the pandemic. Charging demand and frequency of sessions decreased during the pandemic.
Fabianek[53]	Germany	BEV	Interview, online survey	Users reported encountering dysfunctional charging stations with 20% of users find a car blocking access to the charging station. Availability and functionality of the charging station was rated more important than price.
Obeid [78]	United States	PEV	Behavioural experiment, modelling	Participants were willing to pay for the convenience of regular charging
Mohamed [44]	United States	EV	Survey, modelling	Most EV users preferred to travel longer for cheaper charging stations instead of travelling to a more expensive one that was closer. Although most EV users preferred faster chargers even though its more expensive.

Franke [79]	Germany	EV	Field study (survey and travel diaries)	Users tend to recharge their vehicle when there is plenty of range left, charging around 3 times per week.
Bonges [20]	United States	EV	Review	Several solutions suggested on how to reduce pressure on charging stations (using inconvenient charging spaces, financial penalties and increase availability of charger).
Li [80]	China	BEV, PHEV	Electric Vehicle Public Data	Neighbourhoods with denser charging facilities, users conduct charging significantly much more often.
Halbey [36]	Germany	BEV and ICEV	Focus groups	Participants felt strongly about including WI-FI and service areas to charging stations to make the locations more desirable. All focus groups agreed that talking extra time to charge was not acceptable and no one was willing to wait for several hours as participants believed charging should be similar to refuelling. BEV users were also willing to change their habits and take extra breaks to recharge.
Pevec [47]	Worldwide	EV	Survey	Participants living in small, rural locations were more likely to accept greater distances between neighbouring charging stations than participants from larger/urban places. Potential EV owners wanted charging stations to be as easily accessible as petrol stations.

Daubitz [54]	Germany	All respondents had experience with BEV	Computer-assisted Cognitive Interviews.	Participants were worried about failing to find an available charging station and did not trust the existing infrastructure. They also found a wait time of 30 minutes for fast charger to be unacceptable. Most were not willing to change their routines to adapt to long waiting times.
Philipsen [33]	Germany	BEV non-BEV	Questionnaire	Respondents perceived motorway service stations as the most important location for recharging stations followed by workplace/gas stations, shopping centre, leisure facilities and educational institutions. Reliability of charging stations was the most important criterion followed by dual use, and accessibility. There was no willingness to vacate a parking after charging station had been completed
Schmidt[81]	Germany	EV	Modelling	Found that increasing the number of charging stations or increasing the charging power can positively influence user charging behaviour. Also found that dwell time, arrival time and charging speed did not improve user behaviour.
Halbey [37]	Germany	BEV and ICEV	Questionnaire	Respondents believed that the most attractive charging location was a service area and more willing to increase the distance between charging stations from 50 to 150 km to use it. Participants agreed that 15-30 minutes are considered as acceptable waiting period followed by driving range, charging location and charging network density.

IEE [82]	China	EV	Modelling	Found that multiple price scale and the configuration of charging stations can improve user satisfaction and revenue of charging station.
Caperello [17]	United States	PEV- Nissan Leaf	Interview	Some participants were unsure how to find public chargers or what the correct charging etiquette was in various situations.
IOP [83]	China	Electric car	Modelling	Found four user strategies for EV charging dependent on distance, cost, time to charge and waiting time.
Chakraborty [84]	United States	PEV, PHEV and BEV	Survey, Modelling	When the price of charging either at home or public charging station is too high PEV drivers prefer to charge at their workplace.
Figenbaum [41]	Norway	BEV and ICEV	Interview, survey, open data collection	Participants preferred to use the same charging operator each time to avoid having to learn a new payment system. Charging stations were found to be not as easy to use as petrol stations with BEV owners desiring more information about the availability and operational status of charging points.
Li [85]	China	BEV	Survey	BEV users with a short history were more concerned about availability range.
Siddique [86]	United States	PEV (BEV or PHEV) - 46% bEV	Charge point data	Dwell time varied across charging locations category and was shorter on weekdays and in the mornings.
Lee [87]	United States	PEV, BEV, PHEV	Survey	Public charging was the least relied on charging infrastructure with people preferring home charging and workplace charging.

Anderson [88]	Germany	EV	Survey	Participants viewed public charging infrastructure as insufficient and were willing to pay more for additional power. Facilities should be located with 5 to 10 minutes walking distance of charging stations
Helmus [89]	Netherlands	EV	Computer stimulation based on real-world data	Found a potential decline in habitual occupancy at the expense of increasing occupancy for habitual users.
Wang [90]	China	EV adopters	Survey	EV adopters from upper class cities accepted longer charging durations with both slow and fast charging post. While EV adopters from lower class cities accepted lower density of charging stations.
Helmus [91]	Netherlands	EV users	Modelling based on charging transactions	Determined 13 different charging session types based on start connection time, duration, hours between sessions and distance between sessions.
Braunl [92]	Germany	EV	City business modelling	Many people agreed with the cities EV policies especially rules like do not taking my parking spaces.
Chen [40]	China	EV	Survey	After charging in residential areas, shopping malls, parks and subway entrances are the next idea options for charging. The charging price has a strong influence on consumer satisfaction and consumers prefer fast

				charging modes. Young people were insensitive to charging price, long distance and prefer to charge at night.
Gnann [93]	Other: both Sweden and Germany	BEV	charging data	The larger the battery of the vehicle the lower the occupancy of fast charging point.
Coffman [94]	Multiple countries	EV, HEV/ICEV, BEV, PHEV,	Review	The literature suggests that optimal distribution and type of public charging networks is dependent on typical driving distance, vehicle driving range, types of trips (including duration of parking), presence of home charging (and type of home charging), charging time, and impacts to the power system.
Gutjar [43]	Germany	EV and potential users	Survey, interviews	People with high intention to buy an EV prefer web-based payments over card however debit transfer is the most preferred method in the elderly. People with low intention to buy an EV prefer RFID over Plug&Charge. However, people with high intention disliked RFID the most.
Hoer [95]	Norway	EV	web-based questionnaire	Respondents preferred fast charging options and were willing to pay to reduce overall wait time.
Wolbertus[96]	Netherlands	EV	charging stations data	There was a large number of unique users however they only occurred for a small amount of sessions.
Schoenberg [97]	Germany	EV	charging station	Determined the number of charging points needed to prevent long waiting times.

				database and then computer simulation	
Hardinghaus [46]	Germany	BEV and PHEV	Survey and focus group		Suggests a reservation system with flexible timeslots with minimal additional fees. Many participants from the focus group have experienced a lack of available chargers and believe it should be as fast a petrol station While others suggest longer time slots.
IEEE [98]	United States	PEV	Charging stations data		Found that starting time impacted the connection time and that longer wait times led to less uptake of EVs.
Krause [35]	Germany	EV	Questionnaire Interview		Found that EV users tend to start looking for recharging options when they have used 72-80% of their battery range.
Anderson [50]	Germany	BEV and PHEV	Survey		Found that majority of public charging stations were located suburban areas followed by rural and then urban areas. While Participants preferred to use semi-fast/fast chargers, slow charging was more commonly used especially when the car could be parked for long periods of time.
Khaleghikarahrodi [99]	United States	EV	Data from public charging stations		Found that majority of users exhibited convenient charging usage followed by users who procrastinated when their state of charge dropped below 50% and by users who were either anxious about charging or waited till their state of charge was close to 0.

Liu [100]	China	BYD QinEV	Modelling	Found that in the early stages, high charging costs are lucrative for drawing in a greater charging demand.
Helmus [15]	Netherlands	Full-EV, PHEV and Non-EV	Survey	Majority of participants were willing to move their car at the request of another driver but were less inclined to do so in the evening/nighttime or if they had not received their desired battery level.
Hovet [101]	United States	EV	Charging station data	Many EV users remained parked at the charging station even after charging session was complete. Most charging events occurred on weekends however the average usage on weekdays was more than double the daily usage on weekends.

Appendix D – Grey Literature Sources

Table 5 - Scoping review characteristic of sources and the main results of included journal articles

Description of the characteristics of sources and the main results from each included grey literature related to charging etiquette.

Title	Type of source	Geography	Focus of the article	Main finding
Consumer guide to electric vehicle charging [102]	Guide	United States	Focuses on understanding what you need to know when charging your vehicle	Only park in charging bay when charging Do not unplug another EV without their permission Charge only when necessary Move your vehicle once charging session is complete
Charging electric vehicles (getting the best out of EV batteries, home and public charge points and maximising savings [103]	Government document	United Kingdom	Focuses on what you need to know about charging your vehicle	Return charger to correct doc and remove any trip hazards Only park in charging bay when charging leave a sign on the dashboard indicating when adequate charging is expected to be complete or contact information Move your vehicle once charging session is complete Move your vehicle once charging session is complete
Electric vehicle charging etiquette [104]	Pamphlet	United States	Focuses on what you need to know about charging etiquette	Return charger to correct doc and remove any trip hazards Only park in charging bay when charging Avoid charging over 80% Move your vehicle once charging session is complete

Electric vehicle charging stations at WPI [105]	Pamphlet	United States	Provides instructions on the charging etiquette on university campus	Return charger to correct doc and remove any trip hazards Only park in charging bay when charging Report faults to charging provider Top up only what you need Obey sign posted time limits and be aware of your charging time Move your vehicle once charging session is complete
EV charging etiquette [106]	Pamphlet	DUBAI	Focuses on Charging etiquette	Return charger to correct doc and remove any trip hazards Only park in charging bay when charging
Electric Vehicle Charge Point Etiquette Guide[107]	Guide	Scotland	mentions to general, rapid and destination charging etiquette	Return charger to correct doc and remove any trip hazards Only park in charging bay when charging Do not camp, hog or overstay Only use rapid charging if necessary Move your vehicle once charging session is complete Do not unplug another EV without their permission Obey sign posted time limits and be aware of your charging time ensure you have started your charging session before leaving your vehicle reasonable to leave the car unattended at designated charging Use appropriate public chargers
Electric Car Charging Etiquette Guide [108]	Guide	United States	this is the resource from the previous website listed. Provides a guide on the charging etiquette	Choose appropriate charger for your visit Only park in charging bay when charging only use rapid charging if necessary Obey sign posted time limits and be aware of your charging time Do not unplug another EV without their permission Be courteous to other drivers Leave a sign on the dashboard indicating when adequate charging is expected to be complete or contact information No non-EV cars parking in EV spots Top up only what you need

Advancing Iowas electric vehicle market [109]	Pamphlet	United States	Focuses on charging behaviours within Iowa and briefly mentions charging etiquette	Obey sign posted time limits and be aware of your charging time Do not unplug another EV without their permission
Buying an electric vehicle [110]	Guide	New Zealand	Focuses on providing a guide for adopting an E	Return charger to correct doc and remove any trip hazards Only park in charging bay when charging Report faults to charging provider Obey sign posted time limits and be aware of your charging time Do not unplug another EV without their permission Only use public charging if you cannot charge at home Return to vehicle when charging is completed - monitoring charging levels while away Use apps - (plug share or need to charge)
Tampa Electric's electric vehicle and energy education program [111]	Guide	United States	Focus is on plug-in electric vehicle student readiness guide - preparing students on how to use EV	Return charger to correct doc and remove any trip hazards Only park in charging bay when charging Keep bay area clean - do not litter Do not unplug another EV without their permission Leave a note asking the EV charging to plug your vehicle in next Charge only when necessary
Electric vehicle charging etiquette [104]	Website	Australia	Provides a list of charging etiquette	Choose appropriate charger for your visit Return charger to correct doc and remove any trip hazards Only park in charging bay when charging Report faults to charging provider avoid charging over 80% Offer to pay nominal amounts for overnight charging be courteous to other drivers Use apps - (plug share or need to charge)

EV charging etiquette: A few tips on courteous EV charging [112]	Website	United Kingdom	Provides examples of CE	Return charger to correct doc and remove any trip hazards Only park in charging bay when charging Report faults to charging provider Avoid charging over 80% Leave a sign on the dashboard indicating when adequate charging is expected to be completed or contact information Return to vehicle when charging is completed - monitoring charging levels while away
OPERATING AN ELECTRIC VEHICLE GSA Fleet Electric Vehicle Training Series 2016[113]	Audiovisual presentation	no country	Training guide on how to operate EV	Do not unplug another EV without their permission Move your vehicle once charging session is complete Charge vehicles overnight Plan ahead
Electric vehicle charging stations: Information and guidance related to the installation and management of electric vehicle charging stations on campuses [114]	Guide	no country	Electric vehicle charging policy for this location	Choose appropriate charger for your visit Only park in charging bay when charging Obey sign posted time limits and be aware of your charging time Charge only when necessary
Victoriia Beach Herald [115]	Report	Canada		Only park in charging bay when charging Avoid charging over 80% Move your vehicle once charging session is complete Top up only what you need Move your vehicle once charging session is complete Use apps - (plug share or need to charge)
EV Handbook ELECTRIC VEHICLE OWNERSHIP BASICS [116]	Report	no country	Focuses factors to considered when buying an EV	Report faults to charging provider Move your vehicle once charging session is complete Leave a polite note if someone has broken the 'rules' Educate and spread awareness about proper charging etiquette Leave reviews No non-EV cars parking in EV spots

Metropolitan Council Electric Vehicles Planning Study: Analyses & Recommendations [117]	Report	United States	addresses the second goal of the Electric Vehicles Planning Study, following the Electric Vehicle Landscape Summary published in December 2021	Move your vehicle once charging session is complete Use apps - (plug share or need to charge)
The Chicken-and-Egg Electric Vehicle Dilemma of British Columbia: EV Policy Recommendations for the Modernization of the Cowichan Valley Regional District Official Community Plan and Zoning Bylaws [118]	Thesis	Canada	Focuses on understanding the objectives and policies measures that need to be taken to develop charging infrastructure	Obey sign posted time limits and be aware of your charging time Do not unplug another EV without their permission Leave a sign on the dashboard indicating when adequate charging is expected to be complete or contact information Educate and spread awareness about proper charging etiquette
CHARGING YOUR NEW ELECTRIC VEHICLE Everything You Need to Know for Anxiety-Free, Money-Saving Travel[119]	Audiovisual presentation	no country	A guide to everything you need to know about charging your EV from ports, chargers, and rules	Charge only when necessary Move your vehicle once charging session is complete leave a polite note if someone has broken the 'rules' leave reviews Use apps - (plug share or need to charge)
Go Ultra Low Oxford Monitoring and Evaluation [120]	Report	United Kingdom	Focuses on evaluating the performance of charging infrastructure and charging habits as well as community responses	Move your vehicle once charging session is complete educate and spread awareness about proper charging etiquette formal rules

Your Electric Vehicle Charging Book Provided by your trusted energy source, your Touchstone Energy Cooperative [121]	Report	United States	Provides a guide to how to choose and use charging infrastructure	Charge only when necessary Move your vehicle once charging session is complete Use apps - (plug share or need to charge)
Fulton-Montgomery Community College Electric Vehicle Fuelling Station Locations & Procedures[122]	Guide	United States	Focuses on the procedures that apply to faculty, students and staff who use EV at the college	Only park in charging bay when charging Report faults to charging provider Charge only when necessary Move your vehicle once charging session is complete Reasonable to leave the car unattended at designated charging Provide penalties for non-EV parked in EV spaces
If the Battery's Full, Give That Cable a Pull: My Advice to Public EV Charger Users[123]	Article	United States	Focuses on the authors experience with charging etiquette	Only park in charging bay when charging Do not camp, hog or overstay only use rapid charging if necessary be courteous to other drivers Charge only when necessary Move your vehicle once charging session is complete Return to vehicle when charging is completed - monitoring charging levels while away leave a polite note if someone has broken the 'rules'
The power outlet [124]	newsletter	United States	current initiatives	Do not block or queue in front of other charging stations leave a sign on the dashboard indicating when adequate charging is expected to be complete or contact information
INFRASTRUCTURE & ENVIRONMENTAL SERVICES COMMITTEE AGENDA[125]	Agenda	United States	Discussed a variety of issues	Only park in charging bay when charging only use rapid charging if necessary Charge only when necessary Move your vehicle once charging session is complete Use apps - (plug share or need to charge)

NeMo D7.1. Global adoption methodology and self-certification methodology for CPOs and EMP [126]	Project proposal	European		Leave a sign on the dashboard indicating when adequate charging is expected to be completed or contact information
Victoria Beach Herald	newsletter	Canada	mentions an article of a persons experience with EV	Obey sign posted time limits and be aware of your charging time Move your vehicle once charging session is complete
Get your charge on - everything you need to know about E-mobility [127]	Guide	United States	This e-book will provide you with an introduction to today's electric vehicle landscape	Do not block or queue in front of other charging stations Be courteous to other drivers Leave a sign on the dashboard indicating when adequate charging is expected to be completed or contact information Only use public charging if you cannot charge at home Move your vehicle once charging session is complete
10 EV Charging Tips for new drivers [128]	newspaper	New Zealand	filled with common news articles	Choose appropriate charger for your visit avoid charging over 80% Only use rapid charging if necessary Leave a polite note if someone has broken the 'rules' Plan ahead
Midsize BEVs in 2017 & 2018[129]	Audiovisual Presentation	United States	Focuses on different EV models	Return charger to correct doc and remove any trip hazards Do not unplug another EV without their permission Leave a note asking the EV charging to plug your vehicle in next Charge only when necessary

EV Fast Charging Design & Operational Guidelines[130]	Report	Canada		Return charger to correct doc and remove any trip hazards Do not unplug another EV without their permission Charge only when necessary Return to vehicle when charging is completed - monitoring charging levels while away Use apps - (plug share or need to charge)
Guidelines for the Installation of Electric Vehicle Charging Stations at State-Owned Facilities[131]	Guide	United States	The suggested guidelines for electric vehicle charging station installation vary throughout the State and across the country based on existing laws, regional requirements, and consumer needs. These guidelines consider the parameters within which Connecticut State Agencies operate.	Return charger to correct doc and remove any trip hazards Obey sign posted time limits and be aware of your charging time Charge only when necessary Move your vehicle once charging session is complete Leave a polite note if someone has broken the 'rules' It's okay to ask for charge No non-EV cars parking in EV spots
Considerations for Public-Sector Electric Vehicle Charging Station1 Deployment for Core Government and the Broader Public Sector [131]	Report	Canada	focuses on providing recommendations for EVs and supply equipment	Only park in charging bay when charging Don't leave EVs plugged in after charging in complete No non-EV cars parking in EV spots
Electric vehicle charging stations [132]	Gov website	United States	provide overview on policies and etiquette	Return charger to correct doc and remove any trip hazards Only park in charging bay when charging

Electric Vehicle Charging Proposed Policy [133]	report	United States	parking commission has come up with etiquette rules to enforce	Only park in charging bay when charging Obey sign posted time limits and be aware of your charging time No non-EV cars parking in EV spots
Get up to speed about driving an electric vehicle[134]	Guide	Canada	To make the learning curve a little less curvy, here are some tips and tricks for driving your electric vehicle. Once you get the hang of it, it's a breeze	Obey sign posted time limits and be aware of your charging time Move your vehicle once charging session is complete Return to vehicle when charging is completed - monitoring charging levels while away Use apps - (plug share or need to charge)
Urban Policy Implications on the Electric Vehicle Transition in Berlin and Washington, DC [135]	Thesis	Germany and United States	This thesis argues for an approach which goes beyond the conventional urban climate governance view.	Only park in charging bay when charging Only use rapid charging if necessary Leave a sign on the dashboard indicating when adequate charging is expected to be completed or contact information Top up only what you need
Municipal Electric Vehicle Readiness[136]	Study	United States	The purpose of this study is to determine the barriers and solutions to PEV readiness for the town of Fairfield.	Only park in charging bay when charging Obey sign posted time limits and be aware of your charging time
Impact of public electric vehicle charging infrastructure on EV adoption[137]	Report	Canada	Survey to understand the role of public EV charging infrastructure	Only park in charging bay when charging Do not camp, hog or overstay Obey sign posted time limits and be aware of your charging time

Electric Vehicle Public Charging Guidelines[138]	Guide	no country	A list of etiquette for charging public	Choose appropriate charger for your visit Only park in charging bay when charging Obey sign posted time limits and be aware of your charging time Leave a note asking the EV charging to plug your vehicle in next Return to vehicle when charging is completed - monitoring charging levels while away leave room for others to access adjacent chargers Use apps - (plug share or need to charge)
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Appendix E – Demographic tables

Table 6- Qualitative Study Individual Interview Demographic statistics

Characteristic		Number	Percent
<i>Gender</i>	Male	11	73.33%
	Female	4	26.7%
<i>Age</i>	20-29	2	13.33%
	30-39	5	33.33%
	40-49	4	26.67%
	50-59	2	13.33%
	60-69	1	6.67%
	70+	1	6.67%
	<i>State</i>	NSW	9
ACT		1	
Victoria		1	
Queensland		1	
South Australia		1	
Western Australia		2	
<i>EV group member</i>	Yes	5	33.33%
	No	10	66.67%
<i>Owns at least one EV</i>	Yes	11	73.33%
	No	2	13.33%
	Will by the end of year	2	13.33%
<i>EV Brand</i>	Tesla	7	46.67%
	Volvo	2	13.33%
	Nissan	3	20%
	Hyundai	2	13.33%
	Rarely	3	
<i>Frequency of Public Charging</i>	12-16 times a month	1	
	4-8 times a month	3	
	1-3 times a month	2	
	Every 2-3 months	2	
	Rarely	3	
<i>Industry</i>	Technology	5	33.33%
	Research	2	13.33%
	Retired	1	6.67%
	Supply-chain	1	6.67%
	Allied Health	3	20%
	Public servant	1	6.67%
	Education	1	6.67%
	EV organisation	1	6.67%

Table 7 – Qualitative Study focus group demographic statistics

Characteristic		Number	Percentage
<i>Gender</i>	Male	3	75%
	Female	1	25%
<i>Member of EV group</i>	Yes	3	75%
	No	1	25%
<i>Owns at least one EV</i>	Yes	3	75%
	No	1	25%
<i>Industry</i>	AEVA	2	50%
	NRMA?	2	50%

Appendix F – Interview Sources

Table 8 - Qualitative Study Quotes and corresponding domains from interviews

Quotes	Domains /themes
<p><i>"I guess like trying to do the right thing. So, everyone is in the same sort of situation, don't charge more than you need to. Be mindful of the fact that other people want to use the chargers. And leave the charging bay area in a suitable condition. Don't leave cables lying around for someone to trip over. Don't just park there. Like don't use it as your own sort of personal parking spot."- C22</i></p>	<p>Knowledge</p>
<p><i>"I'll do it. If this car been there for half an hour, it's charged and I need to charge. I've got young kids, so if they're screaming and I need to get somewhere. Yeah, I'd unplug it." – C18</i></p>	<p>Justified etiquette</p>
<p><i>"Actual cars parked in EV spots which I'm sure is a common compliant and my technique there is to go and put their windshield wipers up so they know that someone has been very unimpressed by their decision". – C8</i></p>	<p>Reinforcement</p>
<p><i>"Etiquette is important to have, otherwise it's just the wild west, right? And that's never going to work. There's only a finite amount of charging stations to go around so you got to have some sort of law and order" – C18</i></p>	<p>Belief about consequences</p>
<p><i>"If there is always somewhere to charge, then you don't really have to worry about what people are doing at the charging stations" – C1</i></p>	<p>Belief about consequences</p>
<p><i>"I think for me it's because of the time. It would be more about having other things there, I guess a services station on the main highways and a bakery or a couple of food outlets, toilets, or even a green space for us to run our dogs around because when we do our longer trips, we always take them". – C14</i></p>	<p>Environmental context and resources</p>

"I believe that without the stick, you know you're not going to get any change and we've seen how with idle fees there has been almost instant change from people because we do not like being fined." – C12

Reinforcement

"I got a text to say it was all charging was almost up to 80%." – C14

Advancing technology

"You can actually have a clock that you can turn manually that says I'm finished with charging at approximately this time. And you put it on your dashboard for everyone to see." – C10

Improving communication

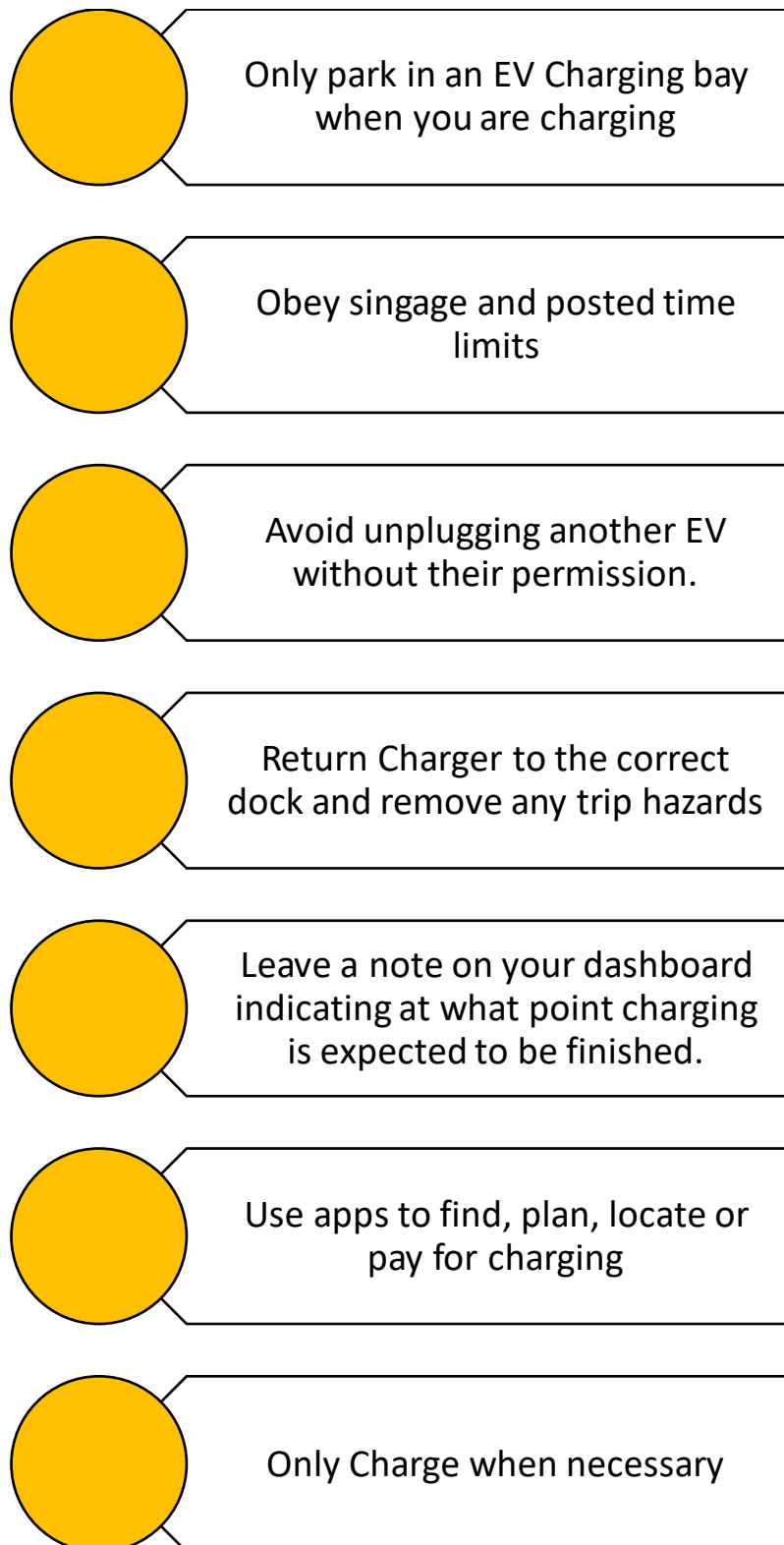
Appendix G – Frequency Counts of TDF Domains

Table 9 – Qualitative study frequency count of domains across interviews and focus group sessions.

Domains	Interviews	Focus groups
<i>Knowledge</i>	38	8
<i>Skills</i>	12	5
<i>Social professional role and identity</i>	13	15
<i>Belief about capabilities</i>	21	6
<i>Belief about consequences</i>	27	2
<i>Intention</i>	1	0
<i>Social influences</i>	27	10
<i>Reinforcement</i>	14	14
<i>Emotion</i>	5	1
<i>Goals</i>	0	0
<i>Memory attention and decision</i>	2	2
<i>Environmental context and resource</i>	50	26
<i>Behaviour regulation</i>	0	2
<i>Optimism</i>	0	1

Appendix H – Charging etiquette rules.

Figure – Scoping Review Frequency count of Top 10 Charging etiquette rules



Appendix I – Coded Recommendations

Table 10 – Scoping Review Coded Recommendations

Framework	Domain	Construct	Barrier/Facilitator	Recommendation
CFIR 2.0	Innovation	Innovation Design	(+/-) layout of stations (+) standardise the stations	Invest in improving design of charging infrastructure to be easy and consistent across brands and companies. Governments or EV organisations may choose to create a more standardised approach to ensure similarity between different companies. Optimise the physical layout of charging stations by increasing the number of bays and types of charging speeds to make it easier and more convenient for EV drivers to use the charging stations. Stakeholders should investigate the suitability of charging stations for a wide range of EV drivers.
CFIR 2.0	Innovation	Innovation complexity	(-) inconsistent across brands (-) too many different types of plugs (-) multiple apps to find charging stations	Provide real-time updates of multiple brands of charging station availability in one source (app, monitor, GPS) to allow EV drivers to make informed decisions about where and when to charge.
CFIR 2.0	Inner setting	Physical infrastructures	(+) Comfortable and convenient environments (+) Accessibility (+) access to amenities	Building charging stations near amenities, restaurants, rest stops, parks, shopping centres to provide EV drivers with things to do while they charge their vehicles.

TPB	Control beliefs	(-) inconvenience, (-) physical obstacles	Enhancing EV drivers' perception of control by increasing driver's confidence in correctly using charging infrastructure through clear instructions, demonstration, and guidance around charging etiquette.
TPB	Attitudes towards behaviours	(+) negative towards bad charging etiquette (-) broken or damaged infrastructure	Addressing negative attitudes towards charging infrastructure through providing improving the reliability of charging infrastructure. Create processes for drivers to easily report broken charging infrastructure, schedule regular maintenance of charging infrastructure and have technicians on standby to fix charging stations located in rural area.

Table 11- Qualitative Study Coded Recommendations

Framework	Domain	Barrier/Facilitator	Recommendation
TDF	Environmental context and resources	(-) limited available charging stations (-) lack of adequate signage (-) long waiting times (-) limited amenities (-) cost (-) broken or unreliable infrastructure (-) poor lighting (+) signage (+) shade (+) regular maintenance	Enhance the visibility and accessibility of charging stations, make charging more convenient, build more infrastructure (limit the distance between them) Create and implement signage like council car parks that list acceptable or unacceptable for drivers to follow
TDF	Knowledge	(+) Knowledge (+) Educate Car dealers (+) Plan ahead	Developing a range of targeted resources and media campaigns, provide expos, instructional videos to increase knowledge and awareness of charging etiquette within the general population.

TDF	Reinforcement	<ul style="list-style-type: none"> (+) Fines, (+) penalties (+) idle fees (+) warnings (+) Incentives 	Place a stronger focus on the enforcement of charging etiquette, provide warnings, penalties, and fines in a similar manner to those who overstay or park in disabled parking. Provide fines for drivers who fail to move their EV after 15 minutes of charging session being complete or penalise drivers who charge more than 80% during busy period by making them pay a higher rate.
Themes	Advancing Technology	<ul style="list-style-type: none"> (+) SMS reminder system (+) universal app to find all charging stations (+) universal plugs (+) centralised apps for complaints (+) standardising features on stations (+/-) booking system (+) Use cameras to spot bad etiquette 	Utilise technology to help facilitate good charging behaviours such as sending the driver a text message when charging is complete with a warning to collect your vehicle which move your vehicle after 5 to 10 minutes. Provide drivers with resources to communicate with each other with whether it's through the charging app or QR code, protect the anonymity of both drivers as some drivers may not feel comfortable sharing their details.
Themes	Improving communication	<ul style="list-style-type: none"> (+) Placard system (+) providing contact details 	