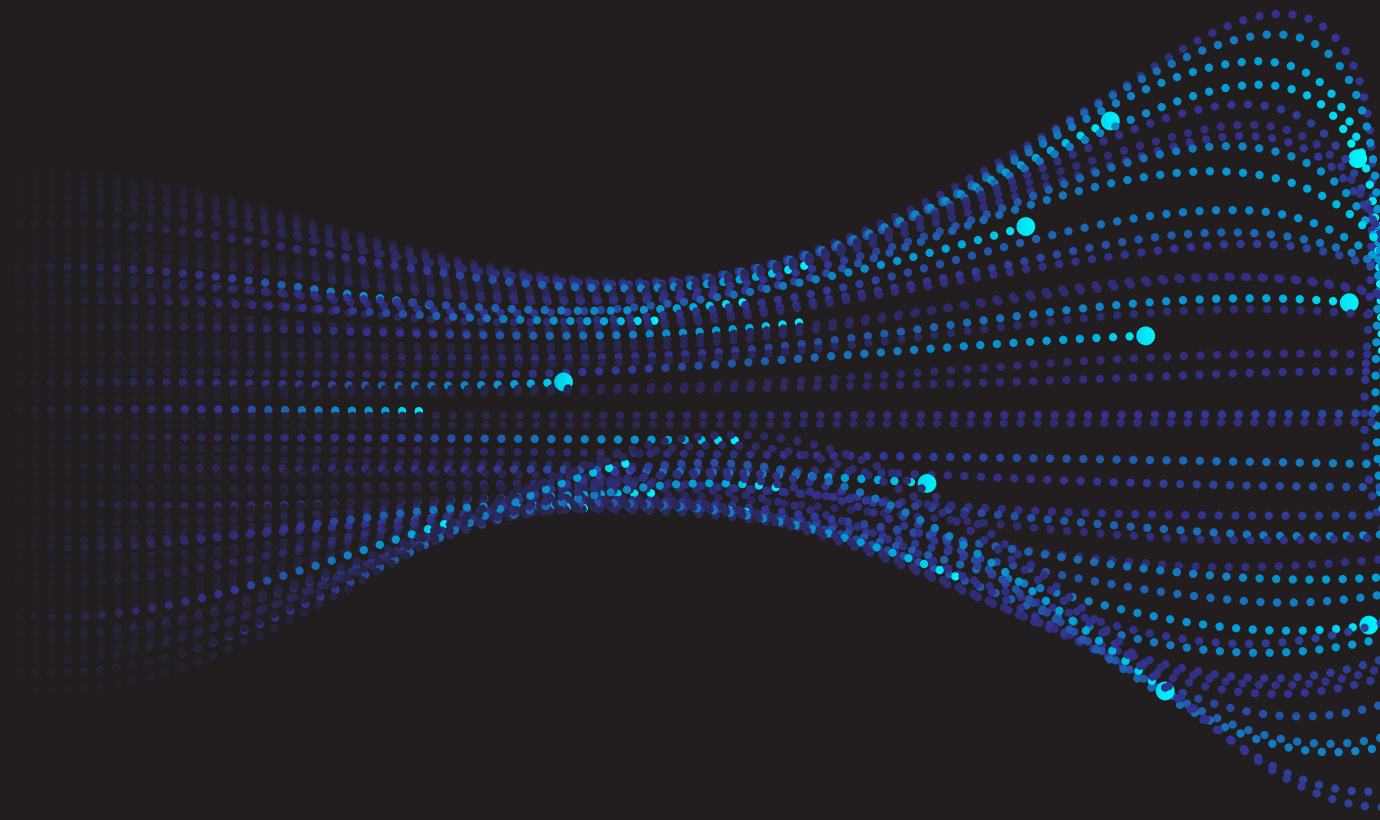


# STATE OF ELECTRIC VEHICLES

AUGUST 2020

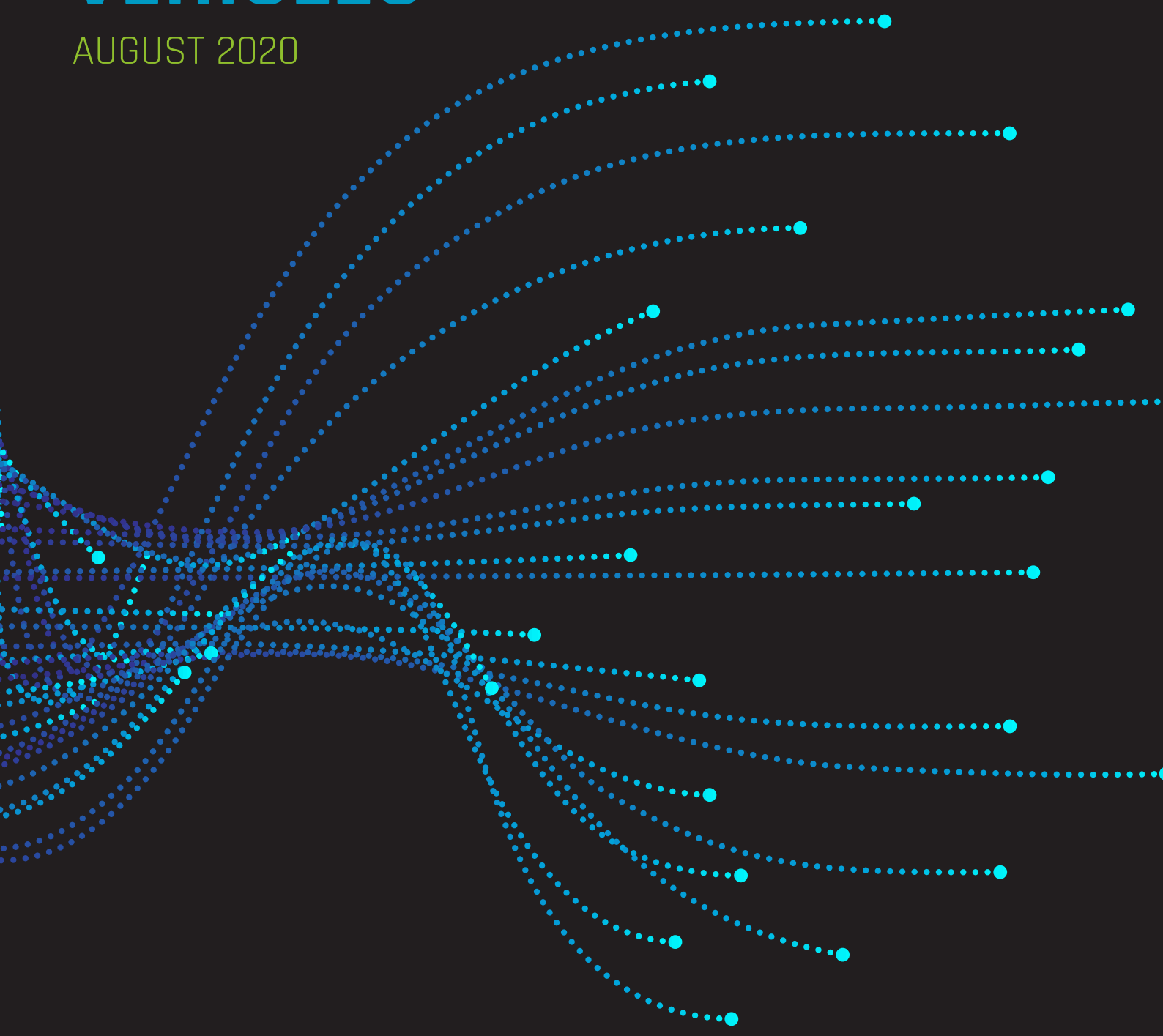


[electricvehiclecouncil.com.au](http://electricvehiclecouncil.com.au)



# STATE OF **ELECTRIC VEHICLES**

AUGUST 2020



# CONTENTS

06 2020 HIGHLIGHTS

09 EXECUTIVE SUMMARY

13 CHAPTER 1: MARKET UPDATE

- 13 Electric vehicle sales
- 14 COVID-19
- 15 Consumer attitudes survey
- 22 Case study: Lane Cove development building now for the electrified future

24 CHAPTER 2: AUSTRALIA'S EV INDUSTRY

- 24 Passenger vehicles
- 28 Bikes and scooter
- 29 Commercial vehicles and buses
- 36 Case study: East waste makes haste, leading the way on electric garbage

38 CHAPTER 3: CHARGING INFRASTRUCTURE

- 38 Public charging
- 42 Home and workplace charging
- 44 Case study: Evie Networks, the Aussie company building a nation-wide ultra-fast charging network

## 46 CHAPTER 4: EV MINING AND MANUFACTURING

- 46 Battery value chain
- 51 Charger manufacturing
- 52 Electric vehicle manufacturing
- 58 Case study: Voltra and BHP break new ground underground

## 60 CHAPTER 5: EVS, THE ENVIRONMENT, AND THE ENERGY GRID

- 60 Emissions impact
- 61 Battery stewardship
- 64 Built environment
- 67 Integration with the grid
- 72 Case study: Realising electric vehicle-to-grid services

## 74 CHAPTER 6: EV POLICY

- 75 Policy progress and scorecard
- 77 Policy highlights

## 80 APPENDIX

- 80 Appendix 1: Carmakers' commitments to electric vehicles
- 84 Appendix 2: Electric vehicle model availability
- 90 Appendix 3: Carmakers' investments into secondary battery applications
- 90 Appendix 4: Bus partnerships in Australia

## 93 REFERENCES

# 2020 highlights

In 2019, EV sales increased by



## 200%

with 6,718 EVs sold,  
petrol/diesel vehicle sales  
fell by 7.8%

EV sales accounted for

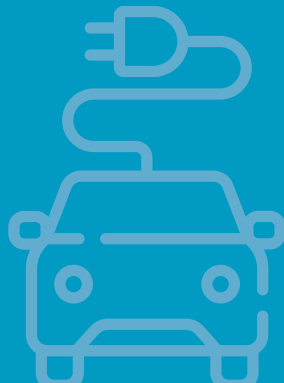
## 0.6%

of new sales in  
Australia in 2019



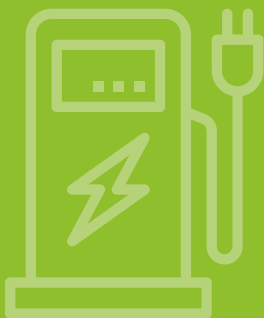
## 3,226

EVs sold in the first  
half of 2020



## 56%

of surveyed  
consumers would now  
consider purchasing  
an electric vehicle  
as their next car

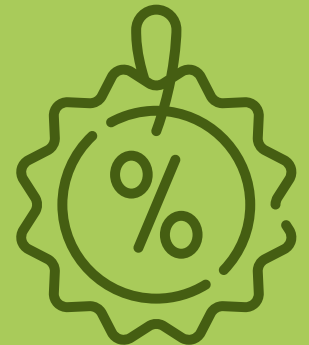


## 68%

of consumers want  
governments to provide  
more public charging  
infrastructure

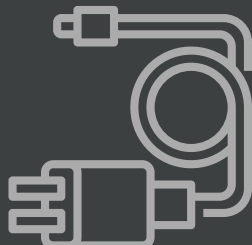
## 68%

of consumers want  
government subsidies to  
reduce the cost of buying  
an EV



## 66%

of consumers want  
government subsidies to  
reduce the cost of installing  
home charging equipment

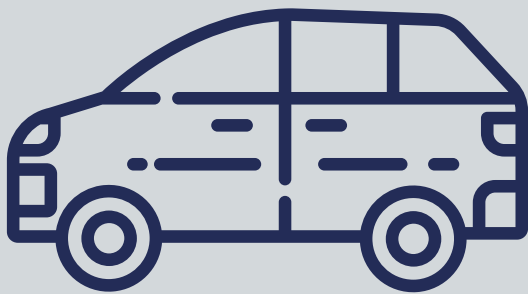


## 82%

of consumers identify  
public fast charging  
as "important"



Australia has **2,307** public charging stations; **357** of these are fast public charging stations (an increase of more than 40% in the last 12 months)



There are  
**28 EV models**  
for sale in Australia

Electric vehicle policy scorecard:

ACT	NSW	QLD	VIC	SA	TAS	WA	NT	FED
B	C	C	D	D	D	F	F	F







# Executive summary

The State of Electric Vehicles is an annual report prepared by the Electric Vehicle Council, the national peak body representing the electric vehicle industry in Australia. This report provides data and insights into the electric vehicle industry in Australia and highlights priority areas for further action needed to accelerate the electrification of transport in Australia.

The last year has seen an increase in electric vehicle sales, improvements in consumer sentiment, and the rollout of public charging infrastructure. A number of states and territories have announced new policies to support electric vehicles.

However, Australia continues to lag comparable countries when it comes to electric vehicle market share, model availability, consumer awareness, industry development, and – critically – government support.

It remains clear that if the Australian electric vehicle industry had comparable policy support to other countries, we would enjoy access to more low-cost electric vehicle models and greater consumer confidence in electric vehicles. Australia would also be capitalising on more opportunities to create jobs in the sector.

## Sales accelerate rapidly

Despite the lack of national coordination and support, in 2019 electric vehicle sales tripled from 2,216 to 6,718.

So far in 2020, electric vehicle sales are proving to be resilient even through COVID-19, with 3,226 electric vehicles sold in the first half of the year despite a 20% reduction in overall car sales.

Yet global comparisons of electric vehicle market share illustrate how far we are behind. Electric vehicles now account for around 2.5% to 5% of all new vehicles sold across developed countries. In Australia electric vehicles account for only 0.6% of all new sales.

## Shifting consumer sentiment

There is reason to be optimistic that the gap between Australia and the world may start to tighten in coming years.

A survey of 2,902 Australians carried out for this report shows consumers continuing to warm towards electric vehicles. Of those surveyed, 56% would now consider purchasing an electric vehicle as their next vehicle, representing a steady increase from 48% in 2018 and 53% in 2019.

Consumers cite reduced environmental footprints, lower running and maintenance costs, and relative performance as the most common reasons to encourage an electric vehicle purchase.

The price of electric vehicles continues to be a discouraging factor. This concern should dissipate as the price of electric vehicles reaches parity with petrol and diesel equivalents. This point of parity could be reached much sooner with the introduction of national fuel efficiency standards, comparable to other countries like the UK and the US.


Many consumers said they were discouraged by the driving range of electric vehicles but, when asked how far they expected fully electric vehicles to drive per charge, almost 80% of respondents underestimated the range of electric vehicles currently available in Australia.

## Charging ahead

The rollout of public charging infrastructure has continued apace over the past year on the back of significant investment from the private sector, some state governments, and the federal government through the Australian Renewable Energy Agency.

There are now 1,950 standard charging stations (less than 50kW) at over 1,200 locations, a 16% increase since July 2019; and 350 fast and ultra-fast charging stations (50kW and over) at over 150 locations across Australia, representing a 42% increase since July 2019.

Given the importance that consumers place on charging infrastructure availability, it is imperative that private and public investment in infrastructure continues. Testament to this, Infrastructure Australia has included the rollout of a national electric vehicle fast-charging network as a High Priority Initiative in its 2020 Infrastructure Priority List.



Almost 80% of consumers underestimated the range of electric vehicles currently available in Australia.

## Consumer choice throttled

Australian consumers have more electric vehicles to choose from than ever before. There are now 28 electric vehicle models available in Australia, and eight of these are priced under \$65,000. Six more models are expected to arrive on our shores before the end of next year, including two priced below \$50,000.

When surveyed about the requirements for bringing electric vehicles to a market, carmakers told the Electric Vehicle Council the absence of a national electric vehicle policy is restricting the supply of more electric vehicles to Australia, especially when such policies exist in comparable markets.

Globally, carmakers are rolling out more electric vehicle models, but so far production cannot keep up with demand. This means that without policy signals, Australians will continue to be denied access to the full global range of electric vehicles.

## Battery supply chain potential untapped

Australia continues to waste incredible opportunities when it comes to the battery supply chain. While our mining industry is benefitting from the global electric vehicle boom, Australia is not adding value in mineral processing, battery component manufacturing, and battery recycling.

Australia could see a surge in jobs and revenue if policymakers were to support R&D and investment in these sectors.

## Still waiting on government to release handbrake

Most apparent at the federal level, but also present at the state level, is the continued reluctance by governments to proactively position Australia's transport sector to benefit from electrification.

If governments wish to reduce transport emissions, improve air quality, remove fuel insecurity, and grow local jobs then policy support for electric vehicles must be part of the equation.

The Electric Vehicle Council has initiated a new policy scorecard to rate governments against a range of effective and evidence-backed policies to encourage and support electric vehicle uptake.

In 2020, the ACT government is the clear leader, closely followed by the NSW and QLD governments. With electric vehicle strategies under development by the federal, Victorian, South Australian, Northern Territory and Western Australian governments, the next 12 months should see further improvement in these ratings.



# Chapter 1: Market update

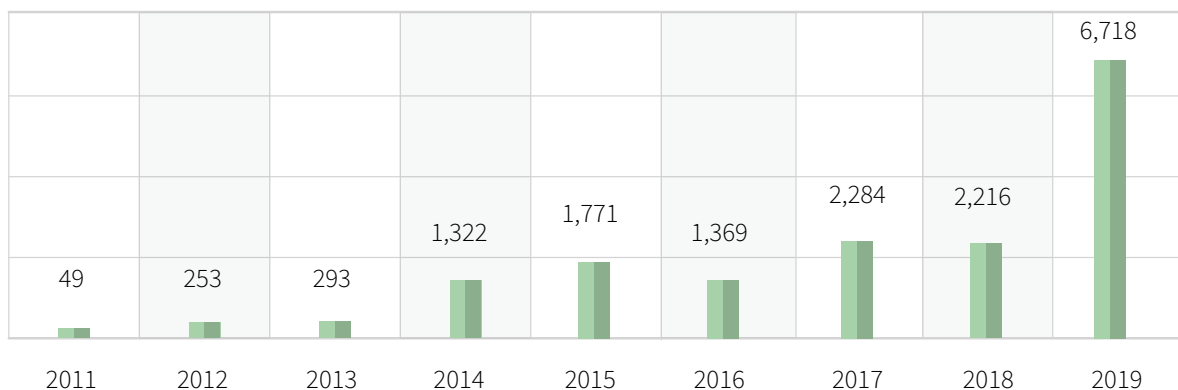
## Electric vehicle sales

Electric vehicle sales experienced a bumper 2019 in Australia, tripling from 2,216 new vehicles in 2018 to 6,718 in 2019. This jump came despite a 7.8% fall in combustion engine vehicle sales in the same period.

Global plug-in vehicle sales continued to climb with 2.26 million vehicles sold in 2019, an increase of 9% from the previous year.<sup>1</sup> That equates to 2.5% of all new vehicles sold globally. Electric vehicle sales in developed nations were around 2.5% to 5% of new car sales, with the notable exception of Norway where electric vehicles accounted for 56% of new cars.<sup>2</sup>

Australia's market share for plug-in electric vehicles still lags behind other developed nations at 0.6%, but the steady introduction of new models presents an opportunity for growth.

Electric vehicle sales in 2020 have been remarkably resilient, with 3,226<sup>3</sup> electric vehicles sold in the first half of the year despite a global pandemic that contributed to a 20% decline in overall new vehicle sales.<sup>4</sup>



## 3,226 EVs have been sold in the first half of 2020

According to available data – which excludes Tesla sales – private purchases accounted for 51% of electric vehicle sales in 2019 compared to 37% in 2018. Fleet sales made up the remainder. Combined with the significant overall rise in electric vehicle sales, this shift suggests a marked increase in the interest of individual consumers.

1 Plug-in vehicles refers to both fully electric vehicles and plug-in electric hybrid vehicles.

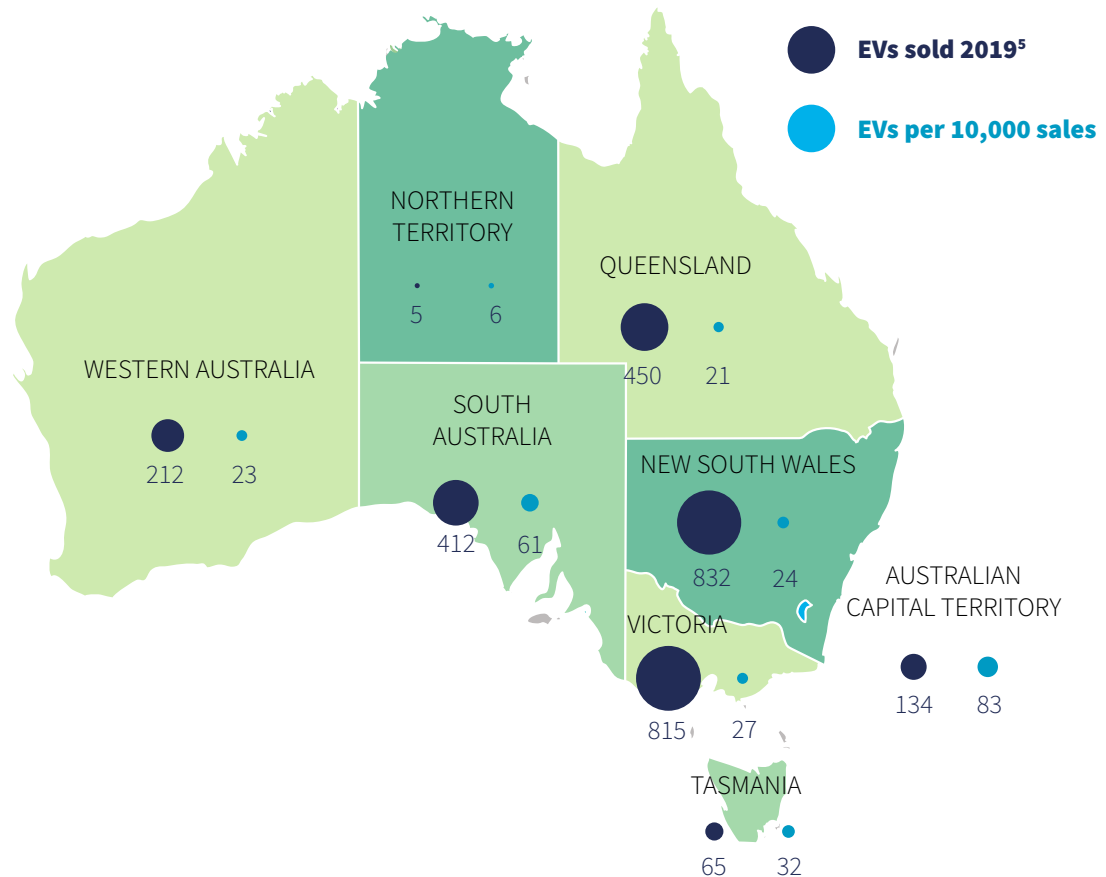
2 EV Volumes.com

3 EV sales figures include the EVCs Tesla sales estimate. Tesla does not disclose local sales figures.

4 VFACTS (2020)

Electric vehicle market penetration differs across Australian states and territories. Victoria and NSW continue to have the highest total number of electric vehicles with 2,540 and 2,532 respective sales between 2011 and 2019 (Tesla is excluded from this count). The two most populous states were also level in 2019 with 832 sales in NSW and 815 in Victoria.

However, as a percentage of new car sales, the ACT strongly outperforms others with 83 electric vehicles purchased for every 10,000 vehicles sold.



## COVID-19

The consequences of COVID-19 have been felt across the global electric vehicle industry. With many assembly plants closed, supply chains have slowed and vehicles sales have decreased globally. However, our survey of carmakers revealed that current industry expectations are that these complications will not have a significant impact on the sale and availability of electric vehicles in Australia. They remain optimistic on sales for 2020/21 even as the trend for declining sales of petrol and diesel vehicles continues.

Economic recovery plans at all government levels should support zero emissions technologies, community infrastructure projects, and jobs in the green economy.

Stimulus measures to boost the economy for the electric vehicle industry include investment in charging infrastructure, manufacturing, fleet and consumer incentives, and future mobility solutions and services such as on-demand transport.



# Consumer attitudes

A recent survey carried out by the motoring clubs NRMA, RACV and RAA on behalf of the Electric Vehicle Council asked consumers about their views towards electric vehicle ownership and policies. The survey had 2,902 respondents from NSW, ACT, Victoria, and South Australia.<sup>6</sup>

## HIGHLIGHTS

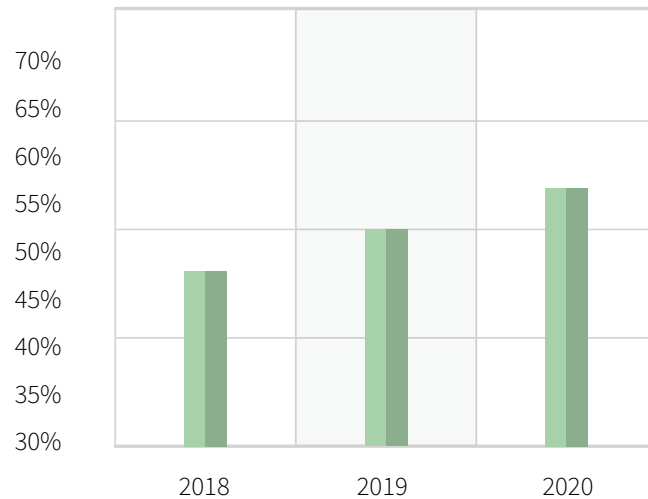
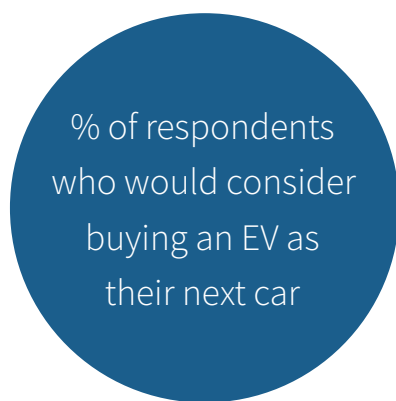
- + **56%** of surveyed consumers would now consider **purchasing an electric vehicle as their next car.**
- + Consumers are encouraged by electric vehicles' **lower environmental footprints, lower running and maintenance costs, and relative performance.**
- + Consumers are concerned about the **lack of accessibility to charging equipment, purchase cost, and uncertainty over driving range.**
- + Almost **80%** of consumers **underestimate electric vehicle range.**
- + Consumers rate **public fast charging** and **home charging** as equally important.
- + **Environmental benefits** are regarded as the main public benefit of transitioning to electric vehicles, but **fuel security** and **public health** benefits are also highly regarded.
- + Consumers want to see governments provide **public charging infrastructure, subsidies for home charging installation, and subsidies to reduce vehicle purchase costs.**
- + Almost **half** of consumers say they would power their electric vehicle using **renewable energy.**
- + Almost **two-thirds** of consumers say that the COVID-19 pandemic means governments should **continue prioritising electric vehicle policies at the same level or make them an even higher priority.**

<sup>6</sup> The survey was carried out in May/June 2020. The NRMA received 1,227 responses; RACV received 1,071; and RAA received 604 responses. In instances where not all respondents answered each question, this is indicated in footnotes.



## Consumer attitudes towards electric vehicle ownership

The majority of respondents (56%) in the survey would consider purchasing an electric vehicle as their next car purchase. This continues an upward trend from 48% in 2018 and 53% in 2019<sup>7,8</sup>.



The percentage of respondents who would not consider purchasing an electric vehicle dropped significantly from 45% in 2019 to 31% in 2020, while those unsure has increased from 2% to 13%. This suggests that outright consumer opposition to owning an electric vehicle is now significantly lower.

Respondents were also asked if COVID-19 had changed their view on owning an electric vehicle as their next vehicle.<sup>9</sup> 53% indicated that their view remains the same, with just over one-third of respondents (35%) noting they are not sure if COVID-19 has had an impact on their views on electric vehicle ownership, reflecting the uncertainty of the current environment.

### Factors that encourage electric vehicle purchases

Respondents were asked whether certain factors would encourage or discourage them from buying an electric vehicle.<sup>10</sup> The most common factors to encourage people to buy an electric vehicle are:

- + Environmental footprint
- + Running and maintenance costs
- + Electric vehicle performance

<sup>7</sup> Electric Vehicle Council and ClimateWorks (2018)

<sup>8</sup> Electric Vehicle Council (2019a)

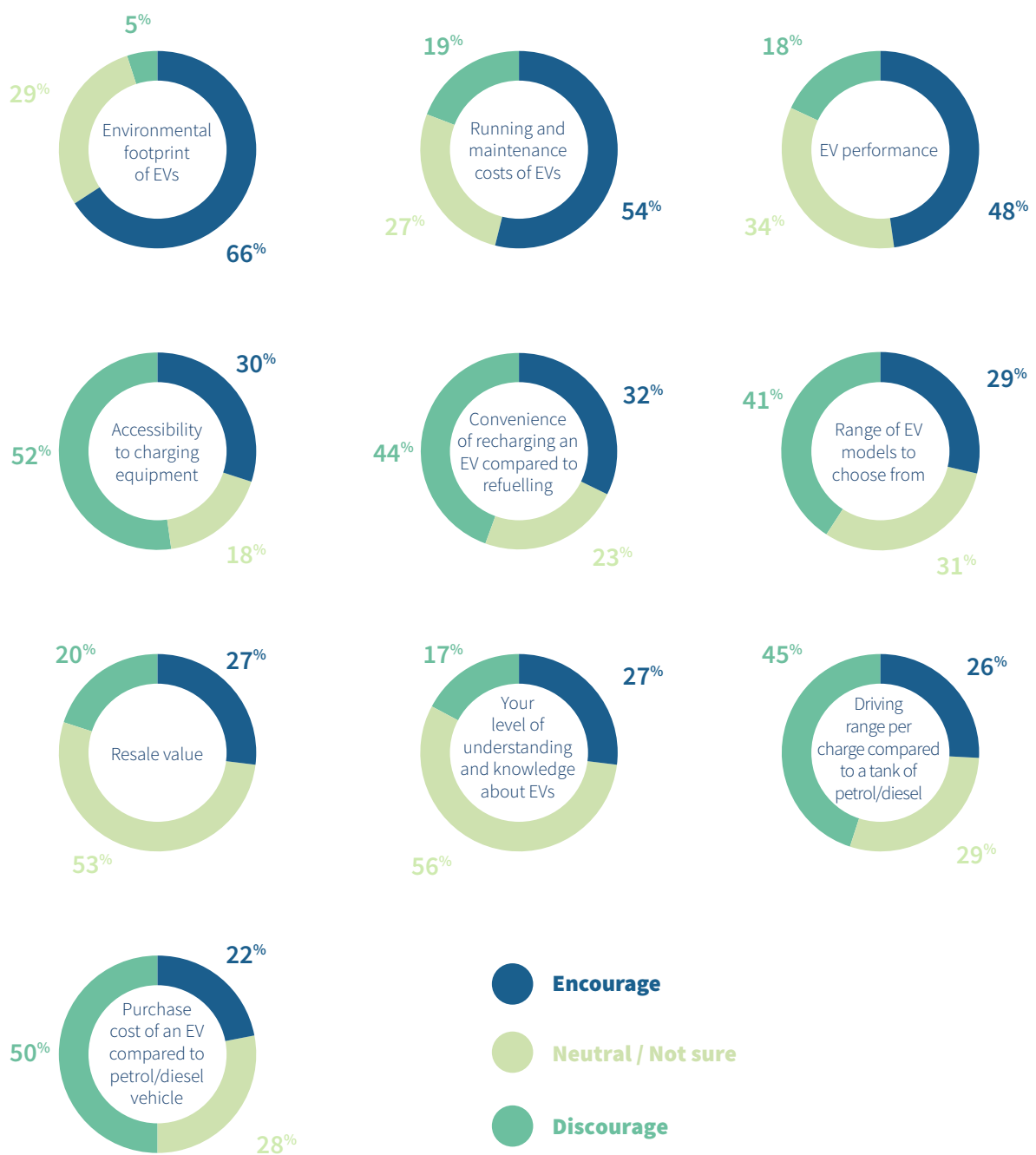
<sup>9</sup> 1,831 respondents from NRMA and RAA

<sup>10</sup> 1,831 respondents from NRMA and RAA

## Factors that discourage electric vehicle purchases

The most common factors to discourage the purchase of an electric vehicle are:

- + Accessibility to charging equipment
- + Purchase cost of an electric vehicle compared to a petrol or diesel vehicle
- + Driving range per charge compared to fuel tank
- + Convenience of recharging over refuelling



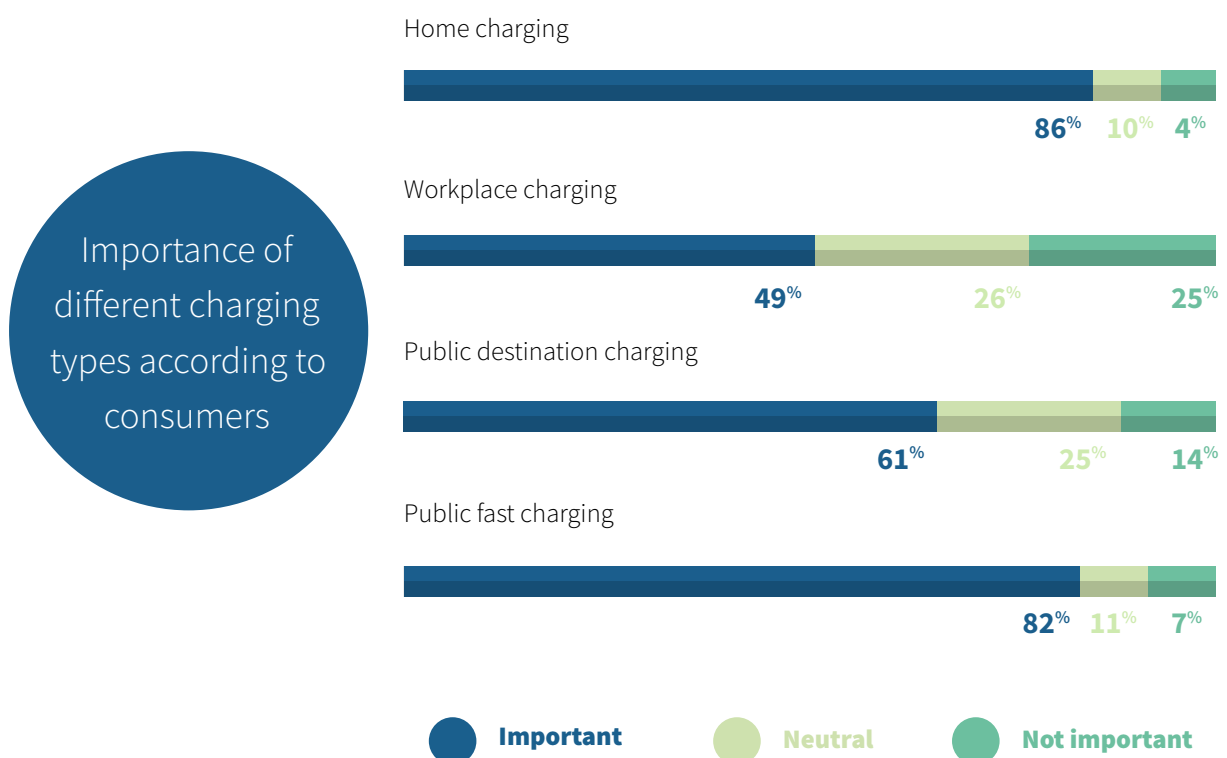
## Consumer attitudes towards charging

The survey results demonstrate a divergence in perceptions towards the ease and convenience of electric vehicle charging. While many respondents see accessibility (52%) and convenience (42%) of charging as common factors that discourage purchasing an electric vehicle, around one-third of respondents actually see these factors as encouraging. This highlights the importance of convenient access to charging infrastructure in consumers' attitudes towards electric vehicle purchases.

Respondents found all types of charging infrastructure to be very important. Home charging is regarded as the top priority – with 86% of respondents identifying it as important, while only 4% see it as unimportant.<sup>11</sup> A similar percentage of respondents (82%) regarded public fast charging as important.

Destination charging – where chargers are installed at hotels, restaurants, shopping centres and other venues – was regarded as important by 61% of respondents, an increase from 41% in 2019. Meanwhile 49% of respondents said workplace charging is important compared to 38% in 2019.

The increased importance attributed to all types of charging compared with last year demonstrates a growing consumer appetite and need for adequate charging infrastructure. As outlined later in this chapter, consumers see the provision of public charging infrastructure one of the top priorities for governments when it comes to electric vehicle policies.



## Consumer anxiety over driving range

Concern regarding electric vehicle range is a well-known barrier to electric vehicle purchases. 45% of respondents in 2020 said this is a factor that discourages them from buying an electric vehicle.

This year, the Electric Vehicle Council tested whether public concerns around range matched the actual range provided by battery electric vehicles. Respondents were asked how far they expected battery electric vehicles to drive per charge.

Seventy-nine per cent of respondents indicated a range of less than 400km per charge.<sup>12</sup>

Consumer perceptions of EV driving range vs average vehicle range

79% say *less* than 400km

AVERAGE EV RANGE

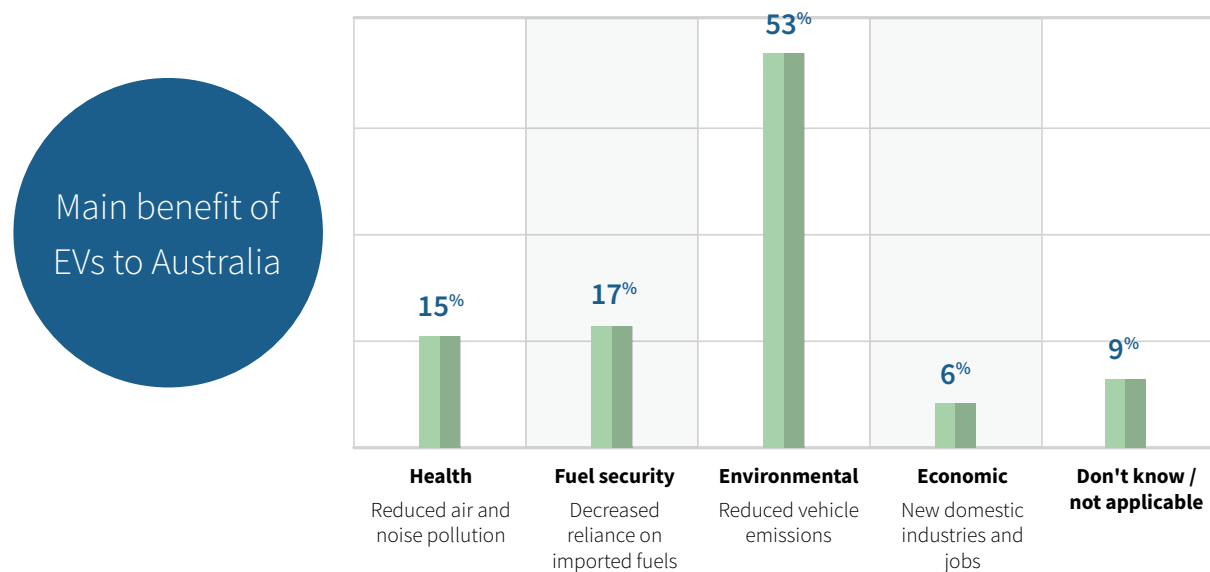
400KM

21% say *more* than 400km

The range of passenger vehicles currently available in the Australian market averages around 400km per charge (varying from 260km to 650km).<sup>13</sup> This means that almost 80% of people underestimate the range of electric vehicles currently available. This is a clear example of how a lack of consumer awareness can exacerbate barriers and suppress enthusiasm for electric vehicles.

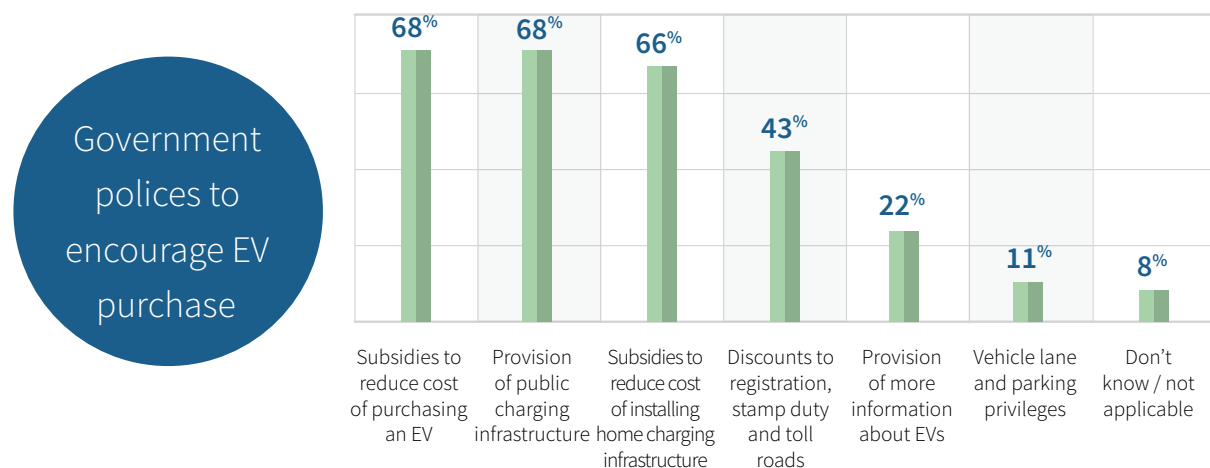
### Public Benefits of electric vehicles

Respondents were asked what they saw as the main public benefit of Australia transitioning to electric vehicles. Environmental benefits were clearly the most common response, while improved fuel security and health benefits were also relatively popular. This is consistent with the 2019 survey results.



### Priority government policies to encourage electric vehicles

Respondents overwhelmingly support government policies to provide public charging infrastructure, reduce the cost of electric vehicles, and reduce the cost of installing home charging. These three policies have been consistently identified by respondents as the top three priorities since 2018.



13

This calculation was based off standard ranges for each battery electric vehicle model currently available in Australia. See Appendix 2 for more information on vehicle ranges.

When asked if the COVID-19 pandemic should impact government policy supporting electric vehicles, 38% of respondents said government prioritisation of electric vehicles should remain the same, but almost a quarter (23%) thought electric vehicle policies should become a higher priority because of COVID-19.<sup>14</sup> Only 11% thought they should be a lower priority while 28% were not sure. The reasons cited behind the need for electric vehicles to become a higher policy priority include:

- + Accelerating emissions and pollution reduction – many respondents noted the air quality and noise benefits from reduced vehicle use during lockdown periods and want governments to replicate those benefits by prioritising electric vehicle policies.
- + Increasing fuel security – respondents noted the increased potential for disruption to global oil supply chain impacts from the COVID-19 pandemic, noting Australia’s heavy reliance on imported fuels. Electric vehicles would help reduce this reliance and protect Australia from such disruption.
- + Stimulating economic activity – many respondents identified that current economic conditions provide an opportunity for Australia to use its mineral endowment and skillsets to grow jobs in the electric vehicle sector.

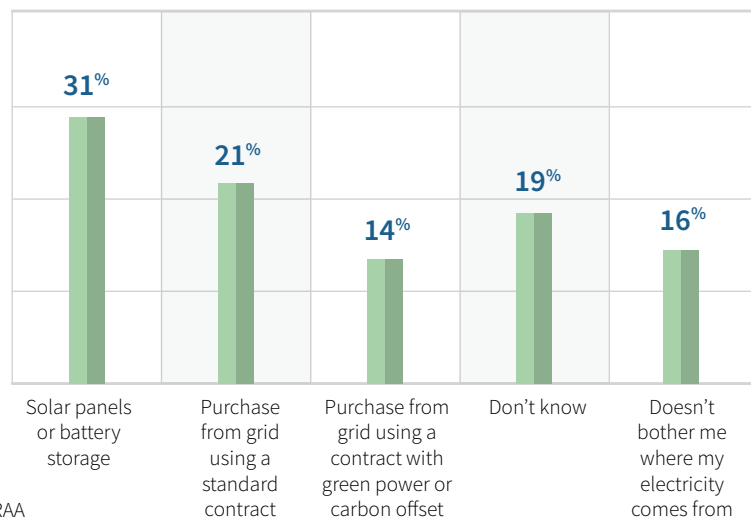
■ COVID-19 has highlighted the importance of caring for people and our environment. It has also shown the benefits of reduced pollution from petrol/diesel cars on the road, prompting a rethink for all. EVs will allow us to utilise renewable energy generated in Australia to power vehicles, while decreasing reliance on imported fossil fuels and reducing carbon emissions. A win on all counts.”  
*Survey respondent, 2020.*

■ Australia’s expertise in renewable technologies and access to the raw materials for renewable technology and batteries mean we could develop the processing and manufacturing capabilities here. That would support an enormous nationwide industry of new jobs, services and environmental benefits.”  
*Survey respondent, 2020.*

### Source of electricity

Almost half (45%) of respondents say they would charge their electric vehicle using renewable energy – either via rooftop solar panels and household battery (31%) or via an electricity contract which utilises green power or carbon offset (14%). This relatively high figure is consistent with respondents’ prioritisation of the environmental benefits of electric vehicles.

Intended source of electricity for EV charging



## CASE STUDY

# Infinity Cove: building now for the electrified future

In 2019, Sydney-based property developer Urbancom unveiled Infinity Cove, their new development in Sydney's Lane Cove. Many developers have been quick to harness the benefits of solar power and smart home automation but for Infinity Cove, Urbancom took a step further; the building's carpark features electric vehicle chargers for apartment owners.



As part of the design for *Infinity Cove*, Urbancom included the option for an electric vehicle charger for each of the 97 apartments.

Surprisingly, and despite residents not owning electric vehicles, 40 buyers embraced the upgrade - many saw it as a way to futureproof their investment.

For those who opted out, *Infinity Cove* has been constructed as 'EV ready', meaning in the future residents can install an electric vehicle charger at low cost and low hassle. The car park has the electrical capacity, electric vehicle charging distribution boards, and a smart charging system to make installing an electric vehicle charger easy and affordable for the remaining 57 car spots.

To make this happen, Urbancom partnered with EVSE Australia, an electric vehicle charging infrastructure provider. Together, they worked closely with engineers and site electricians to ensure the electrical infrastructure of the building can support existing and future charging needs.





For Urbancom and EVSE, the goal was to make the process as simple as possible for residents.

**“You come home, you plug your car in, and you go about your business,”** says Sam Korkees,

co-founder of EVSE. Each charger is directly linked to the apartment’s electricity meter allowing a straight-forward billing process.

Given that upwards of 80% of charging tends to occur at home, owning an apartment with simple and easy charging will become increasingly valuable as electric vehicle uptake increases across Australia.

Developers who ignore the global electric transport trend could be subjecting future residents to red tape whenever they attempt to get charger installation approved via strata, body corporate or landlords.

By making *Infinity Cove* ‘EV ready’, Urbancom has added value to their development, and avoided costly and complicated infrastructure upgrades for the future.

**“Future-proofing is paramount to our brand. I don’t only want to have a positive impact on the environment, I also want to improve the living experiences of our residents,”** says George Daoud, Urbancom’s managing director.

*Infinity Cove* provides a great example of the future of sustainable housing and the benefits of adopting an EV-ready mindset. As the number of electric vehicles increases in Australia, developers like Urbancom will continue to enlist suppliers, such as EVSE, to provide living spaces that are ready for the future of transport.

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# Chapter 2: Australia's EV industry

## Passenger vehicles

### Electric vehicle model availability

The commitment to electrification continues to be the trend for carmakers globally. Investment in electric vehicle research and development, the introduction of new models, new partnerships between carmakers, investment in vehicle manufacturing plants, and contracts with battery manufacturers are all strong indicators that the industry is shifting towards electric road transport.

See Appendix 1 for a breakdown of carmakers' global electrification plans.

Australians now have access to 28 electric vehicle models from 11 different carmakers. This is significantly fewer than other comparable markets, including other right hand drive markets. For example, consumers in the United Kingdom have 130 electric vehicles to choose from.<sup>15</sup>

Nonetheless, there are now seven more electric vehicle models available for purchase in Australia than there were in 2019. Of the 28 models available, 12 are battery electric vehicles and 16 are plug-in hybrid vehicles. Eight of these vehicles are priced under \$65,000. SUVs are the most common vehicle segment, with 12 electric SUVs available.

By the end of 2021, we expect to see six new electric vehicles on the road – five of these will be battery electric vehicles, and one plug in hybrid. Two of these will be under \$50,000. See Appendix 2 for a full list of electric vehicles available in Australia.

Australia's limited model availability is restricted by an unsupportive policy environment with no fuel efficiency standards or national electric vehicle policy.

### Carmakers views on bringing electric vehicles to Australia

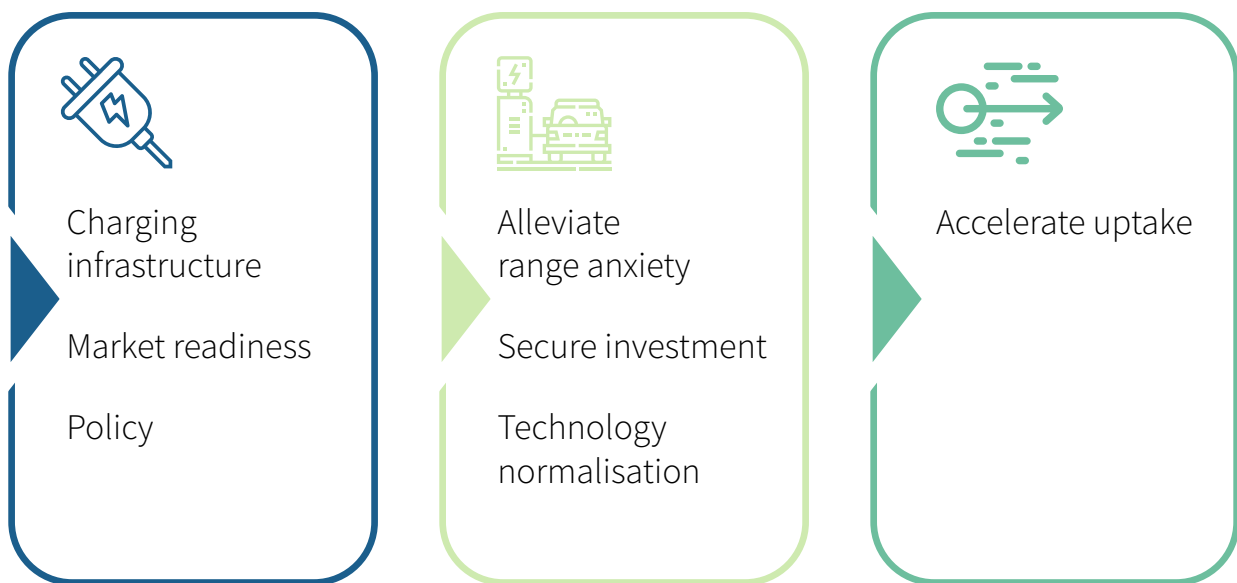
The Electric Vehicle Council surveyed our members about electric vehicle allocation to Australia. These members included the Australian offices of Audi, BMW, Harley Davidson, Hyundai, Jaguar Land Rover, Mercedes-Benz, Mitsubishi, Nissan, Porsche, Renault, Tesla, and Volkswagen.

Global production of electric vehicles is expanding but is still relatively limited due to the nascent nature of the industry and its supply chain. With a limited number of electric vehicles in production, Australian offices must compete against other national offices to convince global executives to allocate vehicles to the Australian market.

The three main factors that global offices consider when allocating vehicles to a market are:

- + Government electric vehicle policy
- + Market readiness
- + Charging infrastructure

These factors are interrelated.



### Government policy

The Electric Vehicle Council's survey of carmakers demonstrated broad agreement that the lack of a federal government electric vehicle policy in Australia is restricting the supply of electric vehicles to our shores. Unsurprisingly, vehicles are instead allocated to markets with supportive policy signals for the sale of low or zero-emission vehicles.

Carmakers say that the policies that most influence electric vehicle allocation are fuel efficiency standards, consumer incentives and electric vehicle sales targets. These measures have encouraged the sale of electric vehicles across Europe, China, the United States, New Zealand, and Canada.<sup>16</sup>


Since 2005, transport emissions in Australia have increased more than 60%. Passenger vehicles accounted for 43% of this increase,<sup>17</sup> making vehicles a key contributor to our increasing carbon emissions. In 2018, the average carbon dioxide emissions intensity for new passenger and light commercial vehicles sold in Australia was 180.9g/km, 45% higher than in Europe. In 2019, that figure failed to improve, holding steady at 180.5g/km.<sup>18</sup>

<sup>16</sup> International Energy Agency (2019)

<sup>17</sup> ClimateWorks Australia (2020)

<sup>18</sup> National Transport Commission (2020)

BloombergNEF recently forecast that 28% of global passenger vehicle sales will be electric by 2030. Sales in China and Europe will make up 72% of those electric vehicle sales, a figure driven by European CO2 regulations and China's electric vehicle credit system, fuel economy regulations, and city policies restricting new internal combustion vehicle sales.<sup>19</sup>



Automakers focus their passenger EV efforts on the markets with the most stringent regulations for the next ten years, leading to low rates of EV adoption in the Rest of the World Category.

BloombergNEF<sup>20</sup>

While some state and territory governments in Australia have included electric vehicles in recent emissions reduction targets or net zero emissions strategies, the lack of a federal policy and overarching framework to support the industry in Australia is viewed by global carmakers as a signal that the Australian market is not yet ready for electric vehicles.

### Market readiness

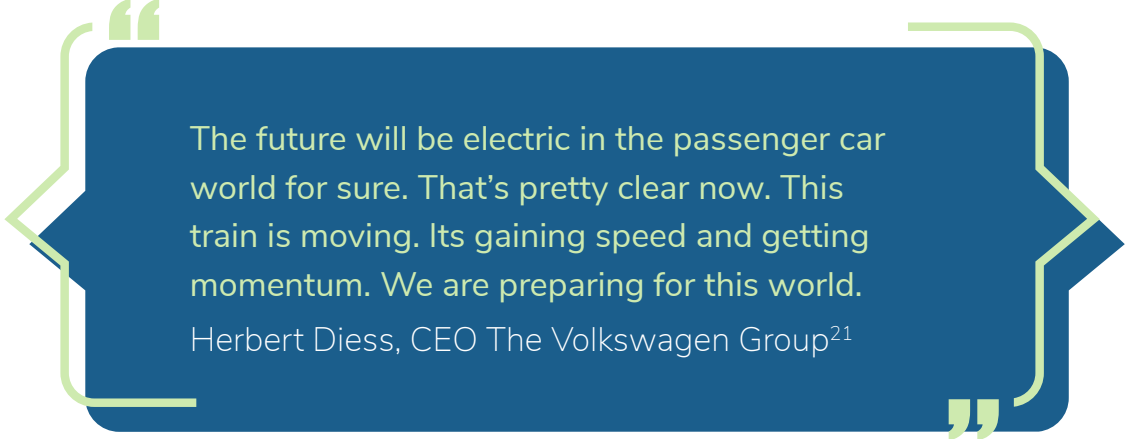
Market readiness is a measurement to determine how prepared consumers are for a new product. In allocating electric vehicles to Australia, carmakers weigh the appetite for electric vehicles of Australian consumers, to ensure supply does not outstrip demand.

Information gathered by the Electric Vehicle Council from carmakers highlighted the need for greater signals of market readiness in Australia.

One critical step is to educate consumers – including private vehicle owners, fleet managers, dealers, and car financiers – on the total cost of ownership of electric vehicles. This cost is generally lower than for petrol and diesel vehicles due to fuel and maintenance savings.

19 BloombergNEF (2020)  
20 BloombergNEF (2020)

In particular, the manner and degree of public discussion and political discourse regarding electric vehicles and their associated technologies was also highlighted by carmakers as important to familiarising and normalising this new technology.



The future will be electric in the passenger car world for sure. That's pretty clear now. This train is moving. Its gaining speed and getting momentum. We are preparing for this world.

Herbert Diess, CEO The Volkswagen Group<sup>21</sup>

### Charging infrastructure

Markets that have charging infrastructure to support electric vehicle uptake are, of course, favoured when it comes to carmakers allocating electric vehicles to particular markets. While market sentiment is important, investment in charging infrastructure is also required to demonstrate that a country is physically ready for electric vehicles.

Carmakers view Australia's charging infrastructure as reasonably robust. As outlined in Chapter 3, there has been significant investment in public charging from the private sector, some state governments, and the Federal Government through the Australian Renewable Energy Agency.

However, given the importance that consumers place on charging infrastructure availability and given that the number of chargers will need to grow alongside electric vehicle uptake, it is imperative that private and public investment in infrastructure continues to grow.

### Electric Vehicle Vision

Given the evolution of the automotive sector towards low and zero emissions technologies, electric vehicles are set to take on greater importance in carmakers' business plans, especially as they become more affordable and demand increases.

When asked about the future of electric vehicles in Australia, carmakers agreed:

- + There will be an ever-increasing number of electric vehicles in Australia
- + Consumers will have a greater choice of electric vehicle models
- + Australia is part of carmakers' global electrification strategies, targets, and business plans
- + Carmakers are committing to carbon neutral manufacturing
- + Government policies will determine the rate at which electric vehicles are allocated to Australia

21 BloombergNEF (2020)  
22 Electrek (2020)

## Bikes and Scooters



### Electric bicycles

The number of electric bicycle models in Australia has tripled over the last three years and is the leading growth segment in the bicycle market. There are currently more than 50 brands offering a range of e-bike models.<sup>23</sup>

Electric bicycle sales have been growing steadily in Australia with a particularly large spike in the last six months.<sup>24</sup> Bicycle retailer Bicyclesonline saw e-bike sales rise 310% in May 2020.<sup>25</sup> The recent increase is likely due to commuters seeking alternative forms of transport due to COVID-19 and the increased demand for delivery drivers during restaurant and café lockdowns.<sup>26</sup>

Meanwhile councils in Sydney<sup>27</sup>, Melbourne<sup>28</sup> and Brisbane<sup>29</sup> are installing pop up bike tracks to support the increased use of bicycles.<sup>30</sup>



### Scooters and three wheelers

There are a number of suppliers of electric scooters in Australia, including Bzooma, Vmoto and Fonzarelli. Fonzarelli have so far sold 800 electric scooters in Australia.<sup>31</sup> In the first quarter of 2020, Vmoto sold 380 electric scooters .

Fleet operators are additionally turning to electric scooters for last mile delivery services. Australia Post currently operates fleet of 1,000 Kyburz electric three-wheelers, with another 1,000 on order for delivery in early 2021.



### Motorbikes

A gradual shift towards electrification is also occurring in the motorcycle industry. This year Harley-Davidson launched the Livewire, its first fully electric motorcycle.

The electromobility trend has also given rise to a domestic e-motorbike manufacturing industry, with Australian-based Fonzarelli and Savic each bringing an electric motorbike to market in 2020. Further information on domestic manufacturing is provided in Chapter 4.

23 The Guardian (2019)  
 24 Sydney Morning Herald (2020)  
 25 Channel News (2020)  
 26 Sydney Morning Herald (2020)  
 27 Transport for NSW (2020)  
 28 City of Melbourne (2020)  
 29 Bicycle Network (2020a)  
 30 Bicycle Network (2020b)  
 31 Motorbike Writer (2019)

## Commercial electric vehicles and buses

While the number of electric trucks, vans and buses is increasing in Australia, there remains significant opportunities to increase the rate of uptake.

The Electric Vehicle Council surveyed the sentiment of commercial vehicle manufacturers regarding the Australian market. Several unique challenges were identified.

Australian Design Rules (ADRs) were identified as a key barrier to uptake of commercial trucks and buses as they restrict the ability to easily import vehicle models that are readily available in other markets.

ADRs are national standards for vehicle safety - they promote the safe sale and import of vehicles. It has been noted however, that Australian standards are often not in line with those of international markets, meaning vehicles need to be customised before they are legally roadworthy in Australia.

When a vehicle model is non-compliant with ADRs, the application and financing for customisation and import costs and time to deployment. Electric vehicles are designed differently to hold the battery pack, and ADRs should recognise this without disadvantaging electric vehicles because of domestic design limitations.

Australia's Heavy Vehicle National Law also limits electric truck and bus use. The regulated Gross Vehicle Mass (GVM) limits do not accommodate for the additional weight of the battery when considering vehicle payload, reducing the amount of cargo or passengers a heavy electric vehicle is permitted to carry. As a result, operating electric trucks and buses in Australia is more complex and expensive, meaning fewer electric trucks and buses are used on our roads.

The Electric Vehicle Council continues to work with governments to encourage a supportive regulatory environment for commercial electric vehicles and buses. The Electric Vehicle Council recommends:

- + Reviews of the Australian Design Rules and Heavy Vehicle National Law to ensure alignment with international standards with respect to electric vehicles.
- + Exceptions for GVM payloads of electric trucks and buses to increase the availability of compliant imports.
- + Exempting electric vehicles from heavy vehicle road curfews given they cause significantly less noise pollution than combustion engine counterparts.
- + Increasing GVM limits for drivers of electric vehicles. Typically, a car license permits a driver to carry a load of 4.5 tonne, however, the weight of an electric battery means drivers may need to apply for a light rigid license despite the actual payload being the same.





### Commercial electric vehicles

Commercial vehicles include light commercial vans, light and medium duty trucks, waste management service vehicles, mining and utility vehicles and customised and specialised vehicles. Internationally, this segment is growing steadily. That uptake includes the fleets of global companies such as Amazon, British Gas, IKEA, FedEx, DHL, and UPS.

Organisational sustainability mandates will play an important role in driving the transition to electric vehicles in the coming years.

The opportunity for transition of light to medium duty electric trucks and electric vans presents a significant opportunity for commercial fleets to reduce their carbon emissions given that 84% of all freight vehicles are light commercial vehicles.<sup>32</sup> In 2019, freight vehicles contributed 38% of Australia's transport emissions.<sup>33</sup>

There are a limited number of electric commercial vehicles available in Australia. In the light commercial van segment, the Renault Kangoo is available.

In the heavy and specialised vehicle segment, SEA Electric – a Victorian manufacturer that converts existing drivetrains – is the only supplier in Australia. They have sold 105 vehicles to date, primarily to councils, refuse management services and last mile delivery services.

The total market in Australia is approximately 20,000 vehicles per year – based on light, medium and suitable heavy vehicles. With the normalisation of on-line shopping as a consequence of COVID-19 lockdowns, we expect that that the light duty segment will grow in size. Our vision is to capture 10% of this market, or 2,000 trucks per year.

Glen Walker, Regional Director Oceania, SEA Electric<sup>34</sup>

32 Australian Bureau of Statistics (2020)

33 ClimateWorks Australia (2020)

34 Electric Vehicle Council Member Survey (2020)

However, the three major commercial vehicle suppliers to Australia – Hino, Fuso, and Isuzu – have indicated their intention to bring more electric models to market.

- + Hino has plans to supply Hino Kits for assembly by SEA Electric in Q3, 2020<sup>35</sup>
- + Isuzu Australia Limited and SEA Electric ran a pilot program in 2018 to test the viability of electric trucks in Australia.<sup>36</sup>
- + Daimler trucks and Fuso are providing fleet customers with eCanter trials to examine potential for mass market adoption.<sup>37</sup>

We can expect to see more electric utility vans and trucks from new manufacturers in the coming years with suggestions that Rivian is considering Australia as a launch market.<sup>38</sup> The Tesla Cybertruck is now available to order online. Additionally, a deal struck by BYD, Nexport and Macquarie will see the roll out of BYD's electric commercial vehicle line in Australia and New Zealand in 2021.<sup>39</sup>

There is also movement in the mining sector towards electric vehicles. Replacing heavy mining vehicles and lighter utility vehicles with electric alternatives offers significant benefits to the workers and operators of underground and open-pit mines.

Like all electric vehicles, electric mining vehicles provide a quieter and smoother ride, with higher torque and less heat than conventional vehicles. With the temperature extremes, tight turns and heavy loads of mining work, these advantages are particularly valuable. The steep inclines of mines also increase the effectiveness of regenerative braking in charging the vehicles while they are on the move. There are also direct productivity advantages in underground mining as electric vehicles do not count towards restrictions on the number of diesel vehicles which are required to ensure sufficient ventilation. This allows operators to have more vehicles working in the same shaft without increasing risks to workers.

Demand for zero emissions vehicles in the mining sector has additionally seen the emergence of vehicle conversions from GB Auto, Conquest Equipment and Zero Automotive.

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35 Truck & bus news (2020)  
36 Go Auto News Premium (2018)  
37 Diesel News (2020)  
38 The Driven (2019a)  
39 Go Auto News Premium (2020)

### CURRENT EXAMPLES OF COMMERCIAL ELECTRIC VEHICLES

Australia Post	In 2019, Australia Post was the first Australian company to trial Fuso's eCanter. Its powertrain is developed by parent company Daimler. <sup>40</sup>
IKEA through distributors: ANC, KINGS transport and All Purpose (distributors)	IKEA's global commitment to fully electric vehicle delivery fleets by 2025 has required their Australian distributors to procure electric vehicles for their deliveries.
Salvation Army	SEA Electric donated a truck to Salvation Army, making Salvos Stores the first charity retailer in Australia to have an electric vehicle in its distribution fleet.
Woolworths	Using electric trucks for online delivery and secondary freight. <sup>41,42</sup>
City of Casey, Victoria via VM Water Management Services	Using 3 SEA Electric garbage trucks.
Metropolitan Adelaide Councils via East Waste	Using 1 SEA Electric kerbside garbage truck.
Fremantle, Western Australia and Hobson's Bay, Victoria via Cleanaway	Using SEA Electric garbage trucks.
Sendle via Bonds Courier	20 vehicle fleet of Renault Kangoo ZEs, with plans for further fleet expansion. <sup>43</sup>
ACT Government & Rosenbauer	Agreed to develop a plug-in hybrid electric fire truck for trial in Canberra. <sup>44</sup>

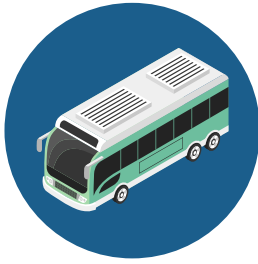
40 The Driven (2019b)

41 Australian Financial Review (2019)

42 The Woolworths Group (2019)

43 ACT Government (2019)

44 The Driven (2019c)



## Electric buses

Electric buses present a significant opportunity for Australian transit operators to reduce vehicle emissions, noise pollution, and running costs. There are currently 100,473 buses operating in the public and private sectors with bus trips accounting for 5% of public transport journeys.<sup>45, 46</sup>

Approximately 1,300 new heavy buses are registered each year in Australia, usually on a one-for-one replacement basis as an older bus reaches the end of its service life. Current regulation stipulates replacement buses must be of Euro 5 standard, with the introduction of Euro 6 standards tipped for 2027.<sup>47</sup>

Given that new buses can be in service for up to 25 years, continuing to rely on diesel engines locks in higher emissions for decades despite electric bus technology already being available to the Australian market.

The time for electric buses has already arrived, there are more than 400,000 in operation including in Barcelona,<sup>48</sup> Bogota,<sup>49</sup> London,<sup>50</sup> Los Angeles,<sup>51</sup> Santiago,<sup>52</sup> and Shenzhen.<sup>53</sup>

There are currently a number of trials underway by both public and private operators to test the feasibility of electric buses. Electric bus model availability is increasing in Australia, with suppliers including BYD, Carbridge, Gemilang, Precision Buses, Volgren, and Yutong.

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45 Australian Bureau of Statistics (2020)  
46 Infrastructure Australia (2019)  
47 Scania (2019)  
48 Sustainable Bus (2020)  
49 Intelligent Transport (2019a)  
50 Intelligent Transport (2019b)  
51 Electrive (2019b)  
52 CleanTechnica (2020)  
53 The Guardian (2018)

### GOVERNMENT TRIALS AND COMMITMENTS

GOVT	OPERATOR	BUS	DESCRIPTION
VIC	Transdev	Volgren-BYD	Electric bus trial on route 246 until 2021. Bus is based at Transdev's North Fitzroy depot.
NSW	Premier Transport Group	Yutong - ABC Bus Sales	Electric bus trial for six months on NSW South Coast between Bombaderry Rail and Kiama Station.
	Transit Systems	Gemilang-BYD	Electric bus trial on routes 431, 433, 447 and 470. Buses are based at Leichardt depot.
	The NSW Government completed an EOI for further electric bus trials in May 2020 as part of their commitment to transition its 8,000 buses.		
ACT	Transport Canberra	Carbridge Toro Battery Electric	Electric bus trial completed in 2019.
	Transit Systems	Yutong	Electric bus trial for 1 year until November 2020. Bus is based at Tuggeranong depot.
	The ACT Government has committed to 100% electric buses by 2040.		
Brisbane City Council	Brisbane Metro	HESS AG, Volgren, and ABB	The new Brisbane Metro project will deploy 60 trackless electric buses across two routes.
WA	Transperth	Volvo	Four Volvo electric buses will be delivered in 2021 as part of the existing 900 Bus Supply Agreement between Volvo and Transperth.

### PRIVATE SECTOR USES CASES, TRIALS, AND COMMITMENTS

OPERATOR	BUS	DESCRIPTION
Lendlease & Logan Coaches	Yutong	40 seat electric bus for Yarrabilba residents in Queensland since 2019.
Adelaide Airport & Skybus	Precision Buses	Commitment to electric buses and expected fleet commencing by 2021. <sup>54</sup>
Sydney Airport & Carbridge	BYD-TORO	Used by the Airport since 2017.
Brisbane Airport Corporation	Carbridge	11 electric buses and a \$3 million investment in dedicated electric bus facility. <sup>55</sup>

### TRIALS INTO ELECTRIC AND AUTOMATED SHUTTLE BUSES

RAC WA Intellibus	Electric and automated shuttle bus operating around WA. <sup>56</sup>
RACQ, Redland City Council	Fully electric Easymile smart shuttle trial on Karragarra island. <sup>57</sup>
Sydney Olympic park, NSW Government	Automated precinct shuttle trial with a Naveya bus. <sup>58</sup>
Curtin University shuttle	First Australian University to trial automated bus. <sup>59</sup>

54 Adelaide Airport (2020)  
 55 Brisbane Airport Australia (2019)  
 56 RAC WA (2019)  
 57 Brisbane Times (2019)  
 58 Transport for NSW (2019)  
 59 Curtin University (2017)

## CASE STUDY

# East Waste makes haste, leading the way on electric garbage

This year, East Waste rolled out their first electric garbage truck to manage kerbside waste collection in seven metropolitan Adelaide councils. The electric truck replaced a diesel vehicle and is expected to remove 62 tonnes of carbon dioxide from our streets annually – the equivalent of cars.

The vehicle was supplied through Superior Pak with electric drivetrain technology from SEA Electric.

Being a first mover had its challenges – including a lack of Australian-based data, local case studies, and model availability. To make the case for electrification, the vehicle had to stack up and operate as a standalone vehicle.

**“We conservatively project that our new electric vehicle will save more than \$220,000 over the seven-year life of its diesel predecessor,”** says Rob Gregory, East Waste General Manager. **“Even with the extra \$150,000 purchase price, that is a \$70,000 saving.”**

Those savings are thanks to reduced maintenance and fuel costs. Charging overnight and off peak at the depot also means East Waste saves on electricity costs. To offset the electricity used from recharging at night and to create a ‘green’ loop, they installed a solar panel system to power the site during the day.

The bright white garbage truck is easily identifiable and drivers have reported lots of positive feedback from residents.

**“With reduced air pollution comes the removal of noise pollution as the truck travels from house to house on bin collection day. It is almost silent.”** says Rob.

The vehicle has required a bit of getting used to for drivers who are used to driving by sound and feel, but the quiet and smooth ride has made the adjustment worth it.

Early adoption means that East Waste and others in the industry will have an intimate understanding of what is needed from an electric garbage truck as the electric revolution continues to expand to the garbage bins near you.



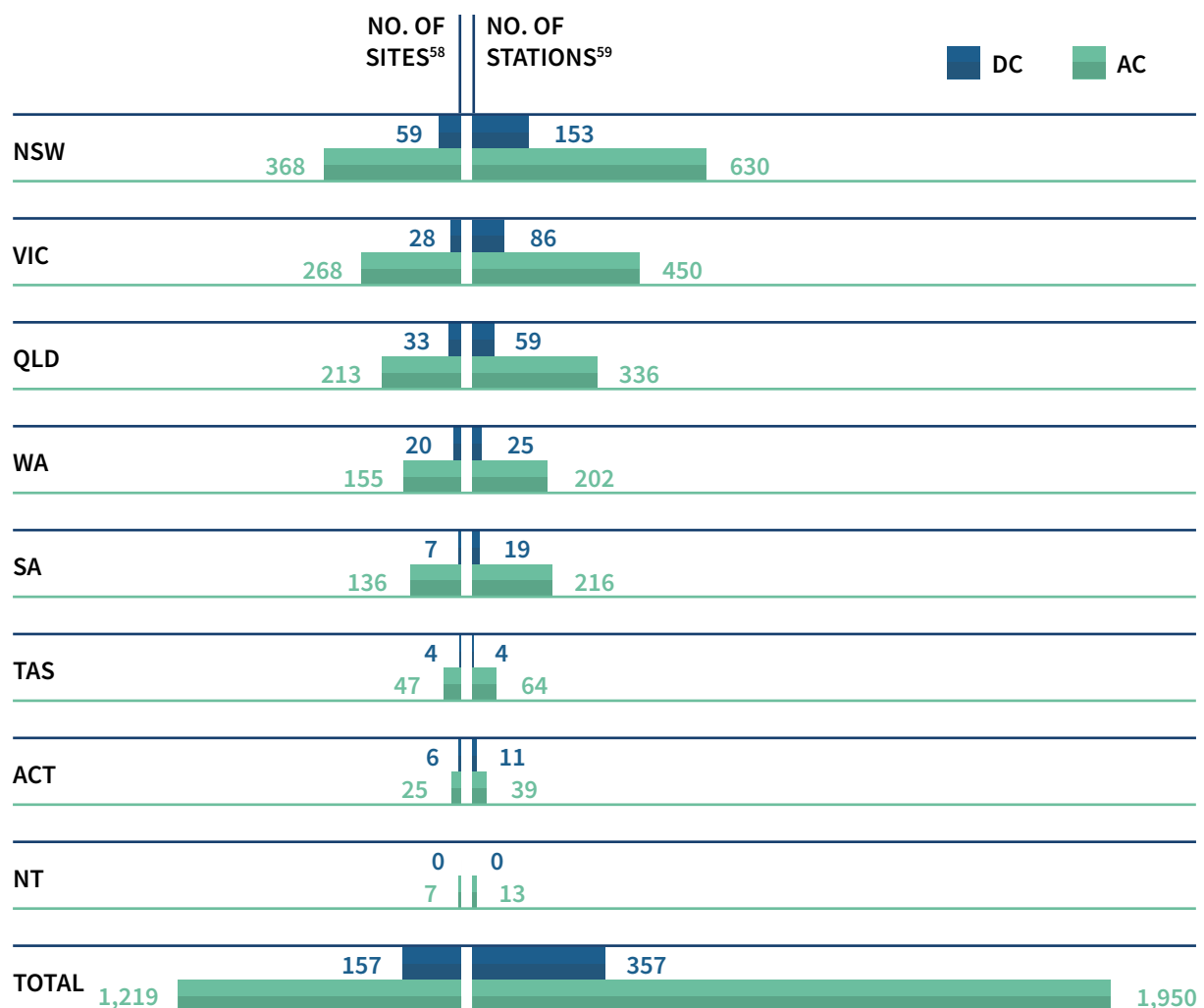




# Chapter 3: Charging infrastructure

## Public electric vehicle charging in Australia

The last 12 months saw continued investment in public charging infrastructure across Australia, with the number of charging stations growing by 40% since July 2019.<sup>60</sup>



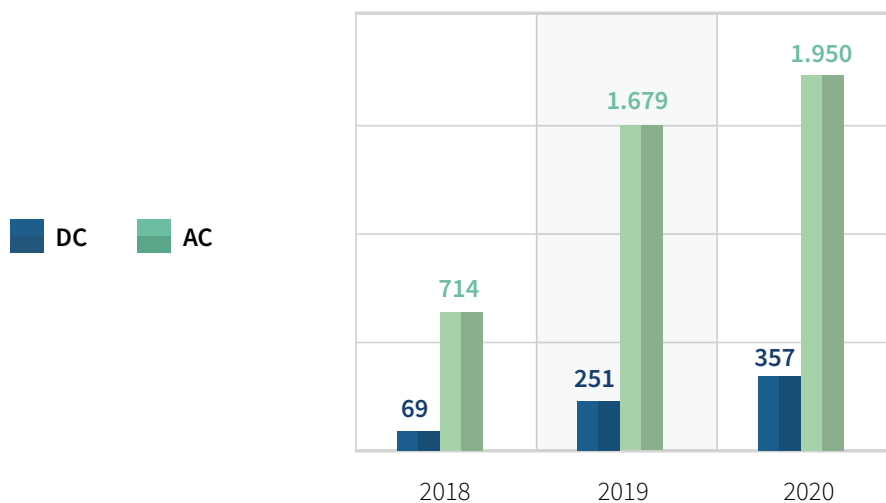
<sup>60</sup> Electric Vehicle Council (2019a)

<sup>61</sup> No. of sites – indicates the number of locations that have charging infrastructure installed

<sup>62</sup> No. of stations – indicates the total number of charging stations installed across all sites

There are now over 350 fast and ultra-fast charging stations (50kW and over) at over 150 locations across Australia. This represents a 42% increase in the number of fast charging stations since July 2019.

There are also almost 2,000 standard charging stations (less than 50kW) at over 1,200 locations. This represents a 16% increase in the number of charging stations since July 2019.



Public charging infrastructure is needed along major highways, in urban centres and at popular destinations. While the majority of charging tends to occur at home, for Australians without off-street parking, home charging can sometimes be inconvenient or impossible. Public charging infrastructure is therefore not only a matter of convenience but often critical to allowing for the continued uptake of electric vehicles.

Public charging infrastructure also helps to address consumer concerns about running out of power, a concern known colloquially as “range anxiety”. In our survey of consumers, discussed in Chapter 1, a majority of respondents (52%) cited insufficient access to charging equipment is discouraging them from buying an electric vehicle. This result is in line with global research. In a global McKinsey survey from 2016, consumers ranked insufficient access to charging stations as the third most serious barrier to buying an electric vehicle, behind price and driving range.<sup>63</sup>

Our survey further confirmed the vital importance of fast public charging, with 82% of surveyed consumers rating fast public charging infrastructure as either important or very important. In addition, when asked about government policies to encourage electric vehicle adoption, over two-thirds of consumers saw the provision of public charging as a priority.

## Fast charging networks

There is significant private sector investment already underway in public charging infrastructure in Australia, with 367 fast and ultrafast charging stations at 157 locations now installed across Australia and many more planned. The majority of these are being installed at places of interest by property owners and managers, however there are also several fast and ultra-fast public charging networks currently being rolled out across the nation.

Infrastructure Australia has included the rollout of a national electric vehicle fast charging network as a High Priority Initiative in its 2020 Infrastructure Priority List.

AUSTRALIAN FAST CHARGING NETWORKS	
Chargefox	Building 22 ultra-rapid charging sites across Australia, with 16 already operational and planning underway for the next phase of the network.
Evie Networks	Building 42 ultra-fast highway charging sites across Australia, with 5 already operational. Hundreds more are planned.
NRMA	Installed more than 39 DC chargers across NSW, with 20 more currently planned.
QLD Electric Super Highway	18 DC charging sites now available across QLD with an additional 13 sites now planned.
RAC Electric Highway	Built 11 DC chargers across WA.
Tesla	Installed 36 super charger sites across Australia.

## Barriers to fast charging infrastructure

The rollout of public fast charging infrastructure in Australia is being funded by both industry and government. There is a strong case for governments to continue providing co-funding for public fast charging infrastructure due to the inherent 'chicken and egg' dilemma between public fast charging infrastructure and electric vehicle uptake.

Government funding has so far been typically directed towards the capital costs of setting up this infrastructure. However, electricity supply costs are proving to be high and difficult to recover due to distribution network charges, especially at low levels of customer utilisation but even at the projected higher utilisation levels over time.

## Energy costs

The main contributor to high energy costs are the large commercial customer peak demand charges or the network capacity charges that are typically assigned to these public fast charging sites by default.

Ultrafast public chargers have the potential to draw a significant amount of power from the electricity network at a single point in time. However, because this draw of power is generally brief – unlike, for example, a factory with continuous machinery – and may occur outside of times when there is a critical peak in demand on the network, it is a unique type of mobile load profile. This means that the costs of ultrafast public charging to the electricity network may be overstated and therefore over-recovered.

Public charging operators are currently incurring significant fixed costs based on this default tariff approach which presumes a high electricity network impact that has not been reflected by early empirical data.

Since the current energy use profile of public charging customers is different to that of the commercial and industrial customers that the electricity sector currently groups them with, more consideration needs to be given to determining the appropriate tariffs to recover a fairer share of electricity network costs without unduly penalising and impeding investment in public fast charging for end-user motorists.

## Connection costs

In addition to pricing issues, the current grid connection processes are also delaying and adding costs to installing ultrafast public charging infrastructure. Across Australia, each Distribution Service Network Provider (DNSP) has different processes and requirements for connecting ultrafast electric vehicle chargers to their networks.

It is typically unclear how long the connection process will take and how much it will cost. For public charging developers, there is often limited visibility into existing network loading levels and constraints at preferred charging site locations, often leading to wasted time and money in assessing the technical feasibility of potential sites. In some instances, it can take more than one year to secure a viable connection agreement.

Large upfront capital contributions are often required to pay for augmentation to the grid infrastructure, and the uncertainties and delays in receiving this cost advice are a major source of commercial risk. These timeframes and costs, as well as the lack of clarity and consistency in the process, are further impeding public charging rollout in Australia.

It is ideal to resolve these issues as soon as possible for two main reasons. First, these energy supply costs and processes are having a fundamental, unfavourable impact on the viability of public fast charging infrastructure which is further exacerbated by the currently low level of utilisation of these sites. Second, given the relatively low number of ultrafast public charging sites and electric vehicles in the present market, there is reduced risk for electricity networks to trial alternatives now compared to in the future as uptake increases.

The Electric Vehicle Council is currently leading a Taskforce under the Distributed Energy Integration Program to work with the public charging operators, the electricity sector, and energy regulators to find a way forward on issues around electricity pricing and connections.

## Home and workplace charging in Australia

While public fast charging is critical to support electric vehicle uptake in Australia, most charging will continue to occur at home, given off-street parking is available in many Australian homes and this is where most cars are parked for the longest period of time.

Our consumer survey (summarised in Chapter 1) also demonstrates the importance of home charging; 86% of the Australians we surveyed rated home charging as important.

Installing electric vehicle charging infrastructure in most homes is relatively straight-forward. However, as outlined in Chapter 5, retrofitting the required electrical infrastructure in multi-residential and commercial buildings is often more complex and costly. Governments should require all new buildings to be constructed as 'EV ready' to reduce the need for subsequent retrofitting.





Almost half of survey participants (49%) also regarded workplace charging as important, which is considerable given almost one-third of Australians do not drive to work.<sup>64</sup>

While workplace charging is not currently widespread in Australia, this is an area which is also expected to grow as more workplaces install charging equipment and drivers come to expect access to charging during a workday. Cars are also parked at workplaces for long periods of time, which means that electric vehicle drivers will increasingly be expecting to be able charge at work, especially those who do not have access to home charging. Workplace charging may become regarded as an important employee benefit, as well as a way to support company sustainability goals.

## Recommendations to governments

Ensuring Australia has access to adequate charging infrastructure requires government action. Governments need to work with the energy industry and public charging operators to overcome identified barriers to the effective roll out of public fast charging infrastructure. Prioritising public charging in this way will also encourage further industry investment.

It is also necessary for governments to help facilitate home and workplace charging. Mandating new buildings to be 'EV ready' will reduce the need for retrofitting in multi-residential and commercial buildings. Subsidising home and workplace charging would also be an effective action for government to take to remove some of the cost barriers to purchasing an electric vehicle and charger.

## CASE STUDY

# Evie Networks, the Aussie company building a nation-wide ultra-fast charging network

In early 2017, The St Baker Energy Innovation Fund approached Paul Fox with a mission that had previously proven impossible.

**“They asked me to create a nationwide charging network from scratch, by any means necessary;”** says Evie Networks Co-founder Paul Fox.

**“So by the end of 2017, Evie was born out of the idea that if no one else is going to build essential infrastructure, then we’re going to do it.”**

Within a few months, Paul had brought on board Dr Andrew Simpson, one of Tesla’s original design engineers, and Chris Mills who had deployed over 50,000 mobile phone towers and is now Evie Networks’ CEO.

Today the company employs 17 people across three cities and has recently opened the first five of 42 highway stations set to be rolled out across Australia in the next two years. They also plan to build “hundreds” of additional charging sites.

Under its business model, Evie Networks builds, owns and operates the sites while sourcing hardware from Australian company Tritium and other local manufacturers. They also offer deployment and charger management services to site hosts that want to own their chargers.

**“Providing ultra-fast charging stations at accessible highway locations around the country, all open-access and ‘pay-as-you-go’ is about serving EV drivers and opening up new journeys;”** Chris says.

One of the main challenges faced by Evie Networks and similar Australian companies has been the long lead time to acquire high quality sites and the necessary grid connections.

**“We’ve tackled grid connections very directly, because avoiding short term challenges leads to compromises on the quality of the site and therefore customer experience, which will only stifle the industry in the long term;”** Paul says.



An uncompromising focus on customer experience has also led Evie Networks to team up with partners in retail, mixed-use development, quick service restaurants and convenience, recently announcing partnerships with Ampol – formerly known as Caltex – and Puma Energy which is owned by Chevron.

**“Our goal is to make charging an EV easier than filling up with petrol,”**

Paul says.

**“Securing quality site partners and strong grid connections takes time, but our approach is bearing fruit, especially as site hosts see the retail benefits and energy networks become much more familiar with this type of load.”**

Evie Networks’ energetic performance is no surprise; the company’s name originates from Australian rock legend Stevie Wright’s 1974 song ‘Evie (Let Your Hair Hang Down)’.

**“The song is classic Australian road trip music,” says Paul. “So the name Evie is all about recapturing that feeling, the freedom of the open road alongside a reliable friend.”**





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# Chapter 4: EV mining and manufacturing in Australia

The manufacture of electric vehicles and their components presents a significant opportunity for Australia to build on its existing infrastructure and capabilities to create jobs and economic growth. We are already seeing some of this potential with the development of a lithium-ion battery value chain and electric vehicle and charger manufacturing. It is vital that Australia continues to attract investment and solidifies itself as a participant in the global electric vehicle industry.

Australia is already well-positioned to develop a lithium-ion battery value chain, from the mining and processing of critical minerals to battery manufacturing, repurposing, and recycling. Our mineral reserves, skilled workforce, port access, export infrastructure and mining reputation make us as a strong competitor in attracting investment for an onshore industry. Currently, Australia exports the main commodities used in lithium-ion battery production in the form of mineral concentrates, capturing very little of our battery value chain potential.<sup>65</sup>

In order to become a global competitor in the battery value chain, Australia must invest in the technology and skills needed for minerals processing and battery componentry manufacturing. This is where the most value is added and where Australia is at its weakest. Investment in these stages would create significant economic opportunities.<sup>66</sup> Australia should additionally close the loop on lithium-ion batteries through a circular economy, so that old electric vehicle batteries are processed for the minerals needed to manufacture new batteries onshore.

Australia also has the potential to re-establish itself as a vehicle manufacturing country, by capitalising on existing industry infrastructure. Indeed, there remain many domestic manufacturers of automotive parts whose products could be used in the production of electric vehicles. Investment in electric bus manufacturing alone would see the creation of 19,000 manufacturing jobs – with workers involved in the production of bus bodies, chassis, battery chargers, and a range of other components.<sup>67</sup>

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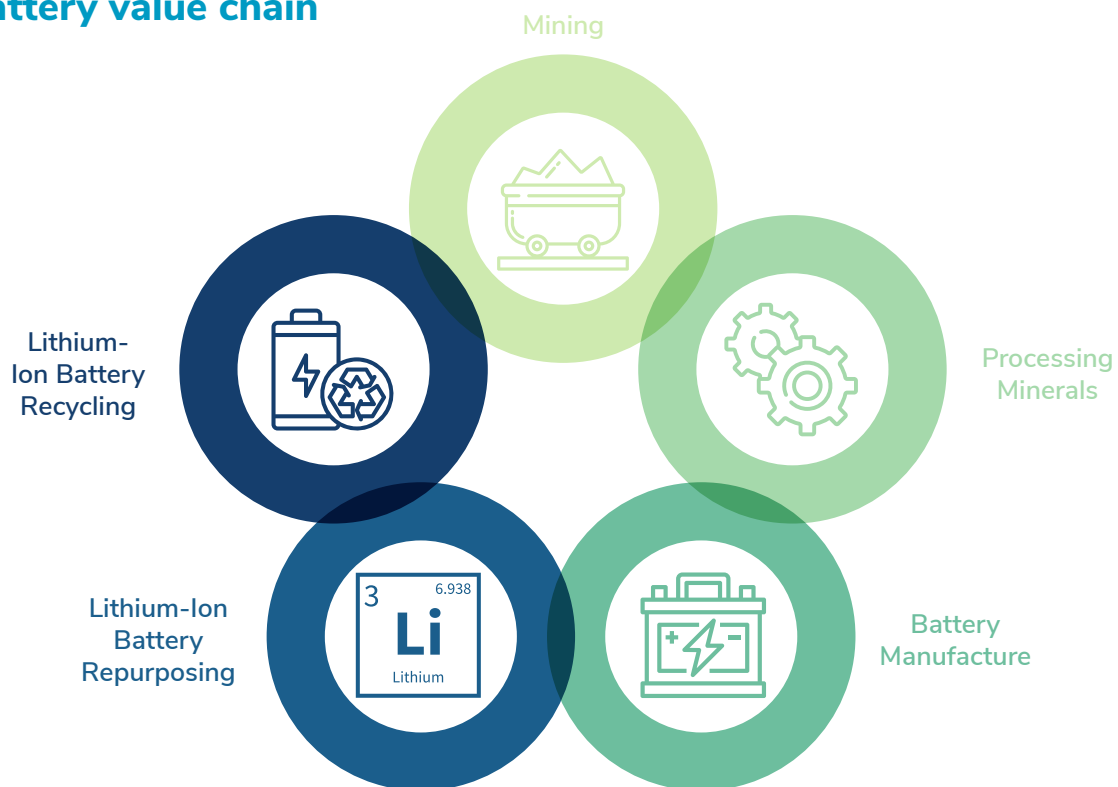
65 Future Battery Industries CRC (2020a)

66 Future Battery Industries CRC (2020b)

67 Beyond Zero Emissions (2020)

The need for vehicle chargers presents further opportunities for industry development. Already, Australia has established itself as a leader in the design and manufacturing of charging infrastructure. The current lack of local demand, however, means that much of this production is exported. Investment in a network of charging infrastructure across Australia cities and states, such as a fast charging national highway, and would provide thousands of skilled jobs and lock in the benefits of world-leading Australian technology.

## Battery value chain



### Mining

The most expensive part of an electric vehicle is the lithium-ion battery that powers it. Demand for lithium-ion battery technologies is forecast to grow by 23% over the next ten years.<sup>68</sup> The global automotive lithium-ion battery market is projected to reach US\$ 95.3 billion by 2030, growing at 11% per year.<sup>69</sup>

The Australian mining sector is already benefiting from the global electric vehicle transition. Australia currently produces nine of the ten of minerals used to make most lithium-ion battery anodes and cathodes and has commercial reserves of graphite, the remaining element.<sup>70</sup>

In 2018, Western Australia accounted for 57% of global lithium production.<sup>71</sup> In 2018/19, Western Australia exported a total of \$6 billion in battery minerals to 45 different countries. China was the biggest market for these exports, accounting for 59%.<sup>72</sup>

68 Government of Western Australia (2020)

69 Bloomberg (2019)

70 Australian Trade and Investment Commission (2018)

71 Government of Western Australia (2019)

72 Government of Western Australia (2020)

## Minerals processing

While Australia is currently well-established in the mining of battery minerals, it is underdeveloped in other areas of the battery value chain, including minerals processing. The federal government has identified significant potential for Australia to expand its capacity for the processing of critical minerals.<sup>73</sup> Critical minerals are those which are “vital to the economic wellbeing of the world’s major and emerging economies.”<sup>74</sup>

Some lithium producers have already begun investing in Australian processing plants:

- + **Tianqi Lithium:** launched stage one of the world’s biggest and first fully-automated lithium chemical manufacturing facility outside of China in September 2019, in Western Australia’s Kwinana. The facility’s construction employed 900 people temporarily with a further 200 jobs set to be ongoing.<sup>75</sup>
- + **Albemarle:** has begun production of two processing units for lithium hydroxide in Kemerton.<sup>76</sup>
- + **Covalent Lithium:** plans to commission a lithium hydroxide processing facility in Kwinana in 2021.<sup>77</sup>

Austrade has also identified the following as possible target sites for lithium-ion battery cell manufacturing: Kalgoorlie and Bunbury in WA, Adelaide in SA, Newcastle in NSW, Geelong in Victoria, Townsville in QLD.<sup>78</sup>



73 Australian Trade and Investment Commission (2019)  
 74 Geoscience Australia  
 75 Tianqi Lithium Australia (2020)  
 76 Australian Financial Review (2020)  
 77 ICN Gateway (2020)  
 78 Australian Trade and Investment Commission (2018)

## LITHIUM-ION BATTERY COMPOSITION

Lithium-ion batteries are made using different chemistries. The size and chemistry determine the battery's range and functional longevity. In the coming years, new battery chemistries will enter the market and provide higher energy densities and longer battery lives.<sup>79</sup>

The price of batteries per kWh has been consistently falling over the last decade as battery manufacturing reaches greater scale, higher density energy cathodes are used, and improvements are made to battery pack design. In 2019, the average price of lithium-ion batteries was \$156 per kWh<sup>80</sup> compared to \$176 per kWh in 2018.<sup>81</sup>

In 2019, the average battery pack size across light duty vehicles was 44kWh, up from 37kWh in 2018, resulting in electric vehicle models with more range.<sup>82</sup>

### Battery manufacturing

Australia is currently missing out on battery manufacturing opportunities. In 2017, for example, the production of mineral concentrate delivered \$1.13 billion in revenue for Australia. However, no further revenue was delivered from the major value adding steps, meaning Australia only captured 0.53% of the total value of its exported lithium. The global value chain - which Australia failed to capture any of - was estimated as \$2 billion from refining, \$22.1 billion from precursor production and \$187 billion battery cell production and battery pack and system assembly.<sup>83</sup>

To date, China has been leading the world on battery manufacturing. However, the European Union's car CO<sub>2</sub> regulations attracted €60 billion investment in European battery and electric vehicle production in 2019, triple the amount invested in China that same year.<sup>84</sup>

The growth in European investment in battery manufacturing demonstrates the path for Australia to expand its own activities along the battery value chain. Policy to support the uptake of electric vehicles has an enormous impact on where manufacturers choose to invest. As carmakers ramp up production of electric vehicles, they are building deeper relationships with battery manufacturers to manage supply, through direct investment or long-term contracts.<sup>85</sup> The longer Australia waits, the more established those relationships become and the harder it will be for our industry to capitalise on these opportunities.

79 Bloomberg NEF (2020)  
 80 Bloomberg NEF (2019a)  
 81 Bloomberg NEF (2019b)  
 82 International Energy Agency (2020)  
 83 Future Battery Industries CRC (2020a)  
 84 Transport & Environment (2020)  
 85 Reuters (2020)

Future opportunities exist in 'moving along the value chain', by leveraging resource-endowments as a foundation for subsequent processing and manufacturing activities. As the majority of the value-add in battery value chains comes at the mid- and down-stream, these stages will offer the best returns for the Australian economy."

Future Battery Industry Cooperative Research Centre<sup>86</sup>

In 2018, the Federal Government released its *Lithium-ion Battery Value Chain* report which concluded that while Australia has the required technology for the mining stages of lithium-ion batteries, it still requires the equipment, processes and technology to convert raw materials into end-user batteries. The report noted progress being made by Australian companies in developing relevant technologies and even small-scale lithium-ion battery capabilities, but found that Australia still needs to attract investment and technology transfer and/or patents from existing lithium-ion battery manufacturers to develop the required level of capability.<sup>87</sup>

The Federal Government has provided \$25 million in funding towards the establishment of the Future Battery Industries Co-operative Research Centre (FBICRC) in Western Australia. The FBICRC is currently funding a range of projects that will "help expand Australia's battery minerals and chemicals production, develop opportunities for specialist battery manufacture, support the deployment of batteries to households, communities and industry, and optimise the circular economy for the use and re-use of battery systems."<sup>88</sup>

However, given the enormous and timely nature of this economic opportunity, such efforts – while welcome – are insufficient. Current policies target the mining and manufacturing sectors as a whole and new battery related projects may end up competing with established industrial bases. The FBICRC therefore recommends that governments prioritise specific battery programs as part of their broader industry policy.<sup>89</sup>

Government investment in battery research and development is occurring around the world. In 2020, the German government will invest more than €1.5 billion (\$A2.4 billion) in battery cell research and production.<sup>90</sup> Meanwhile, the European Investment Bank has loaned €350 million to Northvolt, a Swedish battery start up, to build Europe's biggest battery plant.<sup>91</sup>

86 Future Battery Industries CRC (2020c)

87 Australian Trade and Investment Commission (2018)


88 Future Battery Industries (2020)

89 Future Battery Industries CRC (2020c)

90 PR News Wire (2020)

91 Reuters (2019)

There are also significant opportunities for Australia in the research and development stage of battery manufacturing. Our skilled workforce and world leading research capabilities provide the right environment to further develop battery chemistries. Monash University has already demonstrated success in battery development, this year publishing a paper on the application Lithium-Sulphur batteries and their potential use in electric vehicles. The research has attracted interest from some of China and Europe's largest lithium battery manufacturers, and further testing is to take place in Australia in 2020.<sup>92</sup>



“Accelerating global demand presents Australia with a once-in-a-generation opportunity to transition into a major processing, manufacturing and trading hub if an adequate business case can be built.”

Future Battery Industries Cooperative  
Research Centre<sup>93</sup>

Recent modelling undertaken by EY and WWF suggests that a \$500 million investment by the Federal Government in battery manufacturing (plus \$240 million in low-cost finance), would create 6,800 jobs and leverage \$5 billion in industry investment by 2030.<sup>94</sup>

Western Australia would be home to approximately 70% of 30,000 new jobs which would exist in the secondary processing of lithium and the manufacture of battery cell components (cathode/anode). Separately, the state's Future Battery Industry Strategy committed Western Australia to delivering an 19,261 jobs in this area.<sup>95</sup>

## Electric vehicle charger manufacturing

Australia is already proving its capability in designing and manufacturing charging equipment. Expanding this capability and supporting further investment in this sector would see the creation of local advanced manufacturing jobs.

Tritium, a Brisbane-based company founded in 2001, is one of the world leaders in developing DC fast charging infrastructure. Given the relatively small market in Australia for fast charging infrastructure, most of their products are exported to Europe and the US where Tritium has achieved significant success. Tritium chargers now make up around 15-20% of Europe's charging station market, 15% of the North American market, and 90% of public charging stations in Australia.

92 Monash University (2020)  
93 Future Battery Industries CRC (2020a)  
94 WWF Australia (2020)  
95 Government of Western Australia (2020)

Tritium employs over 300 people across sales, support and marketing, R&D and engineering and their global headquarters in Brisbane boasts the largest R&D facility for electric vehicle chargers in the world. Its products are manufactured in Brisbane with around 60% of components coming from Australian suppliers.<sup>96</sup>

JET Charge is another Australian company that designs and manufactures custom electric vehicle charging solutions in Australia. JET Charge's focus has been on designing novel projects to enhance streetscapes and make charging easier to access.

Notable JET Charge projects include:

- + a collaboration with smart light pole manufacturer and deployer ENE-HUB across Blacktown and Canada Bay city councils, as well as some trial sites in Los Angeles;
- + Paymate: a world first hardware agnostic payment solution; and
- + an integrated Parking Meter and electric vehicle charging station with Duncan Solutions in The Rocks in Sydney.

Charger innovation is also occurring in the realm of underground mining. Vehicle chargers used in such harsh environments tend to be less sophisticated but more physically robust than regular electric vehicle chargers. Often these chargers also need to be negatively pressurised to ensure mine dust does not interfere with circuitry. Such chargers also need internet connectivity which necessitates careful planning and specific infrastructure given that mining vehicle chargers are often located in remote regions and deep underground. ABB, a global technology company that employs 1,100 people in Australia, currently offers industrial chargers used by electric mining vehicles.

## Electric vehicle manufacturing

There is potential for Australia to reinvigorate its vehicle manufacturing capacity with onshore electric vehicle assembly.

There is a surprising amount of automotive equipment manufacturing... there's still a remarkably strong automotive parts industry that's both feeding into off-shore assembly and a very healthy domestic aftermarket – Australians love tinkering with their cars.

Mark Goodsell, Australia Advanced Manufacturing Council.<sup>97</sup>

96 Create (2019)

97 The New Daily (2020)

In 2015, a Senate Committee report on the ‘Future of Australia’s Automotive Industry’ found that government policies were necessary to “give businesses the certainty to invest and assist them to overcome some initial challenges to realising new opportunities.”

### Passenger electric vehicle manufacturing

There is a growing appetite for modern automotive manufacturing in Australia. International investors, well-aware of Australia’s existing and highly-skilled automotive workforce, see significant opportunities.

GFG will shortly launch its very own EV and is excited about the opportunity to bring vehicle manufacturing back to Australia. We are currently finalising our launch plans (including which state to locate the manufacturing facility in) and will be using technology developed by Gordon Murray Design of UK. We plan to build our first production line in Australia with additional plants to follow in other markets in our global footprint.

Sanjeev Gupta, CEO GFG Alliance.<sup>98</sup>

#### LOCAL MANUFACTURING OF PASSENGER ELECTRIC VEHICLES

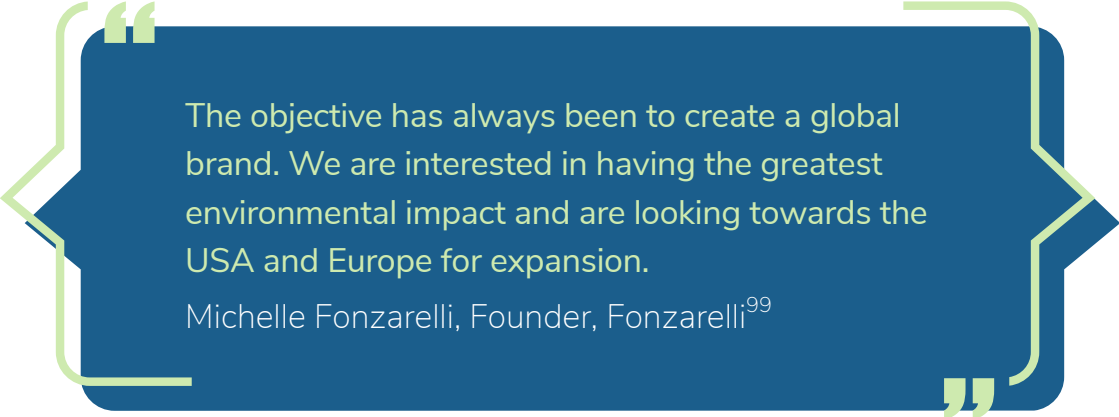
Evant & BYD	Adelaide-based firm Evant has signed a Memorandum of Understanding with Warren Buffet-backed Chinese vehicle manufacturer BYD to collaborate on the development and production of electric vehicles in South Australia.
GFG Alliance	Intention to build its first production line of a new electric vehicle in Australia. Location if facility is still to be determined.
ACE EV & Aldom	ACE EV – an electric vehicle manufacturer – and Aldom – a truck body maker – have partnered to assemble electric vehicles in Adelaide. The aim is for 50% of components to be Australian-made.  Next steps are for the ACE-EV Cargo to pass ANCAP testing.

98 The Australian (2019)



## Two wheeler manufacturing

There is a small but growing industry of Australian-designed and manufactured electric scooters and motorbikes. Fonzarelli is a Sydney-based company that designs and assembles electric motorbikes in their Redfern warehouse. Its Australian-made parts, such as the stainless-steel frame, are made in Sydney's Northern Beaches.



The objective has always been to create a global brand. We are interested in having the greatest environmental impact and are looking towards the USA and Europe for expansion.

Michelle Fonzarelli, Founder, Fonzarelli<sup>99</sup>

Savic is a Melbourne-based company designing and assembling scooters and motorbikes. Currently, the company relies on overseas supply chains, but has signalled that emerging technology in Australia, such as metal 3D printing, will help localise production and provide cost efficiencies.<sup>100</sup>

## Commercial electric vehicle manufacturing

Most electric trucks in Australia are currently conversions or customised versions of pre-existing drivetrains from Toyota, Hino, Mercedes Benz and Fuso. Many of these conversions are completed by Victorian-based SEA Electric, however a range of other companies are also entering this space.

One of the benefits of conversions is that vehicles are often commissioned and customised according to clients' specific needs. There are two main applications of commercial electric vehicles in Australia – mining and last mile delivery services.

99 Driven Woman Magazine (2019)  
100 The Shift (2020)

### LOCAL MANUFACTURING OF COMMERCIAL ELECTRIC VEHICLES

SEA Electric	<ul style="list-style-type: none"> <li>+ Since 2017, has built or committed to build 272 units in Australia with SEA-Drive electric power system.</li> <li>+ Presence in Australia, New Zealand, the US, Thailand, South Africa and Israel.</li> <li>+ Customises Isuzu, Hino, Iveco, Ford van, Mercedes-Benz and Dennis Eagle vehicles.</li> <li>+ Employs 65 people at its Dandenong factory.</li> <li>+ Building a new Victorian facility in the next 3 years in Morwell, which will create 500 jobs with the capacity to assemble 5000 vehicles annually.<sup>101</sup></li> <li>+ Opened a facility in California to supply the North American market after securing a 100-unit order.</li> </ul>
GB Auto	<ul style="list-style-type: none"> <li>+ The exclusive distributor in Australia for the Tembo 4x4 e-LV Electric Cruiser and Electric HLX.</li> <li>+ Converts the Tembo into battery powered 100% electric Land Cruiser and Hilux vehicles based on customer requirements.</li> </ul>
Zero Automotive	<ul style="list-style-type: none"> <li>+ Zero Automotive has formed a supply partnership with Toshiba.</li> <li>+ The ZED70 is manufactured in Edwardstown, South Australia, and is currently undergoing its first public trial in Adelaide.</li> <li>+ Production takes in excess of six months.<sup>102</sup></li> </ul>
Voltra	<ul style="list-style-type: none"> <li>+ Australian company that designs and manufactures a converted Landcruiser with 100% electric drive for underground mining.</li> <li>+ In 2019, BHP successful trialled one of Voltra's 100% electric converted Landcruisers. The trial is set to be expanded to WA mines.<sup>103</sup></li> </ul>
Safescape	<ul style="list-style-type: none"> <li>+ The Bortana EV is a mine-ready underground electric light vehicle.</li> <li>+ Customers are able to reserve production slots now.</li> <li>+ First vehicles will be rolling off the production line at the end of this year and production will ramp up with demand in 2021.</li> </ul>

101 ABC News (2018)

102 Which Car (2019)

103 International Mining (2019)

## Electric bus manufacturing

Australian electric bus manufacturing is limited and typically relies on an imported chassis. However, there is significant potential in the sector. A recent report by EY and WFF suggests that \$240 million of Commonwealth investment in electric bus manufacturing would see the establishment of 10,000 jobs in the sector, resulting in a \$233 million industry.<sup>104</sup>

A NSW parliamentary inquiry is currently looking into the benefits of electric buses and barriers to their wider use in regional and metropolitan areas. As part of this inquiry, BCI Bus International,<sup>105</sup> Nexport,<sup>106</sup> and Electromotiv<sup>107</sup> expressed interest in local manufacturing or assembly of electric buses, contingent on there being a sufficient baseline of demand in Australia for electric buses.

AUSTRALIAN-BASED BUS MANUFACTURERS AND SUPPLIERS		
Australian Bus Corporation (ABC)	Bus designer and manufacturer in Australia	Formed a partnership with Ebusco to launch the Ebusco 3.0 in Australia.
Aluminium Revolutionary Chassis Company (ARCC)	Bus chassis manufacturer, based in Sydney	Currently has an aluminium electric bus chassis prototype under production and another in the development stage. Provides electric vehicle chassis kit options and refurbishes diesel and gas buses with electric power trains. <sup>108</sup>
Bustech	Bus manufacturer, based in Queensland	Designs, engineers, and manufactures chassis' and bodies for mass passenger vehicles. The ZDi bus is an Australian-made electric bus, built using a Bustech chassis.
Custom Bus Group, Custom Denning	Bus chassis manufacturer, body builder and assembler, based in Sydney	'The Element' is an Australian designed and produced e-bus, assembled by Custom Denning. The first four buses will be ready for on road testing in October 2020.
Nexport	Official Australian chassis supplier for BYD	Nexport and BYD, an electric vehicle manufacturer, are exploring ways to bring chassis manufacturing to Australia.
Precision Buses	Bus manufacturer, based in South Australia	In 2015, a joint venture of Queensland's Bustech and Adelaide's Precision Buses brought to market Australia's first designed, engineered and manufactured electric bus.
Volgren	Build and designs bus bodies, based in Australia	Partnership with BYD and builds electric buses in Australia using imported BYD chassis. <sup>109</sup>

<sup>104</sup> WWF Australia (2020)

<sup>105</sup> BCI Bus International (2020)

<sup>106</sup> Nexport Pty Ltd (2019)

<sup>107</sup> Electromotiv (2019)

<sup>108</sup> ARCC (2020)

<sup>109</sup> Sustainable Bus (2019)

Given the specificity of bus requirements, Australia's electric bus industry will require robust partnerships between component manufacturers, engineering firms, and transport operators. These collaborations are beginning to take place but could be significantly accelerated through government support of localised production.

For a list of current bus industry partnerships, see Appendix 4.



## CASE STUDY

# Voltra and BHP break new ground underground

In December 2018, South Australian manufacturer Voltra teamed up with BHP to kick off the first Australian trial of an electric vehicle at an underground mine. Over the following 12 months, Voltra's eCruiser completed daily double shifts ferrying equipment and personnel around mine shafts at BHP's Olympic Dam site.

The eCruiser uses the drivetrain of a Toyota Landcruiser, one of the most popular light vehicles in Australian mines but has several advantages over its diesel predecessors.

Underground mines often have restrictions on the number of diesel vehicles that can be in a shaft due to ventilation requirements. This means that replacing light diesel vehicles with electric ones allows mines to increase the number of heavy diesel vehicles in a shaft and improve productivity without increasing emissions, ventilation requirements, or risks to workers.

**“We asked BHP ‘how do we need to adapt this electric vehicle to your operational needs?’”, says Voltra Project Manager Andrew Daffin. “We’ve been working very closely with the people who are driving all day every day to find out what’s going to make their lives easier.”**

With temperatures upwards of 40 degrees, heavy dust, and rugged slopes, mine shafts can be incredibly uncomfortable places to work. Because of that, one of the main benefits of the eCruiser was its single-speed electric engine providing a smoother ride with less heat and noise.

Meanwhile, the steep inclines were transformed into an advantage by the latest in regenerative braking technology.

**“The drivers don’t need to use the brakes, the vehicle holds itself all the way down through the regenerative braking, and that feeds charge back to the battery packs,”**

Andrew says.

Not using the brake pedal as often also reduces wear and tear, a constant menace in the harsh environment of a mine. Throughout the trial, the eCruiser required less maintenance and downtime than its diesel counterparts.

The vehicle was also well-suited to the shift structure of a workday out in the mines.

**“The vehicle would cover around 100 kilometres, come back and still be at 30 to 40%,”** says Voltra Project Manager Andrew Daffin. **“So while the workers are having lunch, they can throw it on to charge and in half an hour to forty minutes, the vehicle’s back to fully charged again.”**





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# Chapter 5: EVs, the environment, and the grid

## Emissions impact

Transport already accounts for 19% of Australia's emissions and that number is set to grow throughout the decade, making electric vehicles crucial in decarbonising our economy.

Australia's road vehicle fleet rates among one of the least efficient in the developed world.<sup>110</sup> In 2019 the average emissions intensity of a new vehicle sold in Australia was 180.5 gCO<sub>2</sub>/km, only achieving a 0.2% decrease from the previous year. In fact, over the past three years, average vehicle emissions intensity has fallen by less than 1% in total.<sup>111</sup>

As a result, Australia has poorer new vehicle efficiency than Saudi Arabia, the USA, China, and the EU.<sup>112</sup>

Consumers are concerned about their ability to reduce emissions, with 53% of our surveyed consumers rating the environmental benefit as the top public benefit from electric vehicles (see Chapter 1).

Similarly, throughout multiple years, around half of our survey respondents said they would seek to charge an electric vehicle from renewable sources, including rooftop solar and green energy from their retailer. The electric vehicle sector has responded to these preferences, the major public fast charging networks in Australia are powered by 100% renewable energy.

When charged with renewables, electric vehicles produce zero exhaust emissions, but they even compare favourably when charged from our electricity grid.

The Federal Government recognises this benefit in Australia's Emissions Projections 2019:<sup>113</sup>

*Although electric vehicles have no direct combustion emissions they increase electricity use, which is accounted for in the electricity sector. The emissions intensity of electric vehicles has been estimated by multiplying the demand for electricity by the projected average emissions factor for electricity in the National Electricity Market. Over the projections period to 2030, new electric vehicles are assumed to have increased energy efficiency. With the average emissions intensity of grid electricity projected to decline, the emissions associated with the use of new electric vehicles per kilometre travelled is projected to improve by 33 per cent over period 2020 to 2030.*

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110 American Council for an Energy Efficient Economy (2018)

111 National Transport Commission (2019)

112 National Transport Commission (2019)

113 Department of Industry, Science, Energy and Resources (2019)

PROJECTED EMISSIONS INTENSITY OF NEW PASSENGER AND LIGHT COMMERCIAL VEHICLES <sup>114</sup>				
	2020	2025	2030	CHANGE FROM 2020 TO 2030 (%)
Internal combustion engines (g CO <sub>2</sub> -e per km)*	177	166	157	-11
Electric drivetrain (g CO <sub>2</sub> -e per km)*	153	129	103	-33

\* This is an average of small, medium and large passenger vehicles and light commercial vehicles.

This uses generous assumptions for internal combustion engine (petrol and diesel vehicle) emissions reductions of 1.2% per annum, much higher than the average 0.3% they have achieved over the past three years and uses only average emissions intensity for electric vehicles.

Given half of respondents stated a preference to source renewable energy for their vehicles and given public fast charging is generally sourced from renewables, this average could be discounted again, conservatively by 50%.

The emissions benefits are already present across Australia, increasing each year as the grid decarbonises.

## Battery stewardship

Battery sustainability and stewardship is an important part of the electric vehicle industry and supply chain. It is critical to consider the waste management of electric vehicle batteries now in order to prepare for increasing future volume.

There are different ways a battery can be managed, and different applications of waste management are considered for faulty, damaged, or end-of-life batteries. Depending on the reason for retirement from a vehicle, a battery may be refurbished, repurposed, or recycled. Typically, barring a collision or mechanical defect, batteries reach their end of life at 80% of their initial capacity.<sup>115</sup>

Regulation restricting the transport of lithium-ion batteries nationally and internationally will influence resource recovery in the sector. Markets with stronger electric vehicle uptake, such as the European Union, China, and the United States, have started to implement policies to regulate battery end of life.<sup>116</sup>

Policy to stimulate industry growth and a circular lithium economy will be necessary to provide certainty to investors. As it is widely accepted that stockpiling or transporting lithium-ion batteries are not viable options in the long term, management of end-of-life electric vehicle batteries will require regional solutions.<sup>117</sup>

<sup>114</sup> Department of Industry, Science, Energy and Resources (2019)

<sup>115</sup> International Energy Agency (2020)

<sup>116</sup> International Energy Agency (2020)

<sup>117</sup> Harper, G., Sommerville, R., Kendrick, E. *et al.* (2019)



Given Australia's geography and the risks associated with transporting lithium-ion batteries, carmakers in Australia will look for domestic solutions to end-of-life electric vehicle batteries. This creates a great opportunity for investment in a secure onshore industry that also improves environmental outcomes.

### Refurbishing

In a refurbished battery, the functioning modules and cells are used for application in another electric vehicle battery. This is often the use case for factory faulty batteries, where the battery can be easily recovered by a carmaker and has not been damaged or discharged. For example, Tesla and Nissan offer refurbished battery packs for warranty replacement of original battery packs in electric vehicles.<sup>118</sup>

### Repurposing

In a repurposed battery, the battery's remaining capacity is reused for a secondary application, such as stationary energy storage. A battery must undergo several processes to be safely used for a secondary application. Carmakers are investing in repurposing opportunities to give them control over the secondary use applications and to ensure they are reliable and financially viable.

See Appendix 3 for more information on this investment.

In Australia, there is an emerging industry for electric vehicle battery repurposing. Relectrify is a Victorian-based company that specialises in battery management systems and inverter technology for battery storage applications of electric vehicle batteries. They have partnerships with international carmakers such as the Volkswagen Group<sup>119</sup> and Nissan Motors US<sup>120</sup>. There is opportunity to develop the applications of Relectrify's technology in Australia.

### Recycling

When a battery is recycled, it is processed for its constituent materials. The establishment of an effective recycling battery recycling industry is important to the sustainability of lithium-ion batteries and electric vehicles.

Using the projections from the World Economic Forum and Global Battery Alliance, battery production will increase to a base demand of 2,600 GWh in 2030. An estimated 54% of these are expected to be recycled in 2030, thereby contributing 7% to the overall demand for raw materials. This will require recycling capacities to increase by a factor of more than 25 in 2030 compared to today.<sup>121</sup>

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118 Union of Concerned Scientists (2020)  
119 Relectrify (2020)  
120 Smart Company (2020)  
121 World Economic Forum (2019)

While Australia is unlikely to reach the threshold of electric vehicle batteries in this scenario – due to our historic slow uptake – there is an opportunity to invest in recycling facilities to help the global electric vehicle industry with the necessary future recycling capacity.

Several companies in Australia currently provide lithium-ion battery recycling up to different stages of the recycling process. The recycling plants are concentrated in Victoria and Western Australia.

LOCAL LITHIUM-ION BATTERY RECYCLERS	
CMA Ecocycle <i>Victoria</i>	Ecocycle collects lithium-ion batteries from dealers and service centres and then stores and dismantles batteries - diverting the materials to the correct recycling streams. <sup>122</sup>
EcoGraf <i>Western Australia</i>	EcoGraf has successfully trialled its graphite purification technology to recycle lithium-ion battery anode material in Germany. They intend to produce spherical graphite in Western Australia for export directly to major anode manufacturers while at the same time developing an upstream mining business to produce natural flake graphite as feedstock and for other traditional industrial markets. <sup>123</sup>
Envirostream <i>Victoria</i>	Envirostream is an Australia with the capacity to collect, sort, shred and separate all the components of spent lithium-ion batteries.
MRI <i>Victoria</i>	MRI collect lithium-ion batteries and export them under permit to their recycling partner in Korea. <sup>124</sup>
Neometals <i>Western Australia</i>	Neometals has developed a proprietary sustainable process for the recovery of valuable constituents from cell production scrap and end-of-life lithium-ion batteries and are testing the commercialisation of the process at a pilot plant in Canada. <sup>125</sup>

122 Ecocycle (2020)

123 Ecograf (2020)

124 MRI (2020)

125 Neometals (2020)

## Circular economy

The development of onshore electric vehicle battery recycling is a huge opportunity for Australia to close the loop on the battery value chain and create a circular economy with significant environmental and economic benefits.

Closing the loop on the production of battery materials reduces the environmental footprint of the mining and processing aspects inherent in battery production, improves sustainability and prevents the components of spent batteries from leaking into groundwater and oceans as a consequence of their relegation to landfill or transport to other jurisdictions.

Adrian Griffin, Managing Director of Lithium Australia<sup>126</sup>

In Australia, there are currently no specific regulations covering the management of end-of-life lithium-ion batteries. However, carmakers in Australia have signed contracts with domestic recyclers for faulty batteries. The Electric Vehicle Council is working with carmakers to investigate ways to promote the development of a domestic battery recycling industry.

The Electric Vehicle Council is working with the Battery Stewardship Council to explore the potential inclusion of electric vehicle batteries in a proposed design scheme as part of the Federal Government's Product Stewardship Act 2018.

## Built environment

The built environment plays an important role in facilitating and encouraging electric vehicle uptake. As electric vehicle uptake grows, so will the need for more charging infrastructure. Consumers will expect to be able to charge their vehicles at homes, workplaces, and businesses.

Retrofitting the electrical infrastructure needed to enable electric vehicle charging can be costly; it is less expensive to ensure buildings have the appropriate electrical infrastructure at the time of development. For residents in multi-unit dwellings – which is the fastest growing form of residential property ownership – installing charging equipment is particularly complex. Given that dwellings in Australia are typically built to last 40 years, developments built today should have the appropriate electrical infrastructure to support expected electric vehicle uptake.

Internationally, governments are updating building codes to mandate that future developments are 'EV ready'. This requires the installation of electricity capacity in residential and commercial

buildings to permit electric vehicle charging for users of the building. The building code updates also stipulate the need to build electrical capacity into the site at time of construction to avoid costly retrofitting.

In Australia, there is currently little regulation requiring that future developments be 'EV ready'. The building and development sector is regulated through the National Construction Code (NCC). Each State and Territory references the NCC in their legislation. While 'EV ready' is not yet part of the NCC, some state governments are recognising the future role of charging infrastructure provision in sustainability assessments for new developments and renovations.

In March 2020, the NSW government announced it will support amendments to NSW regulations to ensure new buildings are 'EV ready'. Additionally, the ACT government committed to amend the Parking and Vehicle Access General Code to require all new multi-unit and mixed-use developments to be 'EV ready' as part of *The ACT's Transition to Zero Emissions Vehicles: Action Plan 2018-21*.

Several local governments have also begun updating their development control plans to facilitate the capacity building of electrical infrastructure. Some of these councils include City of Sydney, City of Yarra, Moreland City Council, Woollahra Council and Waverley Council. In Victoria, the Built Environment Sustainability Scorecard (BESS) is an assessment tool to help builders and developers show how a development is sustainably designed. This year it is being updated to include 'EV ready' provisions for member councils.

In 2019, the Electric Vehicle Council partnered with Ai Group to make recommendations that will assist planners in specifying electric vehicle charging readiness in new construction. The *Achieving "Electric Vehicle ready" in the built environment* discussion paper makes five recommendations to highlight the technical infrastructure needs in both residential and commercial premises to facilitate integration, charging and energy management:

- 1** Government forms a technical infrastructure group comprised of key stakeholders to develop a road map to address gaps in standards and building regulation with the objective that new builds be 'EV ready'.
- 2** For new standalone and semi-detached domestic dwellings with off-street parking, at least one dedicated circuit supporting the future installation of a vehicle charger shall be included as part of the electrical installation.
- 3** The provision of dedicated distribution boards in new multi-residential car parks for connection of future charging equipment.
- 4** A load management system is installed in multi-residential development to support vehicle charging.
- 5** That a mechanism to enable appropriate cost allocation for energy used in charging electric vehicles is included in multi-residential buildings.

Having the ability to charge at home is an encouraging factor when considering purchasing an electric vehicle, especially as over 80% of electric vehicle charging is done at home.<sup>127</sup> Our own research outlined in Chapter 1 shows that home charging is considered important by 86% of consumers. By making new developments ‘EV ready’, access to home charging will become a possibility for more consumers.

To further support equitable access to charging in multi-unit dwellings, the Electric Vehicle Council recommends that governments also consider ‘right to charge’ policies. These policies are being adopted in jurisdictions such as California to provide equitable access to electric vehicles and their associated technologies for those living in multi-unit residences.

“Right to charge” laws provide residents at multi-unit dwellings (and other properties) with the right to install a charging station for the individual’s use provided that certain conditions are met (e. g. the individual assumes responsibility for all associated costs).

Northeast States for Coordinated Air Use Management.<sup>128</sup>

As illustrated in the case study in Chapter 1, electric vehicle readiness is becoming increasingly considered by the property development sector as the potential value associated with future proofing new developments is recognised.

In commercial developments, there is already a number of well-known businesses and developers installing charging infrastructure for electric vehicles in carparks. In 2017, Westfield installed 40 electric vehicle chargers across Australia.<sup>129</sup> This year, Dan Murphy’s installed its first charger in NSW<sup>130</sup> and Vicinity Centres is installing chargers as part of their solar energy and efficiencies program.<sup>131</sup>

‘EV ready’ provisions in commercial car parks allow property owners to capitalise on additional revenue from charging while encouraging shoppers to spend more time in shops.<sup>132</sup> In mixed-use dwellings, there is the opportunity to innovate car park usage, to account for different load management and charger utilisation from different building users. For example, workers and consumers can use chargers by day while residents do so at night.

127 US Office of Energy Efficiency & Renewable Energy (2020)

128 Northeast States for Coordinated Air Use Management NESCAUM (2020)

129 Visionstream (2017)

130 The Driven (2020a)

131 PV Magazine Australia (2019)

132 Sydney Morning Herald (2019)

Regular shoppers stay in the centre for 46 minutes compared with EV owners who stay on average for 106 minutes. The extra time suggests the investment in chargers – totalling in the hundreds of thousand dollars – is worthwhile.

Tim Weale, National Manager – Retail Solutions, Mirvac Retail <sup>133</sup>

## Integrating electric vehicles with the energy system

Electric vehicles require the convergence of two traditionally separate sectors: transport and energy. The electrification of transport will inevitably require new thinking from the energy market on how it can meet the needs of electric vehicle customers, support the integrity of the energy system, and most importantly, benefit from a new source of distributed energy.

There is no doubt that electric vehicles will provide opportunities for the energy market. The Australian Energy Market Commission (AEMC) regards electric vehicles as central to the energy system of the future. The AEMC predicts that electric vehicles will act as a home battery, enable households to sell battery power back into the grid and earn money for doing so, and lower household energy bills. Electric vehicles can also contribute to managing supply and demand across the electricity grid while reducing emissions in the energy sector.<sup>134</sup>

It is also important to consider the opportunities and challenges that come from fleets and other modes of transport such as buses. These larger electricity consumers will have the potential to benefit more from pricing signals while also delivering more benefits to the energy system.

However, benefits from electric vehicles will not be realised without ensuring our energy system is adapted to support the rollout of electric vehicles and take advantage of their offerings to the system.

### Public charging

As outlined in Chapter 3, public charging is vital to support the uptake of electric vehicles, but the current design of the energy system could be optimised to encourage a faster roll-out of this infrastructure. Now is the time to consider how to design the pricing system to reflect the real costs they impose on the energy system, ensuring investment in public charging infrastructure is not stifled.

133 Sydney Morning Herald (2019)

134 Australian Energy Market Commission (2020)

## Household charging

Household charging offers a range of opportunities for the energy system. However, if left unmanaged, these opportunities could turn into problems. For instance, ANU research has calculated that electric vehicles have the potential to make up at least 25% of the grid's demand if one million electric vehicles were plugged in at the same time.<sup>135</sup> While this is unlikely to occur anytime soon, given the current rate of electric vehicle uptake in Australia, it is important to remember that one million vehicles only represents approximately 7% of the vehicle pool in Australia.<sup>136</sup>

However, these problems can be avoided if we put in place the right settings that deliver benefits to consumers for charging their cars during optimal times of the day. This could be overnight, when the electricity system has spare capacity, or during the middle of the day when there is surplus solar generation.

There is no silver bullet solution to encourage optimal charging times; a range of methods will need to be employed to suit different consumers. These will likely include structuring electricity tariffs and retail products to incentivise charging during off-peak, and using smart meters and other smart technologies to optimise charging times for consumers based on signals from the energy system.

Grid operators also want to have the capability to remotely turn off electric vehicle charging equipment in times of critical peak events to assist in avoiding blackouts – so-called demand response capability. In November 2019, the COAG Energy Council agreed to mandate demand response capability in all household electric vehicle charging equipment by mid-2026. This capability will be determined by adherence to the Australian standard for demand response capability (AS 4755) or via any applicable international standards (which will be determined prior to 2026).

The electric vehicle industry has raised concerns about this decision. Relevant parts of AS 4755 remain under development so it is unclear as to the applicability of this standard to electric vehicle technology. It is also unclear if any international standards will be determined to meet the needs required by the grid operators. This could mean that Australia ends up adopting additional requirements for electric vehicle charging that are not seen anywhere else in the world.

Adding additional requirements would increase costs for Australian charging equipment and further stifle the electric vehicle industry in Australia. Critically, it could also create a perverse incentive to bypass charging equipment and charge via home power points. This would lead to poorer outcomes for consumers while encouraging the very behaviours which the energy sector was trying to avoid.

As the energy system considers how it can integrate electric vehicles, it has a duty to ensure it supports the needs of the electric vehicle industry and not act as a barrier by creating additional burdens for customers. The corresponding energy market regulatory settings must clear the way for mass electric vehicle uptake. This is why the Electric Vehicle Council is partnering with the energy industry, governments and regulators to identify joint solutions to these issues. An example of this work is the taskforces we helped to set up to jointly progress current electric vehicle grid integration issues. See the following section on EV Grid Integration Taskforces for more information.

135 Sturmborg, B. (2020)

136 Australian Bureau of Statistics (2020)



## Vehicle to grid capability

One of the most exciting opportunities for the energy system is Vehicle to Grid (V2G) capability. V2G technology enables energy to be passed from the vehicle battery back to the electricity grid.

Currently, there are few vehicles and charging stations available in Australia that are compatible with V2G. As of today, the only electric vehicle on the market that will accept V2G without voiding battery warranty is the 2019 Nissan LEAF. Later this year, the Wallbox Quasar bi-directional charger will be available in Australia, enabling bi-directional DC charging in homes and workplaces.<sup>137</sup> However, more vehicles and charging stations will be V2G-compatible over the coming years.

V2G technology has been demonstrated by a range of overseas trials but there is currently limited certainty about consumer uptake and requisite incentives.<sup>138</sup> More trials on the commercialisation of V2G will need to occur to ensure that there is an economic benefit for all market participants. Like other forms of distributed energy generation, V2G must be scaled up from individual consumers and aggregated in order to deliver a sufficient benefit to the energy system.

In a world first, a V2G trial will be undertaken in the ACT with 51 fleet vehicles providing Frequency and Ancillary Services (FCAS) to the electricity grid. See the following case study for more details.

ANU research quantifies the enormous opportunities of V2G potential in Australia:



The battery capacity of 19 million vehicles would likely exceed 1,800 gigawatt hours. This is equivalent to more than 10,000 “Tesla big batteries”, such as those used to help power South Australia, or five of the new Snowy 2.0 hydro-electric projects.

Bjorn Sturmberg, ANU<sup>139</sup>

137 Jetcharge (2020)

138 Everoze & EVConsult (2018)

139 Sturmberg, B. (2020)

## EV GRID INTEGRATION TASKFORCES

In early 2019, the Electric Vehicle Council convened a number of workshops to bring together the electric vehicle industry and the energy sector to jointly identify grid integration issues and develop solutions.

In late 2019, the Electric Vehicle Council then used this work to partner with AEMO, ARENA and other representatives from the energy sector to establish the EV Grid Integration Working Group. Now part of the Distributed Energy Integration Program, this Working Group has established four taskforces to focus on immediate priority issues:

- ✦ High Capacity Tariffs and Connections – Led by the Electric Vehicle Council and Evie Networks, this taskforce will address tariff and connections issues currently facing the public charging industry.
- ✦ Residential Tariffs and Incentives – Led by the Electric Vehicle Council and AGL, this taskforce will examine how to optimise household charging that suits electric vehicle owners, the energy system, and all energy consumers.
- ✦ Data availability – Led by AEMO, this taskforce will look to address current information gaps relating to electric vehicles in the energy sector.
- ✦ Standards development – Led by AEMO and the Federal Government, this taskforce will look to identify gaps in technical standards relating to electric vehicles and the energy system.

These Taskforces will meet over the next 12 months to deliver solutions to address these issues.





## CASE STUDY

# Realising Electric Vehicle-to-Grid Services

Australia will be the location of a world first vehicle-to-grid charging trial aimed at accelerating the integration of electric vehicles and the electricity grid to benefit drivers and electricity users.

The Realising Electric Vehicle-to-Grid Services (REVS) project will deploy 51 Nissan LEAF EVs across the ACT to provide V2G services over two years, making it one of the largest V2G trials undertaken anywhere in the world.

Unlike any previous V2G trials, the vehicles will be used to provide what is called contingency Frequency Control Ancillary Services (FCAS) to the National Electricity Market. FCAS was traditionally provided by big power stations to provide a fast injection or reduction of energy to avoid blackouts during unexpected faults. This trial is looking at how a fleet of EVs can provide the same service.

Fifty of the Nissan LEAFs are part of the ACT Government fleet – with an additional LEAF coming from ActewAGL's fleet – and will be used as normal fleet vehicles. Historical data suggests that the vehicles will be parked, plugged in, and available to provide services to the grid for 70% of the year.

**“Nissan has been a global leader in this space. With several successful trials conducted in overseas markets, realizing it in Australia is an important milestone,”** says Nissan Australia Managing Director Stephen Lester.

The project has a wide range of partners including the Australian National University (ANU), Nissan, JET Charge, SG Fleet, ActewAGL, Evoenergy, and the ACT Government. The project also received \$2.4 million in funding from the Australian Renewable Energy Agency (ARENA).

**“One EV battery typically contains as much energy as an average household uses over two-to-four days and can react to events in a tenth of a second,”** says Dr Bjorn Sturmberg, REVS project lead from ANU.

Traditionally, overseas trial of V2G have focused on personal vehicles. Given fleets account for more than half of all new vehicle sales in Australia, and the potential value stream of V2G to fleet owners, the results of this fleet-focused trial will also help inform this important segment of the market.

**“When electric vehicles are plugged into a bi-directional charger, the vehicle owner can be financially rewarded for providing energy back into the grid when it's needed, making electric vehicles an even more attractive proposition, especially for fleet owners,”** says ActewAGL's Todd Eagles.



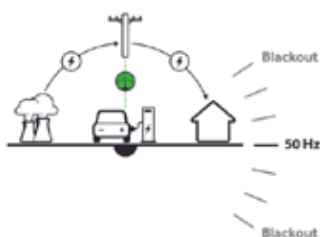


The outcomes and learnings from this trial will inform the development of a roadmap for the commercialisation of V2G technology in Australia, which will be a win-win for electric vehicle owners and the energy market.

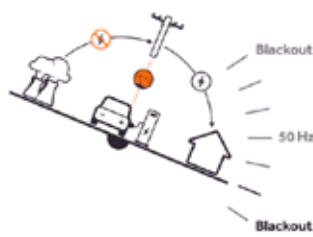
**“We believe that we can make EV charging effectively free for Australian drivers through a combination of smart charging, demand response, and vehicle to grid technology,”** says Tim Washington, JET Charge Co-founder and CEO. **“Our goal is to see this within five years.”**

The Realising Electric Vehicle-to-grid Services (REVS) project is using electric vehicles (EVs) to support the grid. The electricity grid is stable when power supply = power demand.

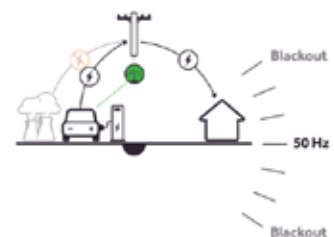
Our EVs monitor the grid frequency whenever they're plugged in.



When generators trip, the frequency drops...



...and our EVs quickly inject power to rebalance the system.



## Chapter 6: EV policy

Australia still lags behind the developed world in implementing policies that support the uptake of electric vehicles. The last 12 months have seen some new policies emerge at the state level but there have still been no significant policy developments federally. It remains critical that governments at all levels adopt policies that reduce barriers to consumers and signal market viability to international carmakers.

The Electric Vehicle Council's consumer survey identified the key barriers to consumer uptake as high purchase costs, concerns about accessible charging infrastructure, and insufficient consumer awareness.

Another barrier is the restricted availability of electric vehicles in Australia, particularly lower priced models. As outlined in Chapter 2, carmakers need to see policy support for electric vehicles to justify bringing them to particular markets. Those markets with government policies in place that encourage or mandate emissions reductions from vehicles are the markets that attract electric vehicles. These policies include emissions reductions targets, fuel efficiency standards, and average OEM fleet emissions regulations. Australia currently has none of these in place.

During technology transformations, government does have a role...whether it's on the emissions side and creating certainty about reduction in emissions that need to happen from a vehicle transportation perspective, whether it's on the charging infrastructure side ... having policy certainty over a horizon [and] making it attractive to industry to get behind it [will ensure] the rest of it will happen.

Robyn Denholm, Tesla Chair<sup>140</sup>

Given Australia's potential to be an important player in the global electric vehicle supply chain, there is also a role for governments in supporting industry growth in mining, manufacturing, and the automotive sector. These opportunities, outlined in Chapter 4, would generate jobs in regional areas and green industries.

While there is some policy support for EVs in Australia, it remains far less than the policy support being provided in comparable countries. This lack of support remains even though transitioning Australia's vehicle fleet to electric would generate numerous public benefits over maintaining the status quo, including:

- + environmental benefits – electric vehicles will reduce carbon emissions from transport which now accounts for 18.9% of Australia's emissions.<sup>141</sup>
- + public health benefits – electric vehicles generate less air and noise pollution. EVC analysis found that each electric vehicle on the road in NSW will save \$2,400 in public health costs<sup>142</sup>
- + fuel security benefits - approximately 90% of our fuel supply is imported.<sup>143</sup> Transitioning to electric vehicles will secure our long-term fuel security.
- + economic benefits – the benefits of switching from liquid fuel to electrified transport infrastructure alone would result in a net increase of 13,400 jobs by 2030.<sup>144</sup>

Given Australia's comparatively low electric vehicle uptake, gaps in consumer knowledge, and limited model availability of lower priced electric vehicles in Australia, it is clear that current policy support remains inadequate.

## Policy progress

In terms of advancing electric vehicle policies in Australia, NSW has made the most progress over the last year, bringing it more in line with the level of progress already made by the ACT and Queensland Governments. NSW recently announced commitments to further invest in public charging networks, provide co-funding for fleets to transition to electric vehicles, and electrify Sydney's bus fleet.

The Queensland Government has continued to implement *The Future is Electric: Queensland's Electric Vehicle Strategy* and invest in public charging infrastructure along its Electric Super Highway.

The ACT is progressing on meeting its strong targets to electrify its own fleet, including its bus fleet, and has committed to making its buildings electric vehicle ready.

Victoria, South Australia, Western Australia, and the Northern Territory all have electric vehicle strategies coming out this year, so we expect these states to start implementing more electric vehicle policies over the next 12 months.

The Federal Government was due to release an electric vehicle strategy in mid-2020 but has not. Over the last 12, months ARENA and the CEFC has provided some funding of electric vehicle projects, and the government recently increased the 2020-21 Luxury Car Tax (LCT) threshold to \$77,565 for fuel efficient vehicles (the first threshold increase since 2009) which will reduce the amount of LCT being paid on electric vehicles.

141 Department of Industry, Science, Energy and Resources (2020)  
 142 Electric Vehicle Council (2019b) *Cleaner and Safer Roads in NSW*  
 143 Department of Environment and Energy (2019)  
 144 Electric Vehicle Council et al (2018)



Based on international evidence of effective electric vehicle policies, the Electric Vehicle Council has identified the need for the following policies in Australia:

- + Setting an electric vehicle sales or fleet target
- + Investing in public charging networks
- + Developing and implementing a national electric vehicle strategy
- + Providing electric vehicle purchase incentives and subsidising home charging installations
- + Providing tax incentives for electric vehicle owners
- + Public awareness initiatives
- + Setting electric vehicle targets for government fleets
- + Transitioning to electric bus fleets
- + Mandating electric vehicle readiness requirements for new buildings
- + Developing electric vehicle industry development strategies and incentives

This year, the Electric Vehicle Council has rated the progress of each state/territory government and the Federal Government against each policy. We note some jurisdictions have made some key policy announcements but are yet to commence implementation of these policies. We have scored each jurisdiction according to their level of progress on implementation, so we expect to see significant improvements by some states over the next 12 months in many of these policy areas. We also note that several jurisdictions have electric vehicle strategies under development, so we also hope to see a number of relevant policy announcements over the next 12 months.

Policies	QLD	NSW	ACT	VIC	SA	TAS	WA	NT	FED
EV Sales/Uptake Target	0%	0%	0%	0%	0%	0%	0%	0%	0%
Investment in public EV charging networks	75%	50%	25%	25%	25%	75%	0%	0%	25%
EV Strategy	50%	50%	50%	25%	25%	0%	25%	25%	25%
EV purchase incentive/Home charging installation subsidy	0%	25%	0%	0%	0%	0%	0%	0%	0%
EV tax incentive	25%	25%	75%	25%	0%	0%	0%	25%	25%
Public awareness initiatives	25%	25%	0%	0%	25%	25%	0%	0%	0%
Govt Fleet EV Target	25%	25%	100%	0%	25%	0%	0%	0%	0%
Electric bus transition plan	0%	25%	75%	0%	0%	0%	0%	0%	N/A
EV readiness requirements for buildings	0%	25%	50%	0%	0%	0%	0%	0%	0%
EV industry development plan and incentives for EV industry	25%	0%	0%	25%	25%	0%	25%	0%	0%

Based on this progress, the EVC has scored each state on how well it is doing on electric vehicle policies.

Scorecard	ACT	NSW	QLD	VIC	SA	TAS	WA	NT	FED
	B	C	C	D	D	D	F	F	F

### ELECTRIC VEHICLE POLICY HIGHLIGHTS

Federal Government	<ul style="list-style-type: none"> <li>+ Developing National EV Strategy.</li> <li>+ Increased 2020-21 Luxury Car Tax threshold to \$77,565 (increase of \$2,039) for fuel efficient vehicles.</li> <li>+ Funded EV projects through ARENA and CEFC.</li> </ul>
QLD Government	<ul style="list-style-type: none"> <li>+ Developed <i>The Future is Electric- QLD's EV Strategy</i>.</li> <li>+ Invested in the Phase 1 and Phase 2 of the Queensland Electric Super Highway (QESH).</li> <li>+ Set government fleet target: QFleet Electric Vehicle Transition Strategy (2018-2022) has set a target of doubling the number of EVs (including BEVs and PHEVs) in their fleet every year for four years. Also includes an initiative to encourage agencies to replace existing ICE vehicles with PHEVs of a similar type through subsidising lease rates and increasing rates on high emitting vehicles.</li> <li>+ Provide reduced registration fees for EVs: BEVs attract a registration fees at the lowest rate.</li> <li>+ Provide reduced vehicle duty rate to hybrid and BEVs passenger vehicles.</li> <li>+ Operating the Queensland Electric Vehicle Committee (QEVC), comprised of representatives from industry, government, academia and other key stakeholders.</li> <li>+ Advance Queensland program \$2.5 million investment in EV charging hardware firm Tritium.</li> </ul>
NSW Government	<ul style="list-style-type: none"> <li>+ Developed <i>NSW Net Zero Plan Stage 1: 2020-2030 (2020)</i> and <i>NSW Electric and Hybrid Vehicle Plan (2019)</i>.</li> <li>+ Committed co-investment in regional fast chargers (\$3 million) and chargers in commuter carparks in the Sydney (\$2 million), in collaboration with industry and local government. Announced additional funding for fast chargers through new EV Infrastructure and Model Availability program.</li> <li>+ New EV Infrastructure and Model Availability program will also include a competitive funding process to co-fund the uptake of EVs in vehicle fleets.</li> <li>+ Set government EV fleet target: 30% of all new passenger vehicles to be electric or hybrid by 2023, with at least 10% to be fully electric.</li> <li>+ Committed to transition all of Sydney's buses to zero emission buses, and developing a strategy to inform the wider transition to zero emission buses. Five electric buses trials underway in Sydney with further zero emission bus trials being planned in Sydney.</li> <li>+ Provide low-emissions vehicles (including EVs) with 20% discount on light vehicle registration cost.</li> <li>+ Provided co-funding to the Charge Together Fleets program to develop a total cost of ownership calculator and an information tool for fleets.</li> </ul>

<p>ACT Government</p>	<ul style="list-style-type: none"> <li>+ Developed <i>Transition to Zero Emissions Vehicles Action Plan 2018-21</i> and <i>Climate Change Strategy 2019-25</i>.</li> <li>+ Set government EV fleet target: all newly leased ACT Government passenger fleet vehicles will be zero emissions vehicles from 2020–21 (where fit for purpose).</li> <li>+ Developing plan to transition the Transport Canberra bus fleet to 100% zero emissions vehicles by 2040.</li> <li>+ Committed to amend the Parking and Vehicle Access General Code to require all new multi-unit and mixed-use developments to install vehicle charging infrastructure</li> <li>+ Committed to work with local and state governments to facilitate the installation of charging stations on major routes to and from Canberra and explore opportunities to promote investment in public charging infrastructure by 2021.</li> <li>+ Provides annual vehicle registration discount of 20% for zero emissions vehicles.</li> <li>+ Exempts zero emissions vehicles from stamp duty when registered for the first time.</li> <li>+ Permits zero emissions vehicles to drive in ACT transit lanes until 2023.</li> </ul>
<p>VIC Government</p>	<ul style="list-style-type: none"> <li>+ Developing Zero Emissions Vehicle Roadmap.</li> <li>+ Invested in ultra-rapid and fast chargers at seven locations across Victoria.</li> <li>+ Undertaking trial of one electric bus until Jan 2021.</li> <li>+ Provide \$100 discount for EVs and hybrid vehicles in annual registration.</li> <li>+ Provide reduced Motor Vehicle duty rates for green passenger cars</li> <li>+ Supporting the development of SEA Electric’s new electric truck manufacturing facility in the Latrobe Valley creating 500 jobs.</li> </ul>
<p>SA Government</p>	<ul style="list-style-type: none"> <li>+ Developing EV strategy.</li> <li>+ Fleet SA set a target of 30% Low Emission Vehicles by 2019 for the Govt fleet which was achieved ahead of time (currently 50.6%), with Hybrid, Plug-in Hybrid and Battery Electric Vehicles now comprise 21% of the fleet (Predominantly Toyota Hybrids).</li> <li>+ Provided co-funding to the Charge Together Fleets program to develop a total cost of ownership calculator and an information tool for fleets.</li> <li>+ Provided grant funding towards the development 2 x BEV buses for use in metro fleet.</li> <li>+ Provided co-funding for public chargers with free charging periods.</li> <li>+ Signatory to the Memorandum of Understanding on electric vehicles to identify opportunities to collaborate in promoting and accelerating the transition to electric vehicles in Australia.</li> </ul>
<p>WA Government</p>	<ul style="list-style-type: none"> <li>+ Formed the Western Australian Electric Vehicles Working Group in 2018.</li> <li>+ Signatory to the Memorandum of Understanding on electric vehicles to identify opportunities to collaborate in promoting and accelerating the transition to electric vehicles in Australia.</li> </ul>
<p>TAS Government</p>	<ul style="list-style-type: none"> <li>+ Established the Electric Vehicle ChargeSmart Grants Program which has provided over \$600,000 in grant funding to support fast chargers, destination chargers and workplace chargers.</li> <li>+ Stimulating over \$2.5 million investment in fast chargers and further investment in destination and workplace chargers.</li> <li>+ The Smart Fleets program helps local government to prepare to integrate electric vehicles into their fleets.</li> <li>+ Established Electric Vehicle Working Group to develop a coordinated approach to support the uptake of electric vehicles in Tasmania.</li> </ul>

## Local Governments

In many local governments across Australia, there is a strong appetite to implement policies that support electric vehicles. These policies include community outreach, planning instruments, public charging infrastructure, and transitioning local government fleets to electric.

The Electric Vehicle Council continues to work with local governments on implementing these initiatives. We will be releasing a Local Government Resource Pack later this year which will document best practice approaches for local governments to assist them in doing their part to accelerate electric vehicle adoption in Australia.

# Appendix

## Appendix 1: Global car makers' commitments to electric vehicles<sup>145</sup>

AUTO GROUP	AUTOMAKER	COMMITMENT TO ELECTRIFICATION
BMW Group	BMW	<ul style="list-style-type: none"> <li>» €400 million on Dingolfing vehicle plant for electric vehicle production.</li> <li>» €5.95 billion on research and development in 2019 for electric vehicles.</li> <li>» €340 million on Leipzig EV plant.</li> <li>» €225 million on Munich battery plant.</li> <li>» 25 electrified models by 2023.</li> <li>» 5 BEVs by the end of 2021.</li> <li>» By 2025, EVs will account for between 15-25% of sales.</li> </ul>
	Mini	<ul style="list-style-type: none"> <li>» Part of BMW strategy</li> </ul>
Daimler AG	Mercedes-Benz	<ul style="list-style-type: none"> <li>» €10 billion on the development of the EQ vehicle portfolio.</li> <li>» By 2022, will bring more than 10 different all-electric vehicles to market.</li> <li>» 50% of passenger car sales will be PHEVs or BEVs by 2030.</li> <li>» Electrify the entire MercedesBenz portfolio - choice of at least one electric alternative in every MercedesBenz model series, taking the total to 50 overall.</li> </ul>
	Smart	<ul style="list-style-type: none"> <li>» 5.4 billion yuan (\$777 million) joint venture with Germany's Daimler to roll out its first fully electric vehicle in 2022.</li> <li>» Smart will remake itself into an EV-only manufacturer.</li> </ul>
FCA	Alfa Romeo	<ul style="list-style-type: none"> <li>» Alfa Romeo will launch 6 plug-in hybrids by 2022.</li> </ul>
	Fiat	<ul style="list-style-type: none"> <li>» Part of the FCA Group strategy of \$1Billion on infrastructure and plants across Italy.</li> <li>» \$700 million in the Mirafiori plant in Turin in preparation of the 2020 electric Fiat 500.</li> <li>» Full electric line up around the 500 family; company expects full utilization of Italian plants by 2022.</li> </ul>
	Jeep	<ul style="list-style-type: none"> <li>» Jeep will stop selling diesel cars in Europe by 2021.</li> <li>» Introduce four new, fully electric models by 2021.</li> <li>» Electric option for each vehicle by 2021.</li> <li>» 2 vehicle launches per year – 10 PHEVS and 4 BEVS by 2022</li> </ul>
	Masarati	<ul style="list-style-type: none"> <li>» A full-electric sports car that reaches more than 186 miles per hour.</li> <li>» Plans for 8 PHEVS and 4 BEVS.</li> </ul>

AUTO GROUP	AUTOMAKER	COMMITMENT TO ELECTRIFICATION
Ford Motor Co	Aston Martin	» By 2025, Astom Martin will relaunch the Lagonda brand as a pure-electric luxury marque.
	Ford	<ul style="list-style-type: none"> <li>» 2020 release of the Mach E.</li> <li>» By late 2022, will launch a full-electric F-150, with two midsize EV crossovers.</li> <li>» By 2022, 6 BEVs in North America, and a total of 16 globally.</li> <li>» \$1.45 billion in two southeast Michigan manufacturing facilities.</li> <li>» 3,000 new jobs to strengthen its leadership in trucks and SUVs and support the company's expansion into electric and autonomous vehicles.</li> <li>» By 2025, will invest \$11 billion with the aim of having 24 hybrid and 16 fully electric vehicles in its global model portfolio by 2022.</li> <li>» \$500 million investment in Rivian.</li> </ul>
General motors Corporation	General motors Corporation	<ul style="list-style-type: none"> <li>» Launch the Hummer EV SUT in late 2021 as a 2022 model.</li> <li>» \$2.3 billion on a joint venture battery plant in Ohio with long time cell supplier LG Chem.</li> <li>» \$300 million assembly plant for Chevrolet EV.</li> <li>» 20 BEVs by 2023.</li> <li>» A commitment to spend \$2.2 billion to retool its Detroit-Hamtramck assembly plant to build nothing but electric vehicles.</li> <li>» EVs for all of its brands, in volume, at a profit, and sell 1 million EVs a year by 2025 out of annual global sales of 10 million vehicles.</li> </ul>
	Buick	» Two Buick SUVs by 2025.
	Chevrolet	» Chevrolet will produce a 2022 Bolt EV.
Honda Motor Co	Honda	<ul style="list-style-type: none"> <li>» By 2022, all European mainstream models will be electrified, three years earlier than previously planned.</li> <li>» Launch 6 electric vehicles by 2023.</li> <li>» Electrify two-thirds of all cars by 2030.</li> <li>» \$180 million investment in EV/battery plant in Thailand</li> <li>» \$130 million investment in India</li> </ul>
Hyundai Motor Group	Genesis Motor	» Launch its first all-electric models in 2021, before expanding its electrical product range in 2024.
	Hyundai	<ul style="list-style-type: none"> <li>» Aims to achieve annual sales of 670,000 electric vehicles by 2025, of which 560,000 are BEV and 110,000 are fuel cell vehicles.</li> <li>» By 2024, \$20 billion investment in EVs, AVs and batteries.</li> <li>» Wants to electrify most of the new models in key markets such as South Korea, the USA, China, and Europe by 2030. Emerging markets such as India and Brazil are expected to follow by 2035.</li> <li>» By 2025, the Hyundai brand alone intends to launch 16 BEV models on the global market, not including its subsidiary Kia.</li> <li>» In the target year 2025, 1.67 million electrified vehicles are to be sold, of which more than 560,000 are battery-electric cars.</li> </ul>
	Kia Motors	<ul style="list-style-type: none"> <li>» 11 EVs by 2025.</li> <li>» EVs will make up about 20% of sales in key regions by 2025.</li> <li>» Plans to establish "Establish Mobility Hubs" in cities with stricter environmental regulations.</li> <li>» By 2025, plans to launch 44 electrified models – which includes hybrids and plug-in hybrids as well.</li> </ul>

AUTO GROUP	AUTOMAKER	COMMITMENT TO ELECTRIFICATION
Mazda Motor Corp	Mazda	» A target of 5% BEVs in 12 years.
PSA	Citroen	» Groupe PSA's five brands – Peugeot, Citroën, DS Automobiles, Opel and Vauxhall – will offer clean mobility solutions in the form of all-electric zero-emissions vehicles or plug-in hybrids emitting less than 49 grams of CO <sub>2</sub> per kilometre.
	Opel	» By 2025, electric or hybrid offshoots for all 40 models of its brands.
	Peugeot	» 5 EV models by 2021.
Renault-Nissan-Mitsubishi alliance	Infiniti	» Nissan's luxury brand will sell 100% electric and hybrid cars, starting in 2025. » The first Infiniti electric vehicles will roll off the production line in 2021.
	Mitsubishi	» 2023 launch for production of 9,500 battery electric vehicles (BEV) and about 29,500 hybrids. » Alliance with Nissan and Renault.
	Nissan	» 8 BEVs by 2022. » \$335 million in EV and battery plant in Thailand. » \$10 billion investment in EV. » In alliance with Mitsubishi and Renault Nissan plans to launch eight new electric cars by 2022. » Investment of \$300m at a plant in Japan to make its production methods more compatible with manufacturing an increasing number of electrified vehicles.
	Renault	» 9 BEVs by 2022. » \$220 million joint venture with Brilliance to build electric commercial vehicles in China. » \$10 billion investment in EVs. » Alliance with Nissan and Mitsubishi.
Rivian Automotive	Rivian	» An all-electric start up that has received \$500 million from Ford Motors and \$700 million from Amazon. » It also closed a \$1.3billion investment round in December 2019.
Subaru	Subaru	» By 2030, a minimum 40% of global sales will be electric vehicles (EVs) or hybrid electric vehicles (HEVs).
Tata Motors	Jaguar Land Rover	» Plans to manufacture a range of new electrified vehicles at its manufacturing plant in Castle Bromwich, UK. » Commitment to offer customers electrified options for all new Jaguar and Land Rover models from 2020. » EV investment \$2.34billion.
Tesla Inc	Tesla	» Electric Vehicle only manufacturer.
Toyota Motor Corporation	Lexus	» Expand its electrified vehicle line-up with the production of first PHEV. » New, dedicated BEV platform. » By 2025, Lexus will have available electrified versions of all Lexus vehicle models, with sales of electrified vehicle models to outpace those of conventional internal combustion engine vehicle models.
	Toyota	» 10,000 units planned for 2020 and 30,000 for 2021. » The first new BEVs by 2021. » 10 models are expected by 2025.



AUTO GROUP	AUTOMAKER	COMMITMENT TO ELECTRIFICATION
Volkswagen Motor Group	Audi	<ul style="list-style-type: none"> <li>» €37 billion for research and development expenditure and investment in property, plant and equipment to 2025.</li> <li>» Upfront expenditure of €12 billion solely for electric mobility between 2020 and 2024.</li> <li>» 30 electrified models by 2025, including 20 BEVs.</li> </ul>
	Bentley	» PHEV version of Bentayga by 2021.
	Bugatti	» Bugatti Chiron is expected to be ready by 2024.
	Porsche	<ul style="list-style-type: none"> <li>» By 2022, will invest more than €6 billion in electromobility, focusing on both plug-in hybrids and battery electric vehicles.</li> <li>» 50% BEVs by 2025.</li> </ul>
	Seat	<ul style="list-style-type: none"> <li>» Launch its first purely electric car in 2020.</li> <li>» Six electric and plug-in hybrid models by the beginning of 2021.</li> </ul>
	Skoda	» 10 electric models in its range by 2025, including 6 BEVs.
	Volkswagen	<ul style="list-style-type: none"> <li>» €44 billion for the development of electric vehicles, autonomous technology and new mobility services by 2023.</li> <li>» 1 million EVs annually by 2025.</li> </ul>
Zhejiang Geely Holding Group	Polestar	<ul style="list-style-type: none"> <li>» All electric Volvo brand.</li> <li>» Initial investment of €650 million (with Geely) to initiate the construction of luxury electric cars.</li> <li>» Medium-term goal is to produce 50,000 to 100,000 cars a year – including the Polestar 1 hybrid model, the Polestar 2 and a future SUV (both fully electric).</li> </ul>
	Volvo	<ul style="list-style-type: none"> <li>» In 2020, launch plug-in hybrids and pure electric cars.</li> <li>» By 2025, 50% of cars sold to be pure electric, and the other 50% to be hybrids.</li> <li>» 1 million EVs by 2025.</li> </ul>

## Appendix 2: Electric Vehicle model availability

Passenger vehicles available now:

OEM	MODEL	BEV/ PHEV	SEGMENT	PRICE (AUD)	BATTERY SIZE	ALL ELECTRIC RANGE (UP TO) KM WLTP	0-100KM/H (SECONDS)
Audi	e-tron 55 quattro	BEV	SUV	\$ 146,700	95 kWh	436km	5.7 in boost mode
	e-tron 50 quattro	BEV	SUV	\$ 137,700	71 kWh	336km	6.8
	e-tron 55 Sportback quattro	BEV	SUV	\$157,700	95 kWh	436km	5.7 in boost mode
	e-tron 50 Sportback quattro	BEV	SUV	\$148,700	71 kWh	336km	6.8
BMW	330e	PHEV	Sedan	\$77,257.30	10.3 kWh	60km	5.9
	i8 Coupe	PHEV	Sports	\$318,900	11.6 kWh	55km	4.4
	i8 Roadster	PHEV	Sports	\$348,900	11.6 kWh	55km	4.6
	i3	BEV	SUV	\$68,100	42 kWh	260km	7.3
	i3s	BEV	SUV	\$69,900	42 kWh	260km	6.9
	Countryman	PHEV	Mini	\$57,200	8 kWh	19km	6.8
Hyundai	Ioniq Plugin Elite	PHEV	Sedan	\$ 41,990	8.9 kWh	63km	10.6
	Ioniq Plugin Premium	PHEV	Sedan	\$46,490	8.9 kWh	63km	10.6
	Ioniq Electric Elite	BEV	Sedan	\$ 48,490	28 kWh	311km	9.9 (sports mode) 10.2 (normal Mode)
	Ioniq Electric Premium 2020	BEV	Sedan	\$52,490	38 kWh	311km	
	Kona Elite	BEV	SUV	\$60,140	64 kWh	449km	7.6
	Kona Highlander	BEV	SUV	\$64,490	64 kWh	449km	7.6

OEM	MODEL	BEV/ PHEV	SEGMENT	PRICE (AUD)	BATTERY SIZE	ALL ELECTRIC RANGE (UP TO) KM WLTP	0-100KM/H (SECONDS)
Jaguar Land Rover	I PACE	BEV	SUV	\$119,000	90 kWh	470km	4.8
	Range Rover Sport	PHEV	SUV	\$128,200	13.1kWh	48km	6.7
	Range Rover	PHEV	SUV	\$175,101	13.1kWh	48km	6.8
Mercedes Benz	EQC	BEV	SUV	\$137,900	80 kWh	434km	5.1
	A250e	PHEV	Hatch and Sedan	\$62,000	15.6 kWh	73km	6.6
	A250e	PHEV	Hatch and Sedan	\$64,600	15.6 kWh	73km	6.7
	C300e	PHEV	Sedan	\$82,300	13.5 kWh	52km	5.4
	GLC300e	PHEV	SUV	\$83,500	13.5 kWh	46km	5.7
	E300e	PHEV	Sedan	\$119,600	13.5 kWh	50km	5.7
Mitsubishi	Outlander	PHEV	SUV	\$47,390	13.8 kWh	54km	n/a
Nissan	Leaf	BEV	Small car	\$49,990	40 kWh	270km	7
Porsche	Cayenne E-Hybrid	PHEV	SUV	\$141,200	17.9 kWh	TBC	5.0
	Cayenne Turbo S E-Hybrid	PHEV	SUV	\$292,200	17.9 kWh	TBC	3.8
	Cayenne E-Hybrid Coupe	PHEV	SUV	\$151,000	17.9 kWh	TBC	5.1
	Cayenne Turbo S E-Hybrid Coupe	PHEV	SUV	\$297,900	17.9 kWh	TBC	3.8
	Panamera 4 E-Hybrid	PHEV	Sedan	\$251,800	14 kWh	51km	4.6
	Panamera Turbo S E-Hybrid	PHEV	Sedan	\$466,600	14 kWh	50km	3.4
	Panamera 4 E-Hybrid Sport Turismo	PHEV	Sedan	\$259,100	14 kWh	51km	4.6

OEM	MODEL	BEV/ PHEV	SEGMENT	PRICE (AUD)	BATTERY SIZE	ALL ELECTRIC RANGE (UP TO) KM WLTP	0-100KM/H (SECONDS)
Renault	Zoe Intens <sup>146</sup>	BEV	Small car	\$49,490	41 kWh	300km	14.5
	Kangoo MAXI	BEV	Light commercial van	\$49,990	33 kWh	200km	22.4
Tesla	Model S – Standard	BEV	Sports	\$108,100	-	490km (NEDC)	4.2
	Model S – Long range	BEV	Sedan	\$123,500	-	660km (NEDC)	3.8
	Model S – Performance	BEV	Sedan	\$133,000	-	650km (NEDC)	3.2
	Model S – Performance (Ludicrous mode)	BEV	Sedan	\$142,300	-	650km (NEDC)	2.6
	Model X – Standard	BEV	SUV	116,500	-	425km (NEDC)	4.8
	Model X – Long Range	BEV	SUV	\$131,900	-	575km (NEDC)	4.6
	Model X – Performance	BEV	SUV	\$141,100	-	550km (NEDC)	3.6
	Model X – Performance (Ludicrous Mode)	BEV	SUV	\$149,600	-	550km (NEDC)	2.9
	Model 3 – Standard Range Plus	BEV	Sedan	\$66,000	-	460km (NEDC)	5.6
	Model 3 – Performance	BEV	Sedan	\$85,000	-	560km (NEDC)	3.4
Volvo	XC90 T8	PHEV	SUV	\$114,000	11.6 kWh	45km	5.6
	XC60 T8 Polestar Engineered	PHEV	SUV	\$98,990	11.6 kWh	45km	5.6
	S60	PHEV	Sedan	\$84,990	11.6 kWh	49km	4.4
	V60	PHEV	Wagon	\$86,990	11.6 kWh	49km	4.6

## Passenger vehicles available in the future

OEM	MODEL	BEV/ PHEV	SEGMENT	PRICE (AUD)	BATTERY SIZE	ALL ELECTRIC RANGE (UP TO) KM WLTP	0-100KM/H (SECONDS)	DATE AVAILABLE
BMW	Mini Electric	BEV	Mini	\$35,191	32.6 kWh	270km	7.3	Mid 2020
MG	ZS EV	BEV	SUV	\$46,990	44.5 kWh	262km	8.2	Q4 2020
Porsche	Taycan 4S	BEV	Sedan	\$190,400	79.2 kWh	365km	4.0	Dec 2020
	Taycan Turbo	BEV	Sedan	\$268,500	93.4 kWh	420km	3.2	Dec 2020
	Taycan Turbo S	BEV	Sedan	\$338,500	93.4 kWh	405km	2.8	Dec 2020
	Taycan 4S	BEV	Sedan	\$190,400	79.2 kWh	365km	4.0	Dec 2020
Volvo	Volvo XC40	PHEV	SUV	TBC	10.7 kWh	46km	7.3	2020
	Volvo XC40	BEV	SUV	TBC	78 kWh	400km	4.9	2021
	Polestar 2	BEV	Wagon	TBC	78 kWh	500km	4.7	2021

## Two wheeled vehicles available now

OEM	MODEL	SEGMENT	PRICE (AUD)	BATTERY SIZE	ALL ELECTRIC RANGE
Fonzarelli	Arthur 1	Scooter	\$3,990	3 kWh	50
	Arthur 2	Scooter	\$4,990	5.5 kWh	50
	Arthur 3	Scooter	\$6,990	8 kWh	100
	X1	Scooter	\$10,990	8 kWh	80
	NKDa	Motorbike	\$7,715	8 kWh	50
	NKDs	Motorbike	\$10,715	8 kWh	100
	NKD+	Motorbike	\$13,215	10 kWh	150
	NK Dx	Motorbike	\$15,715	12 kWh	200
Harley-Davidson®	LiveWire™ <sup>147</sup>	Motorbike	\$49,995	15.5 kWh total, 13.6 kWh min usable	235km City Range & 152 combined stop-and-go and highway range.
Savic	Alpha	Motorbike	\$23,990	11 kWh	200
	Delta	Motorbike	\$16,990	9 kWh	150
	Omega	Motorbike	\$12,990	7 kWh	120

## Commercial electric vehicles available now

OEM	MODEL	TRIM	BEV/ PHEV	SEGMENT	PRICE (AUD)	BATTERY SIZE	ALL ELECTRIC RANGE (UP TO) KM
Bortana EV	BEV	Agrale Marruá				52 kWh	Approx. 120km
GB Auto	TEMBO 4x4 E-LV	Converted Toyota Land Cruiser 70 series & Hilux	BEV	Mining		28.4 kWh	80km
	TEMBO 4x4 E-LV	Converted Toyota Land Cruiser 70 series & Hilux	BEV	Mining		56.8 kWh	160km
Renault	Kangoo MAXI		BEV	Van	\$49,990	33 kWh	200km
SEA Electric	E4V	Van	BEV	Van	\$113,500	88 kWh	300km
	E4B	Mini-Bus	BEV	Mini-Bus	\$123,500	88 kWh	300km
	816	Truck Cab- Chassis	BEV	5-8.5t GVM Truck	Varies Based on Specification	100-136 kWh	275km (Unladen)
	FE	Truck Cab- Chassis	BEV	12-14t GVM Truck	Varies Based on Specification	136 kWh	320km (Unladen)
	GH	Truck Cab- Chassis	BEV	>14t GVM Truck	Varies Based on Specification	136-220 kWh	230km (Unladen)
	616	Truck Cab- Chassis	BEV	<5.5t GVM Truck	Varies Based on Specification	70-100 kWh	250km (Unladen)
Voltra	e-cruiser	70 series Toyota landcruiser	BEV	Mining		42.24 kWh	
Zero Automotive	ZED 70		BEV	Mining	\$200,000	88 kWh	350km

## Commercial vehicles available in the future

	MODEL	BEV/PHEV	SEGMENT	PRICE (AUD)	BATTERY SIZE	ALL ELECTRIC RANGE (UP TO) KM
ACE	ACE Cargo	BEV	Light commercial	TBA	23.2 kWh	200km
	ACE Yewt	BEV	Utility Van	TBA	23.2 kWh	200km
Daimler Group	eVito	BEV	(Passenger and Cargo Van)	TBA	TBA	TBA
	eSprinter	BEV	Cargo Van and Cab Chassis	TBA	TBA	TBA
	eCanter	BEV	Light Duty Truck	TBA	TBA	TBA



## Appendix 3: Car maker investments and ventures into secondary battery applications

CAR MAKER	VENTURE
Audi	Operates a 1.9 MWh energy storage project at the EUREF-Campus in Berlin using discarded Audi e-tron test vehicle batteries. <sup>148</sup>
BMW	Collaboration with European battery factory Northvolt and materials processing company to develop battery reuse and recycling systems. <sup>149</sup>
BYD	Plans with China Tower to replace lead-acid with used EV batteries to provide backup power for telecom towers. <sup>150</sup>
Daimler	In collaboration with Mobility House and a local utility where 1920 used electric vehicle battery modules are assembled at a retired coal plant to supply balancing power to the grid. <sup>151</sup>
Hyundai	Energy storage partnership with Wärtsilä for utility scale and commercial applications for second life EV batteries. <sup>152</sup>
Jaguar Land Rover	Supply of I-pace batteries to the University of Warwick for application of used batteries as energy storage systems. <sup>153</sup>
Mitsubishi	A solar-plus-storage system is to power the manufacturing of electric vehicles (EVs) at Mitsubishi Motors Corporation's (MMC) Okazaki Plant in Japan. <sup>154</sup>
Nissan	In 2010 launched 4R Energy Corporation with Sumitomo corporation to develop and test EV batteries as part of a stationary energy storage system. <sup>155</sup>
Renault	Energy storage system with Connected Energy to provide firm frequency response to the grid and as a revenue generator for Umicore. <sup>156</sup>
Volkswagen	Creating a "power bank for the e-car", a mobile rapid charger consisting of up to 360kWh second-life EV batteries that can charge up to four vehicles simultaneously. <sup>157</sup>

## Appendix 4: Bus industry partnerships

PROJECT	PARTNERS	ROLE	DETAIL
Brisbane Metro Project	ABB	EV engineering operating in Australia	Brisbane City Council and its project partners will design and build one pilot Metro vehicle for testing in Brisbane. A further 59 Metro vehicles will follow, with fit-out and finishing to take place at Volgren's Brisbane base at Eagle Farm. <sup>158</sup>
	Hess AG	Swiss bus manufacturer	
	Volgren	Australian bus manufacturer	

- 148 Audi (2019)  
 149 Green Car Reports (2018)  
 150 IDTechEX (2018)  
 151 Inside EVs (2018)  
 152 Wärtsilä (2018)  
 153 University of Warwick (2019)  
 154 Energy Storage News (2019)  
 155 Nissan Motor Corporation  
 156 Connected Energy (2019)  
 157 Smart Energy International (2019)  
 158 ABB (2019)

PROJECT	PARTNERS	ROLE	DETAIL
Gemilang and OzPress Industries	ARCC	ARCC provide software engineering support.	Gemilang Australia is planning to build electric buses in Australia <sup>159</sup> with a new facility in Ballarat Victoria established as a bus assembly plant with OzPress Industries. The body of the bus is designed and provided by Gemilang Australia and construction takes place in the Gemilang's Malaysian bus body facility.
	BYD	The chassis is designed and built in China by BYD	
	Gemilang, Industries	Bus body design in Australia	
	OzPress	manufacturer of metal pressings and assemblies	
Joondalup CAT service	Public Transport Authority Western Australia	Transport operator	As part of a bus agreement between Transperth and Volvo, four electric buses will be delivered to PTA. The product buses will be delivered in chassis form and Volvo will work with long term partners such as Volgren to assemble the electric bus here in Australia. Volvo and PTA expect the buses to be in operation by early 2022. <sup>160</sup>
	Volgren	Builds and designs local Australian bus bodies	
	Volvo Buses	Volvo chassis supplier	
Memorandum of Understanding (MoU) for R&D	Ebusco	Dutch electric bus manufacturer	UNSW students and research experts will have the opportunity to work with Ebusco engineers on diverse subject areas, such as transport planning, energy storage and advanced and precision manufacturing. Opportunities to work directly with the company's engineers on the next generation of Ebusco's electric bus fleets.
	UNSW	Research on sustainable future technologies such as manufacturing and engineering.	
Regional partnership	Australian Bus Corporation	Bus design, engineering and manufacturing capability and capacity	The Ebusco 2.2 electric bus and the next-generation, carbon-based Ebusco 3.0 will be manufactured in Australia in a purpose-built high-tech facility. <sup>161</sup>
	Ebusco	Dutch electric bus manufacturer	
SA Government	Bustech	Bus chassis manufacturer	SA Govt \$2million grant to locally develop and build 2 e-buses in 2017.
	Precision Buses	A leading Australian specialist in the development, manufacture and supply of specialised press metal, fabricated components and assembly solutions	
	ZF Lemforder Australia	Motor vehicle parts manufacturer	

159 Business Insider Australia (2017)

160 Volvo Buses Australia (2020)

161 Australasian Bus &amp; Coach (2020)

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