



UNLOCKING DEMAND FOR **RENEWABLY POWERED** **ELECTRIC VEHICLES**



Australian Government
Australian Renewable
Energy Agency

ARENA

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490 South Australians and in particular the 45 that contributed their time to assisting us with the research.

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Executive Summary

The introduction of Electric Vehicles (EVs) will deliver substantial benefits to Australia. Along with environmental benefits, they will deliver long term reductions in living expenses, ensure fuel security, and positively impact the gross domestic product [1].

EVs are no longer a futuristic or niche technology reserved for an elite group of buyers. Globally, 3 million EVs were in operation by the end of 2017, with the International Energy Agency conservatively forecasting that EVs will reach 125 million by 2030 [2]. This EV growth trajectory is further supported by Bloomberg New Energy's 2018 EV Outlook, which highlights how automakers have committed to bringing 289 new EV products to market by the end of 2022 [3]. Many major automotive brands will have EVs as their next generation of flagship models.

Australian sales of EVs have been slow and stagnant. Frequently cited barriers are high up-front cost, low product availability and limited access to public charging infrastructure. These three barriers are commonly referenced as the key market impediments [4]. Inadequate access to affordable EV products for local consumers has not improved from the Australian Electric Vehicle Council initial 2017 State of EVs Report, to its 2018 update [4]. Complacency from industry about increasing product supply in Australia illustrates the direct impact of Government policy inaction on EVs, contrary to what is seen in more successful, incentivised EV markets around the world.

Purpose – Understanding and shaping the demand side of the market

Household surveys conducted by motoring clubs, newspapers and governments illustrate real interest from everyday citizens on the prospect of electric motoring. 11% of motorists surveyed in the recent "Recharging the economy" report have decided that their next vehicle would be electric [1]. The anticipated increase of new EV products into the local market and major international progress in EV adoption has further catalysed this interest. Stakeholders such as NRMA, for example, plan to build a \$10m charging network.

Some State Governments have taken initial action: South Australia was the first to release a low emission vehicle strategy in 2012 [5]; Queensland with their 2017 EV Strategy [6] and 17-station Electric Vehicle Super Highway; and the ACT has announced a Zero Emission Vehicle Action Plan for 2018-2021 [7].

Despite this evidence the question remains - how will these expected early EV adopters (referred here as "intenders", both consumer and fleet), translate their stated enthusiasm to sales as they go through the purchase cycle?

Understanding the outcome of this customer journey is critical for Australia for three key reasons:

Firstly, if we can understand the nature of demand we can ensure we are able to put in place mechanisms to accelerate adoption. This study identified significant impediments to adoption for intenders. As such, a more sophisticated view of the consumer journey

is necessary if we are to unlock the practical and behavioural impediments to purchasing.

Secondly, understanding the demand-side dynamics will facilitate better preparation in terms of maximising the benefits attainable by electrification of the fleet. This study focused on the benefits unlocked when electric vehicles are paired with local solar generation.

Thirdly, understanding this dynamic will also enable better preparation for any unintended consequences of increased penetration of EVs. For example, EVs have the potential to be beneficial, or detrimental, to the national electricity grid, depending on how their loads are managed.

Objectives of Charge Together South Australia

This report represents the first step in understanding the nature of EV demand in the Australian context.

We set out to engage a large cohort of self-identified electric vehicle buyers (within a geographical context) to understand current perceptions, and then conduct a series of observational behavioural research exercises to elicit how they would behave when they embark upon the buying journey. Given strong support for this work from Government, electricity distribution networks and local industry alike, South Australia was the ideal fit for the first Charge Together case study program.

The objectives of the Charge Together South Australia Program (modelled after similar work undertaken by our Evenergi peers overseas) were to:

- Capture data from real-world EV intenders on their impressions of EV shopping experiences, likely charging behaviours and motoring profiles
- Identify the current, real barriers faced by EV intenders, through analysis of marketplace behaviours
- Recommend strategies to rectify these barriers
- Develop and test a series of industry-led and government interventions
- Identify how solar ownership would impact buying behaviour and how to ensure that solar was a key component of the intender journey

Program Approach

This study was undertaken over a three-month period of participant solicitation, data collection, analysis and reporting. Participants were divided into two key groups – residential and fleet. Response to the residential program after five weeks of promotion was strong with 1600 South Australians expressing their interest in participating. As a starting point, this was a higher than expected response.

From that group of 1600, 490 were invited to complete an online survey. Of that group, 48 self-selected for a broader behavioural study, with a further subset of 12 invited for more detailed observational research and behavioural analysis. Forty-five of the 48 residential participants were also provided home energy monitoring equipment to assist

in measuring the impact of residential solar generation on consumer behaviour. On the fleet side we interviewed three fleets in detail and conducted surveys with another ten.

Key Findings

This study identified both the key barriers to adoption for EV intenders as well as gaining an understanding of the overarching experience in the customer journey. The following diagram articulates the dynamics as the pipeline of positive buyers are slowly eroded as they confront the current realities of cost, lack of information, lack of model availability and lack of infrastructure.



Residential consumers:

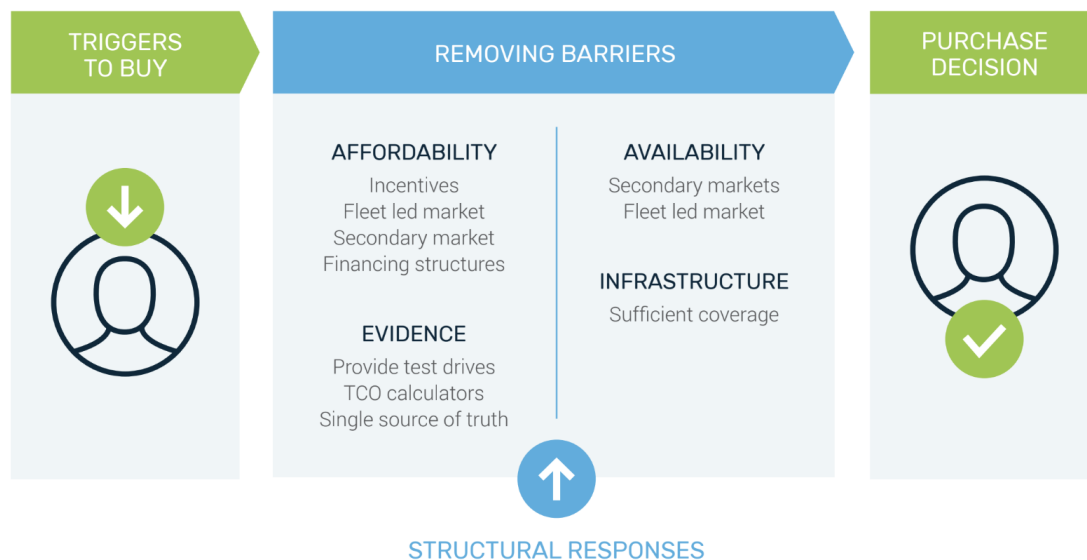
- There is a significant gap between stated intention to buy in Australia and the actual decision to move forward, in Behavioural Economics, this is called the intention-action gap
- There is a significant gap between consumer understanding of EVs and the reality, which makes accurately answering the question, "Would you buy an EV?" impossible for most
- Consumers struggle to understand how EVs will "fit" into their real world environment because consumers frame EVs as 'futuristic'
- There is no single authoritative source of information about buying EVs in Australia
- It is likely that this culmination of barriers will discourage the vast majority of intenders unless there is strong government and industry-led intervention
- There is currently no clear customer journey for buying an EV in Australia.
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Fleet consumers:

- There is a lack of confidence around depreciation and the lack of EV models available
- These industry positions have been "locked in" due to a lack of an authoritative source of unbiased information to support alternative thinking

- There is a disconnect between aspirations of business and government leaders to decarbonize their fleets and the practical needs, incentives and skills of fleet managers to deliver positive outcomes.

Having identified these consumer-based barriers to EV sales, Australia now has the opportunity to address them in a manner similar to Norway and the United Kingdom/United States, who methodically put in place mitigation efforts for each of these barriers.



Recommended Next Steps

The global momentum with respect to EV consumers may have led to unwarranted comfort levels in Australia and outstripped the reality of the barriers facing those intending to buy a vehicle. The gap between intention and likely purchases at the bottom of the funnel will remain wide unless strong intervention is undertaken by Australian governments.

Barriers aside, a major issue may become global supply. A global competition has begun with countries enthusiastic about electrification of their “car park”. Pressures from measures such as CAFÉ legislation in Europe will drain global EV stocks from the supply chain. One senior automotive executive interviewed noted that CAFÉ regulation represents a potential \$1.5 B fine for the company.

When this motivation is added to existing government stimulus provided across most European nations, it is easy to understand why automotive companies may be unwilling to service Australia unless similar enthusiasm and commitment is demonstrated here.

To address the barriers to demand this report suggests:

Amplifying triggers

A unified commitment to projects that align environmental and social benefits with electric vehicle adoption will create positive re-enforcement within communities, corporate and government bodies. For example, our analysis indicated that with solar

and batteries installed a driver in South Australia would emit only .74 tonnes of CO₂ over five years and would be up to \$6,000 better off in the same period.

Creating Evidence

While there are two key EV based organisations in Australia (Australian Electric Vehicle Association and EV Council), there is currently no centralised, authoritative consumer advocacy body is needed in Australia to pull together the interests of individuals, fleets and infrastructure managers, and provide a critical role in providing market-facing tools and evidence to EV consumers.

Addressing affordability and availability

- Government incentives are a requirement for success to lower costs and increase signals to automotive companies that we are open for business
- Fleets adoption programs should be supported to stimulate new car sales, signal to automotive companies and create a secondary market
- Aggregated buying programs should help automotive companies better service the market and underwrite country establishment costs
- Investigate how electricity distribution business models could be used to create subsidisation for electric vehicles given potential for value-capture
- Support and stimulate measures to establish a viable secondary market
- Support formal market for grey importation of electric vehicles
- Development of new business models for electric vehicle packaging

Introduction

The electrification of transportation is part of an over-arching structural change in our transport and energy systems. This change is primarily driven by the well understood impacts of climate change and the significant contribution that transport has on greenhouse gas emissions.

In 2016, Australia became a signatory to the Paris Agreement, agreeing to reduce domestic emissions by 26-28% of 2005 levels by 2030. Transport is Australia's third largest emitter [8] with passenger cars contributing more than 50% of those emissions at 58MtCO₂e in 2017 [9]. Electric vehicles powered by renewable energy have negligible emissions (as low as 6gCO₂/km), compared to an average new car (184gCO₂/km) [10]. The transport sector is currently the least regulated for emissions.

Vehicle electrification offers potential for significant reduction of greenhouse gas emissions, especially when refuelled with renewable energy which enables the greatest road-based transport emissions reduction. Additionally, EVs also offer societal benefits of improved human health through reduced air pollution, especially in urban areas (due to zero tailpipe emissions), reduction of economic vulnerability to current foreign fuel supply chains, potential to further domestic innovation through advancement in related EV technologies, and potential for improved electricity grid utilisation through managed charging.

Despite optimistic forecasts for EV adoption over the next decade, electric vehicles constitute a tiny proportion of cars sold in Australia (.028%) [11] as of 2017. Private buyers of electric vehicles have been characterised as an eclectic mix of environmental enthusiasts, high-end luxury car buyers and "early adopters" of technologies [12]. It is also well understood that perceptions of EVs vary across gender, age, and socio-economic class [13]. Few fleets have made progress with electrification of their fleets.

In markets such as Norway where electric vehicle adoption has reached high levels of penetration (10% of vehicles on the road and almost 50% of new cars bought are electric), EV technology is now considered mainstream. The key research question this project asks is: how does Australia support early EV consumers and shift electric vehicle buying from niche into mainstream? It is only if this support is achieved that we will see volumes required to realise emission reduction and other real benefits offered by EVs.

Global enthusiasm for electric vehicles is gaining in momentum. Each year, more and more countries formalise policies to embrace the benefits of EVs such as New Zealand with its 2016 Electric Vehicles Programme, and the UK and China going so far as to ban combustion vehicles in future years in favour of more energy efficient motoring technologies such as EVs.

However, in Australia, policy action on transport emissions and vehicle fuel efficiency is less bearish. Governments do not publicly acknowledge the merits of switching to alternative fuels or vehicles and, as a result, consumer adoption of this technology remains low, stymied by unresolved barriers.

The introduction of electric vehicles (EVs) offers potential to deliver great national benefit to Australia, but not without intervention. The purpose of this report is to highlight the evident gaps in appreciation for demand-side market dynamics for EVs, particularly the challenges encountered by residential and fleet consumers looking to buy an EV in Australia. Through targeted behavioural research, the tribulations of

today's Australian EV consumers are revealed and through their experiences, emergent marketplace barriers which, if left unresolved, will continue to hinder EV market growth even as new products become available.

Electric vehicles covered in this report

Electric vehicles (EVs) are the focus of this work. EVs are a propulsion technology which use one or more electric motors powered by a grid-charged on-board battery. Use of the term "EV" includes both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs).

It is important to note that EVs and hybrids are not the same technology - EVs are distinguished by the ability of their on-board battery to be recharged directly by the electricity grid whereas traditional hybrids recharge their batteries using the on-board engine.

Battery Electric Vehicles (BEV)

BEVs have a single drivetrain - a battery powered electric motor. Compared to the PHEV, the batteries and motors can be much larger and more powerful, and the all-electric range is far superior (200-500 km) given it is the only form of propulsion in the drive-train. BEVs are recharged by a cable which plugs into an electrical outlet, using grid-based electricity to refuel.

Plug-in Hybrid Electric Vehicles (PHEV)

PHEVs have two different drivetrains - an internal combustion engine (ICE) as you would find in a conventional car and a battery-powered electric motor. The two drivetrains provide the user with options as to what fuel they use to drive on - electricity or petrol. The electricity is provided principally by an on-board battery. As with the BEV, the PHEV battery is powered through "plugging-in" to a charging outlet.

In most cases the battery will only provide all-electric limited range (15-60km) so the petrol engine is designed to take over once the battery is depleted.

Hybrid Electric Vehicles (HEVs)

HEVs are powered by petrol and electricity. The electricity is provided through regenerative braking and you cannot charge the battery through plugging in to a charging outlet.

Electric vehicles in Australia

The electric vehicle market in Australia has had a slow and bumpy start. In 1997 the Toyota Prius became the first electric-drive product available locally; however it was not a pure EV.

The Prius has sold over 80,000 units since its introduction and we have since seen the release of other popular hybrid brands such as the Honda Civic Hybrid, Toyota Camry hybrid and the Lexus CT200h. These hybrid vehicles offered some of the same promise offered by modern day EVs - lower emissions, lower cost of motoring, and a different, quieter driving experience, but those attributes were accompanied by barriers such as fears around depreciation and battery life.

The first wave of EVs arrived in Australia in 2010 with the limited release of the Mitsubishi iMiEV. It was popular with fleets but over time this proved to be an anomaly, sales quickly dropped and by 2014 the car had been withdrawn from the market. The Nissan Leaf was introduced in 2011 and withdrawn in 2016, the Holden Volt was introduced in 2012 and withdrawn in 2015.

A number of new PHEVs have been introduced over time, however these have been luxury car models and out of reach of the majority of buyers. There are now 23 models in Australia with 19 of the 23 priced at over \$60,000 and only one of the more affordable brands readily available (Mitsubishi Outlander) [14].

Australian Bureau of Statistics (ABS) data has found that in the 12 months to November 2017, there were 1,182,631 new cars sold in Australia. From this total there were 2284 electric vehicles sold in 2017.

The Australian vehicle market is among the most diverse in the world with a total of 62 vehicle marques per million vehicles sold each year – fifteen times higher than in Europe and thirty eight times higher than the United States, Figure 6. This makes it a difficult market to succeed in whether you are selling a traditional or electric vehicle.

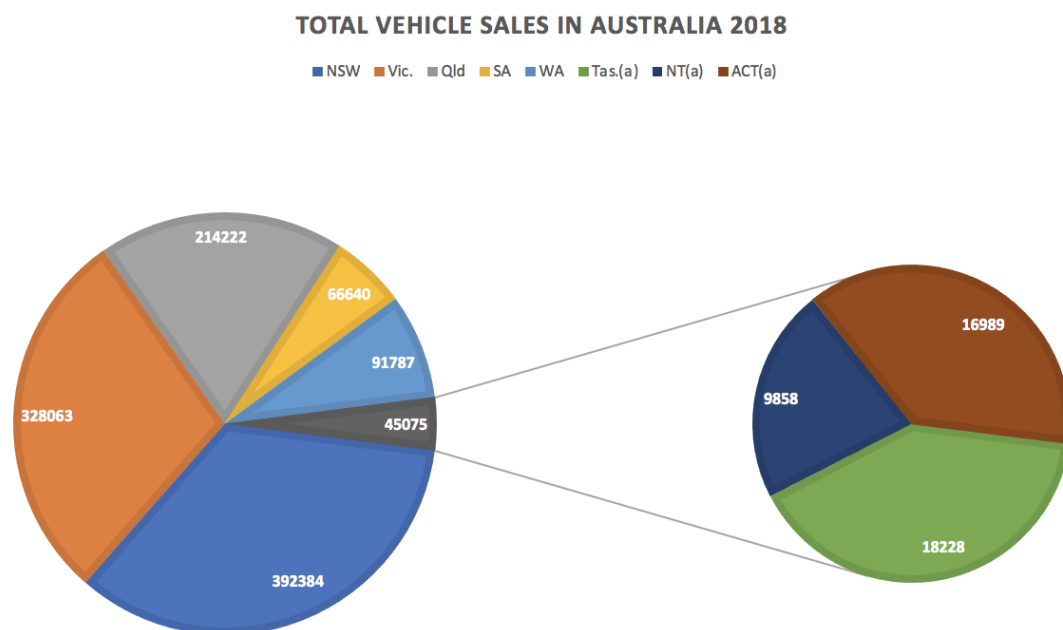


Figure 1 Total Vehicle Sales in Australia

Table 1 Full Battery Electric Vehicles Available in Australia

	Approx. Numbers in Australia	RRP from	Range
Tesla Model S*	600	\$133,521	520 km
Tesla Model X	300	\$143,278	472 km
BMW i3	367	\$78,368	192 km
Renault Zoe	n/a	\$42,470	300 km
Renault Kangoo	10	\$45,990	200 km
Mitsubishi i-Miev (Not currently available)	237	\$52,000	160 km
Nissan Leaf (Not currently available)	635	Not yet available	272 km

*Tesla does not release sales numbers so these figures are estimates aggregated from various published reports.

RRP: OTR price, including Government charges
 Rated Range: Manufacturer specification

Table 2 Plug-in Battery Electric Vehicles Available in Australia

	Approx. Numbers in Australia	RRP from:	All-Electric Range
Mitsubishi Outlander	1869	\$33,580	21 km
Mercedes-Benz C-Class	282	\$75,814	50 km
Holden Volt	247	\$32,010	87 km
Porsche Cayenne	158	\$110,400	36 km
BMW 3 Series	140	\$78,842	30 km
Volvo XC90	140	\$102,888	25.6 km
Audi A3	134	\$66,888	33.6 km
BMW i8	114	\$299,000	54 km
BMW X5	87	\$118,900	31 km
Mercedes-Benz GLE-Class	71	\$92,900	19.2 km
Mercedes-Benz E-Class	10	\$91,100	28 km
Porsche Panamera	9	\$215,100	36.8 km
BMW 5 e Series	8	\$108,900	36.8 km
Renault Fluence	6	\$14,200	185 km
Volvo XC-60	4	\$92,990	56 km
Mercedes Benz S-Class	3	\$319,715	28.8 km
BMW 7 Series	2	\$229,000	43.45 km

It is projected that there will be nine new electric vehicles launched in 2018/2019 most notably the Hyundai Kona, Hyundai ionic and next generation of Nissan Leaf, all of which are in a more affordable price bracket.

An important dynamic is the understanding of which sector is buying electric vehicles. According to V-FACTS database, in 2017 34% of electric vehicles were purchased for private buyers (excluding Tesla's), 64% were purchased for business and 2% were purchased by private buyers.

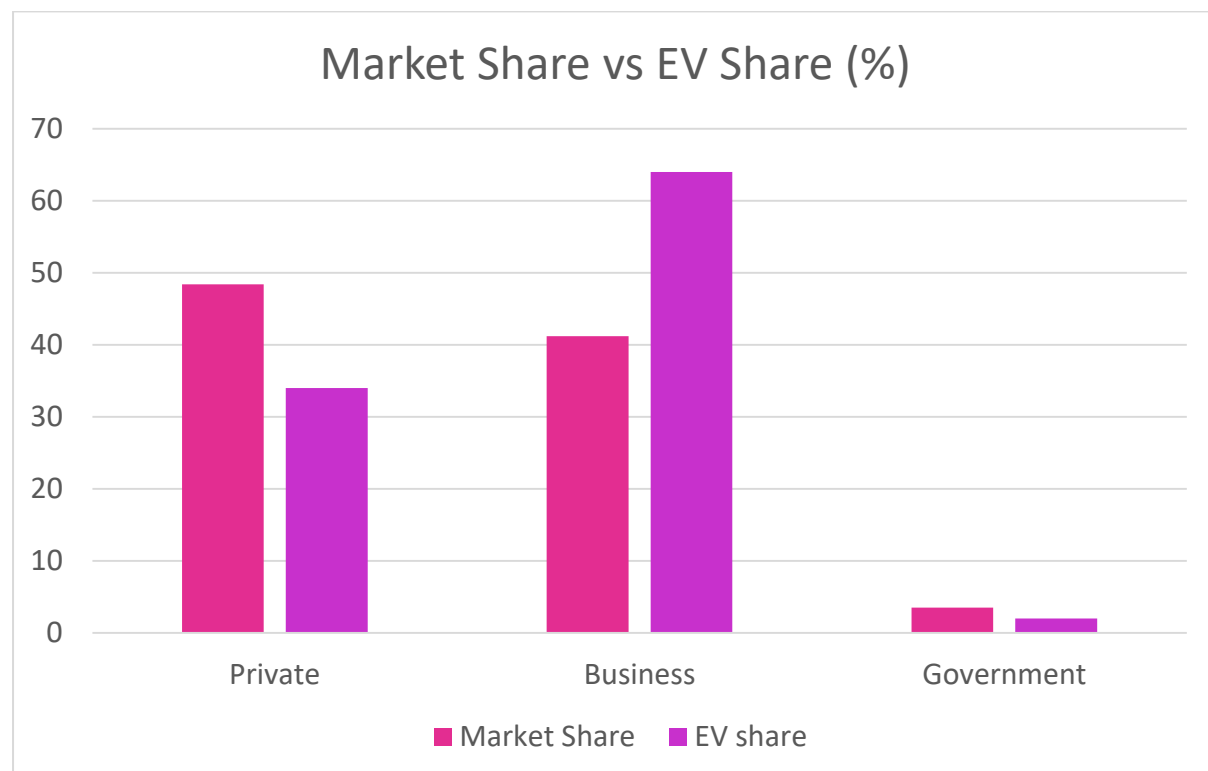


Figure 2 Market share VS Electric Vehicle share in Australia

Forecasted electric vehicle growth in Australia

Factors driving EV growth are evolving rapidly. As illustration to just how fast, Bloomberg New Energy Finance (BNEF) upgraded their forecast for the percentage of EVs in the market globally by 2040 from 35% in their 2016 Electric Vehicle Outlook to 54% (nearly double!) in their 2017 Electric Vehicle Outlook (10). This was due primarily to battery costs falling faster than expected and rising commitments from automakers.

In 2016 The Australian Energy Market Operator (AEMO) produced a forecast of projections as outlined in Figure 3. Recently forecast appears to be conservative compared to other projections, and in March 2018 AEMO's released an update of its electricity forecast (11), and while it maintained its forecast out to 2027, it forecasted much more aggressive growth after that based on the AEMO Energeia 2017 forecast. A comparison of the AEMO projections versus the BNEF and ISD Analytics projections is below. We have used the 2016 report figures in our research as it provides more granular data.

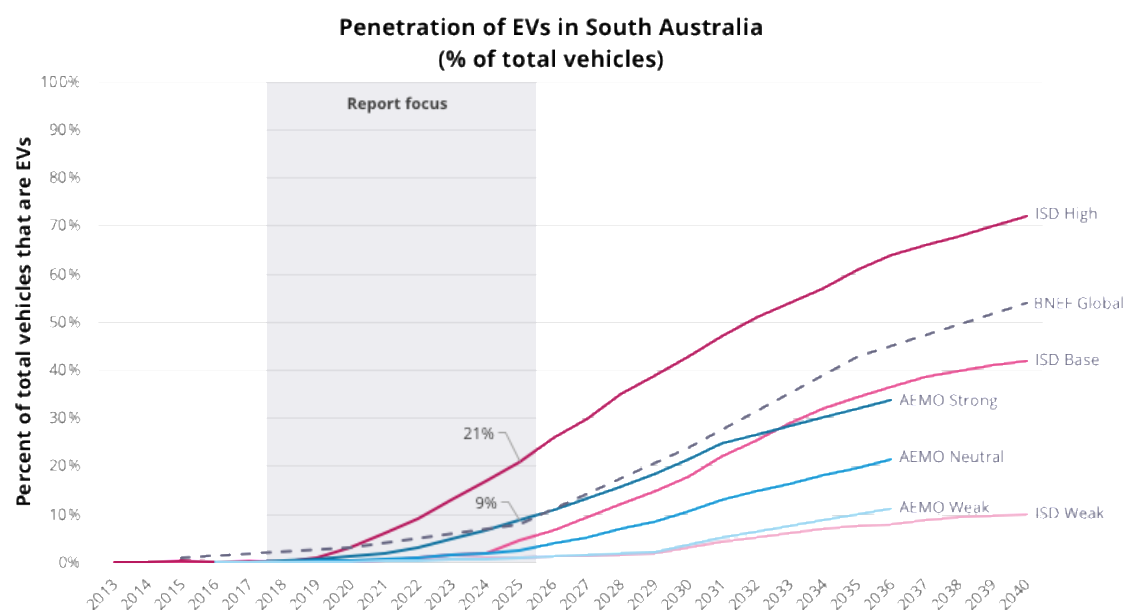


Figure 3: Comparison of AEMO Energeia 2016 (9) and ISD Analytics 2013 (11) projections of penetrations of EVs in South Australia, and BNEF (10) global penetration of EVs out to 2040. Evenergi

Charge Together Approach

Purpose of research

The purpose of this research is to understand better the gap between EV purchasing intent and the likely outcome of a customer journey in the Australian context, considering current policy settings and industry commitment to electric vehicles. Project Sponsors participation in this project was driven by a desire to accelerate the electric vehicle transition while deriving maximum social and environmental benefits for Australia.

Given increasing interest in EVs, macro level stakeholders in Australia have also taken notice, as represented by an increase in public reporting on EVs. For example, a recent partnership with the EV Council, St Baker Energy Foundation and PWC on the economic benefits of larger scale EV adoption [15]. This year, both NSW [16] and Victorian [17] governments have undertaken Parliamentary enquiries on EVs. And in May of 2018, the CEFC and ARENA released a consultant's report on the EV market [18].

The contribution of this work within this context is to enable a more grounded view of the likely near term sales of electric vehicles, given current setting, by delving more deeply into the customer buying journey, and to use this as a base for making structural recommendations to most efficiently address friction within this process.

EVs offer a new motoring paradigm which challenges consumers, suppliers and governments. The unfamiliarity with the technology combined with its complexity creates anxieties for suppliers, buyers and regulators. This research sought to unpack those anxieties so as to recommend interventions which could accelerate adoption, and do so in a way that would "bake-in" social benefits such as renewable energy provision.

Why South Australia?

South Australia has been the “home” of EVs since establishing Adelaide as the finish line for the World Solar Challenge in 1987. Since then, the state’s progressive commitment to innovative policies for new technologies has been steady. The South Australia State Government was the first to commission research on EVs with the Auto CRC’s work on EVs in 2009 [19] which was followed up the first investigation into the impacts of EVs by Renewables SA in 2009 [20], and following subsequent policy such as the Low Emission Vehicle Strategy for 2012-2016.

Selecting a state with a high proportion of renewable energy was also critical, and South Australia has currently 48% renewable energy generation and 37% of its homes have solar power.

Research methodology

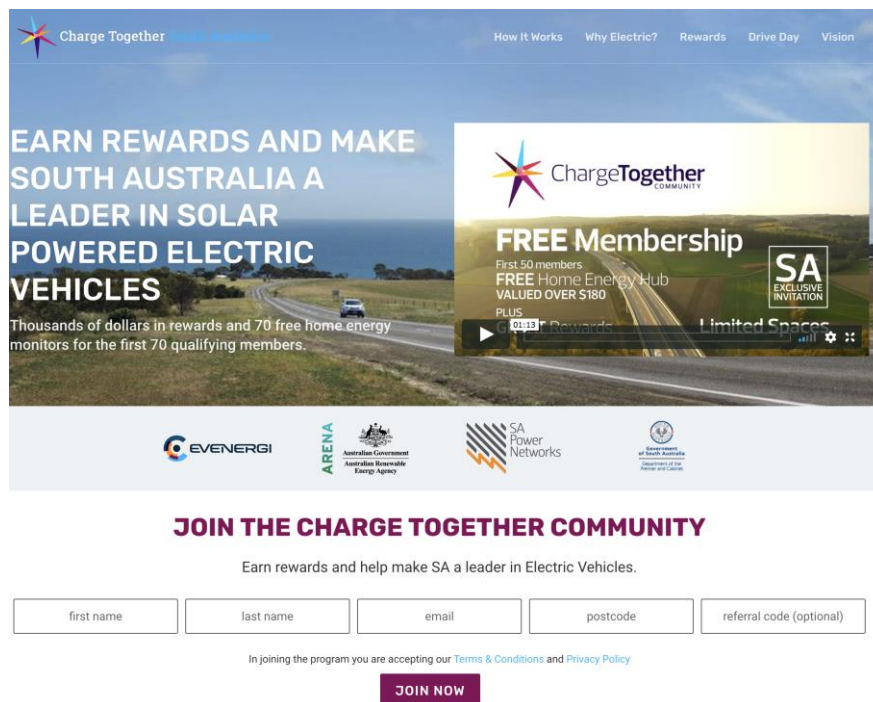
Barriers to adoption of EVs fall into two categories – structural and behavioural – as seen in recent literature (Lane et al (2007) and [21].

The breakdown of these subcategories of barriers refer to those which are related to the individual consumer's behaviour (behavioural) versus those which are impacted by their situation – the structure of their operating environment, such as a policy or market setting (structural). Structural factors include commercial, regulatory and infrastructure provision while behavioural factors include attitude, lifestyles, personality and self-image.

Noting the gaps in current understanding of consumer behaviour in Australia toward EVs, our research approach was focussed on the behavioural aspects of consumer purchase activity. Leveraging Behavioural Economics, this approach sought to extend traditional understanding of structural barriers (which have been well-documented), and further investigate the underlying behavioural anchors that currently hinder EV adoption in Australia.

In better identifying the nuances of the barriers in this sub-category of consumer behaviour, our findings have potential to prescribe practical interventions necessary to unlocking demand for EVs, and accelerating adoption and follow-on environmental and societal benefits.

This project was undertaken over a three-month period of participant solicitation, data collection, analysis and reporting. The program involved creation of a campaign to drive electric vehicle adoption in South Australia – Charge Together South Australia, as demonstrated in Figure 4. Along with the project partners we enlisted a number of manufacturers (Hyundai, BMW, Mitsubishi, and Renault) and other industry stakeholders to support the program.



The screenshot displays the Charge Together South Australia website. At the top, a navigation bar includes links for 'How It Works', 'Why Electric?', 'Rewards', 'Drive Day', and 'Vision'. The main banner features a scenic image of a road and text promoting rewards and solar-powered electric vehicles. A central box highlights a 'FREE Membership' for the first 50 members, including a 'FREE Home Energy Hub VALUED OVER \$180' and 'PLUS Rewards'. A 'SA EXCLUSIVE INVITATION' badge is also present. Below the banner, logos for partners like EVENERGI, ARENA, and SA Power Networks are shown. A section titled 'JOIN THE CHARGE TOGETHER COMMUNITY' includes a sign-up form with fields for first name, last name, email, postcode, and an optional referral code, followed by a 'JOIN NOW' button. A footer note mentions terms and conditions.

Charge Together South Australia

How It Works Why Electric? Rewards Drive Day Vision

EARN REWARDS AND MAKE SOUTH AUSTRALIA A LEADER IN SOLAR POWERED ELECTRIC VEHICLES

Thousands of dollars in rewards and 70 free home energy monitors for the first 70 qualifying members.

FREE Membership
First 50 members
FREE Home Energy Hub
VALUED OVER \$180
PLUS Rewards
Limited Spaces

SA EXCLUSIVE INVITATION

JOIN THE CHARGE TOGETHER COMMUNITY

Earn rewards and help make SA a leader in Electric Vehicles.

first name last name email postcode referral code (optional)

In joining the program you are accepting our [Terms & Conditions](#) and [Privacy Policy](#)

JOIN NOW

Figure 4. Charge Together South Australia website www.chargetogether.com/southaustralia

Participants were recruited through a social media campaign over five weeks, attracting 1600 self-selected registrants at its end. With only 500 participant registrations anticipated, the program was oversubscribed by 300%, illustrating tremendous public interest in EVs.

From the group of 1600, 490 residential consumers were invited to complete an online survey. Upon completion of that survey, a subset of 48 were selected for a broader purchasing behavioural study and a further subset of 12 invited for a deeper and more detailed behavioural analysis.

In addition to the behavioural study undertaken directly with residential consumers, 45 participants were further invited to participate in a second body of work which investigated the use of residential solar to support EV charging. Through this study, residential consumers were given home energy equipment to monitor household energy usage and GPS tracking software to monitor travel habits. In aggregate, the data informed a model of residential consumer recharging behaviour with solar.

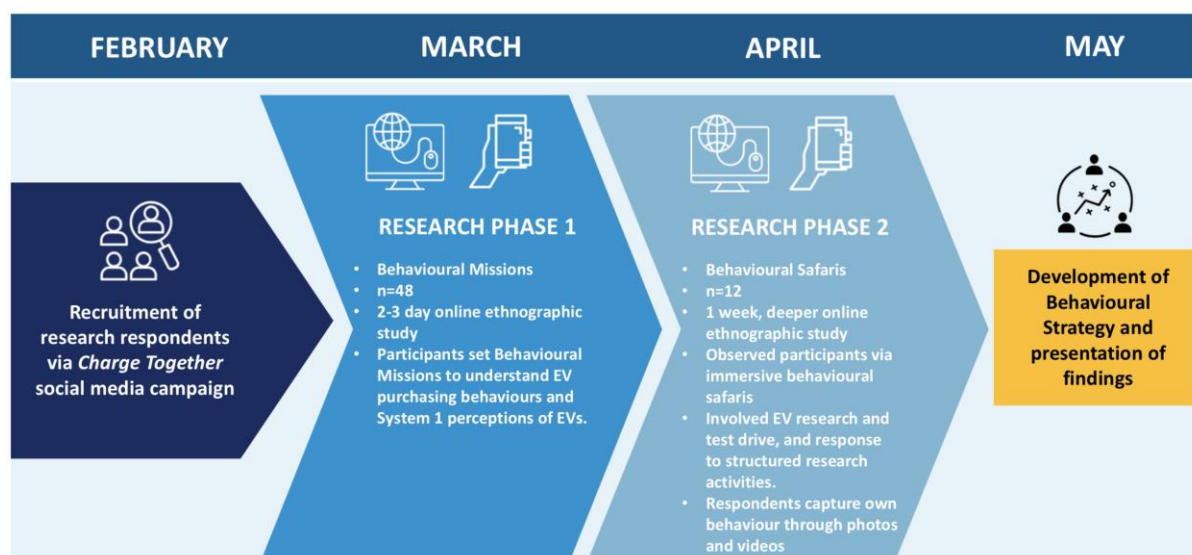


Figure 5 Charge Together behavioural safari process

The observational behavioural research and analysis was conducted in two phases, as outlined in Figure 5. Phase 1 (n=48) spanned two to three days and participants were asked to outline the process they would undertake to purchase an EV, though it was hypothetical as none purchased on completion of the process. Phase 2 (n=12) we called "safaris" and involved a more detailed investigation of the EV purchase process. Safaris were undertaken over one week where participant behaviour was observed around specific activities designed to simulate the researching of purchasing an EV, including a test drive and their submission of photos and videos of their experiences in the Australian marketplace.

Once data was collected the research team analysed the findings using Behavioural Economic principles (outlined later in this document) to provide a scientific basis for assessing the triggers and barriers to EV purchasing behaviour and decision making.

Finally, the analysis was used to establish emergent consumer "personas" which were

used to represent the most common categories of EV consumers from the study, factoring in a combination of their behaviours, driving patterns and energy use to inform future research. Use of personas helped us as a basis of understanding around common EV intender attributes among the residential consumers sector.

We also sought to recruit fleets as part of the program. Fleet participation was solicited via direct networks, and through help of peak bodies such as the Australian Fleet Managers Association as well as the project sponsors. Online questionnaires and in-depth interviews were used to collect data from fleet participants.

Key Findings

Analysis of the experiences of residential and fleet EV intenders in South Australia as part of the Charge Together project revealed a number of key challenges associated with buying an electric vehicle in Australia. Findings were divided into cohorts of residential and fleet buyers.

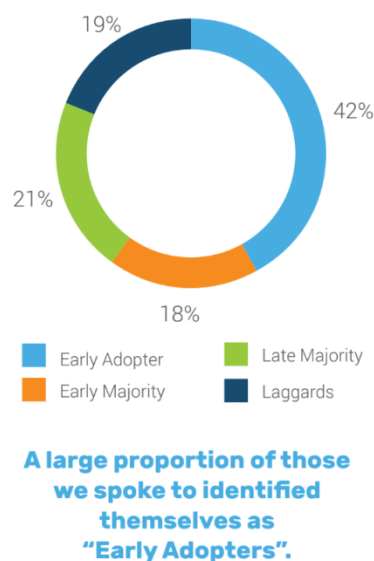
For both groups, these barriers, which include low information access, misalignment of actual experience with expectation and broader economic concerns around total lifetime cost of ownership (including residential asset value) are consistent with recent work on this subject [21], Evidence is building which indicates a need for greater focus on demand-side or consumer-based interventions in the EV market [22].

In addition to the discovery of barriers, this research project established a series of triggers for buying EVs which, if augmented, can support accelerated adoption of EVs in future.

Demographics of private-buyer respondents

From the 490 people that responded to the survey there was a very diverse range of ages – from 25 up to 65+. There was also a broad range of life-stages. 76% identified as male, and the bulk were either working full or part time.

The respondents that nominated themselves for the more lengthy research were primarily from metro areas. All characteristics of participants are consistent with the demography of EV early adopters in prior works [23]. A large number of residential participants openly classified themselves as early adopters of technology.



Around 40% of respondents felt they had the information they thought was required when deciding to buy an electric vehicle. Only 12% expressed a lack of awareness of the cost/benefits of buying an electric vehicle.

95% of the respondents were either currently looking to buy a new vehicle or were looking to buy one in the near future, suggesting that Charge Together South Australia recruitment did reach the target audience of EV intenders (residential consumers who were actually hoping to buy an electric vehicle as their next car). Slightly more people expressed driving as a pleasurable activity than as a function of travel utility. 28 people who drive for a profession also joined the program.

Triggers for buying

Key take-outs

- Environmental benefit is the strongest driver currently for adopting an electric vehicle
- Car performance is increasingly becoming seen as a benefit
- Savings are more a justification than a legitimate trigger to buy within the Australian context
- Evidence of electric vehicles becoming a social norm is becoming a trigger

Consumer motivation for buying electric vehicles is known to be environmental interest, cost savings, and love of technology [24]. Motivations of the Charge Together Australia participants, particularly the residential consumers, did not vary from this trend.

In a comprehensive study by Clean Technica [25] in 2016 of 2000 drivers in 28 countries over 40% identified that Environmental benefit was the stand-out driver, followed by a love of technology and belief that there were financial savings.

Our behavioural research team felt that this self-identification may be misleading in terms of translation to action so they asked several questions that attempted to identify how these participants would behave when presented with a real choice. Their conclusion was that although it is a strong motivation to purchase an EV the environmental benefit is not in itself a powerful enough trigger to initiate purchase of an EV when it came to a decision point as would self-identification as an early adaptor.

*"Don't have solar power yet so it is an area of concern when thinking Electric Car".
Male, young family, environmentalist, non-solar, 35-44*

Many of the respondents strongly identified with the technology aspects of electric vehicles, with many seeing them as being "futuristic". An example of a response was "Bill", an auto enthusiast, who identified with "quiet, powerful performance and smooth driving experience".

The perceptions of financial benefit is more complex. [26] We identified that there are two key groups of EV buyers – high end and low end (organised around income and other factors). While high end adopters are less price sensitive, they are more likely to espouse the financial savings, while low end are more likely to need savings, but are less likely to believe it is a benefit of EV ownership. This may explain the fact that affordability is seen as both a cost and a benefit depending on the context.

In addition, literature on the attraction of savings in electric vehicles is mostly from countries where there are significant incentives. In a National Renewable Energy Laboratory report [27] 83% of respondents in the US in 2017 felt that fuel savings were a major reason to buy an electric vehicle.

*"I'm thinking \$50/week in power and fuel. this is still so much cheaper than what I am paying now and when I am in my new home with solar battery storage, the cost will be even less. It is a win-win either way for me I think."
Female, older family, environmentalist, non-solar owner, 35-44*

Within the 490 that completed the survey **only 20% identified as strongly budget conscious**. All of those who completed the behavioural missions were concerned with costs, but a complicating factor was cost to own.

While people in the survey were aware of the savings, their reaction during behavioural safaris (which are essentially a set of missions that participants are set on) indicate that it will not be a strong positive trigger in a market like Australia which has little financial incentive to purchase a vehicle. Having said that, there was a level of “justification” logic applied by some of the cohort who were committed to buying the vehicle and were attempting to then justify their position.

The final trigger to buying is far less well documented as it is a strongly attitudinal trigger, and that is the identification of electric vehicles as an impending social norm. It did become clear in the behavioural safaris that a sense of an impending electric vehicle diffusion was driving many to start the journey towards transition.

*“I feel excited that a choice is finally being made available, time drags whilst waiting for change.”
Male, older family, environmentalist, solar owner, 35-44*

An interesting result of this research was how strongly buyers identified the purchase of an electric vehicle with ownership of solar. **55% of respondents have solar with another 40% having either considered or are in the process of considering solar panels**. This reflects the world leading penetration of rooftop solar in South Australia, which stands at 37%, however it is higher than expected. There was a specific indication from a number of respondents that buying solar was a condition precedent to buying an electric vehicle.

Fleet buyers are generally seen as being much more rational than individual consumers. Behavioural psychology therefore takes a lesser role as actors generally make sound decisions based on total cost of ownership (financial and environmental). Fleet managers are less worried about self-image issues, but are very focused on servicing costs. They are also much more conscious of risks in decision making and seek as much future certainty as possible.

For fleet managers the general triggers for purchasing revolve around environmental targets established by sustainability managers or other leadership. In our survey 40% of respondents cited environmental drives as their key motivation, 40% total cost of ownership and 20% were motivated by an innovation agenda. The total cost of ownership driver is likely due to the fact that in some high utilisation vehicle types electric vehicles may start to have a better Return on Investment. In addition the larger scale of purchasing could afford more competitive pricing.

Barriers to adoption

Key take-outs

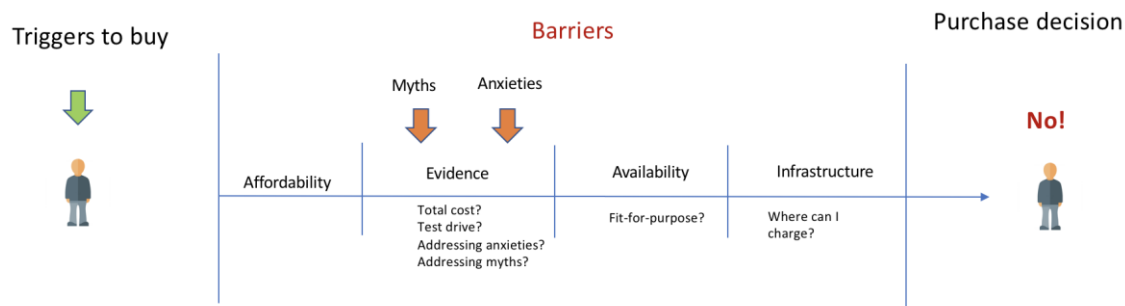
- Immediate responses when asking someone about buying an EV led to answers that focused on timing of purchase – they were seen as futuristic, and how they would fit within their home – they were seen as “foreign”

- In general, affordability is a significant barrier and understanding total cost of ownership, while important, will not solve this issue alone
- Currently infrastructure is a major purchasing barrier, however international experience shows that this can be partially solved through provision of education and strategically placed fast charging infrastructure
- Availability is a significant practical barrier to adoption and will lead the majority of people to delay purchase

Barriers to adoption have been covered in many studies and typically the most powerful have been availability, affordability, infrastructure (and associated range anxiety) and battery life. This was certainly supported in our research with **70% indicating that purchase price was an issue, 60% indicating that battery life was a concern and 42% listing concern around charging infrastructure.**

Within the literature there are many barriers stated, however it is important to distinguish between the populations of surveys. Clearly geography (and related local incentives) will lead to very different barriers. It is also important to differentiate between surveys of those familiar with electric vehicles and those of general populations.

By way of example of this difference, in a study of barriers in a market with good availability, Ireland [28] only 16% of respondents felt that availability of vehicles presented a problem, however almost all of the participants in our behavioural safaris would have ended the purchasing journey due to this issue.



Understanding the Barriers - System 1 responses

The behavioural safaris started by looking at the System 1 responses to buying an EV. These responses are automatic, quick intuitive, emotional reactions. The aim was to surface key “anchor” points and associations with the prospect of owning an EV.

When the respondents considered buying an electric vehicle the system 1 response was often that they felt EVs were a futuristic device that they were enthusiastic about but would consider later. They also felt that within a short time enhanced features will be available at a lower cost. This sense is reinforced in the electric vehicle buying journey as there is so much media globally relating to the falling prices of electric vehicles in the market.

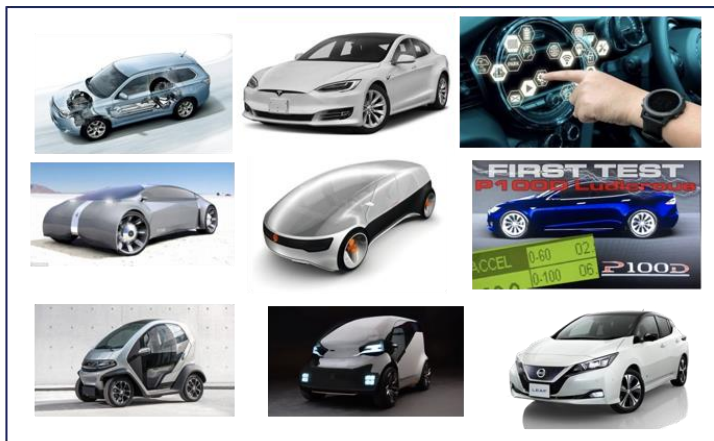


Figure 6 System 1 responses from participants

People also tended to frame the decision in terms of things they would have to change in their life more generally. For example, some mentioned that they didn't have solar and would only get a vehicle once they installed solar, others talked about how they would charge the vehicle at home.

Affordability as a barrier to buying electric vehicles

In our online survey we asked the direct question as to whether people would pay more for electric vehicles. **32% felt they would need to cost the same, and around 51% would need them to be less expensive. Only 6% indicate they would pay more.** A recent study by climate works [14] found that 8.3% said they would be willing to pay more for an electric vehicle and another 26.4% would pay more if there was better infrastructure in place.

A further complicating factor with electric vehicles, when people talk about "paying more", is whether they talking about the recommended retailer price, or the total cost to own the vehicle? There is a general perspective within the automotive industry that people are highly sensitive to the "sticker price" (upfront cost) of a vehicle. In a report from NREL [29] some respondents showed a willingness to pay increased upfront cost if it cut their fuel costs by one-third. 14% would pay up to \$9,000 and 51% said they would pay "some" incremental cost. This indicates that there is a significant proportion of the community who do think in terms of total cost of ownership, but that surprisingly half just look at the upfront cost of a vehicle.

This may be due to a phenomenon of bounded rationality with respect to fuel economy (often referred to as the "energy paradox"). This indicates that when people claim that fuel economy is a big decision point in buying a vehicle, they then spend very little time reflecting upon it [30].

Among our behavioural research cohort there was an awareness of cost benefits of owning an EV compared to a fuel-powered car. As part of the behaviour missions, several had gone to great lengths to verify these savings. Calculations were frequently based on varied estimations and assumptions. It is likely that this effort would only be expended by early adopters.

This research indicated that upfront purchase price will continue to be a significant barrier if no clear and easy tools or heuristics are provided to understand TCO and the long-term cost benefit. Even with these tools, for many there are strong behavioural barriers to purchasing a more expensive vehicle.

Lack of Infrastructure and range anxiety as a barrier to buying electric vehicles

Research has supported the concept that infrastructure availability is correlated with electric vehicle adoption [31]. In a study of 2500 random car owners in Northern Ireland, 59% of respondents felt that needing to recharge your vehicle would be an issue, and 55% felt that vehicle range would be a barrier to purchasing [28].

Experience has shown that in practice, once EVs become more common in a country, infrastructure availability will be a high barrier for those with no home charger availability, but less so for those with access to off-street charging. [32] Results predicted that the dissemination of public slow-charging options will have no influence on the diffusion of EVs in Germany out to 2030. More recent research indicates that strategic placement of fast chargers has the largest impact on attitudes [33].

Within our cohort, provision of charging infrastructure certainly concerned a large number of respondents, with **40% saying that lack of charging infrastructure would be a major issue**. We also asked participants in the behavioural safaris to try to spot infrastructure or other EV related cues within South Australia that gave them a sense that electric vehicles were a presence in South Australia. There were virtually no indicators of EVs in the market.

*"Sorry, looking for a couple of days but cannot find any evidence of the EV industry".
Male, Older Family, Necessity, Environmentalist, Saver*

We also evidenced a strong behaviour of almost all of those evaluating transitioning to an EV – anchoring their decision around the longest distances that participants would need to drive rather than the typical distances driven.

Compounding concerns around availability of infrastructure is the perception (and reality in many cases) that charging infrastructure is not compatible.

*But there should be a universal recharging protocol enforced for all electric vehicles, as there is with electric appliance 3 pin plugs.
Male, Car enthusiast, SINK/DINK, Environmentalist, Saver*

Availability of electric vehicles as a barrier

Regardless of the intent of our participants, they soon realised there were very few vehicles available immediately for purchase. At the time of writing there was only one readily available affordable electric vehicle in the market – Mitsubishi Outlander. The BMW i3 was the next realistic option, with Renault Zoe accessible soon. Hyundai Ioniq will be launched in the market in 2018 as both a PEV and PHEV.

Over the past year I have climbed in and out of dozens of cars to try to find my ideal. VW Golf would have fitted the bill if we only had an electric version for oz.
Female, Empty Nester, Environmentalist, Solar, Saver

For fleet managers this issue is also a significant issue, as finding vehicles that are “fit for purpose” as part of procurement exercises means that even for the few vehicles that are available, they must compete with many other Internal Combustion Engine alternatives in a structured evaluation process.

Lack of Evidence as a barrier to buying an electric vehicle

Lack of evidence around electric vehicles was a major issue within the project. The participants were stunned by the lack of information in the Australian market with respect to buying electric vehicles. This was true of both searching online and talking to dealers.

Developed EV markets have easy access to information. Key information available includes cost calculators, information around incentives, technical standards, infrastructure advice, case studies of current users, myth busting information. A great example of this type of initiative is Go Ultra Low¹ in the United Kingdom market.

Participants in the behavioural safaris found the frustrating lack of evidence as outlined below:

- Concerns around inability to conduct test drives. A study on new innovation diffusion by [34] identified that “trialability” is key to adoption of a new innovation
- Questions around cost of ownership
- How to service a vehicle
- Questions around vehicle safety
- Questions around battery life
- Questions around availability of new and second hand vehicles

These same types of barriers were found in market with rich consumer experience data (such as in the U.S.) where car dealers were seen to inhibit EV sales due to poor training and mixed motivations [35], and in the U.K. where lack of informational material on vehicle range inhibits consumers [36].

“Finding a car to test drive was not as easy as I thought. From the research I went to the car yard strip in Reynela, I wanted to try the Hyundai, Mitsubishi or Nissan Leaf. After arriving and discussing with the car yards I was surprised that there were no cars available to drive (tried all car yards in the end to find any dealer with an electric car).”

Male, SINK/DINK, Car Enthusiast, Environmentalist, Solar, Spender

“The other consideration is mechanical issues. Would my local RAA mechanic be able to provide roadside assistance should I run into trouble?”

Female, Older Family, Necessity, Environmentalist, Non solar, Spender

“It is nearly impossible to find information on the safety features of the PHEV and how they rate in crash testing etc. How will the battery react/be an issue in an accident?”

Female, Older Family, Necessity, Environmentalist, Non solar, Spender

¹ <https://www.goultralow.com/>

Self-image as a barrier to electric vehicle adoption

Today, cars are still, to many people, a reflection of their self image. This factor can not be under-estimated as it moves beyond a perception that buying a car is purely a rational choice based on cost/benefit analysis.

There was for example, some concern about the aesthetics of electric vehicles being outside of the "norm", with some expressing a desire for these vehicles to appear more like vehicles they were used to.

The closed in full colour look at the front of EVs still weirds me out. I know they don't need a grille because they don't have a fuel-powered engine, but I'd still like them to pretend in order to maintain the appearance I consider desirable.

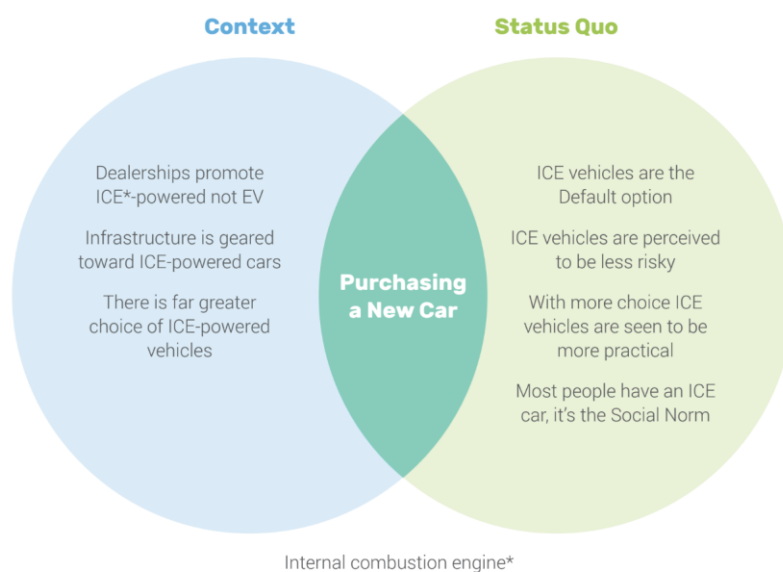
Male, SINK/DINK, Car Enthusiast, Environmentalist, Non solar, Spender

Customer journey as a barrier - an accumulation of anxieties

Barriers need to be understood in terms of an overall customer journey. In a digital world consumers expect immediate and complete information. A study by Google of 700 Australian consumers in 2015 showed that the average purchase cycle for a vehicle is 2.3 months [37]. During that cycle 56% consider new or used, they research extensively via google, YouTube, manufacturer websites and other specialist websites.

Given the complexity of this customer journey, from a behavioural standpoint, the decision not to buy is a culmination of anxieties rather than any one specific issue. The purchasing of an EV is uncharted territory for most buyers in the Australian context and this creates a new set of challenges as people cannot apply their trusted approaches to evaluation.

Researchers were left with the general sense that the biggest contextual barrier to successfully transacting through the Electric vehicle (EV) buying cycle in the Australian context is that EVs are seen as 'uncharted territory' for the consumer, who simply do not feel ready enough to purchase because of the accumulation of anxieties and lack of evidence, both in the real world and on the customer purchase journey.



Barriers for Fleet Consumers

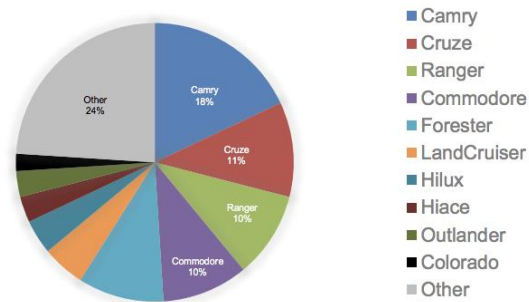
“Fleet operators, both in public authorities and the private sector, can contribute significantly to the deployment of EVs: first through the demand signals that they can send to the market, and second thanks to their broader role as amplifiers in promoting and facilitating the uptake of electric cars by their staff and customers.” [38]

In Australia the vast majority of fleet managers do not have electric vehicles as high on their priorities. They generally feel that there are too many barriers to seriously consider wide scale adoption of electric vehicles. Most programs are driven by CSR goals as opposed to economic goals. The most common complaints are the lack of “fit for purpose” product, the significant price gaps and the lack of certainty around residual values.

There is no question of the importance of getting fleets as a first mover in the electric vehicle space. Over 50% of new cars are bought for business use (it is very difficult to determine what % of these are fleets).

Case Study – SA Government fleet

As of 30 June 2017 Fleet SA had a fleet of 7,151 passenger, SUV and light commercial vehicles. The government has a 30% low emission target and is meeting 22.7% so far with a handful of Mitsubishi Outlander PHEVs. They have 600 Hybrids in their fleet, 20 outlanders and 2 BMW i3s.



The fleet uses Lease Plan for vehicle purchasing, and it is common for any large fleet to outsource many of its functions to a major leasing partner.

There are a number of key barriers for SA Government in adopting electric vehicles :

- For SA Fleet, the total cost of ownership is primarily driven by depreciation. They own the vehicle (as opposed to a lease structure where the finance company owns the vehicle) which means that they take the risk on residual values. They will sell vehicles after 3 years or 60,000 kms.
- From their perspective, there is simply not the required variety of plug in electrics available for their needs in Australia, and for those that are available the key concern is the depreciation rates.
- SA Fleet provides the vehicles to the various agencies and the fuel costs are borne by the agency, so ultimately SA fleet is not judged for fuel efficiency as this is absorbed in the agencies' budgets.
- The servicing costs of their fleet are currently low - because the vehicles are turned over after 3 years, and the bulk of servicing is covered by manufacturer's warranties. As such the low servicing costs of an Electric Vehicle are not absorbed by SA government - but will benefit the next owners of the vehicles.
- The other major perception is that the rate of change in Electric Vehicles is so fast that they should wait to commit to a generation of vehicles that better suits their needs.

During the study we had detailed discussions with South Australian Government Fleet, South Australian Networks and then a number of smaller fleet players. There was a strong disconnect between the ambitions of governments and sentiment within fleet departments, who did not have incentives aligned with buying vehicles and did not have sufficient tools to evaluate.

The Australian Fleet Managers Association believes that fleets have been slow to adopt EVs, as a result of similar concerns to consumers – range anxiety, upfront costs and

dynamics of charging. The limited survey data supports this view. Below is a summary of answers to the question: *“What are the barriers to your organization owning (more) EVs?”*. Meeting charging needs appears to be the strongest barrier, followed by depreciation uncertainty, range of the vehicles and total cost of ownership costs.

Barriers to EV ownership in SA fleets

Sample: 8 respondents

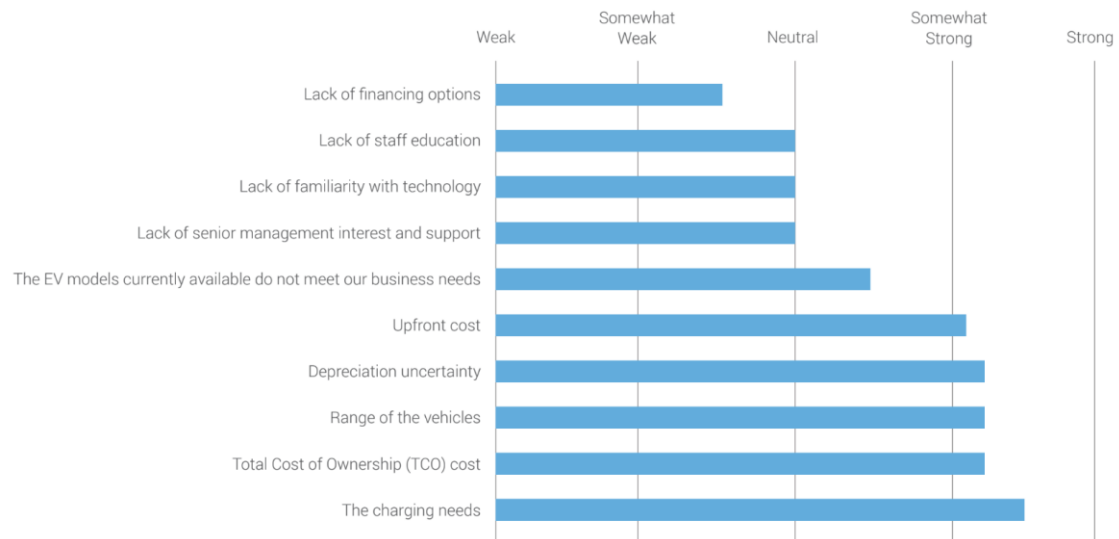


Figure 22: Rank of barriers for fleet managers weakest to strongest captured in response to the question: *“What are the barriers to your organization owning (more) EVs?”*, Source: Everergi

We drew the following conclusions from this survey:

- There is a fairly low engagement with the topic of Electric Vehicles amongst fleets
- There is a very low percentage of EVs in fleets today. EVs in fleets are predominately executive vehicles that are charged at home.
- Few fleets have targets for EVs ownership. There is also very little consensus on how much of their future fleet will consist of EVs.
- Barriers for adoption are consistent with consumer barriers. This is as one might expect given the nascent nature of the market.
- Drivers for purchasing EVs are broad, from economic to environmental concern and desire to innovate
- Only 33 EVs, mostly Mitsubishi Outlander PHEVs, are owned by just 3 of survey respondents (SA Fleet, Town of Gawler and Centacare Catholic Family Services Adelaide). All of these were executive vehicles charged at home.
- None of the survey respondents declared they had specific targets for EVs. Only one organisation (SA Fleet) had a target for low emissions vehicles but two other organisations indicated that purchasing of EVs might result from their organisation meeting carbon emission reduction goals. Only two organisations gave predictions on the percentage of EVs in their fleet by 2025 from 5% (Town of Gawler) to more than half (Uniting SA).

How to accelerate adoption of renewably powered electric vehicles

Behavioural insights

From studying the participants and identifying the triggers and barriers to EV adoption our researchers used Behavioural Economic principles as a framework to help develop key behavioural interventions that may be possible to drive forward adoption. The following are some key themes that emerged from the research which we then applied in the next section to more specific interventions.



Authority Bias

Barrier: The current perception is that EVs are not quite ready to suit mass market needs. The perception is that they are only currently purchased and driven by environmentalists or very wealthy people.

What is authority Bias: We are often swayed by authority: giving particular weight to one source of information over another because we view it as being more legitimate or coming from a greater source of expertise.

Science: 50% increase in compliant behaviour when people on the street were asked to do a small task by a man in uniform, vs the same man in plain clothes. [39]

Interventions: Centralise and solidify a national consumer advocacy body bringing together major corporate and government actors supported by local state and regional initiatives



Disruptive Anchors

Barrier: For most people, EVs are the future, not the now. As a result they are often framed as risky and surrounded by inaccurate myths, all of which reduces motivation to purchase an EV in the short term.

What are disruptive anchors: When making a decision, consumers anchor or rely on a specific piece of information and then adjust from this point. Anchors may be based on price, past experience, occasions, and social norms. A disruptive Anchor is one that quite literally disrupts existing attitudes and behaviour.

Science: A demonstration of the anchoring effect by Daniel Kahneman and Amos Tversky showed how random numbers could influence people's answer to a question.

They tested the impact of arbitrary roulette numbers on decision making and found that people were primed by the number in the first task. [40]

Interventions: Draw out less obvious benefits - performance, cost of ownership, servicing, and national security. Re-frame EVs as part of normal daily activity. Re-anchor range anxiety within more realistic travel patterns.



Social Norms

Barrier: Currently the strong social norm in Australia is buying a conventional car. This frames EVs as risk.

What are social norms: When we are uncertain of what to do we look to others to guide us.

Science: The UK tax department nudged people to pay their taxes by using social norm statements in their reminder letters like '9 out of 10 people in your town pay their taxes on time. This led to a 15 percentage point rise in responses, from 67% to 83% compliance. [41]

Recent research has shown that by simply describing how norms are starting to change, it's possible to get people to change their own behaviour in the same way. Psychologists of Stanford University [42]

Interventions: Constantly communicate global social shift. Strongly communicate local markers of change. Re-frame EVs as part of normal daily activity.



Heuristics and Chunking

Barrier: There is too much uncertainty in the buying process and no logical customer purchase journey in Australia

What is Heuristics and Chunking: Shortcuts (also known as heuristics) are simple rules of thumb that help people to make quick decisions and judgments. The principle of chunking: A large task or goal can be daunting and put people off. Breaking down a task into parts makes it seem much more achievable and manageable.

Science : Shah and Oppenheimer (2006) state that all heuristics aim to reduce cognitive effort by: Examining fewer pieces of information, relying on easy-to-access information, simplifying the weighting of information, integrating less information in decision process and considering fewer alternatives overall. [43]

Key measures for residential consumers

- Establish a well-funded national EV consumer advocacy body
- Stimulate supply with carrot and stick incentives from Government
- Encourage fleet initiatives and aggregated buying opportunities
- Explore new business models to capture value through financialising or regulated value capture from electricity distribution business
- Enable a strong second-hand vehicle market
- Targeted responses to infrastructure implementation

The diagram illustrates the process of a purchase decision, starting from 'Triggers to buy' and ending with a 'Purchase decision' (Yes!). The process is divided into four stages: Affordability, Evidence, Availability, and Infrastructure. Above the timeline, 'Removing barriers' is shown, which includes 'Amplify triggers' and 'Bust myths'. Below the timeline, 'Structural responses' are indicated by three arrows. The final outcome is a 'Yes!' decision.

Triggers to buy	Removing barriers				Purchase decision
 	Affordability	Evidence	Availability	Infrastructure	 Yes!
	Incentives Fleet led market Secondary market Financing structures	Provide test drives TCO calculators Single source of truth	Secondary markets Fleet led market	Sufficient coverage	

Structural responses

The Australian community and the automotive sector must be able to send a strong signal that Australia is a ready and willing participant in the electrification of its fleet. As the rest of the world steams towards Electric Vehicles, supply constraints will emerge

as manufacturers focus on the most attractive markets before deciding to invest in the local training, infrastructure and marketing required.

Private and fleet early adopters of the technology should be rewarded for the friction that they will still have in the purchase journey. These adopters will underpin the normalisation of electric vehicles and will provide future buyers with the required stock of second-hand vehicles.

Based on the findings in this research and review of other markets and publications there are seven key recommendations for means of acceleration of adoption in Australia.

- Create clear authoritative, well-funded source of information to address anxieties
- Encourage fleet led adoption cycle
- Open up grey imports of electric vehicles
- Policy to drive availability
- Policy to improve affordability (what is the gap)
- Policy to assist with targeted infrastructure
- Re-inforce the direct connection with environmental benefit

Measure 1: Amplification of key triggers – environment and social benefits

It is clear that while there are other potential triggers for adoption, within the Australian context the environmental benefit remains the key trigger in the medium term. As such, a focus on the environmental benefits of electric vehicle ownership is one of the most powerful things that can be done to accelerate EV adoption.

The strong connection between buying an electric vehicle, powering it with renewable energy, and of electric vehicles as part of a wider movement towards a renewable energy supply chain is critical to adoption. [45] identified this relationship in his study of 14 countries which indicated that a 1 % increase in renewables would lead to a 2-6% increase in electric vehicle penetration.

A conventional deterrent to electric vehicle adoption is that they may not reduce greenhouse gases or pollution if they are powered by non-renewable sources. In a briefing to NSW Parliament [16] it is noted that “charging EVs from high fossil fuel electricity networks generates more greenhouse gas emissions than charging EVs from low fossil fuel electricity networks”. This statement is clearly inaccurate for the many people who will charge their vehicles from solar, nor is it true for states such as South Australia, or the ACT which have emissions factors of almost half of NSW [9]. Several studies have demonstrated the environmental benefits of electric vehicles in most grid generation scenarios on a lifecycle basis [46], [47]

Our total cost of ownership tool showed that a BMW i3 running for five years in South Australia would emit 4.77 tonnes of CO₂, compared with 14.22 for a Toyota corolla. A Mitsubishi Outlander PHEV would emit 6.81 tonnes compared to 14.38 for a Subaru Impreza 2.0¹²

² Figures are based on 15,000 kms driven per year, 30% weekday charging. Emission figures are “well to wheel”.

More importantly, discussion of current carbon emission savings for electric vehicles ignores the key point – electric vehicles are a key part of underpinning a social movement towards a renewable energy supply chain. This is recognised in the NSW Report which concludes that this issue “can be viewed as an opportunity to align EV and energy policies, in order to harness the benefits of technological innovation across the entire economy”. [16]

An example of this alignment is the drive to integrate electric vehicles with decisions around local solar and battery usage. In South Australia there is a major commitment to this future with the government supporting installation of 50,000 solar and battery systems as part of a Virtual Power Plant project.

A key part of this project was focused on understanding the practical benefit of local renewable energy on ownership of electric vehicles. Our analysis indicated that with solar and batteries installed, a driver in South Australia would emit only .74 tonnes of CO₂ over five years and would be up to \$6,000 better off in the same period³.

Clearly with solar and batteries these numbers become even more compelling as the following table demonstrates.

	5 year carbon (Tonnes CO ₂)		
Vehicle	without solar	with solar	with solar and battery
Tesla model X	6.81	4.73	0.74
Tesla Model S	6.25	4.33	0.69
BMW i3	4.77	3.3	0.54
Renault Zoe	5.22	3.61	0.59
Nissan Leaf	5.68	3.94	0.63
Mitsubishi Outlander	6.81	4.73	0.74
Renault Kangoo	5.45	3.77	0.61

Governments and other groups such as the electric vehicle council are starting to use every opportunity to amplify all the key benefits of electrification which go far beyond the environmental and into the demonstrated economic and domestic security benefits.

Being late adopters of this innovation gives Australia the opportunity to integrate these benefits into the architecture of policy and industry initiatives.

³ Based on Tesla model X with 7kW, north facing solar array and 10kWh battery driving 15,000 kms per year 30% weekday. Emission figures are “well to wheel”.

Measure 2: Creating Evidence for electric vehicle intenders – National Consumer Advocacy group for Electric Vehicle buyers

During the research a number of key behavioural interventions were documented and the question became how to harness and capture these benefits. The “Charge Together” program attracted 1600 drivers within a month. That was 60 per day and it had no visible sign of drop off in momentum as the budget was exhausted. This enthusiasm and interest also needs to be harnessed on an on-going basis.

Currently in the Australian context the key organisations representing the Electric Vehicle community are the Australian Electric Vehicle Association (AEVA) and the EV Council. AEVA has been focused on owners and enthusiasts and the EV Council has focused on EV suppliers. As various states are becoming engaged with the electric vehicle journey local bodies are being established as the voice of the Electric Vehicle stakeholders.

There is currently no well-funded organisation focused on consumer advocacy in Australia. Similar programs in the United Kingdom (GoUltraLow), Norway (Norway electric vehicle association), and New Zealand (Drive Electric) have all had positive impacts on electric vehicle adoption.

The opportunity in Australia is to learn from global experience and establish a model for consumer advocacy for both fleets and consumers and a key recommendation from this report is funding to research and establish the governance structure for this body. From other markets it seems clear that dispersion of this voice across multiple bodies has not been successful practice.

The overall goal of the body would be to create a clear and authoritative source of information to address anxieties, enhance triggers, bust myths and reframe electric vehicles from a risky sacrifice to a smart choice (that gives you more money, time, sustainability and a more pleasurable driving experience).

Members of the body should include all levels of government, major fleets and automotive bodies, and some of the activities would include:

- Communicate EVs as a social norm – report on local and global momentum
- Rally, support and promote other government, consumer group or industry led adoption programs and commercial products
- Represent infrastructure priorities from a consumer perspective
- Create sense of momentum and drive EVs as a social norm
- Create and provide a logical customer journey
- Provide evidence required to soothe anxieties and bust myths. Note that “mythbusting” must be done very carefully and in a positive light so as to not give salience to negative anchors
- Consumer aggregation to provide forward demand information to manufacturers
- Fleet information and aggregation
- Give salience to less obvious benefits – driving experience, service, economic benefit
- Promote the direct connection between Electric Vehicles and Environmental benefit

- Reframe EVs by clearly showing how they fit into daily life
- Keep an accurate and up to date register on the timing of model availability
- Create transparency to model pipeline
- Create more opportunities to test drive vehicles
- Create tools to ease range anxiety
- Create tools to authoritatively demonstrate total cost of ownership

The key here is to help guide customers by establishing a trusted source of information that consumers can reference, while ensuring that industry competition is not stifled. There are three stages of customer enquiry and at each stage a different solution is required:

Phase of customer journey	Recommended sources of data
"Do I want an electric vehicle at all?"	<p>A nationally available reference site backed by an authoritative and impartial body</p> <p>Structure for test drive regardless of dealer enthusiasm</p>
"Which EV do I want?"	<p>Impartial total cost of ownership tools.</p> <p>Structure for test drives regardless of dealer enthusiasm</p> <p>Potential for grey importing vehicles that are not currently available</p>
"Where should I buy the EV?"	<p>Generally industry led via car sales websites or direct dealer or automotive sources.</p>

Measure 3: Easing affordability and availability

In many ways affordability and availability are interlinked. Policies and industry action which help to make vehicles more affordable will show commitment to manufacturers which will encourage them to deliver more vehicles.

As outlined in this document there are two key aspects to affordability. Firstly there is the total cost of ownership approach and secondly there are measures that bring down the “Sticker price” of the vehicle. According to this research both are critical.

From the perspective of total cost of ownership, the project developed an online tool for evaluating the total cost of ownership. Based on the assumptions in this tool, like-for-like vehicles will typically have a \$10,000 - \$15,000 premium in an Electric Variant, but that gap will reduce to around \$5,000 - \$7,000 over a five year ownership cycle. For some use cases such as deliveries this may actually be positive. As is suggested above, what is now required is an authoritative body to provide this ongoing detail to the community.

The following initiatives can be considered as providing the means to ease issues around affordability and availability of vehicles.

Government incentives - There is no evidence that electric vehicle adoption will occur without some form of government incentives. These incentives not only improve affordability, they also send signals to global automotive companies that we are open for business, increasing model availability.

Removal of policies designed to protect the now defunct automotive manufacturing industry should be the first point of call. A recent report from the Electric Vehicle council and NRMA [15] suggested Federal taxes like the Luxury Car Tax (LCT), Fuel Excise, Fringe Benefits Tax (FBT) and Goods and Services Tax (GST); state charges like Stamp Duty, Registration and Compulsory Third Party (CTP), could all be explored.

Government supply side policy - Some countries have created policies which force some level of supply commitment from manufacturers. California has ZEV policy which enforces a percentage of vehicles to be Zero Emissions and CAFÉ regulation in Europe which sets emissions standards which will impose strong financial penalties on manufacturers who do not comply. While these policies are fairly extreme there should be some level of supply side policy to ensure we secure some global supply.

Fleet led adoption - fleet adoption can deliver lower cost purchase of new vehicles and then the follow-on benefits of establishing a secondary market. Strong support should be given to initiatives that help fleets to migrate to electric vehicles. One potential model is to provide a competitive grant fund for fleets to access to support migration to electric vehicles, including gap funding for the price of the vehicle, risk of depreciation and cost of powering with renewable energy.

Aggregated buying - mechanisms such as national fleet buying initiatives, as experienced in EV Smart Fleets in the US and EV100 project <https://www.theclimategroup.org/project/ev100>, inspired many countries to commit to migrating their fleet. This project was picked up in New Zealand with a

number of local corporations committing to the transition. Advantageous buying was possible via these programs.

In December 2017, Government News online reported a Memorandum of Understanding between South Australia, Adelaide, Tasmania, Hobart, Western Australia and the Australian Capital Territory with the Electric Vehicle Council. The Memorandum of Understanding will involve actions such as states and cities combining their purchasing of electric vehicles to increase the model availability in the Australian market. The Memorandum of Understanding will also seek to 'coordinate the strategic planning and construction of infrastructure for electric vehicles and to seek to align states' standards and incentives'. [48]

Value capture via distribution networks - The benefits of electrification of the fleet will, to some extent, be captured by electricity companies. Distribution companies, as highly regulated entities, have a structure that may be ideal for providing subsidisation for electric vehicles or charging infrastructure – with a reasonably low return on capital requirement for infrastructure investment.

The instrument for capturing long term investments in their asset base could be used as a 'no-net cost to community' approach to funding the mid-term pricing gap. To be 'no net cost to community', work would need to be done to ensure that there was no significant additionality in community costs (above and beyond those captured as financial benefit back to distribution businesses at their regulated return over the long term.)

Creating a viable secondary market - A clear barrier to adoption by fleets is depreciation. A viable solution to this is to establish a strong second-hand market for electric vehicles. ClimateWorks noted this opportunity in a study for the Victorian government [49] using a previous initiative in creating a secondary market for Toyota Camry Hybrids.

Strong support for grey imports of electric vehicles- there are currently 18.8 million registered vehicles in Australia [11] and yet there is no used vehicle market, This substantially reduces the addressable market population will never buy a new car and have a philosophy that it is a better financial decision to purchase a second hand vehicle. In the UK, where Electric vehicle growth has been moving forward for some time there are now 145,000 used electric vehicles in the market. This provides an entry level for these consumers.

Recent changes to road vehicle standards seem to support grey importation of used electric vehicles. This is still to be finalised but should be structured to acknowledge the critical role that this could play in increasing volumes of imports – both for private and fleet operations. The definition of variants that can be delivered, compliance costs and support for a new industry to ensure the compliance, safety and serviceability of vehicles should be examined in light of the critical role this market may play in diffusion of electric vehicles .

Development of new business models - In Australia only one in five new cars sold has a loan attached to it (ABS Data 2017). This compares to a massive 86.5% of private vehicle sales being financed in the United Kingdom. The form of financing in such markets is conducive to thinking in an "all-in" manner where total cost of ownership is more easily expressed. A personal contract purchase (PCP) includes

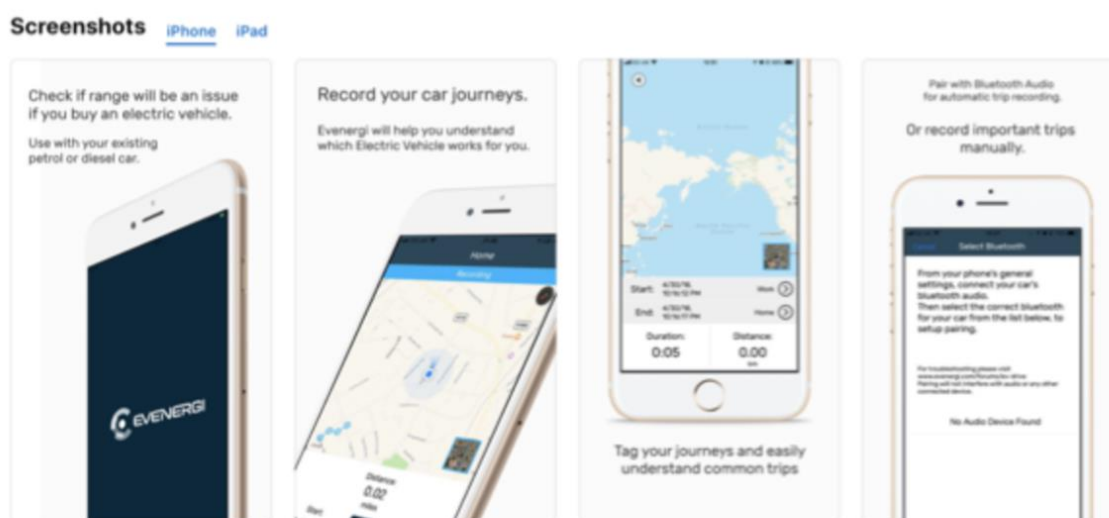
all costs of owning a vehicle and in many cases the buyer just hands it back at the end of term and picks up a new vehicle with the same loan amount. Developing new business models to package electric vehicles may improve perceived affordability.

It must be noted that nothing is a substitutable for strong action by government to bring down the “sticker prices” of vehicles. There is strong evidence that it is currently not possible for electric vehicles to become viable without government support [48]. Norway is currently the leader in driving adoption and their regime includes no purchase taxes, exemptions from road tolls, free municipal parking, 50% reduced company car tax, exemption from 25% of VAT.

Measure 4: Reduce range anxiety

Range anxiety can partially be resolved through public information. Once electric vehicles are more common, range anxiety is much less of a concern than many anticipate. In a study in the US involving 17,000 EV charging locations and 8200 EVs, the majority of charging (~96%) was found to be done at home and work, regardless of the vehicle type (PHEV or BEV). [49]

So the first real step to easing range anxiety is to provide tools and information to consumers. As part of the project we developed an application “EV-Drive” which was used by participants to help them to understand whether car Range would be an issue for them. After 350 drives from 30 participants it was clear that few of them had any challenge in imagining that an Electric Vehicle would be a problem to charge.



There is no contention that providing charging infrastructure is critical for electric vehicle adoption. This research has found that for electric vehicle intenders in South Australia infrastructure availability is a major psychological barrier. [50] investigated the effects of several incentives on per capita EV sales in Norway and found that pricing incentives and increased access to charging stations may be the best policies to increase EV sales. [51] identified that a public fast charging network is an important signal to support growth.

The recent implementation of fast chargers in Adelaide is best practice in terms of providing the type of visible infrastructure required to encourage adoption. In a Carbon Neutral Adelaide Partnership, the City of Adelaide and Government of South Australia have collaborated with SA Power Networks, Mitsubishi and Tesla to offer super-fast direct current (DC) charging services [52].

- Provide tools for consumers to understand range anxiety
- Consider funding for key strategic deployment of fast charging networks in visible locations in South Australia

Conclusion

EVs have great potential benefit for the Australian economy, and are one of the best innovations to target road-based transport emissions reductions. However, without concerted effort to proactively confront demand-side challenges faced by residential consumers and fleets intending to buy EVs, these benefits will be unrealised. A clearly stated and supported pathway to transition motorists from a strictly conventional paradigm to one that includes EVs is necessary to realise benefits and support consumers in adopting new technologies.

The perceived momentum towards adoption of EV in Australia does not account for the demand-side barriers encountered by consumers currently intending to buy an EV. Our research reveals great disconnect between stated consumer intention on EVs, and action taken after experience trying to buy in the local market. With the likeliest of EV residential consumers perceiving the EV market as “futuristic” and with fleet operators unable to find efficient methods to integrate EVs into their operations, EV adoption forecasts are unlikely to be met as anticipated unless there is strong and co-ordinated action.

Other underappreciated barriers to EV consumers such as clarity around total cost of ownership costs, a perceived need for broad public charging infrastructure to alleviate anxiety around battery range, and the absence of a central consumer-focused authority to educate consumers on the genuine risks and benefits of EVs, are holding consumers back from buying.

Despite the many barriers encountered by real world residential and fleet consumers, The Charge Together South Australian case study revealed a number of behavioural interventions which, if leveraged, can be used to better drive consumer behaviour and formulate a basis for resolving barriers. It also became clear that South Australians understand that the electric vehicle revolution is deeply coupled with the transition to renewable power and they are ready, and in fact are expecting, the joint diffusion and coupling of these technologies.

Australia has the unique opportunity now, before the next wave of EV products enter the market place in late 2018, to bolster its efforts and invest in targeted activities to support the consumer purchase process. As late adopters we have the opportunity to learn from global best-practice and ensure that the transition is accelerated, and that we have put in place the mechanisms to ensure that this transition is as efficient, productive and environmentally beneficial as possible.

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