Community Electric Vehicle Transition Plan: Part A

Prepared for the Northern Councils Alliance

Final Version, December 2022

Institute for Sensible Transport

Northern Councils Alliance

VICTORIA State Government | Jobs, Precincts and Regions

NORTHERN Metropolitan Partnership

The Institute for Sensible Transport acknowledges the people of the Wurundjeri Woi Wurrung language group of the eastern Kulin Nation on whose unceded lands we work.

We respectfully acknowledge their Ancestors and Elders, past and present.

We also acknowledge the Traditional Custodians and their Ancestors of the lands and waters across Australia where we conduct our business.

This project was coordinated by the Northern Councils Alliance and the Northern Metropolitan Partnership and was resourced through the Metropolitan Partnership Development Fund. It aligns with the Northern Metropolitan Partnership priorities for the Northern region of Transport Connectivity and Environment Sustainability. Delivery has been overseen by the City of Whittlesea.

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Glossary

AC Alternating Current. An electric current that reverses its direction many times a second at regular intervals.

ARENA Australian Renewable Energy Agency

BEV Battery Electric Vehicles. A type of electric vehicle that exclusively uses chemical energy stored in rechargeable batteries. BEVs use electric motors and motor controllers instead of internal combustion engines.

Charger A device capable of charging an electric vehicle

Charging Ports The location of which a charging plug is connected to the charger. Many chargers are dual port which means two EVs can use the same charger simultaneously.

Charging Station Two or more chargers in the same location.

DB Distribution board. An electrical cabinet that contains circuit breakers and fuses for each electrical circuit within a building or part of a building.

DC Direct Current. An electric current that flows in one direction only.

DNSP Distribution Network Service Provider. They are the organisations that own and control the hardware of the distributed energy network such as power poles, wires, transformers, and substations that move electricity around the grid.

DoT Department of Transport. A government department in Victoria that is responsible for the ongoing operation and coordination of the Victorian transport networks, and the delivery of new and upgraded transport infrastructure.

EPA test The United States Environmental Protection Agency test. This is a testing standard for a vehicle's driving range, and is typically the most conservative of the three.

EV Electric Vehicle. A vehicle that is either partially or fully powered on electric power. Technically, EVs can include two wheeled devices, such as e-bikes, however for the purpose of this report, EVs generally refer to four wheeled vehicles.

EVSE Electric Vehicle Supply Equipment. Commonly called charging stations or charging docks, EVSE provide electric power to electric vehicles and recharge the vehicle's batteries. EVSE systems include electrical conductors, related equipment, software, and communications protocols that deliver energy efficiently and safely to the vehicle.

FCEV Fuel Cell Electric Vehicle. A type of electric vehicle that uses a fuel cell, sometimes in combination with a battery or supercapacitor, to power its onboard electric motor. They are powered by hydrogen and do not produce tailpipe emissions.

GHG Greenhouse gas. A gas that absorbs and emits radiant energy within the thermal infrared range, causing the greenhouse effect.

HEV Non-plug-in Hybrid Electric Vehicle. A type of vehicle that combines an internal combustion engine system with an electric propulsion system that can work either simultaneously or independently.

ICE Internal Combustion Engine, powered by either diesel or petrol.

ICEing The act of deliberately parking an ICE vehicle in an EV charging bay to prevent EVs from being able to charge.

LREV Long Range Electric Vehicle

Micro mobility Personal mobility that is low weight and low speed, typically involving vehicles less than 35kg, travelling at 25km/h or less. Micro mobility can include walking, cycling, e-bike, e-scooter and e-cargo bikes.

NEDC New European Driving Cycle. This is a testing standard for a vehicle's driving range.

PHEV Plug-in Hybrid Electric Vehicle. A vehicle that is powered by petrol or diesel as well as an electric motor and a small battery, able to be charged by plugging into an electrical socket.

Smart charging refers to a charging system where a data connection is shared between electric vehicles, charging stations, and electricity network operators to allow users to monitor, manage and adjust energy consumption. Smart technology can alleviate pressure from the grid system and save associated charging costs for EV users.

VKT Vehicle Kilometres Travelled

V2L Vehicle to Load, whereby the electricity stored in a vehicle's battery is used to power an external device, typically offering a standard 240V outlet.

V2H Vehicle to Home, whereby the electricity stored in a vehicle's battery is used to power a home.

V2G Vehicle to Grid describes the capability of a vehicle to supply energy from the battery to the electricity network.

SA1 Statistical Area Level 1. A classification used by the Australian Bureau of Statistics to describe the smallest unit for the release of census data.

SA2 Statistical Area Level 2. A classification used by the Australian Bureau of Statistics to describe medium-sized general purpose areas built up from whole Statistical Areas Level 1 (SA1s). Their purpose

is to represent a community that interacts together socially and economically.

SB Switchboard. The main electrical cabinet containing the incoming electricity supply and distributes it across a building or to smaller distribution boards

SREV Short Range Electric Vehicle

WLTP Worldwide Harmonised Light Vehicle Test Procedure. This is a testing standard for a vehicle's driving range.

Executive Summary

Transport is a major source of greenhouse gas emissions in Australia, including in the northern region of Melbourne. This project provides a planned response to facilitate the community's transition to lower emission forms of transport.

The primary focus of this project is the development of an evidence based, detailed plan for growing publicly available EV charging opportunities.

The challenge of meeting our emissions target

Australia has legislated a 43% emissions reduction target by 2030. Transport is the fastest rising source of emissions, having grown 60% since 1990. New vehicles sold today have higher emissions than those sold in 2016, due to the growth in large, petrol and diesel utes and SUVs.

The average vehicle in Australia has a lifespan of around 20 years. Last year, 98% of all new vehicles sold were petrol or diesel. Even if all new vehicles purchased from 2023 onwards were zero emission, Australia would not be able to meet the 43% target within the transport sector.

Given the scale of the emissions challenge, a rapid, urgent shift towards zero emission vehicles is required. This must extend beyond EVs, to include implementation of enhanced public transport services, powered by zero emission technology. A rapid increase in the scale of investment in active transport (walking and cycling) networks is also essential. EVs will be beyond for budget of many residents for years to come, and infrastructure to support walking and cycling can have a faster, more affordable impact.

Study area

This report covers participating Northern Councils Alliance (NCA) local government areas, which include:

- Banyule
- Darebin
- Hume
- Merri-bek
- Mitchell
- Nillumbik
- Whittlesea

What does this report do?

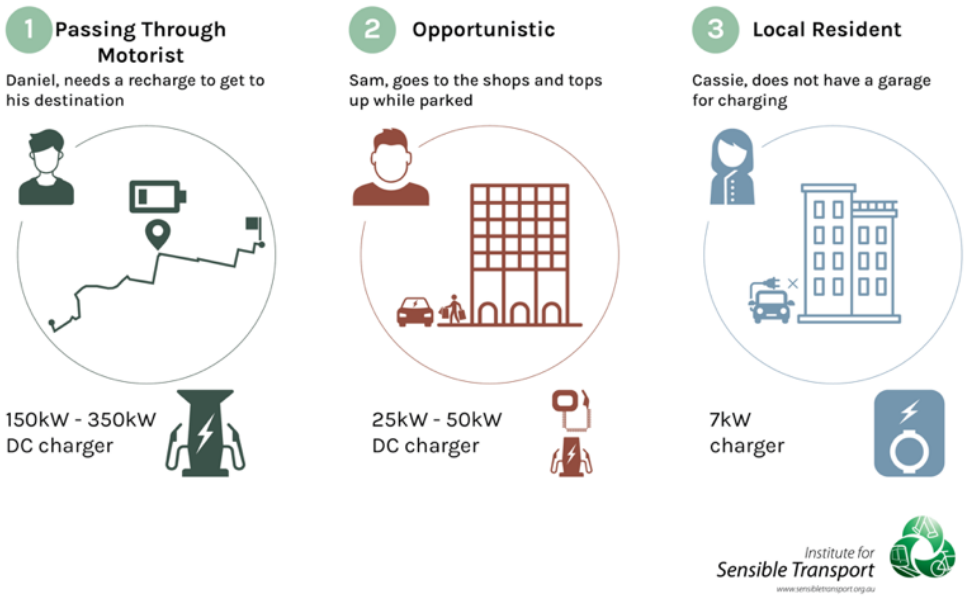
This report offers the NCA region with a community-wide EV transport plan that includes:

- An assessment of the future demand for EVs and charging infrastructure
- A characterisation of the different EV charging markets and charger types, including costs
- A prioritisation framework to assist NCA understand which activity centres are likely to have the highest demand for charging
- A recommended roll out plan for EV chargers across the NCA region
- A set of recommendations designed to bring about wider improvements in the sustainability of the transport system in Melbourne's north.

What we found

This project has several key findings:

- EV sales are starting to grow rapidly in Australia. They now constitute 3.4% of all new vehicles sold. While this is much lower than other OECD countries, it is a rapid increase on previous years. This trend is expected to continue.
- EVs, compared to a few years ago are cheaper, have longer battery life, and are beginning to become available in a more diverse set of body types.
- The charging market is composed of three key charging typologies, as highlighted in the graphic below.
- State and Commonwealth policy is increasingly supportive of EV adoption.

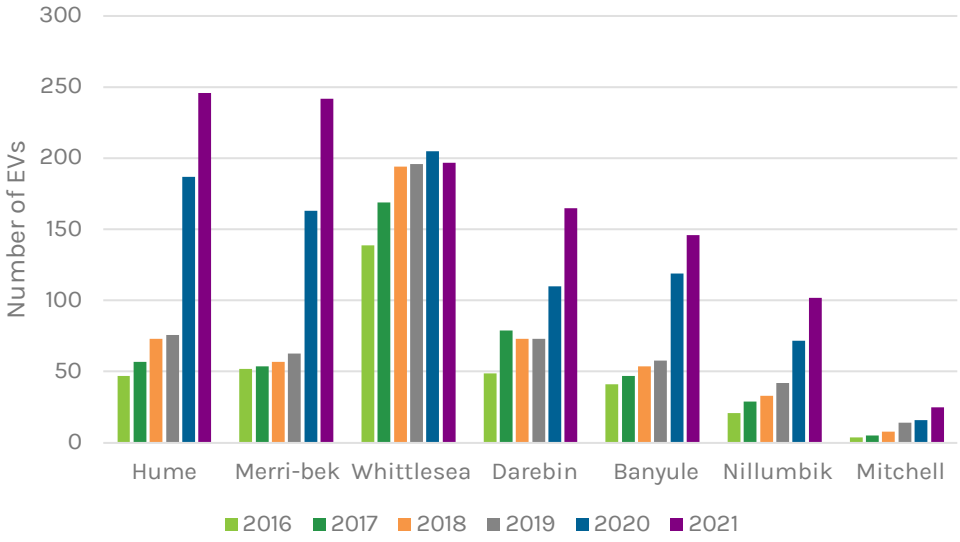


Differentiating the public charging market

- The EV charging industry has a strong appetite for investment, but requires long lease times to recover their investment. It is no longer necessary for local governments to fund charging networks in many instances.
- Local governments providing free charging is no longer necessary. This inhibits the expansion of additional charging opportunities, and can distort travel patterns and charging behaviour.
- The new Commonwealth Government recently announced changes to the National Building Code to support increased sustainability outcomes in new buildings. As part of this, all new multi-dwelling units (apartment buildings) are required to facilitate the future installation of EV charging equipment (see section J1P4 and J9D4 of Volume 1 of the Code).

EV ownership is growing in the NCA

The graph below highlights the growth in EV ownership within the NCA participating councils.

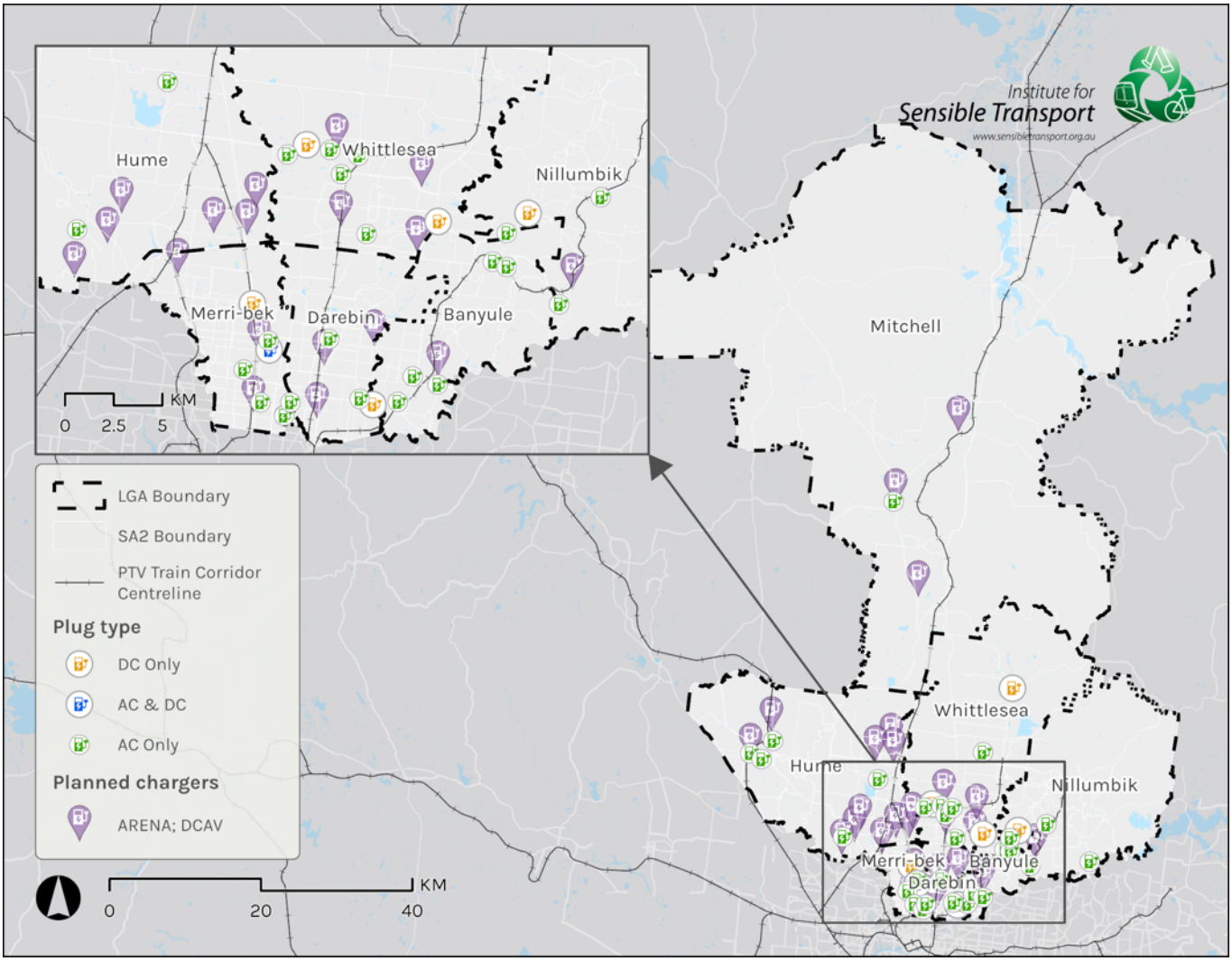


EV ownership between 2016 – 2021 in the NCA

Source: ABS

Existing and planned EV chargers in NCA

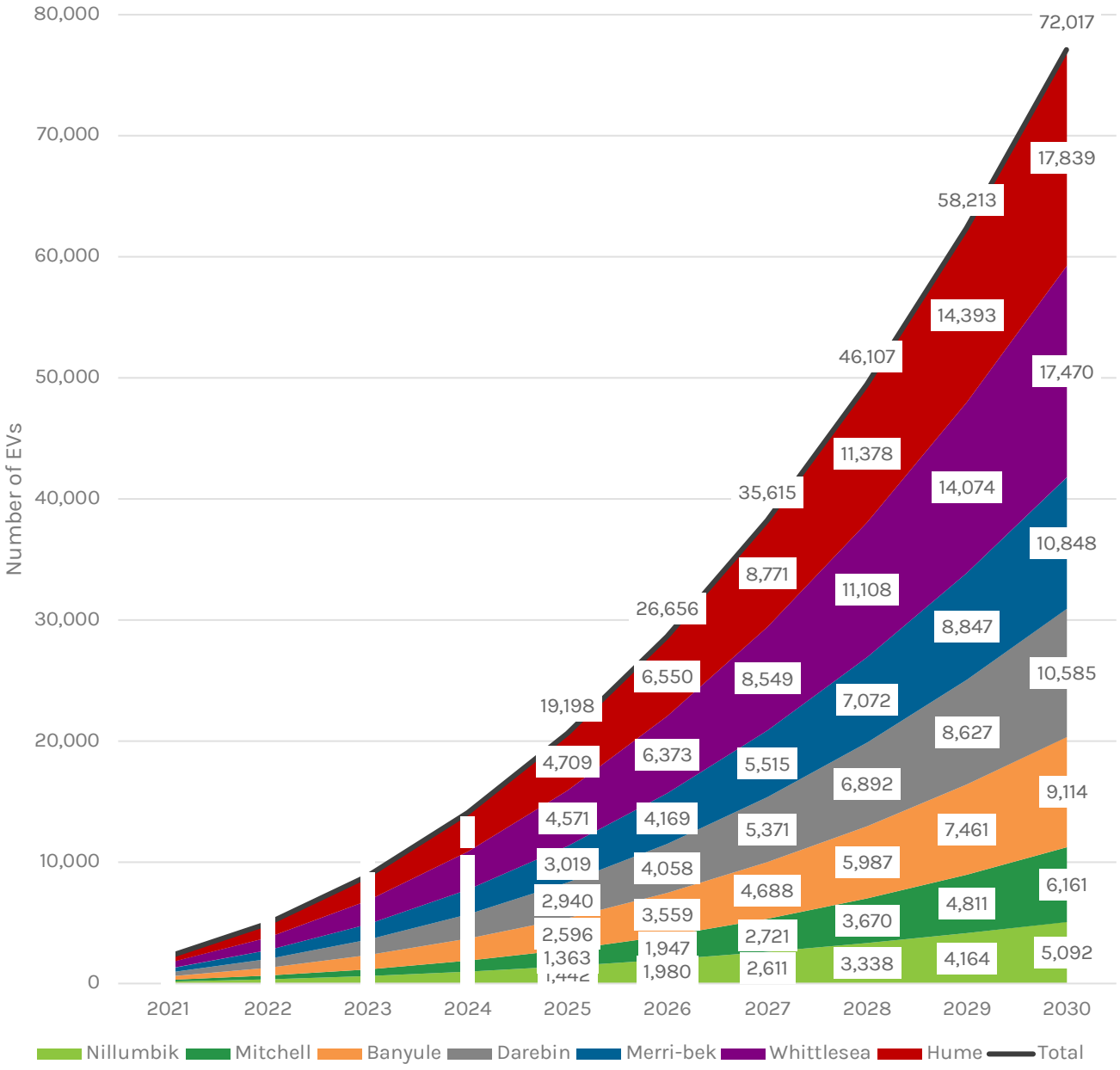
The map below highlights the publicly available EV chargers that exist now, or are funded but yet to be built within the NCA region.



Existing and planned (funded) EV chargers in the NCA

Estimating future EV ownership

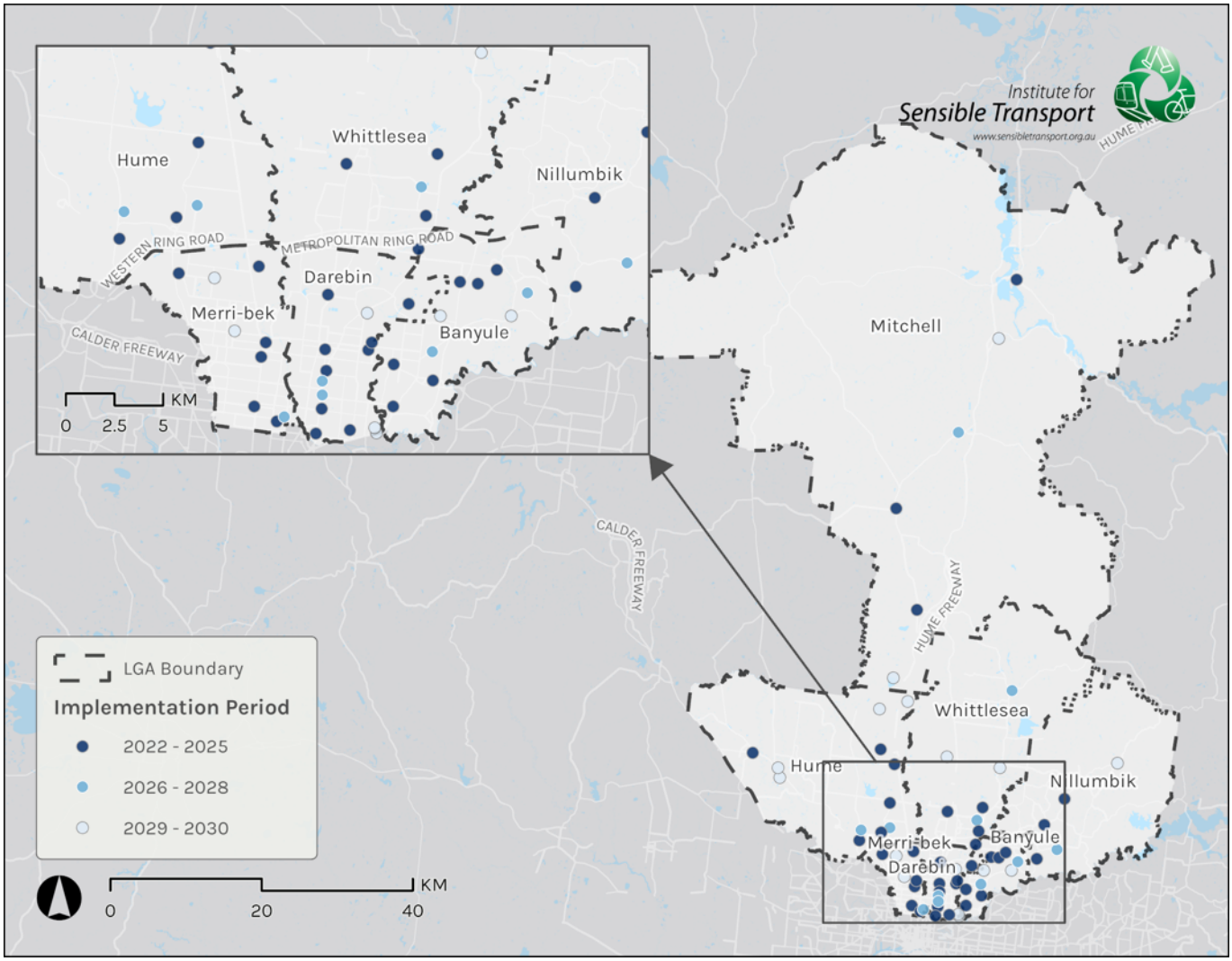
This report has used AEMO and CSIRO forecasts to estimate EV ownership in the NCA region between now and 2030. This process is necessary to understand potential demand for the chargers recommended in this plan.



Forecast EV ownership by LGA

The public charging network

The recommended public charging network consists primarily of medium to fast chargers, located in activity centres. In addition, two *ultra fast* chargers have been recommended, for Beveridge and Keilor (see Figure 41). The opportunistic chargers, prioritised based on the snapshot of current activity centres and forecasted demand are shown in the map below and more information on our methodology can be found in Section 9.1.3.



Recommended implementation period for opportunistic chargers

Consultation conducted as part of this project revealed that the EV charging industry are frustrated with local government recommending specific sites for EV chargers and prefer *areas.* Companies are then able to identify specific sites that offer good opportunities for installing EV charging stations. This report recommends areas, not specific sites.

Readers are encouraged to visit the online, interactive map at the following link for a more detailed look at the breakdown in prioritisation score and recommended number of ports required for each activity centre.

https://storymaps.arcgis.com/stories/8fc4488ecc4d4471b34707da82d70ef5

The role of local government in the charging network

Increasingly, the role of local government in charging will be one of *facilitation*. Councils often own or manage sites that have car parking, and these locations can be focal points for the community (e.g. libraries, commercial areas, town halls, leisure centres etc.), often in the heart of activity centres. Councils are therefore in a powerful position to engage with the EV charging industry to negotiate outcomes in which charging is provided by the private sector at little or no direct financial cost to the council. Indeed it is possible for some sites to attract rental payments from commercial EV charging providers.

A series of four different ownership models were explored. Regardless of the level of involvement councils wish to have on a future charging network, councils should apply scrutiny to bids/expressions of interest from the commercial sector, especially those without a significant, positive track record of running similar systems in Australia. The billing and user interface is fraught with a myriad of issues that are complex and ever changing.

Regardless of the level of involvement councils wish to have on a future charging network, councils should apply scrutiny to bids/expressions of interest from the commercial sector.

What else can NCA do to help lower transport emissions?

A range of other actions are recommended to maximise the emission reduction possibilities in the transport sector. These include:

- Applying for ARENA funding to speed up investment in EVs and charging.
- Work to speed up investment in the walking and cycling network, including protected bike lanes and paths. This must occur at a pace and scale beyond historical levels of investment.
- Advocate for an EV Planning Scheme Amendment to ensure new developments have sufficient charging possibilities.
- Promote the use of cycling and e-bikes for council staff.
- Encourage the car share industry to include EVs into their fleet.
- Hold *come and try* days to increase awareness of zero emission transport options, including e-bikes, e-cargo bikes, and cars.
- Work with higher levels of government to hold business expos that highlight the opportunity for business to transition to carbon free transport.
- Facilitate community bulk buys for EV purchase and explore options for extending this to e-bikes, e-cargo bike etc.

Work to speed up investment in the walking and cycling network, including protected bike lanes and paths. This must occur at a pace and scale beyond historical levels of investment.

1. Introduction

An overreliance on internal combustion engine (ICE) vehicles is contributing to climate change, in Australia and within the Northern Council Alliance region. Transport contributes 20% of greenhouse gas emissions within the northern Melbourne region.

Transitioning to electric vehicles (EVs), powered by renewable energy, provides a significant opportunity to decarbonise transport. There is also an opportunity to look at changes to transport beyond electrification; moving towards a more multi-modal transport system would bring additional co-benefits such as reduced congestion, improved health, reduced transport costs, as well as positive effects for the environment.

This project, the *Community-wide EV Transition Plan* is funded by the State Government via the Northern Metropolitan Partnership. It is one part of a two-part project that outlines opportunities for local government to support the community to reduce their transport emissions. A separate, related project, run concurrently, focuses on the transition of council fleet vehicles from ICE to zero emission vehicles.

1.1 Why this project is necessary

The community in Melbourne's northern region are interested in reducing their emissions and transport costs. The provision of a charging network and other initiatives intended to speed the transition to EVs will help decarbonise the transport system and provide more climate friendly transport choices.

Community sentiment on EVs is evolving rapidly, and some councils have begun to receive requests from residents for public EV charging. This project provides the necessary research to provide a coherent, planned response to enable the community to transition to lower emission forms of transport. In addition to the emission reduction benefit that comes from shifting towards EVs as a replacement for ICE vehicles, there is also a potential economic benefit to the businesses in close proximity to a well-used EV charging station.

1.2 Project objectives

There are six objectives for this project:

1. Develop a comprehensive Community-Wide Electric Vehicle Transport Plan for the NCA region, with a 10-year horizon
2. Increase the capability and capacity of councils to support the roll-out of EV infrastructure and uptake of EVs for businesses and the community
3. Identify key priorities for investment and build the case for these priorities
4. Identify and address key planning and policy considerations relation to EV transition
5. Support advocacy for investment in community-wide EV transition and advocacy to state and commonwealth governments to increase incentives for EVs
6. Position Melbourne's north as a leading hub of EV infrastructure and manufacturing investment.

The primary focus of this project is the development of an evidence based, detailed plan, that provides the blueprint for growing publicly available EV charging opportunities.

Consultation is a critical component of this project, covering different units within the participating councils, businesses, and the EV charging industry as well as the state government.

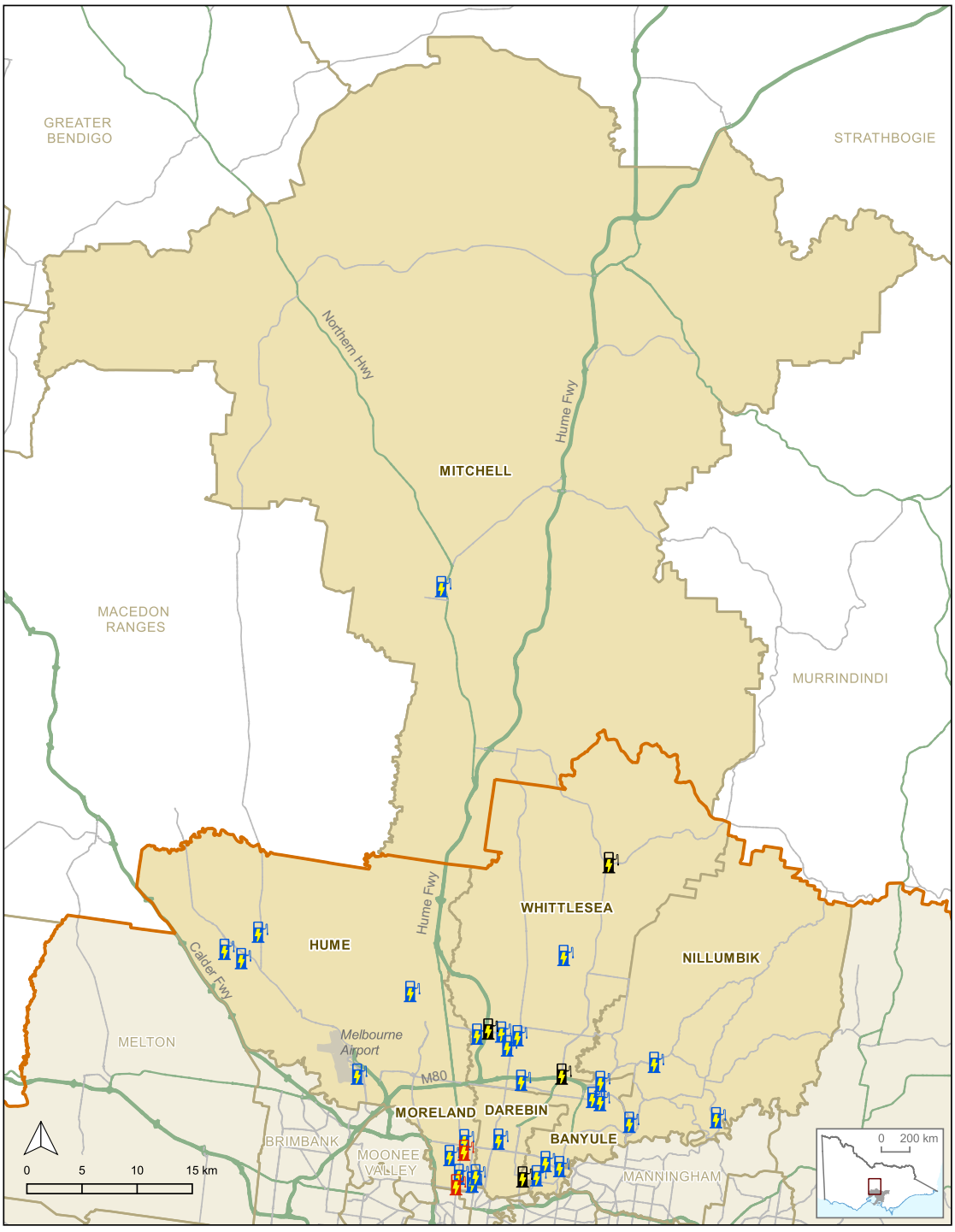
1.3 Study area

This project encompasses the following LGAs:

- Banyule
- Darebin
- Hume
- Merri-bek
- Mitchell
- Nillumbik
- Whittlesea

Figure 1 provides a map of the study area and the existing publicly available charging stations.

Type 2 and CCS electric vehicle charging stations within study area



Legend

Electric vehicle charging station type
- Type 2
- CCS/SAE
- Type 2, CCS/SAE

- Local Government Area of interest
- Local Government Area boundary
- Metropolitan Melbourne region
- Metropolitan Melbourne region boundary

- Freeway
- Highway
- Major road

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Map designed for A4 print. EV charging station locations based on plugshare.com. Station type sourced from plugshare.com, 09 June 2022. All base layers sourced from the Victorian Government. EV charging stations include public, restricted and private sites. Only Type 2 and CCS/SAE plugs shown. Map created 12 June 2022. GDA94/Vicgrid94.

Figure 1 Study area and existing EV charging stations

2. Reducing transport emissions

This project investigates opportunities to reduce transport emissions by assisting the community's transition to EVs. This includes communities and businesses within the Northern Councils Alliance (NCA) area. In this section, we will outline the task for reducing transport emissions to meet State and Commonwealth objectives.

Current estimates show that transport emissions in the NCA area are projected to increase by 2030. Figure 2 shows that over 650,000 tonnes of CO_2-e are currently emitted by the transport sector, rising to 725,000 by 2030.

While Australia has legislated a 2030 target for a 43% reduction in emissions compared to 2005 levels, existing trends suggest this target is unlikely to be met.

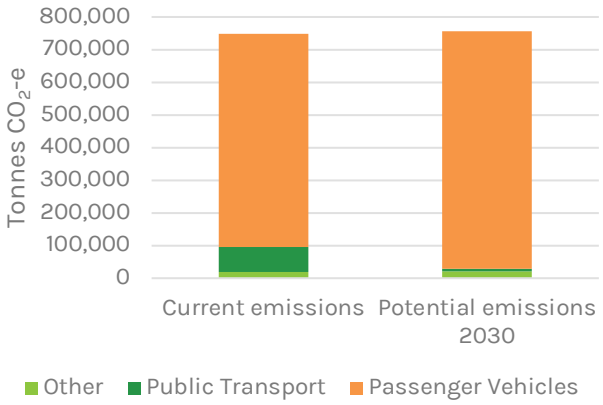


Figure 2 Current and forecast transport emissions Northern Councils Alliance area

Source: Adapted from CSIRO, AEMO, ABS Census, ABS Motor Vehicle Census

A reduction in emissions of 43%, must be seen in the context of rising transport emissions. Transport emissions rose from 95.921 kt of CO_2-e in 2005 to 114,432 kt of CO_2-e in 2019. As such, to achieve a 43% reduction from 2005 levels, current transport emissions must be reduced by around 52%.

These figures highlight the importance of considering transport emissions holistically to drive emissions down to meet state and national emissions targets.

To reach the 43% target, as well as the net zero transport emissions by 2050, we need to look beyond EVs, to a multi-modal transport system.

Ensuring the use of renewable energy for public charging stations and encouraging home charging to use renewable energy (e.g. through rooftop solar PV) are two ways local government can help reduce emissions further.

Statement on the importance of being powered by renewable energy

If powered by standard Victorian grid electricity, EVs only provide very marginal reductions in transport emissions. This highlights the importance of creating a charging network that is powered by renewable energy. It is now commonplace for the commercial EV charging networks to purchase an equivalent amount of electricity from certified renewable energy. To support NCA's commitment to reducing emissions, it is paramount that the electricity is sourced from renewable means. Furthermore, the marketing and branding of the EV charging stations should make it clear that all electricity for the charging network is sourced from zero emission generation.

Box 1 The importance of renewable energy

2.1 Why is it important to reduce transport emissions?

Transport is the fastest growing source of emissions in Australia. Unlike other sectors, which have been reducing their carbon emissions, transport emissions have proved more difficult to combat. Transport emissions in Australia have risen 60% since 1990 and the average emissions of new vehicles sold today are higher than those sold in 2016.

Australian transport emissions have risen 60% since 1990

There are four key methods through which transport emissions can be lowered, as identified in Figure 3. Conversion to EVs is one key method for reducing emissions, but other pathways are also available. Figure 3 serves to contextualise the role

EVs play in reducing transport emissions. It is critically important that councils prioritise the pathways that reduce overall vehicle use, with EVs offering a solution once opportunities for mode shift have been maximised. It is essential for government to prioritise the non-EV pathways if we are to meet our climate change targets. This includes shifting short and medium distance trips to walking and cycling. Other benefits from this approach include improved population health, congestion reduction and other desirable policy outcomes.

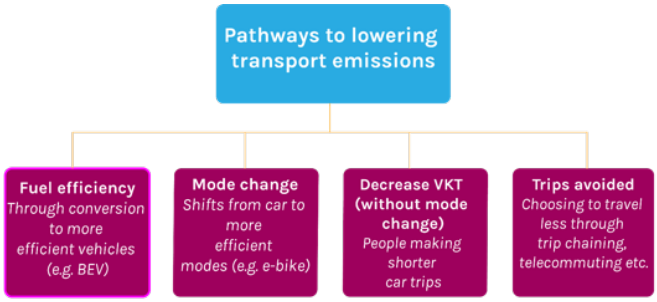


Figure 3 Pathways for lowering emissions

NB: VKT stands for Vehicle Kilometres Travelled

Source: Institute for Sensible Transport

Figure 4 provides a representation of the emissions intensity and space consumption of different modes of transport, drawn from Victorian data. The size of the black balloons is proportional to the emissions *per person kilometre travelled*. The footprints represent the space consumption of each mode of transport. This helps to highlight that an EV, powered with grid electricity, offers only a marginal improvement on emissions. In addition, it also shows how *mode shift* to non-car modes can offer significant energy, emissions and space savings. As the electricity network becomes less emissions intensive in Victoria, the emissions associated with charging EVs with grid electricity will diminish but are expected to continue to be significant for some time.

Ultimately the ambition of local government to combat climate change will be best achieved by maximising the contribution of the modes that have the smallest black balloons in Figure 4. Given that around 40 – 50% of car trips are under 5km, walking and cycling presents significant potential to lower emissions while minimising impact on the transport network, as these modes use less space than motor vehicles.

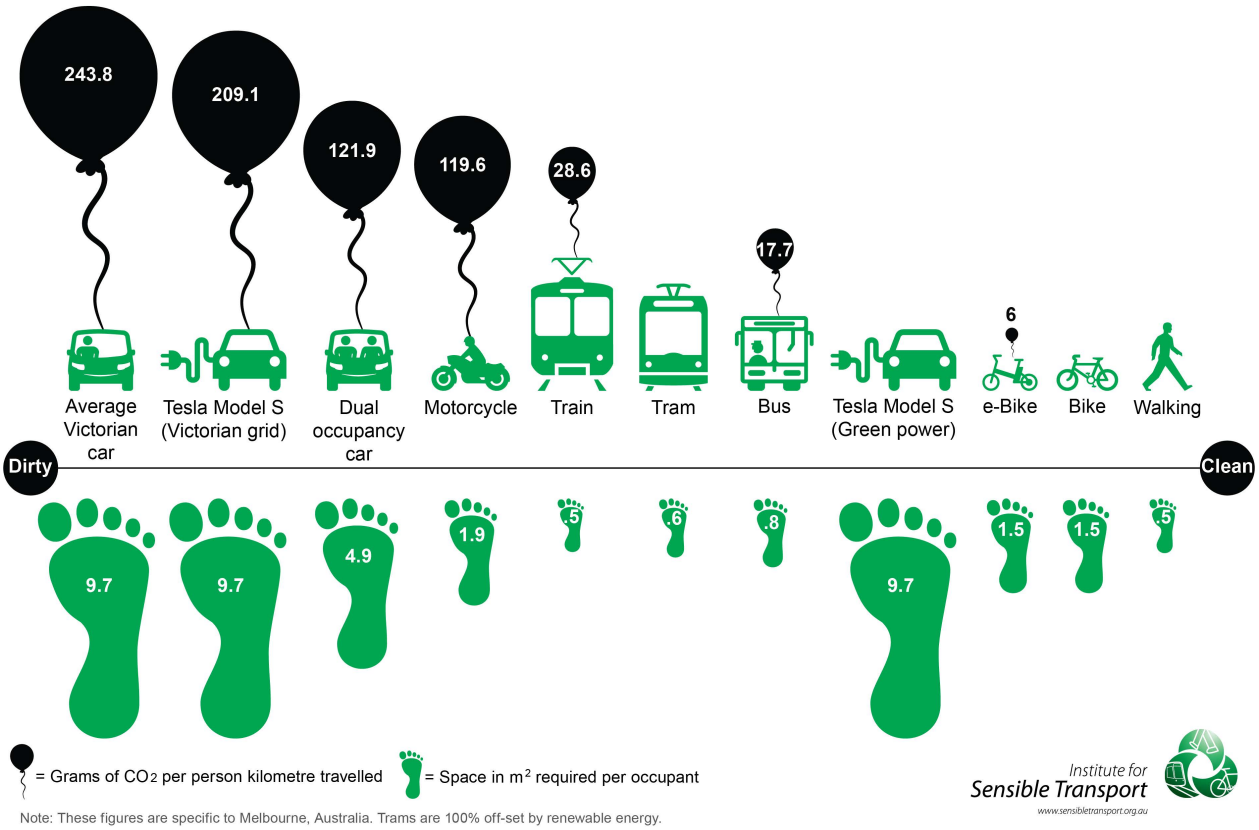


Figure 4 Emissions intensity and space consumption of different transport modes

3. Electric Vehicle Fundamentals

This section briefly describes some introductory information and concepts on EVs and charging fundamentals. The EV market is evolving rapidly, with a greater range of more affordable vehicles and an expanding network of charging options. The growth of the EV market is expected to continue, and it has been estimated that price parity may occur in ~2025/26.

3.1 What is an electric vehicle?

There are several different categories of EVs, and it is important to identify the main types, as shown in Figure 5.

The following provides a brief description of each of the vehicle categories listed in Figure 5.

- *Conventional vehicle* – also referred to as an Internal Combustion Engine (ICE) vehicle, is the standard vehicle type widely known and used since the invention of the motor vehicle. The fuel source for most ICE vehicles is petrol, diesel or gas, with some able to utilise renewable fuels such as ethanol. It is *not* an EV.
- *Hybrid vehicle* – a vehicle that uses petrol/diesel as its only fuel source, but also has an electric motor and battery that can store energy from regenerative breaking. A *Toyota Prius* is a common example of a hybrid vehicle.
- *Plug-in Hybrid Electric Vehicles* (PHEV) - combines a mixture of fuel combustion and electricity. It is similar to the hybrid vehicle described above; however, it has the ability to take electricity from a socket and can store this in a battery. A *Mitsubishi Outlander* is an example of a model available as a PHEV. While good in theory, if the plug in capabilities are not utilised, PHEVs can actually have worse emissions outcomes than standard hybrids. Thus, it should not be assumed that PHEVs lower petrol/diesel consuming, per kilometre travelled. If the owner is not motivated to maximise the plug in capabilities of the vehicle, PHEVs offer no advantage.
- *Battery Electric Vehicles (BEV),* or *All-Electric*, take electricity from a socket and rely entirely on the electricity stored in an on-board battery for propulsion. A *Tesla Model 3* and *Nissan Leaf* are two popular models of BEV.

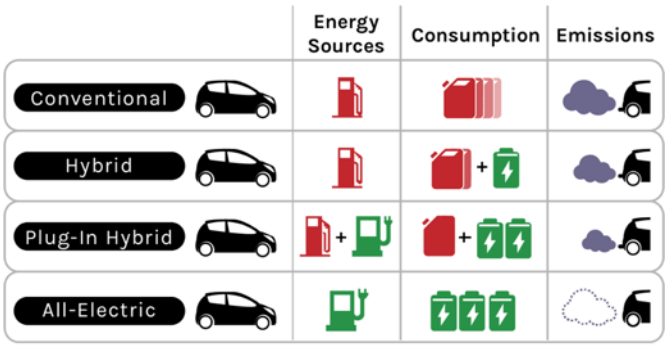


Figure 5 Different types of consumption and electric vehicles

Source: Adapted from Adnan et al (2017)

3.2 Electric vehicles in Australia

While Australia has among the lowest levels of EV adoption in the OECD, it has begun to increase rapidly, from around 2% of new vehicle sales last year, to 3.4%. Figure 6 captures the latest EV sales in Australia, both in total and as a percentage of light vehicle sales.

A number of surveys have found around 50% of consumers are considering an EV for their next vehicle purchase.[1] In October, 2022, with petrol prices around $2.20 per litre, around 1 in 5 website searches for *carsales.com* were for EVs. Figure 7 provides our analysis of EV ownership in Melbourne. This is also displayed on an interactive map (see https://tinyurl.com/59h845cp) which allows the user to see the growth rate over the last few years.

Many of the postcodes within the study area have experienced a very strong growth rate in recent years.

At the time of writing, one of the main barriers to EV adoption is the *supply* of EVs into the Australian market. Many models require a six month wait (or more) once ordered.

Around half of consumers are considering an EV for their next vehicle purchase.

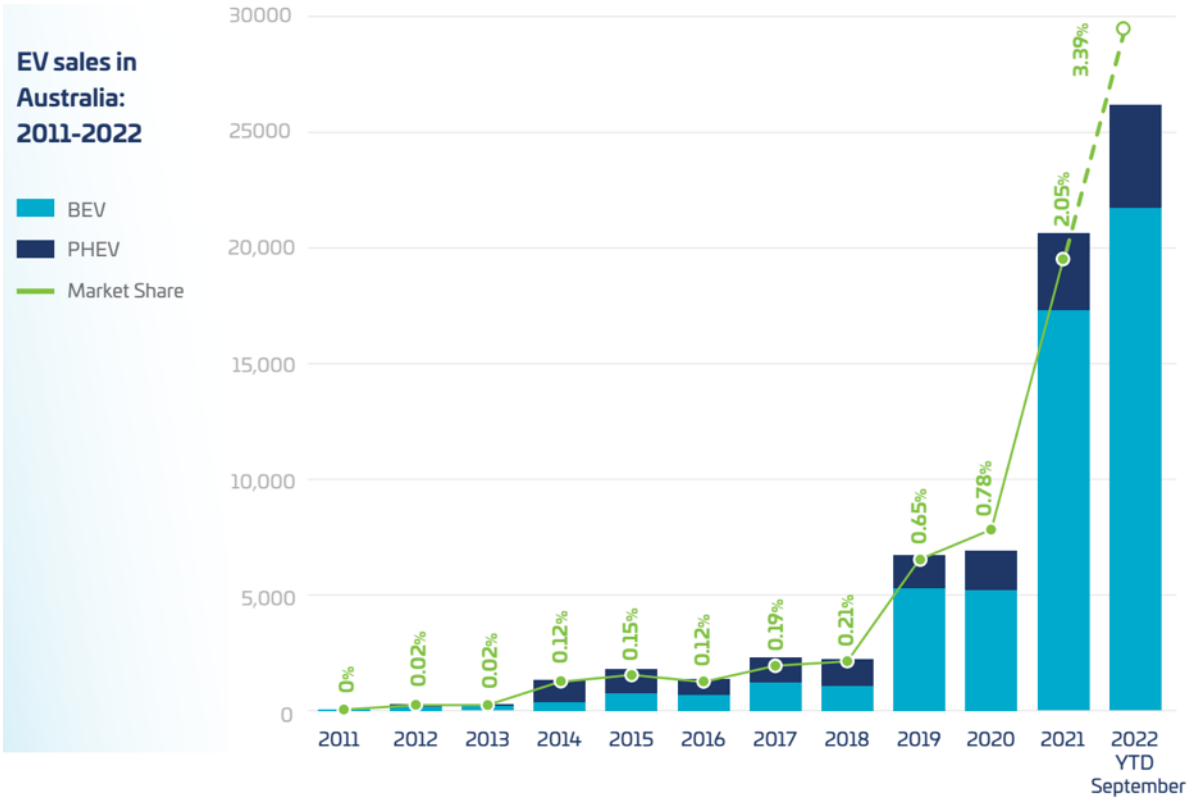


Figure 6 EV sales in Australia

Source: Australian Electric Vehicle Council

[1] https://electricvehiclecouncil.com.au/wp-content/uploads/2021/10/2021-EVC-carsales-Consumer-attitudes-survey-web.pdf

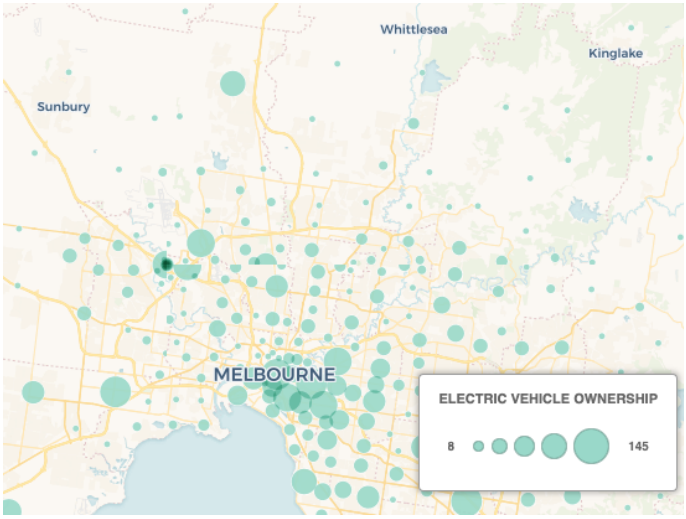


Figure 7 EV ownership in northern Melbourne
Source: Institute for Sensible Transport, using ABS data

3.3 Electric vehicle advancements

Electric vehicle technology has advanced rapidly in recent years. Electric vehicles avoid the tailpipe emissions of ICE vehicles, typically have lower running and servicing costs, and last longer. Compared to just five years ago, EVs:

- Have become cheaper (starting at ~$45,000)
- Offer longer battery range (~300 - 400km as standard, and up to ~600km), and
- Are available in a wider variety of vehicle types.

The introduction of lower price EVs, coupled with a sustained higher petrol/diesel price can make an EV a more cost-effective option, when the vehicle has a high annual mileage.

Electric vehicles also now have access to more chargers, including publicly available fast chargers, in more locations in Australia and this is set to grow further in coming years. Concern regarding the ability to travel long distances is still a key stated barrier to the greater uptake of EVs and more chargers will reduce this barrier.

The next 12 months are set to see the introduction of several lower cost models that, while still more expensive to purchase than their ICE equivalents, will begin to compete strongly in terms of *whole of life* costs, especially for vehicles that travel a relatively high number of kilometres per year.

3.4 Heavy vehicles

As of 2022, heavy battery EVs (BEVs) are in their infancy, with limited models and capabilities. Many of the heavy BEVs, such as rubbish trucks, are available in Australia via conversion, rather than factory built by an Original Equipment Manufacturer (OEM).

SEA Electric are a Melbourne based conversion company that import gliders (a new truck without an engine or transmission) and then builds the BEV drivetrain for clients. They are not a high-volume company and the current lead time is 9 – 12 months, though this is not unusual for some high-volume BEV manufacturers, like Tesla and Hyundai.

Successful transition to a zero-emission freight system requires BEVs to fulfil comparable roles to the ICE vehicles. There are significant differences between ICE vehicles and BEVs when it comes to the capabilities of range per charge and charging times for heavy vehicles. In addition, current BEVs do not have the carrying capacity of ICE heavy vehicles.

One of the current key barriers to the introduction of heavy BEVs is the time it takes to charge a battery coupled with short driving range. This may have a significant impact on productivity and competitiveness for long distance travel.

For tasks where daily kilometres travelled does not exceed the vehicles range per charge (e.g. ~160-200km), the transition to EV is relatively straightforward. This is the case for vans and small trucks that typically do between 120 – 160km per day. Refrigerated trucks typically see a reduction in range of around 30 – 40%.

3.4.1 Battery swap vs fixed battery

Battery swap refers to a similar service to the *swap and go* model for gas BBQ cylinders. While the battery swap concept failed for passenger BEVs (e.g., Better Place[2]), the context for heavy BEVs is somewhat different. In particular, heavy BEVs, when compared to passenger vehicles, have:

- A more restricted set of routes, origins and destinations

[2] https://en.wikipedia.org/wiki/Better_Place_(company)

- Much larger batteries, that take longer to charge
- More time sensitive drivers.

While there is considerable uncertainty as to whether battery swap or fixed batteries will become the market leader in the heavy vehicle sector, it is plausible the market will explore battery swap. This is until battery and charging technology enable heavy BEVs to be time competitive with ICE trucks.

Janus Electric is one company that has invested in battery swap heavy BEVs. Converting a Class 8 prime mover, the batteries have a range of between 400km – 600km and a depleted battery can be replaced with a fully charged one in around 4 minutes. Figure 8 illustrates the Janus battery swap truck. The original Cummins diesel engine was replaced with an electric motor and two 620kWh batteries on either side of the cabin (where the diesel tanks formally were).

Figure 8 Janus battery swap truck

Source: Janus Electric

Based on current market availability of heavy vehicles and the available charging technology, it is likely that only light commercial vans and small rigid trucks will be operating at scale as BEVs on Australian roads within the next decade. These vehicles can be supported by the passenger vehicle public EV charging network.

Opportunities to participate in research and development of zero emission heavy vehicles are likely to arise in the future. Councils should consider these opportunities on a case-by-case basis. One practical step councils can take to support the use of heavy BEVs is to design charging stations to allow *drive thru* charging, which allows longer vehicles to utilise chargers.

3.5 Assessment of EV adoption factors

Figure 9 captures the three broad areas in which government can influence the uptake of EVs. Purchase incentives and traffic priority are largely the domain of national and state government – though councils may wish to undertake an advocacy role to encourage adoption of policies in these areas.

Figure 9 Policies for boosting EV adoption - 3 categories

Source: Institute for Sensible Transport

Purchase incentives and enhanced capabilities are focused on measures designed to make the *vehicle* more attractive to the market. This includes policies such as sales tax exemptions and accelerated depreciation arrangements. This category also includes enhanced vehicle capabilities, such as extended battery range or a diversity of vehicle types. Disincentives for ICE vehicles can also be used to increase the relative value proposition of EVs.

Traffic priority relates to measures such as free use of toll roads and congestion zones, as well as the ability for a single occupant EV to use High Occupancy Vehicle lanes.

Charging refers to having sufficient charging infrastructure to enable people to go where they would like. This project is focused on planning the necessary charging infrastructure to enable the fleet to transition to EV.

Factors required to be in place for higher EV uptake

The factors required to be in place before EVs are preferred (or at least equal to ICE) for typical consumer preferences is summarised below (adapted from AEVA[3]):

1. Awareness and social norms: People need to be familiar with EVs and their capabilities.
2. Range: EVs should have an adequate range (distance) for the vehicle's intended purpose.
3. Charging infrastructure: A perception must exist that there is adequate charging infrastructure.
4. Variety of vehicles: It is important that the EV market contains a sufficient diversity of models to meet the needs of council and staff (cost and features) and the broader community.
5. Cost comparability: Financial incentives and/or lower sticker (official) price will assist consumers. There are two thresholds here; whole of life and sticker price.

Box 2 EV adoption factors

3.6 Victorian policy context

The Victorian government's policies on EVs have evolved rapidly. In particular, we have seen the introduction of:

- A target of 50% EV sales by 2030
- A Zero Emissions Vehicles – Expert Advisory Panel
- A distance-based road user charge on EVs (2.5 cents per kilometre)
- A $3000 rebate at the point of purchase for vehicles less than $68,740 (capped at 4,000 vehicles)
- Additional funding ($22.65m) for public charging infrastructure.

There are currently more than 72 DC Fast Charging sites in Victoria and 383[4] locations with chargers offering speeds below 24kW available for public use. As of 2021, there were 10,311 registered EVs in Victoria.

3.7 Key trends

Several trends are identified that are important to consider in the development of a public charging network, including:

- Greater range of vehicle types
- Extended range, on-board 240V power sockets
- Vehicles capable of Ultra Fast Charging
- Vehicle to Grid (V2G), Vehicle to Home (V2H) and Vehicle to Load (V2L) capabilities, enabling greater flexibility, enhanced resilience and grid stability.

These trends will be considered in the development of a future EV charging network.

3.8 EV Chargers

This project is focused on planning the rollout of an EV charging network across the northern region of Melbourne. This section provides a brief introduction to EV charging basics.

The three main EV charging equipment characteristics that differentiate chargers from one another include (International Energy Agency 2018):

1. Level: the power output range of the EV charging outlet. For most cars, the maximum electric charge in Alternative Current (AC) is lower.
2. Type: the socket and connector used for charging.
3. Mode: the communication protocol between the vehicle and the charger.

The number of chargers and the speed with which a battery can be changed has improved significantly over recent years, and countries (including Australia) are building networks of fast chargers to facilitate long distance travel. Table 1 provides a snapshot of different charging types.

One critically important observation from EV owners regarding their charging habits is that *over 90% of charging happens at home, or work*. This has implications for the selection of appropriate sites for charging infrastructure, and the speed of charger selected. There is also an implication related to *land use*; streets with a predominant residential form that lack off-street parking will

[3] Australian Electric Vehicle Association Inc.
[4] Electric Vehicle Council State of EVs March 2022

result in EV owners being more dependent on the public charging network. This is particularly important for some parts of the study area, such as Brunswick, Brunswick East, Coburg and Northcote.

Table 1 EV Charging types[5]

	Power	Range added per hour	Charging Time	Typical Application
Level 1 - single phase (domestic)	2.4 - 3.7kW	10 - 20km range / hour	5 - 6 hours	Home
Level 2 - slow single phase (domestic or public)	7kW	30 - 45km range / hour	2 - 5 hours	Home, work, shopping centres, car parks
Level 2 - fast three phase (public)	11 - 22kW	50 - 150km range / hour	30mins - 2 hours	Urban roadside
Level 3 - fast charge (public)	50kW	250 - 300km range / hour	20 - 60 mins	Activity centres, and near highways, motorways and key routes
Level 4 - super-fast charge (public)	120kW	400 - 500km range / hour	20 - 40 mins	Highways, motorways and key routes
Ultra fast charge (public)	350kW	1,000+ km range / hour	10 - 15 mins	Major highways and motorways

Vehicle manufacturers are continuing to upgrade their cars to accept high-capacity chargers. In essence, what this means from a usability perspective is that an EV can be fully charged in as little as 15 minutes. It is important to recognise that this will be rare (few vehicles will be able to) and expensive (it is based on a battery optimised for high-speed charging with other downsides). The reality is that most fast-charging sessions, even now, are only ~30 minutes – enough to get you to where you are going.

Over 90% of EV charging occurs at home or work.

3.8.1 Approximate EV charger costs

Table 2 provides approximate costs for different EV charging capabilities. These costs are for Council sites and include wiring and central management/control units (smart chargers). These costs are at P80 (meaning the cost should not be exceeded 80% of the time). Firm costs can only be calculated via an electrical contractor inspecting each site and undertaking the necessary testing.

Table 2 EV chargers - CapEx costs (approx.)

Charger type	$AU Cost
Single port AC 32A 3-Phase 22kW charger	$5,500
Dual port AC 32A 3-Phase 22kW charger	$7,000
Dual port DC 25kW charger (one car at a time)	$30,000
Dual port DC 50kW charger	$50,000

In 2021, ARENA announced a $24.55m funding pool to install a network of fast chargers around Australian cities. Some of these chargers will be located within the study area, and these have been considered when recommending potential sites for additional chargers (see Section 9).

3.9 Bi-directional charging

Bi-directional charging describes the capability of an EV to not just accept charge going into its battery but also for electricity to flow out of the vehicle's battery, to another load (e.g. a house, another EV etc). This is widely considered one of the most important innovations expected to occur over the next few years. Some EVs already on the market have this capability (e.g. Nissan Leaf, Hyundai IONIQ 5). This enables people owning such vehicles to provide power to own's home in the evening, and soaking up solar during the day. From 2025, it is expected *Vehicle to Grid* capabilities will be possible, in which a vehicle's battery can be used to support the grid. Ultimately, bidirectional charging increases the *value proposition* EVs offer the consumer. It is important to note that while there are some vehicle models that offer Vehicle to Grid capabilities, they are not functional in Australia yet, because the standards are not in place to allow it.

CHARIN, the body dedicated to the interoperability of the Combined Charging System (CCS) has developed the graphic shown in Figure 10. This provides an overview of the spectrum of grid integration. In Australia, we are barely on the first step of this pathway with regulations in place in

[5] Relatively few cars can use full capacity of three phase AC chargers.

some states (e.g. South Australia) and early trials of demand management in others (Victoria, Tasmania and the Australian Capital Territory).

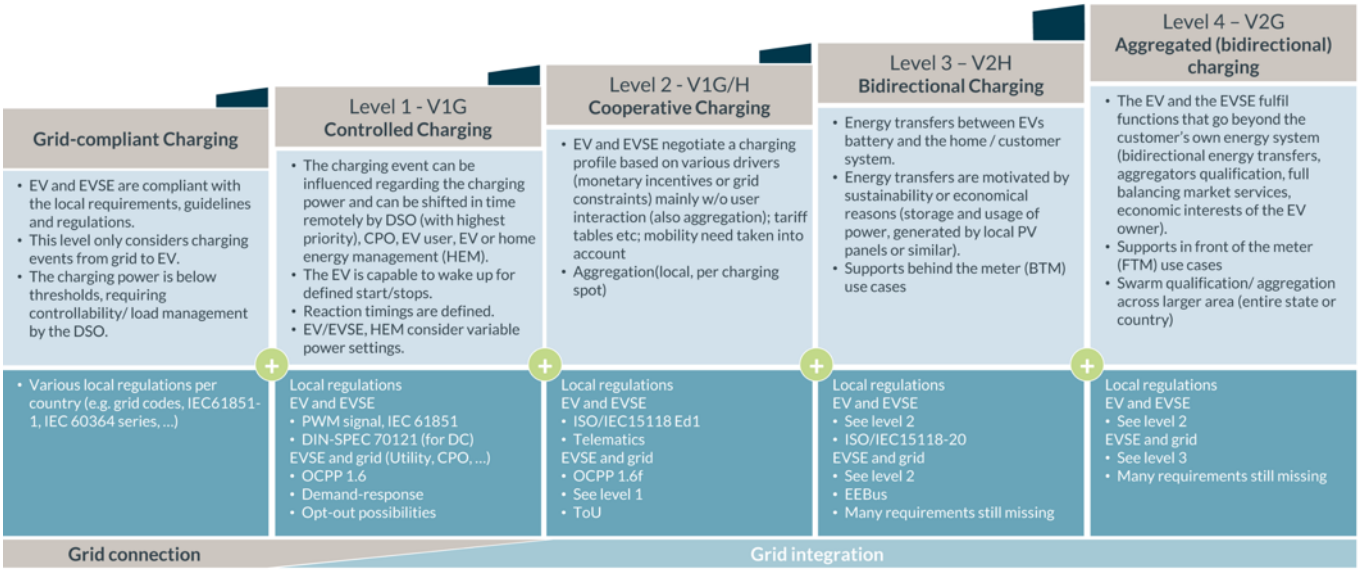
The Combined Charging System (CCS) 2 is the European standard of CCS and is also used in Australia. CCS refers to a combined plug for AC and DC charging and the communication protocol that applies. CCS2 ISO15118-20 It is in draft form and expected to be released in 2022/23.

The DC communications protocol for CCS is different from and not compatible with the CHAdeMO DC communications protocols. The standard is being updated to permit bi-directional charging. While the proposed date for this is 2025, some Original Equipment Manufacturers (OEMs) have announced an early implementation.

The CHAdeMO communications protocol has supported bi-directional charging since 2014. It has been available on all Japanese models produced since shortly after it was published. A number of manufacturers make suitable bi-directional chargers for sale in North America, Europe and Asia. There are several bi-directional CHAdeMO charging devices currently being assessed for approval in Australia.

Bi-directional charging is also possible with AC connections such as the Type 2 connector now adopted as standard for Australia. No manufacturer has enabled this for cars sold in Australia and as yet there are no published standards or approved devices on the market.

Figure 10 shows that bi-directional charging is only one part of grid integration. The other technological component is *networked managed charging*. This is where a network manager can program when vehicles are charged, to reduce the burden on the grid that might otherwise occur. Together with a regulatory framework and economic incentives, they contribute to full grid integration. Grid integration and bi-directional charging are two distinct, albeit complementary elements.



EV – electric vehicle, EVSE – electric vehicle supply equipment, DSO- distributed system operator, CPO – charge point operator

Figure 10 Grid integration levels

Source: CHARIN

3.9.1 Vehicle to Load

This is available now with some recently arrived models (e.g. Hyundai IONIQ 5 and the new Nissan Leaf). This has little to do with grid integration, but provides useful power off the grid on construction sites, camping or in emergencies when power has failed. It is effectively a small-scale alternative to the grid.

Vehicle to Load (V2L) is expected to become a standard feature of most if not all EVs in the future. In essence, it enables a user to plug a device into a standard 240V plug. There are several applications for this capability, including work tools, car fridge etc. Figure 11 provides an image of the new Ford F-150 Lightning, that will have up to 10 power sockets available, enabling tradespeople to use their vehicle to power tools and other appliances.

Figure 11 Vehicle to Load capabilities of the Ford F-150 Lightning

While V2L is not expected to have major implications for the design of the NCA charging network itself, it is expected to increase EV adoption, which will have flow on impacts in terms of potential demand for EV charging.

3.9.2 Vehicle to Home

Vehicle to Home (V2H) describes the ability of some EVs to use the vehicle's battery to supply the electricity to power a home.

V2H is expected to have a major impact on the type of charging equipment EV owners use to charge their battery while at home. Currently, around 80% of EV owners use a standard power point to charge their EV. Once V2H becomes standard, some in the industry expect this to change dramatically, with around 70% of EV owners electing to install a charger that offers V2H capabilities.

3.9.3 Vehicle to Grid

Vehicle to Grid (V2G) describes the capability of a vehicle to supply energy from its battery into the electricity grid. Once CCS 2 becomes the standard, it is expected that many models of EV will provide V2G capabilities.

Vehicle to Grid is important because:

- It increases the resilience of the grid by enabling connected cars to support the grid during times of high demand
- Has the potential for vehicle owners to sell electricity back to the grid.

There are no chargers that currently offer V2G capabilities, but this is expected to become a standard function from 2025. Some in the Australian EV charging industry expect that V2G will be used in home chargers rather than public chargers, although the medium sized Dutch city of Utrecht is planning a large-scale trial of V2G using EVs and public charging infrastructure.[6]

3.10 Factors that influence EV adoption

This section provides a review of the factors known to influence EV adoption. The content is drawn from a mixture of peer reviewed and grey literature. Every effort has been made to include Australian relevant research.

A number of recent studies, conducted separately by the RACV and the Electric Vehicle Council (EVC) have found that around 54 – 60% of respondents state they would consider an EV for their next vehicle purchase.

The EVC conducted a consumer survey in 2021, and presented the results in Figure 12. This indicates the degree to which the factors on the left hand side of the figure act to either *encourage* or *discourage* EV adoption. As will be discussed in this

[6] https://chargedevs.com/newswire/utrecht-plans-to-be-a-bidirectional-city-turning-its-evs-into-a-giant-battery/

section, current *purchase price* and availability of *charging infrastructure* are acting as *discouraging* factors.

Lower running costs and *safety features* are the two top factors encouraging consideration of EV purchase. It is interesting to note that while lower emissions performance might be the key factor for government encouragement of EVs, the three most popular responses in Figure 12 all relate to the *individual*, rather than global factors.

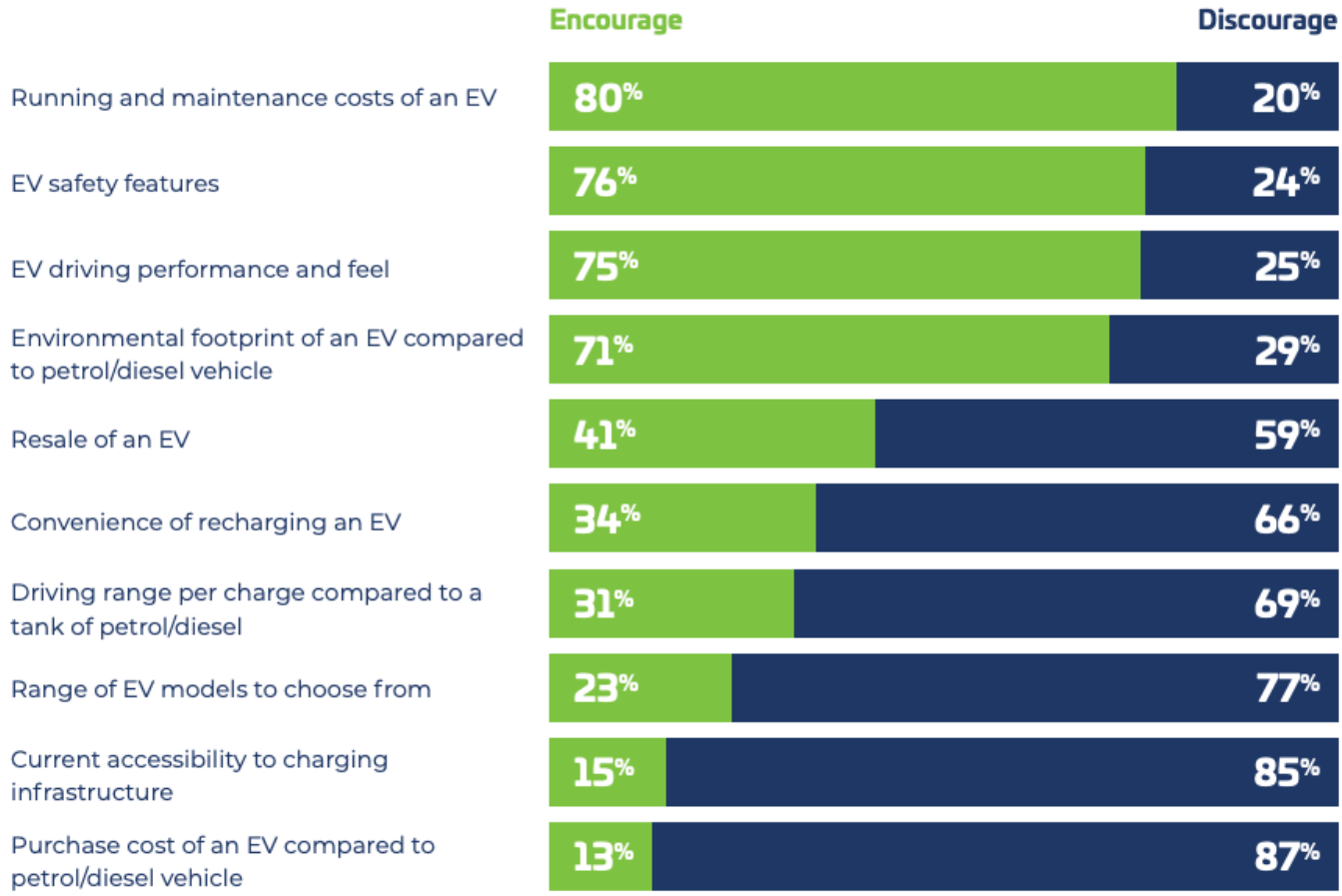


Figure 12 Encouraging and discouraging factors for EV adoption

Source: Electric Vehicle Council https://tinyurl.com/9wa6k6tm

3.10.1.1 Barriers to EV adoption

There are a number of known barriers to the adoption of EVs, and these vary by country. The main barriers being *purchase price* and *driving range*, as identified in Figure 12. A global consumer survey by Deloitte in 2021 found that *driving range* and *lack of charging infrastructure* were the two most commonly reported concerns. These two issues can be viewed as two sides of the same coin and concerns around driving range can be mitigated against via additional charging infrastructure.

Table 3 provides an overview of Deloitte's study of common concerns regarding EVs. Upfront cost was the third highest ranking barrier. These results support the findings from the previously mentioned EVC study.

Many previous studies have cited cost as the main barrier. For instance, the RACV, in conjunction with the Australian EV Council conducted a study with over 1,000 participants. Seventy seven percent of respondents said they were discouraged by the high purchase price.

Other barriers to EV adoption found in the RACV study include:

- Limited range of EV models. Australia, due in part to the lower levels of government support have a small range of EVs to choose from than other Organisation of Economic Cooperation and Development (OECD) markets. This is expected to change over coming years, and since the study was published (2020), more EV models have entered the market.
- Range anxiety. As with many other studies, people responded that limited range, coupled with patchy fast charging possibilities acted as a barrier to EV adoption. Interestingly, the *minimum* range people said on average that they would find acceptable was 461km. This is on the high end of the spectrum of range for the existing models currently available. Some EV drivers often note that concerns around range anxiety diminishes with experience. It is also likely that acceptable range will lower over time as the fast charging network develops into the regions.

Table 3 Concerns regarding EVs

Concern	Australia	United States	Germany	Japan	Rep. of Korea	China	India
Driving range	19%	28%	28%	22%	11%	25%	13%
Lack of charging infrastructure	22%	25%	22%	29%	32%	20%	26%
Cost/price premium	28%	20%	16%	23%	17%	9%	16%
Time required to charge	12%	13%	13%	15%	18%	13%	14%
Safety concerns	14%	8%	12%	10%	19%	29%	25%
Lack of choice	4%	4%	5%	1%	3%	4%	6%
Other	1%	2%	4%	0%	0%	0%	0%

Top concern

Source: Deloitte (2021) Global automotive consumer study

3.10.1.2 Facilitators to EV adoption

The following factors have been identified by recent Australian research (RACV) as factors likely to encourage the EV purchase:

- Lowering cost: Around 3 in 4 respondents to the RACV study said incentives to reduce purchase price was important. Only 40% of respondents to the EVC study indicated that government subsidies were important.
- More public charging: 75% of respondents to the RACV study said greater public charging possibilities would be important before committing to purchasing an EV, compared to 90% for the EVC study.
- Incentives to lower the cost of home charger installation: Some 70% said they would like incentives to lower the cost of installing home chargers.

The earlier cited EVC report from 2021 found that the strongest motivating factors for considering an EV purchase included:

- Lower maintenance costs
- Safety features
- Driving performance
- Environmental footprint.

The EVC report asked what government support prospective EV owners would encourage them to purchase an EV. Figure 13 indicates that subsidies to lower the purchase price to be most important. Interestingly, over a fifth of the sample said there was nothing government could do, as they simply were not interested in purchasing an EV. Lane priority and parking privileges were not considered to be important, although there are jurisdictions such as Norway, in which vehicle lane and parking privileges have been implemented, to encourage the uptake of EVs.

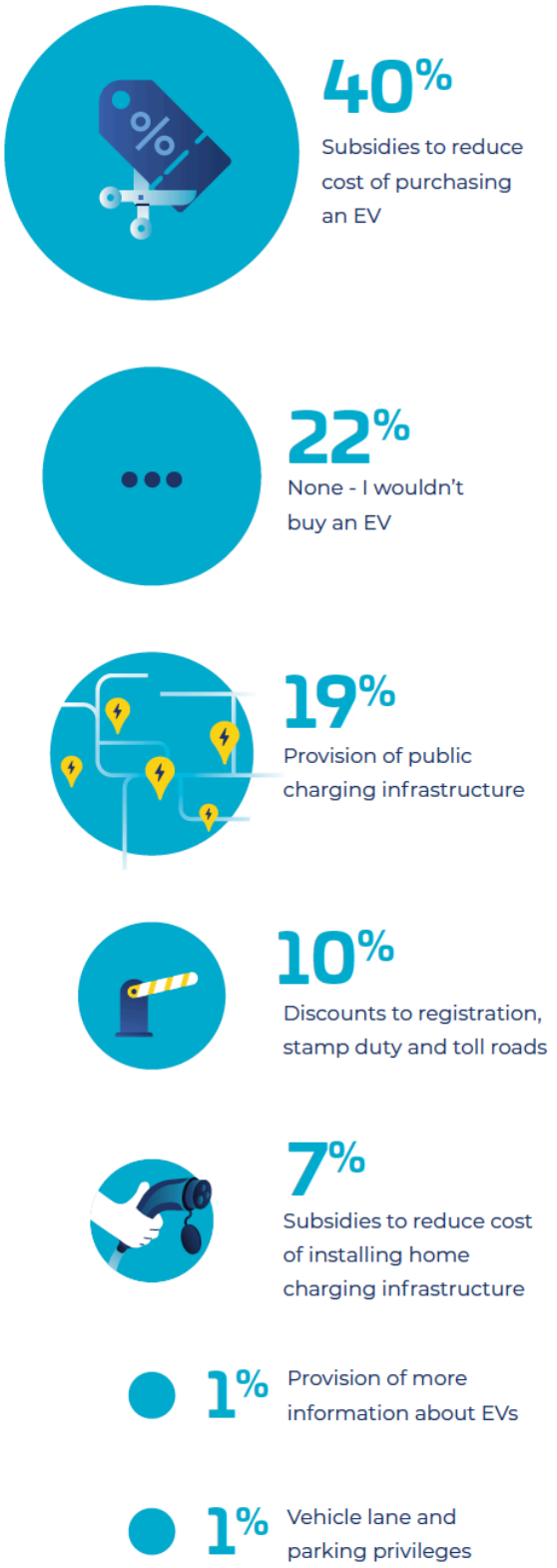


Figure 13 What prospective EV owners want from government (EVC)

Source: Electric Vehicle Council
https://tinyurl.com/9wa6k6tm

3.11 Consumer preferences

3.11.1 Charging costs

The RACV survey asked respondents how much would be acceptable for charging their future EV.

The average response was $24.50 for a full charge. Given that 90% of charging happens at home or workplace, in most instances, the cost for a full charge will be considerably less than $24.50. Table 4 provides a summary of the different costs of EV charging, depending on some of the likely tariffs, using a 70kwh battery.

Table 4 Charging EV costs at different tariffs

	70 kWh EV Battery
Solar feed in tariff rate (5.2 cents per kwh)	$3.64
Standard electricity rate (20 cents per kwh)	$14
Fast charger standard rate (40 cents per kwh)	$28

3.11.1.1 Electricity supply

The RACV survey asked respondents where they would like their electricity to come from when charging their EV. Figure 14 illustrates the responses to this question, highlighting that less than half consider it important that the electricity is generated sustainably.

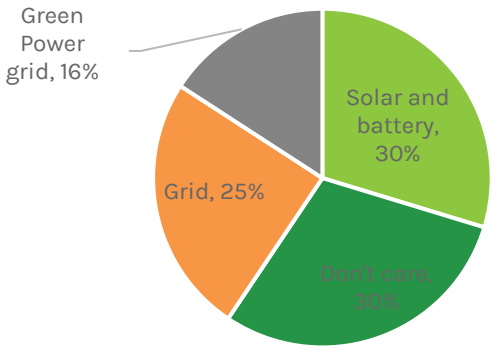


Figure 14 Where do prospective EV owners want their power to come from? (RACV)

Source: https://tinyurl.com/y6du96x7

The RACV results differ from more recent work conducted by the EVC which found that 55% of people would charge their EV with solar panels. This is plausible given that around 25% of households already have solar panels, and one might imagine that EV owners may be more likely than the general population to have installed solar panels. The graphic produced by the EVC to highlight the source of electricity likely to be used to charge their future EV is shown in Figure 15.

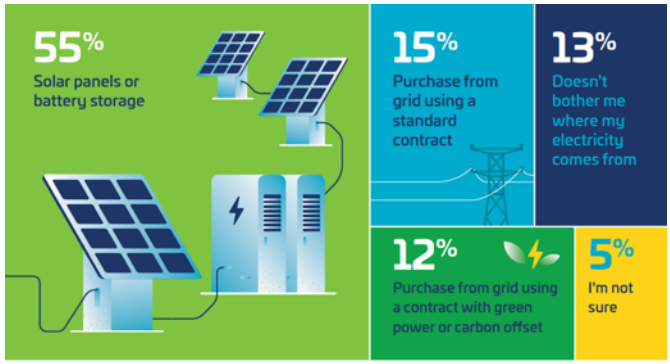


Figure 15 Where do prospective EV owners want their electricity to come from (EVC)

Source: https://tinyurl.com/9wa6k6tm

3.11.1.2 Charging speed

Respondents to the RACV survey were asked what an acceptable wait time would be while charging (presumably when not at their destination). Thirty minutes was the average acceptable wait period, which roughly accords with revealed preference data from existing fast chargers in Victoria.

3.11.1.3 Implications for this project

The synthesis of the barriers and facilitators has some important implications for this project. It highlights that while opportunities for charging are important, a lowering of the purchase price is likely to be the number one issue for most people. This suggests that in addition to the identification of suitable charging sites, the NCA may wish to consider working with other councils to advocate to the state and federal governments for rebates and other incentives that work to lower the upfront cost of EVs.

3.12 Differentiating the charging market

It can be helpful to categorise how EV users differ in terms of their public charging needs. Figure 16 segments the market into three main categories, based on their circumstance and the charge time they are likely to consider acceptable. At the base of each of the three categories is a suggested charger speed. It is important to keep in mind that this is for public access charging. On average, the overwhelming majority of charging takes place in the private setting.

A *passing through motorist* will generally not want to spend a long time waiting for their battery to charge and their priority is to continue their journey with minimal delay. Fast chargers are preferred in these situations and are most suitable close to high volume arterial roads and motorways, as these locations have a much larger catchment of potential users. These are often co-located at, or within close proximity to petrol stations, fast food outlets or other roadside amenities. This enables users go to the toilet, buy a coffee etc., while their vehicle is charging. Typical duration of stay is around 15 – 30 minutes.

Opportunistic charging describes the charging that takes place when someone was going to that particular location anyway, and takes the opportunity to top up, because of the availability of a charger. This can be thought of as analogous to charging a phone not because you are low on charge, but because it is convenient for you to top up the battery. It is common for batteries to have more than 20% charge when entering a charging location in these contexts.

A *local resident* without the ability to charge in an off-street car park will generally find a slow, 7kW public charger suitable for their needs, as overnight charging is possible. These chargers need to be close to where users would have parked anyway and are intended to provide a charging opportunity for those that lack an off-street parking bay in which a charger can be easily installed. As identified earlier, this category constitutes a significant proportion of the population in the areas under the Northern Council Alliance.

Finally, it is important to recognise that an EV owner is likely to move between these different charging categories at different times. A family on a road trip may be a *passing through* charger at one time, and later the same week an *opportunistic* charger.

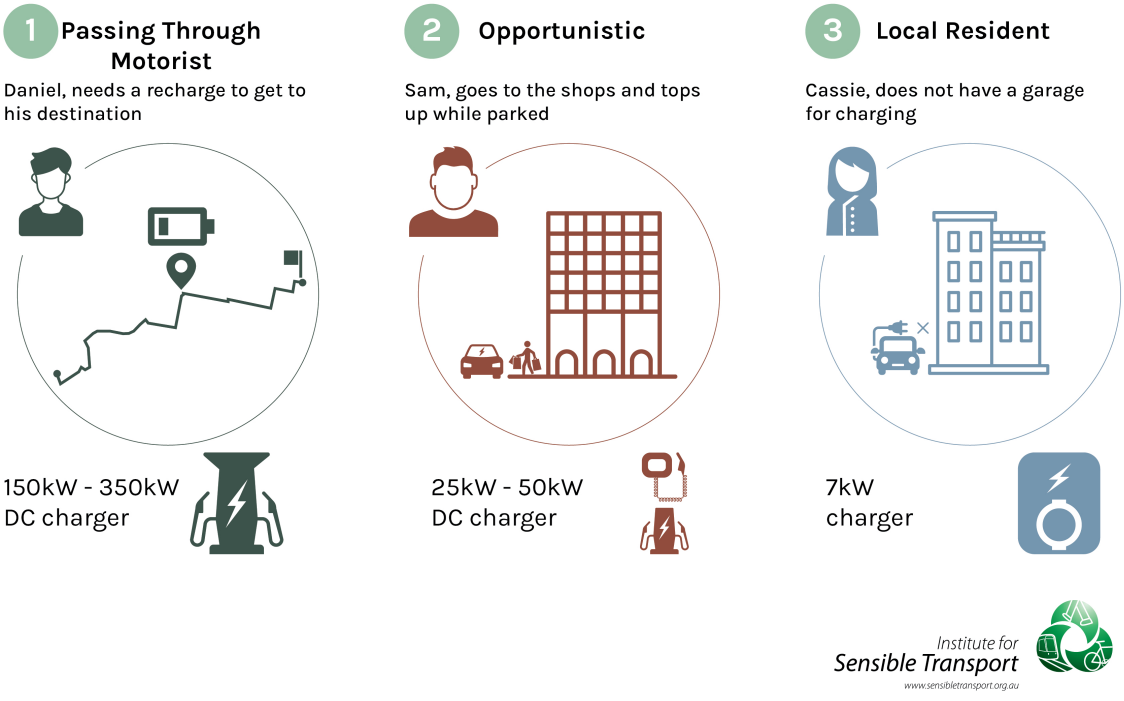


Figure 16 Differentiating the public charging market

Figure 17 provides a simplified, conceptual map of how different land uses may require different charging types. For instance, in streets with residential housing, slow AC chargers are all that is required, as the parked vehicles are typically parked for an extended period of time. At the other end of the spectrum, a service station next to a motorway will generally require fast or ultra fast charging, as vehicle owners are not seeking to dwell in this location for long.

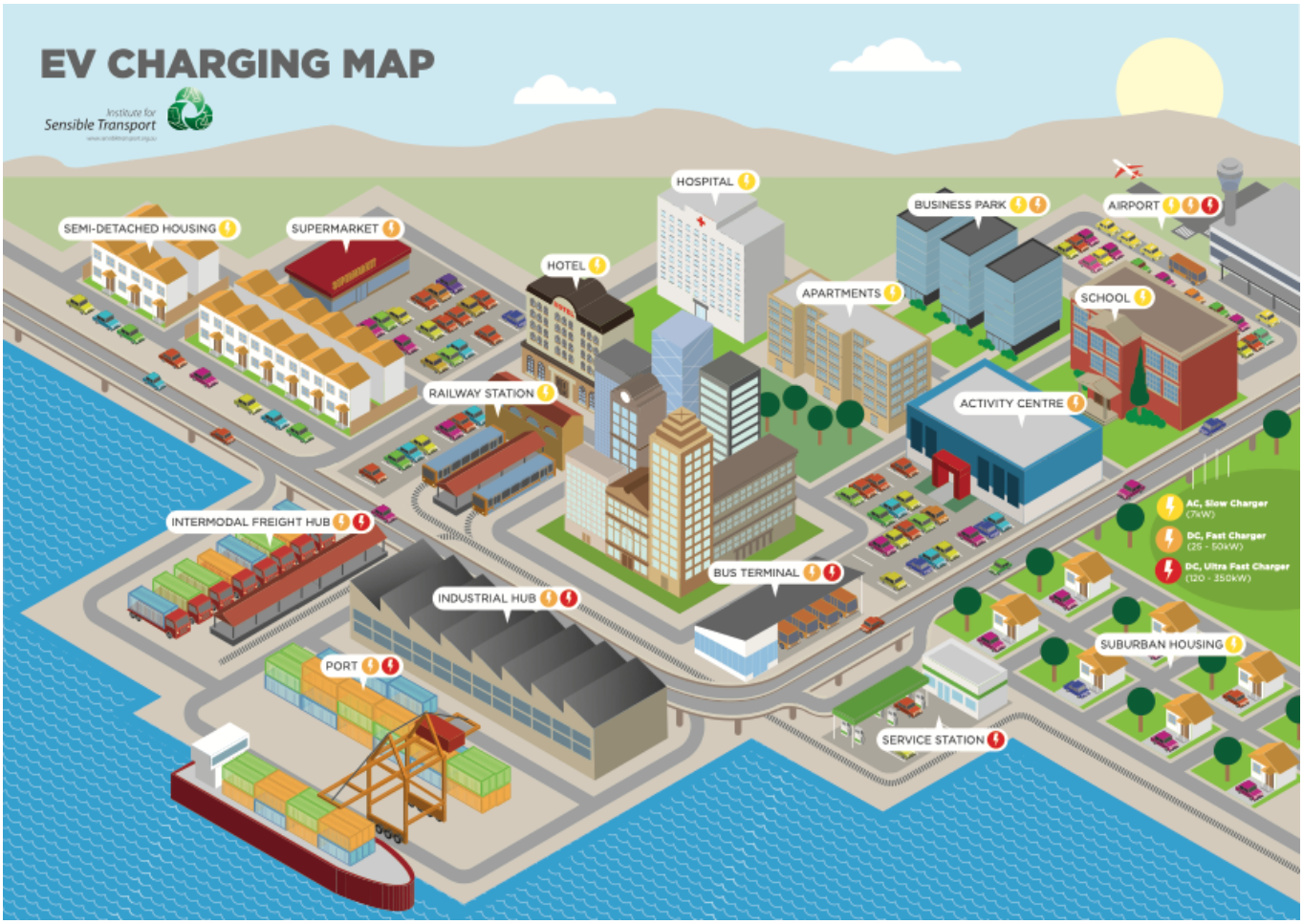


Figure 17 Understanding the EV charging eco-system

Source: Institute for Sensible Transport

3.13 E-bikes and e-cargo bikes.

It is a little-known fact that around 95% of all EVs are actually *e-bikes*.[7] Given that around 50% of all trips in Greater Melbourne are under 5km, and some 30% are under 3km,[8] there is considerable capacity for e-bikes and other forms of e-micro mobility to meet a greater portion of trips within the NCA region.

While the benefits of micro mobility may appear obvious to some, it is worth briefly summarising these benefits explicitly:

- Reduced emissions. Transport is one of Australia's fastest growing sources of greenhouse gas emissions and a major source of Victoria's emissions. Electric micro mobility, even when powered by Victorian grid electricity, is only 1/40 as carbon intensive as a regular motor vehicle's emissions.
- Congestion. Micro mobility consumes about 1/6 of the road volume of a standard motor vehicle. As Melbourne increases its density, and the NCA region is home to more jobs, using scarce road space more efficiently will become increasingly important.
- Health. Micro mobility usually involves some physical activity on the part of the rider. Studies have shown that people using an e-bike for instance gain around 70% of the physical activity benefits of those riding a regular bike.[7]
- Enhanced transport choice. Micro mobility, especially when shared, creates affordable opportunities for enhancing accessibility and transport choice.

Key to enhancing opportunities for electric micro mobility will be the development of a network of protected bicycle lanes and paths. These vehicles will charge at home or work and do not require a publicly available charging network like cars. Improving opportunities for using micro mobility can help to lower emissions, reduce congestion, enhance health, and increase transport choice.

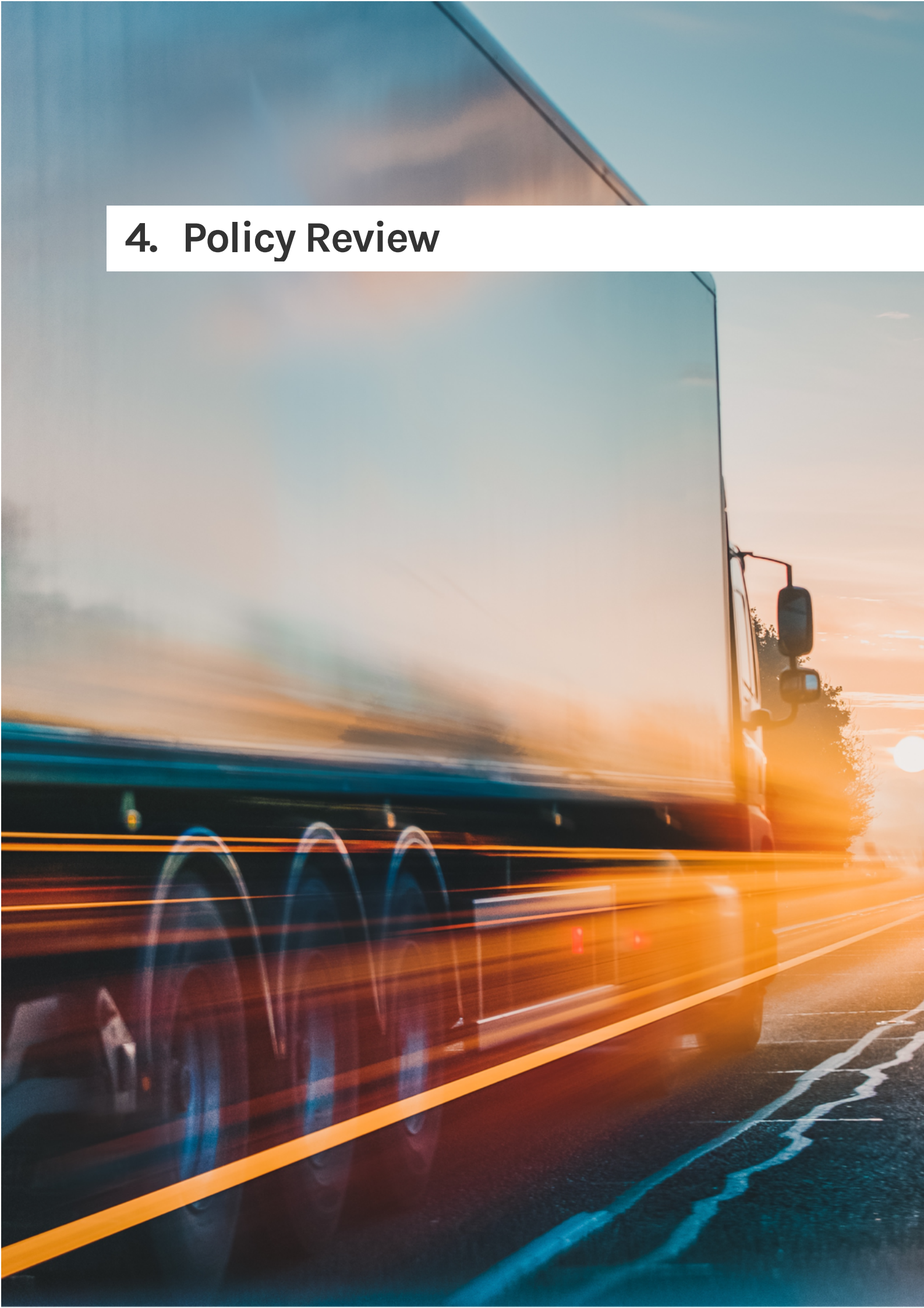
Figure 18 offers an example of a popular form of e-bike in northern Melbourne.

Key to enhancing opportunities for electric micro mobility will be the development of a network of protected bicycle lanes and paths

Figure 18 E-bikes provide an efficient mode for short to medium trips

[7] https://www.sciencedirect.com/org/science/article/pii/S0144164722002550
[8] https://transport.vic.gov.au/about/data-and-research/vista/vista-data-and-publications

4. Policy Review



This section provides an overview of current policy towards EVs, charging, and other forms of low or zero-emission transport. We also look at existing regulatory requirements for the provision of EV charging in the public and private domain, review existing data related to transport and EVs, and potential data capture and management of EV charging.

4.1 Commonwealth

The Australian government has begun funding EV charging infrastructure via their *Future Fuels Strategy*[9]. The chargers must at a minimum, provide a 50kW DC charge to two vehicles simultaneously.

Through the Australian Renewable Energy Agency (ARENA), the Australian government has dedicated $24 million to boost EV charging opportunities in their first round of the Future Fuels Fund. This is primarily concentrated in cities rather than the regions and it is expected that future rounds of funds will focus at least partially on the regions.

The delivery of the 19 fast charging projects will increase by seven-fold the number of fast chargers available. Melbourne sites are shown in Figure 19. A number of these proposed chargers are within the NCA region, and these have been considered in the development of the NCA EV Transition Plan.

The Australian government, at the time of writing, is reviewing the potential introduction of vehicle fuel efficiency standards and other measures to increase the uptake of electric vehicles.[10]

4.1.1 Future Fuels and Vehicle Strategy: Powering Choice, 2021

In November 2021, the Australian government released its *Future Fuels and Vehicle Strategy*[11]. The objective of the Strategy is to accelerate the uptake of new technology, including hybrid, hydrogen, electric and bio-fuelled vehicles. The Strategy notes have already helped to add over 400 charging stations in Australia and will continue to expand this through the *Future Fuels Fund*.

The Strategy's $250m investment intends to leverage private sector investment across four areas:

- Public electric vehicle charging and hydrogen refuelling infrastructure
- Heavy and long-distance vehicle fleets
- Light vehicle commercial fleets
- Household smart charging. A smart charger has the ability for the charger to be turned on/off/adjusted remotely, for instance by a utility company.

New policy reforms are also expected, via coordination with state and territory energy ministers, initially focused on:

- Exploring network tariff reform to identify additional opportunities to encourage charging behaviour and infrastructure rollout that will support optimal grid operation
- Incentivising the use of smart chargers in households
- Tasking the energy market bodies to partner with governments on grid integration matters

Key points of relevance for the NCA EV Transition Plan:

- By 2030, Battery Electric Vehicles (BEVs) and plug in EVs are expected to make up 30% of new light vehicle sales. This is considerably less than Australia's two most populous states, which have a target of 50% by 2030.
- EV registrations increased from 31,191 vehicles in 2019 to 60,417 in 2020.

Given the objectives of this project, the remainder of this summary will focus on the *public EV charging* component of the Future Fuels and Vehicle Strategy. The most pertinent points on the topic of EV charging include:

- Electricity tariff reform to encourage charging that places less stress on the grid.

[9] https://www.industry.gov.au/data-and-publications/future-fuels-and-vehicles-strategy
[10] https://consult.industry.gov.au/national-electric-vehicle-strategy
[11] https://tinyurl.com/8vbnrzke

- Incentivising smart chargers at households. Presumably this will enable easier control of when charging occurs.
- Charging infrastructure will be installed at over 400 businesses, 50,000 households and over 1,000 new public access fast charging stations. This is expected to cover over 84% of the population, in terms of where they live, not necessarily where the owners of EVs may wish to drive.
- Result in 1.7m EVs in Australia by 2030, although many of these could be expected to be on the road in the absence of the actions listed in the Strategy.

Following the completion of the NCA EV Transition Plan, participating councils will be in a strong position to advocate to the Commonwealth for a portion of the chargers funded under the program.

Figure 19 identifies the fast-charging sites included in the *Future Fuels* funding. It should be noted that these locations are indicative and may change. The sites within the NCA area have been considered as part of the development of the NCA EV Transition Plan.

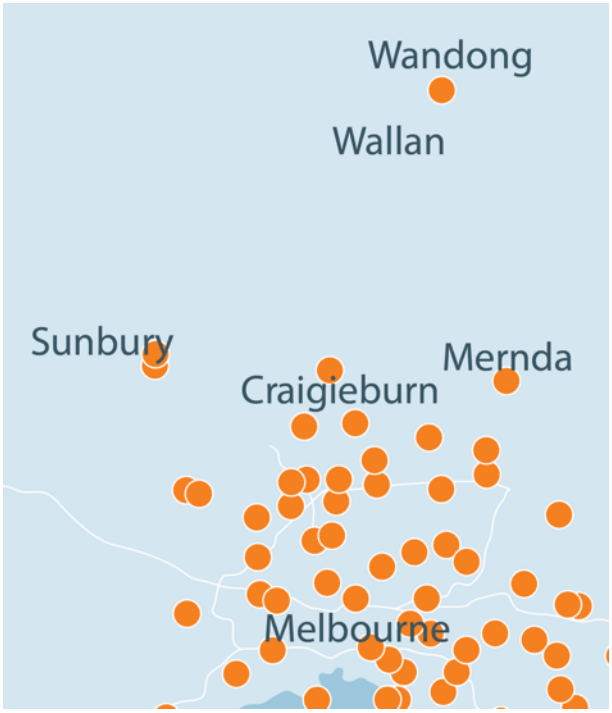


Figure 19 Future Fuels Fast Charging Sites Round 1

Source: https://arena.gov.au/assets/2021/07/future-fuel-fund-maps.pdf

4.1.2 National Building Code

The new Commonwealth Government recently announced changes to the National Building Code[12] to support increased sustainability outcomes in new buildings.

As part of this, all new multi-dwelling units (apartment buildings) are required to facilitate the future installation of EV charging equipment (see section J1P4 and J9D4 of Volume 1 of the Code).

The Building Code stipulates that a separate distribution board be provided to serve EV charging and fitted with a control system that can manage and schedule charging in response to total building demand. Separate distribution boards are required for each storey of car parking.

While this change to the Building Code sufficiently addresses future EV charging installation barriers for apartment dwellers, additional work will be required to overcome barriers for existing buildings.

More information about the changes to the National Building Code can be found in Section 5.1.

4.1.3 National Electric Vehicle Strategy – Consultation Paper

The Commonwealth Government has recently released a consultation paper to inform the development of a National Electric Vehicle Strategy[13].

The Paper highlights the challenge of the Australian vehicle fleet being more polluting than overseas examples, in addition to cost barriers and supply constraints of EVs.

To overcome these challenges, the Paper outlines a proposed framework to increase demand for EVs, increase supply for EVs, and establish the systems and infrastructure required to support EV uptake.

Actions listed in support of these objectives include implementing a vehicle emission standard, reducing tariffs and taxes on EVs, building electricity grid resilience, clean energy financing opportunities, and skilling up local manufacturing to support the burgeoning industry.

[12] https://ncc.abcb.gov.au/editions-national-construction-code
[13] https://consult.industry.gov.au/national-electric-vehicle-strategy

4.1.4 Austroads: Guidelines for low and zero emission vehicle charging infrastructure installation

Austroads new technical document provides guidance for EV charging installation in Australia[14]. This report fits within the Future Vehicles and Technology program at Austroads, which will develop guidance for road agencies on infrastructure to support the uptake of low and zero emission vehicles.

In particular, this report outlines charging guidance to support passenger vehicles and light commercial vehicles that are BEV or PHEV seeking to charge in the public domain.

Site selection guidance is provided, including:

- Charger type and station design
- Proximity to vehicle
- Proximity to amenities
- Access to energy supply
- Appropriate signage and wayfinding
- Safety.

Other considerations, such as accessible parking designs, maintenance of chargers, data collection, payment systems, and decommissioning of chargers is also explored.

The report also provides a gap analysis to guide future work. This includes:

- Planning EV chargers for commercial operations
- Payment system inter-operability
- Operator standardisation and data
- Medium-long term servicing plans
- Cyber-security requirements.

Consideration of future technology is also highlighted for further research. This includes induction (wireless) charging, battery swap technology, bidirectional charging, as well as consideration for residential on-street charging, heavy vehicle charging, autonomous vehicles, and buses.

4.1.5 New South Wales

New South Wales have undertaken a range of policies and initiated projects to support EV uptake. Much of this work is directly relevant to Victoria as the legislation governing EVs and charging are largely the same.

One area where NSW has made headway, and where there is no corresponding Victorian policy, is in supporting people who do not live in detached dwellings to install EV chargers.

The *Residential strata quick reference guide*[15] provides an overview of the different approaches available for strata or owners corporation multi-dwelling units to facilitate EVSE installation.

The guide outlines different approaches for installing and managing EVSE as well as responsibilities for each group (tenants, landlords, body corporate). It also provides a simple step-by-step guide interested parties can undertake to get their building EV ready.

NSW also provide a cost estimate tool for EV charging equipment installations[16]. The tool is detailed in assessing the different components of an installation, including cable trays, conduits, switchboard capacity, and charger types.

4.1.6 Victoria

The Victorian government has articulated Its support for the EV market, with the publication of Its *Zero Emissions Vehicle Roadmap.* They are committed to transition the state government fleet to be fully electric by 2026, and target 50% of vehicles sold by 2030, to be zero emission. While the Victorian government has been criticised by some for introducing an EV specific tax of 2.5 cents per kilometre, it has also provided some incentives for EVs, including:

[14] https://austroads.com.au/latest-news/austroads-releases-new-guidelines-for-low-and-zero-emission-vehicle-charging

[15] https://www.energysaver.nsw.gov.au/reducing-emissions-nsw/electric-vehicles/electric-vehicle-ready-buildings/making-your-residential-strata-building-ev-ready

[16] https://www.energysaver.nsw.gov.au/form/ev-ready-buildings-costing-tool

- $19m for charging infrastructure, with 100 new fast charging sites across Victoria, from 11kW to 100kW.[17]
- $3m for seven ultra rapid fast chargers constructed in Airport West, Barnawartha North, Euroa, Moe, Torquay, Ballarat and Horsham[18].
- Trialling electric buses
- Including more EVs into the government fleet
- $46m for a $3,000 purchase subsidy for EVs under $68,740
- $100 off registration fees for EVs
- $664,000 for chargers in central Victoria

A selection of the key actions included In the Zero Emissions Vehicle Roadmap are shown in Table 5.

While the transition to electric buses in Victoria may, on the surface, provide an opportunity to leverage outcomes that assist in the community transition to EVs, in a practical sense, there is little cross over between these two outcomes. Bus companies will overwhelmingly, if not entirely, rely on charging at their depot. These are locations in which public access is not allowed, and therefore there is little potential to share charging infrastructure.

[17] https://www.energy.vic.gov.au/renewable-energy/zero-emission-vehicles
[18] https://www.premier.vic.gov.au/melbourne-adelaide-electric-vehicle-charge-path-complete

Table 5 Key actions – Victorian *Zero Emissions Vehicle Roadmap*

Public education	• Addressing concerns about ZEVs and their performance • Supporting an improved understanding about ZEV options and transition
Advocacy	• Working with other State and Territories to look at options for developing a harmonised approach to vehicle emissions standards, given the lack of action at the national level, and allowing parallel imports from other right-hand-drive markets
Promoting 'ZEV-readiness'	• Investing $19 million to accelerate the rollout of battery electric vehicle charging infrastructure across regional Victoria, and support electric vehicle fleets • Supporting changes to the National Construction Code from 2022 to reduce barriers to future installation of EV charging in new buildings • Undertaking a $298,000 study on ZEV-readiness in new developments • Developing an online guide for apartment owners and body corporate committees to assist them in identifying and assessing options to enable EV charging in existing buildings[19] • Investigating the need for, and feasibility of, hydrogen re-fuelling stations and other supporting infrastructure
Transitioning our fleets	• Investing $46 million for Australia's first public ZEV subsidy program - supporting the purchase of more than 20,000 ZEVs • Setting a target of 50% of new light vehicle sales to be in ZEV by 2030 • Establishing an expert panel to recommend policies, enabling investments and timelines to support the achievement of the 2030 target • $10 million to green the Victorian Government Fleet, including replacement of 400 vehicles with ZEVs by 2023 • $5 million to establish a Commercial Sector Zero Emissions Vehicle Innovation Fund • $20 million to undertake a ZEV bus trial • Setting a target for all public transport bus purchases to be in ZEVs from 2025
Transitioning our energy sector	• Managing the integration of ZEVs into our energy system through participation in inter-jurisdictional forums and research activities
Transitioning Victorian industry and workforce	• Commencing work on an industry development and transition plan to explore opportunities for Victorian industry associated with ZEV manufacturing, maintenance, repair and recycling • Identifying industry development pathways for emerging technologies, including investigating the potential for hydrogen in transport • Planning to support our workforce through the transition to zero emissions road transport as part of Victoria's clean economy workforce development strategy

[19] https://www.energy.vic.gov.au/renewable-energy/zero-emission-vehicles/ev-ready-buildings

4.1.7 Local

4.1.7.1 Northern Regional Transport Strategy

In 2020, the *Northern Region Transport Strategy* was developed with funding from the Northern Metropolitan Partnership. This Strategy covers all seven participating councils in the Northern Council Alliance as part of this project.

While it does not discuss EVs or charging, the identification of regional transport challenges and the role of strategic places is important for the context of this report. In particular, the *Enabling travel choice to jobs and activity* priority action could encompass the inclusion of EV chargers at key employment and activity centres.

4.1.7.2 Banyule

Community Climate Action Plan

Banyule's Community Climate Action Plan focuses on Banyule becoming a carbon neutral community by 2040. It involves eight priority themes and provides actions for residents, schools, and business. The *zero emission transport* theme is highly relevant to this project, including the actions on the provision of EV charging stations at key locations and incentivising zero or low emission transport modes.

Banyule Integrated Transport Plan 2015 – 2035

The Banyule Integrated Transport Plan identifies climate and the environment as one of the challenges facing Banyule now and into the future. The Plan highlights the need for Council to rationalise their vehicle fleet and converting vehicles and plant to electric. It also identifies the need to reduce reliance on private vehicles, increasing sustainable modes of transport, and better integrating land use and transport as key directions for reducing transport emissions.

4.1.7.3 Darebin

Darebin Transport Strategy 2007 – 2027

This Strategy, last updated in 2022, identifies climate change and air quality from motorised transport as one of several issues facing Darebin. Increasing the role of sustainable transport modes and reducing the attractiveness of the car are listed as key objectives of the Strategy, as is improving health and environmental outcomes.

Developing policies to managing increasing demand for commercial and private EV charging infrastructure and improving access to EV charging in Darebin are listed as actions within the Strategy. Mode share targets to double rates of walking, cycling and public transport were included in the Strategy, but will not be met.

Electric vehicle charging policy

This policy provides guidance for EV charging for new developments in Darebin. It highlights that there is no statutory requirement to provide EV charging infrastructure and points to existing tools that provide guidance on their inclusion in new developments.

The Built Environment Sustainability Scorecard (BESS) tool includes EV charging requirements when reviewing a development application. Darebin's policy goes beyond the minimum recommended in the BESS tool to ensure EV charging in new developments meets future charging needs.

For residential uses, the policy stipulates that a minimum of 20% of car parks built require EV charging infrastructure, with 75% of car parks built with future provision for charging. Alternatively, 20% of car parks in the development are to be shared and have 22kW or higher charging capabilities.

Non-residential uses are stipulated as requiring 5% of car parks having EV charging, with 20% of car parks built with future EV charging capabilities. Alternatively, 5% of car parks be provided with 50kW or above charging capabilities.

4.1.7.4 Hume

Hume Integrated Land Use and Transport Strategy (HILATS) 2011-2020

The HILATS, while written prior to government consideration of EVs, does highlight climate change as one of the challenges facing Hume. It highlights integrating planning of land use and transport, encouraging walking and cycling, and promotion of sustainable transport as part of the policy framework for HILATS.

Climate Action Plan

Hume is currently developing their next Climate Action Plan. This Plan will seek to reduce emissions, adapt to climate impacts, and advocate for more action. As part of reducing emissions, supporting sustainable transport and switching to EVs are listed as potential actions. The accompanying community survey report highlighted Council operations moving to zero emissions (including EVs) as being the third most supported action. It does not appear that public EV charging was considered as part of the community consultation.

4.1.7.5 Mitchell

Council Plan 2021 - 2025

Mitchell Shire does not have a standalone transport or climate change strategy. However, it is in the process of developing a Climate Change Action Plan (CEAP). In the Council Plan, climate change and protecting the environment are listed as key priorities under the Nature theme of the Plan. The number of EV charging points are listed as a success measure for the Plan.

4.1.7.6 Merri-bek

Merri-bek Integrated Transport Strategy (MITS) 2019

The MITS aims to facilitate a demonstrable shift to sustainable transport and a long-term reduction in car use. This includes a transition to a zero-emission transport system by 2040. Actions within this objective include support for EV car share and other actions to support active and public transport, in addition to a reduction in car use. The MITS does not provide further detail on EVs and associated charging infrastructure.

Merri-bek Zero Carbon 2040 Framework

This Framework provides additional detail on supporting EVs, other zero-emission vehicles, and associated transport infrastructure. Key priorities for Merri-bek include transitioning Council's fleet to low or zero emission vehicles. The Framework highlights that switching to active modes of transport offers increased benefits than relying solely on switching to 100% EVs. These benefits include improved health, reduced congestion, and increased open space.

4.1.7.7 Nillumbik

Climate Action Plan 2022 – 2032

Nillumbik's Climate Action Plan includes a focus on Council and community zero emissions energy use and sustainable transport, as part of achieving net-zero emissions for Council by 2030 and the community by 2035. Advocating for sustainable transport outcomes is listed as one of the community's top ten priorities. Objective 6.3 under the 'sustainable transport' focus area highlights a need to transition to zero-emission vehicle use in Nillumbik. This includes transitioning Council's light and heavy vehicle fleet to zero-emission, monitoring emerging technology in transport, and supporting the distribution of EV charging stations across the LGA.

4.1.7.8 Whittlesea

Whittlesea 2040 – A Place for All

Whittlesea 2040 articulates a community vision for the Council over the next two decades. Two relevant goals within the document include *Liveable neighbourhoods* and *Sustainable environment*. *Liveable neighbourhoods* includes support for EVS and car share, in addition to more walking and cycling options.

4.2 Distribution Network Service Providers

Working with DNSPs is one of the most challenging aspects of EV charging installation. High application fees, costs for advice, and opaque decision-making processes all pose barriers to increasing public EV chargers.

Many councils also share community concern around growth in energy demand from EVs and electricity capacity constraints.

Interviews conducted with CitiPower/Powercor/United Energy (DNSP) as part of this project revealed:

- An enthusiasm to facilitate additional charging opportunities.
- A need for DNSPs to better understand and communicate the electrical network supply limitations.

- A strong desire to develop methods of understanding where residential EV chargers are located.
- An interest developing large scale demand management technologies to help moderate the peaks in demand from EV charging, including *smart chargers.*

Two areas CitiPower/Powercor/United Energy are beginning to think about are bidirectional charging, and kerbside charging. While they have not yet been involved in installing kerbside charging, they appreciate that this is likely to be of interest to the community in the future and are in the process of developing their procedures related to future requests.

CitiPower/Powercor/United Energy are still developing their end-to-end customer process for handling requests for chargers, and welcome councils to contact their network strategy manager to discuss requests for charging installs.

4.3 Public EV Charging Market

The current public EV charging market has grown substantially in the last 12 months. Several private operators have national networks of public chargers and provide charging services for government EV fleets and private home installations.

Through the stakeholder engagement of this process, EV charging operators expressed a willingness to invest in a charging network, provided there is long-term financial viability.

Several operators noted the importance of working with local government to deliver the network ahead of time, to reduce range anxiety of prospective EV owners. Access to council land and off-street car parks is seen by the operators as crucial to developing the public charging network. This is due to the reduced cost to access the land compared to privately held land and the long-term stability of council-owned land retaining its same use.

It was noted that if councils were not part of the development of the EV charging network, commercial providers would have a lower number of charging ports in operation. Having a long-term, stable arrangement allows the operators to expand the network now rather than waiting until EV ownership increases.

Charging operators noted their willingness to enter into lease or profit-sharing agreements with councils to access land. The amount of return to council through this varies, on a case-by-case basis. The varied financial viability of chargers by location makes it difficult to be prescriptive to private operators in tendering for new EV chargers. Instead, focusing on competitive tendering that outlines the financial payment to council as a scoring metric allows operators to reveal their best offer to council.

One approach to maximise network development would be to have less busy, but strategically important, sites to be cross-subsidised by more popular sites in the municipality.

5. Planning and regulatory requirements

This section describes the planning and regulatory requirements to facilitate the charging of EVs. Current planning and regulatory requirements for EV chargers are still in their infancy in Victoria. Existing planning requirements are outlined, as well as recommended amendments to maximise the availability of charging opportunities.

The typical life of a new building can be expected to be 60 – 150 years. Most government and infrastructure advisory agencies estimate that EVs will be the dominant motor vehicle within the next 20 – 30 years (if not before) and it is therefore prudent for NCA councils to consider the EV charging requirements of new buildings.

5.1 National Construction Code 2022

The *Draft National Construction Code 2022* contains provisions for EV charging, which are expected to come into force in 2023.[20] The Draft National Construction Code 2022 contains two provisions which support EV charging. J1P4 states that *'a building must have features that facilitate the future installation of on-site renewable energy generation and storage and electric vehicle charging equipment.'*

J9D4 lays out the detailed requirements to support J1P4. Car parks in build classes 2, 3, 5, 6, 7b, and 9 (as shown in Table 6), must be provided with the electrical distribution boards and wiring to support EV charging. In effect, this applies to all multi dwelling units, office buildings, retail, factories and public buildings. Interestingly, car parks are exempt.

The number of bays which are required to be capable of supporting EV charging varies per building class, as shown in Table 6. The code requires all dwellings in multi-dwelling units to be capable of supporting charging, at 7kW. Further, the code requires one electrical distribution board for every 24 EV car parks, per level of car parking. These changes to the National Construction Code will effectively ensure that future buildings will be capable of providing EV charging.

[20] The Draft National Construction Code 2022 is available at https://ncc.abcb.gov.au/news/2022/stage-2-ncc-2022-out-now

Table 6 National Construction Code building classes

Building Class	Details	Charging requirement
Class 1	Housing: • Class 1a: Single dwelling (attached or detached) • Class 1b: Boarding houses, guest houses, or hostels under 300m^2.	Not required.
Class 2	Apartment buildings.	100% of car parking spaces must support 7kW type 2 chargers.
Class 3	Residential buildings which are not Class 1 or Class 2.	20% of car parking spaces must support 7kW type 2 chargers.
Class 4	Sole dwellings as part of a non-residential building (e.g., caretaker's house).	Not required.
Class 5	Office buildings.	10% of car parking spaces must support 7kW type 2 chargers.
Class 6	Shops, restaurants, and cafes.	10% of car parking spaces must support 7kW type 2 chargers.
Class 7	Storage buildings: • Class 7a: Car parks	Not required.
	• Class 7b: Warehouses and storage	20% of car parking spaces must support 7kW type 2 chargers.
Class 8	Factories	20% of car parking spaces must support 7kW type 2 chargers.
Class 9	Public buildings: • Class 9a: hospitals and like • Class 9b: Places of assembly • Class 9c: residential care	20% of car parking spaces must support 7kW type 2 chargers.
Class 10	Non-habitable buildings: • Class 10a: Sheds, carports, garages • Class 10b: Structures (e.g., fence or pool) • Class 10c: Private bushfire shelter	Not required.

Source: Understanding the NCC Building Classifications[21]; Draft National Construction Code 2022[20]

[21] https://www.abcb.gov.au/sites/default/files/resources/2022/UTNCC-Building-classifications.PDF

5.2 Planning Schemes – current treatment of EV charging

The Victorian Planning Scheme guides the development of land and changes in land use in Victoria. The Planning Scheme includes a number of sections that are relevant to overcoming the barrier presented by the need to charge EVs conveniently and affordably. As the primary statutory mechanism that directs the construction of car parking for new developments and changes in land use, changes to the Planning Scheme to encourage EV uptake will be an important tool for NCA member councils to consider.

Planning controls can trigger the need for a permit, for the 'use' of land or structure or for the 'development' of land or structures. Planning controls have the potential to facilitate EV ownership by compelling developers to install the wiring and conduits to enable the easy installation of chargers, or require the full installation of chargers themselves. This section identifies existing areas of the Planning Scheme that may require amendment in order to encourage EV ownership as an alternative to ICE vehicles.

Limited work has been undertaken to date to incorporate EV charging into Victoria Planning Schemes. Indeed, there are very few mentions of EVs or EV charging. Most permit triggers associated with EVs would be because of use of the land for car parking (or other uses/developments). Specific mention is included in *Victorian Planning Provisions 62.02 Building and Works*, which sets out buildings and works not requiring a permit. Within this Clause, *'any requirement in this scheme relating to the construction of a building or the construction or carrying out of works, other than a requirement in the Public Conservation and Resource Zone, does not apply to: An electric vehicle charging station'*. However, Clause 62.02 states that '*this does not apply if a permit is specifically required for any of these matters.'* This means that a permit is not required for the installation of EVSE alone, with a permit only being required where there is a specific requirement to apply for a permit elsewhere in the scheme.

The land use terms associated with EV charging are defined in the table to Clause 73.03 of the Planning Scheme as:

- Car park - Land used to park motor vehicles. It may include charging of electric vehicles.
- Service station – Land used to sell motor vehicle fuel from browsers or charge electric vehicles.

Planning Scheme A recent amendment to Victorian Planning Provision 43.01 Heritage Overlay (HO) has removed the need for a permit to install an EV charging installation in properties that are subject to an HO, as long as it is not visible from the street (other than a lane or public park). Amendment VC142 was gazetted in January 2018, making a series of reforms to the Smart Planning section of the Planning Scheme. Smart Planning's intention is to reduce permit requirements for certain developments and uses, reducing time and financial barriers for local governments and developers. VC142 removed the requirement for a permit to build an EV charging station for properties that fall within an HO. The requirements stipulate that the charging infrastructure not be visible from the street or park and be capable of being removed without impacting the heritage value of the property. It may be necessary to re-consider the wording, as there may be some instances in which a charging station cannot be provided elsewhere. Moreover, there may be more strategic alignment in having a charging station in full public view (to increase community awareness), even under HO conditions.

Limited work has been undertaken to date to incorporate EV charging into Victoria Planning Schemes.

Amendment VC 216 made changes to the Planning Policy Framework (PPF) to support environmentally sustainable development (ESD), including for improved sustainable transport outcomes. A separate piece of work, led by the CASBE and MAV, seeks a planning amendment to insert specific ESD targets and guidelines within the planning scheme.

This work, Elevating ESD Targets, has been submitted to the Planning Minister for consideration by 24 councils. It includes support for low and zero emission vehicles, more provision for EV charging, and bicycle parking facilities. As

this amendment is still in development, it is unclear to what extent it may require developments to provide electric vehicle charging, or if it would go further than the National Construction Code, discussed above.

A 2018 *Senate Inquiry Into Electric Vehicles* sought to take stock of the barriers and opportunities to increasing EV uptake. Unfortunately, the Inquiry did not address potential changes to the Planning Scheme, although it did note planning mechanisms currently act as a barrier to the installation of EV chargers.

There are some additional circumstances where EV charging may trigger a permit. Development of car parking on many zones (commercial, residential etc) can trigger a permit. Overlays, such as Design and Development Overlays, Environmental Significance Overlays, Flooding Overlays, etc, may also contain triggers associated with development. A private land manager seeking any development on Public Land Zones can trigger a permit if an agreement with the landowner has not been entered into. Signage associated with EV charging may also trigger a permit pursuant to Clause 52.05. While these triggers may affect use and development associated with EV charging, this is generally due to the underlying use or development of land for car parking.

5.2.1 Clause 52.06 – Car Parking

Clause 52.06 of the Victorian Planning Provisions (VPPs) is the primary mechanism that facilitates the provision of car parking for new developments and changes in use for a site.

The existing objective of the Clause *'To ensure the provision of an appropriate number of car parking spaces having regard to the demand likely to be generated, the activities on the land and the nature of the locality'*. There are a number of Strategies that sit under the Objective, and while many of them are discredited (e.g., see Taylor and Clements, 2018) and service to entrench car use rather than align with Council's broader strategic objectives, there is an opportunity to add specific requirements for EV charging, to encourage uptake in EV usage and future-proof developments.

The Clause also includes a table that specifies the number of car parking spaces for different uses. The table specifies two separate measures, Columns A and Column B rates. Column A rates are the default. Column B rates are applicable when the site is subject to other modifying overlay, such as the Principle Public Transport Network Overlay and some Parking Overlays.

5.2.2 Parking Overlays

Planning Overlays (PO) enable Planning Authorities to stipulate variations to the standard planning scheme requirements for the sites within the area covered by the overlay (including 'Columns B rates'). POs are often used to set out reductions in the standard car parking rates. They could also be used to set out requirements for the inclusion of EV charging infrastructure for a proportion of the required car parking.

POs vary the parking requirements of Victorian Planning Provision Clause 52.06 – Car Parking. POs allow Council to set maximum and minimum parking rates, tailored to individual parts of the municipality. Schedules to POs could be used to facilitate the charging of EVs. Victorian Planning Provision Clause 45.09 – 8 allows a schedule to a PO to specify 'additional design standards' and 'other requirements for the design and management of car parking'.

The Planning Scheme offers substantial opportunity to ensure that future developments offer EV charging for residents and visitors. Providing EV charging infrastructure from the start will lower the cost and complexity barrier to retrofit larger developments at a later date and offer a compelling value-add for apartment owners.

5.3 Council's role in facilitating the development of a charging network

Councils can play an important role in the planning and provision of EV charging infrastructure, as they:

- Assess planning mechanisms, applications and issue permits. This includes parking provision for new developments, both residential and commercial.
- Own and manage many of the off street car parks that serve as potential publicly available EV charging sites.
- Are leaders in their community and can influence the strategic direction of the build environment and the transport system.

- Have the potential to address disparities in the provision of chargers, which may occur under a purely commercial model.
- Have the ability to seek amendments to the local planning policies and advocate for changes to the state policies.
- Have a role in ensuring that charging locations are accessible to all in the community. This applies to all future publicly accessible charging locations, whether on public or private land.

5.3.1 Public land

A significant proportion of publicly available car parking is owned and/or managed by public agencies, either at the local or state government level. While some 90% of charging happens at the home or workplace, there are a number of circumstances in which EV owners will require charging outside of their home/workplace, such as:

- Those making a long distance trip
- When visiting Activity Centres. This helps to increase the attractiveness of town centres by offering an incentive to spend time and money in these locations.
- Those without the capacity to install chargers at their dwelling.

Public car parking can broadly be classified into two categories; *on-street* and *off-street*. It is preferable to install publicly accessibly EV charging equipment in off-street parking locations, as they:

- Provide more versatility in terms of the ease with which a car can be positioned based on the location of its plug (e.g. some EVs have the connector at the rear, other at the front etc...).
- Are easier to provide larger spaces, and allow those with mobility issues to access chargers. The larger space also reduces the chance of accidental damage.
- Generally offer a larger quantity of parking bays, allowing for a larger bank of chargers and greater potential for expandability.

There are however instances in which on-street locations are appropriate for the installation of EV chargers, such as:

- Where there are no off-street locations
- In residential areas with large numbers of dwellings lacking private off street parking capable of EV charging.

In instances where EV charging equipment is installed on-street, it is vastly more preferable to design the bays for 90-degree parking. This allows EVs with different connector positions to manoeuvre the vehicle to be as close as possible to the charger, reducing the chance of accidental damage. More importantly, this design also avoids conflicts with pedestrian movement, in particular, the trip hazard the charging cable poses. The more generous space around the vehicle enhances user comfort and accessibility. Figure 20 offers an example of this approach.

Figure 20 On-street charging, Whittlesea

5.3.2 Private land

Council has multiple roles, as the planning authority, responsible authority, and as community leaders. It is therefore important that Council provide an encouraging, permissive approach to the development of the EV charging in their LGA, and wider region.

Chargers on private land take the following forms:

- In a dwelling's garage/driveway. This is where most chargers are likely to be located.
- In a workplace car parks, such as an office development.
- Publicly accessible, privately held car parks, where car parking bays are designated for customer use (e.g. shopping centres, super markets, fast food outlets). Some of these locations will lend themselves to ultra-fast

chargers catering to *passing through motorists*. These are in most cases likely to be located close to major freeways.

Council's role in facilitating the development of EV charging on private land is more limited. As the Council is not the land owner, its role may include:

- Information provision.
- Identification of suitable sites
- Assistance coordinating with the Distribution Network Service Provider (DNSP).

In addition to the above, Council can help facilitate the process of installing EV chargers. They can develop fact sheets and guidance documents relating to:

- Installation considerations for private residential land holders (e.g. heritage considerations, installation costs, charger selection). This is similar to the role some Councils play in the installation of photovoltaic (solar) systems.
- Information for renters seeking to install EV chargers
- Information on EV charging options for those without the capacity to charge an EV on their property.
- General information about EV benefits, capabilities, costs and model availability.

5.3.3 Existing residential developments

5.3.3.1 Owner-occupiers

In most cases, owner occupiers in the NCA region will have an off-street car park on their property. This means that in most cases, council involvement will not be required, and the owner will be able to contract an electrician to install an EV charger. The body corporate may need to be involved. Currently, most EV owners simply plug their car into a standard power socket. As costs for smart chargers comes down, more vehicle owners will install smart chargers on their property.

5.3.3.2 Renters

For renters with off-street parking, a paucity of regulation exists to assist in the negotiation between a renter and their landlord regarding the installation of EV charging. The installation costs may vary considerably and can only be assessed on a site-by-site basis. Moreover, there will be a wide range of preferences between renter and landlord in relation to costs, who bears these costs, and the payback period (e.g. up front, or through instalments/increased rent).

In the future, when EVs have become a mainstream option, EV charging may be seen as an important property attribute, and thereby may result in increased rental returns. However, at the time of writing, EV charging is unlikely to attract higher rental yields to the landlord except to a sitting tenant that has requested it to enable the purchase of an EV. The high rental fee may or may not be mutually agreeable and worthwhile for the landlord to install the necessary wiring and recover costs in rent.

5.3.3.3 Those without off-street parking

For dwellings without access to off street parking (rare within NCA except Darebin and Merri-bek), councils may need to set up a process to enable the resident to submit a formal request for an on-street EV charging location nearby to their home. This can be done by creating a web-based form, using the *demand responsive* process. The following process is recommended:

- The resident/household completes an online form requesting an EV charging facility proximal to their home (within ~200m).
- Proof of residential address is uploaded, using the online form (e.g. utility bill).
- Assessment is undertaken by Council to determine suitability of area within 200m of residential address for EV charging.
- The resident pays a notional fee (e.g. $1,000) which is then credited against their use of the charger until exhausted. This avoids frivolous requests.

When Council decide to install a public charger via the demand responsive process, it is important to inform the applicant that they do not have exclusive use. This should be reinforced via street signage. Where the number of chargers in an area increases beyond about four, the number of users per charger can be allowed to increase to between three and four EVs per charger until reports about poor availability become significant.

Figure 21 provides an example of the decision-making framework for residential charging decisions. This provides a transparent, consistent

decision-making chart for the provision of EV charging in the residential setting.

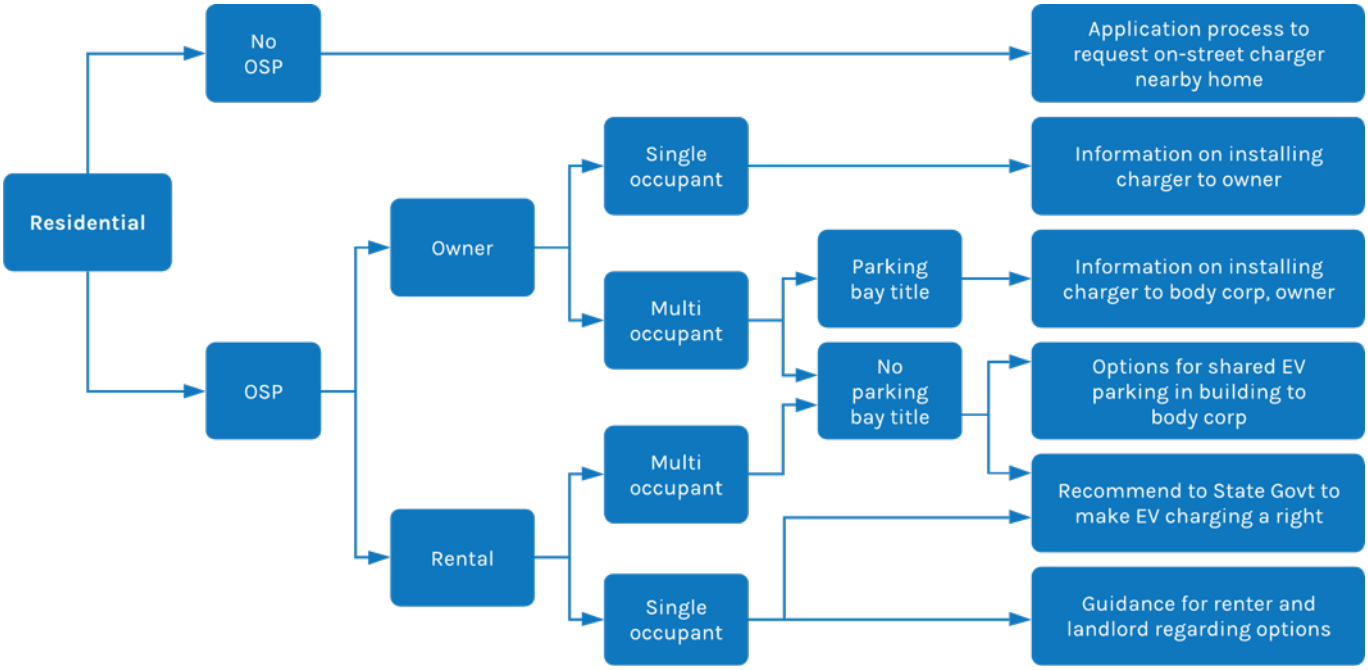


Figure 21 Residential EV charging

NB: OSP is Off-Street Parking

6. Stakeholder Engagement

This project included comprehensive stakeholder engagement including participating councils, state government agencies, community groups, and private businesses. This included a series of workshops with government stakeholders, one-on-one meetings with each participating council and state government agencies. An online survey, and meetings with community and business organisations were also undertaken. In total, 35 different organisations were engaged. This process helped shape the direction of this project and the identification of barriers and opportunities for the NCA members to address.

6.1 Summary

This section provides a summary of the insights garnered from the stakeholder engagement process and highlights the implications for the Northern Council Alliance.

Table 7 provides a list of the organisations interviewed as part of this project, from a total of 53 separate organisations that were contacted.

Table 7 Interviewed organisations

Organisation
La Trobe University
Electric Vehicle Council
Good Car Co
Melbourne Market
Villawood Properties
DCIG (Property developer)
Car Next Door
Lalor Shopping Centre
EVSE Australia
JJs Waste
City of Yarra
Go Evie
JOLT Charge
Bunnings
GoGet
Goulburn Murray Climate Alliance
Central Victorian Greenhouse Alliance
Municipal Association of Victoria
DELWP
Northern Alliance for Greenhouse Action (NAGA)
Northern Councils Alliance (NCA)

Key themes and implications to emerge from the discussions are summarised below:

- Clearly defined roles for each level of government and the private sector are needed for the delivery of a public EV charging network. This will allow councils to focus on their work while leaving others to deliver work best suited to them.
- Councils are already well underway with supporting a transition to EVs and EV charging. This includes rolling out a public EV charging network, transitioning council vehicle fleets to EV, and identifying opportunities to increase EV charging as part of new developments. Some councils have also begun identifying opportunities to change internal travel behaviour, such as using e-bikes for short work trips and EVs for waste management.
- State Government will continue working to set policy at the state level and support EV charging installation via funding programs.
- Private operators saw councils as having a strong role to play in the roll-out of EV charging infrastructure via access to land / car parking.
- When tendering for EV charging, private operators recommended an open approach that allowed flexibility for operators to select exact sites, while being cognisant of the financial viability of leasing arrangements. Private operators also highlighted the need to quickly scale up to meet forecast demand for charging over the next decade.
- Shopping centres and large retail outlets are still in the early stages of considering EV charging and only where clear value to the customer and organisation is present.
- Other council alliances noted the need to upskill staff on EVs and charging equipment. This includes customer facing staff that are likely to receive phone calls / emails from the community for information and decision-making staff who are likely to make decisions on council vehicle fleets or public EV chargers.

6.2 Workshops

A total of three workshops were undertaken with participating councils and State Government representatives. Each workshop focused on a different theme.

6.2.1 Workshop 1

Workshop 1 provided an introduction to EVs and charging. Some participating councils presented on aspects of their work to date on EVs. In particular, Merri-bek gave an overview of their EV charging network and Darebin discussed their policy on EV charging in new developments. Key discussion points from this workshop highlighted the need to clearly define the role of Councils in facilitating EV uptake and the development of a charging network. Also noted were the challenges in working strategically to deliver an EV charging network with DNSPs.

6.2.2 Workshop 2

Workshop 2 explored our methodology for developing a public EV charging network based around activity centres (ACs). There was discussion

around the interaction between walkability of an AC and suitability for EV chargers. A presentation by the Good Car Co on their role in improving access to EVs via community bulk-buy schemes rounded out this workshop. Several participating councils are already engaged with Good Car Co on bulk-buys for their communities.

6.2.3 Workshop 3

Workshop 3 focused on planning mechanisms to facilitate EV charging as part of new developments. The announced changes to the National Building Code are for apartment buildings. Other building types are yet to be considered.

The Planning Scheme, including Parking Overlays, and the Built Environment Sustainability Scorecard (BESS) tool were also explored, in terms of their relationship with the installation of EV charging. A State-wide amendment to the Planning Scheme was noted as the most effective approach.

6.3 Interviews with councils

All seven councils were interviewed to understand current work relating to EVs and charging infrastructure. These conversations also provided an opportunity for the authors to better understand council's position and practices related to EVs and charging. The authors were able to answer questions or clarify areas of interest.

All councils have at least one public EV charger installed within their municipality. These chargers are managed by a mixture of council and private operators. Some have been installed via grant funding, including ARENA and DCAV.

While the development of a public EV charging network has thus far proceeded on an ad-hoc basis, a common question from the council staff focused on clarifying the role of council in delivering EV infrastructure as well as the role of other players in this space (Commonwealth, State, private groups, the public).

One key piece of advice offered to councils from the private sector was *'just start doing it and learn and adapt through the process'*.

One of the biggest barriers noted by councils was the lack of support from electricity distributors. Most EV charging projects require upgrades to the electricity grid. However, application fees, opaque decision-making processes, and upgrade costs are prohibitive. Use of distributor infrastructure, such as light poles and power poles, to install EV chargers has not been allowed by any of the distributors, nor has any work been done (that councils are aware of) to advance this. It is important to note the disparity between the experience of participating councils, and the view of the DNSP interviewed as part of this project (see Section 4.2).

Beyond EV chargers, only Darebin has advanced policy relating to EV chargers for new developments. This policy sits alongside an existing ESD process which uses points to gauge the sustainability of a proposed development. All councils highlighted a need to have EV charging in new developments considered in the Planning Scheme and building regulations as the most appropriate mechanisms.

For interface councils, such as Nillumbik, Mitchell, and Whittlesea, consideration for EVs and emergency management are critical. Events such as bushfires require local government responses to support the community. One area that local government currently provides support is with refuelling vehicles. Some participants raised potential complexities associated with the re-charging of EVs in the event of a natural disaster. An obvious approach would be to ensure EVs are maintained with a near full battery during the fire season. This is easier to do with an EV (which can be charged at home), compared to an ICE vehicle. Similarly, emergency vehicles will require particular consideration of the operational issues associated with the transition to EV.

6.4 State Government agencies

A separate meeting was held with State Government agencies. As a lead agency in promoting and supporting EV uptake, and as the agency funding this project, the State Government is critical to reducing road-based transport emissions.

Integration of EV charging opportunities with the Planning Scheme was discussed. Council eagerness to begin the work was noted, however State-wide changes to the planning scheme are preferred at this stage.

Transitioning to EVs also intersects with other pertinent issues, including electricity grid greening and resilience, and jobs and skills opportunities.

Integrating EVs with the electricity grid will be a focus for the coming years. Of note, is a forum with the State Government and Distribution Network Service Providers (DNSPs) to work through issues that arise. A similar forum could be used to include Councils and EVSE operators to overcome barriers related to public EV charging infrastructure installation.

Providing information to the general public was another opportunity highlighted by State Government officers, as is knowledge sharing and upskilling of people working in the automotive trades.

Finally, the ability to connect EV work for local governments with the Climate Change Act was highlighted by Stage Government agencies.

6.5 Electric Vehicle Supply Equipment (EVSE) Industry

Several telephone and video meetings were held with private EVSE operators. These operators undertake the majority of installation and maintenance activities for EV charging infrastructure in Australia.

EVSE operators supported local and State Government work to expand the network of publicly available EV chargers. Their experience in installing chargers was valuable in the identification of barriers to greater EV charging installation and optimal charger use. In particular, operators noted that some municipal tenders for charging infrastructure was too prescriptive and at times financially unviable due to council stipulations for car park leasing rates and access fees. Specifically, EVSE businesses noted that local government pin pointing a specific site was not helpful, as EVSE's often have a stronger understanding of the opportunities and constraints for particular sites. The knowledge EVSE's have in understanding the electrical infrastructure can help identify sites that can be installed at lower costs. Additionally, when councils offer sites on leases of less than ten years, it reduces financial viability.

EVSE operators noted their preferred approach to working with councils was for a less prescriptive tender request that allowed scope for the operators to choose sites, number and type of charger, and competitive arrangements for car park access fees.

Operators noted that need to increase the speed in which the EV charging network is rolled out to meet future EV charging demand. A more concerted effort is required to meet the scale and speed of change that switching the vehicle fleet to electric will bring.

Operators highlighted the important role the councils have in supporting a public EV charging network via land / parking access for charging operators and supporting the community make the transition more generally.

Public charging infrastructure that uses DC charging was preferred as it better met driver recharging needs. An exception is when on-street charging infrastructure was for resident / overnight charging only.

6.6 Retail and shopping centres

The authors held interviews with a number of large retail and shopping centre organisations to learn what they see as their role in the provision of EV charging infrastructure. One large retail operator had begun trialling EV charging at a number of sites. This was done to begin their pathway to have EV charging installed at all of their sites across Australasia. They were working through similar issues that local governments are facing with their charging networks. Questions such as which charging plugs, charging speed, number of chargers, in-house versus contracting, charging a fee for use, and similar operational elements were raised during the trial.

Larger shopping centres have also begun installing chargers at their sites. Several noted environmental promotion as their principal motive (rather than meet a direct desire to satiate charging demand from customers). Charging infrastructure was usually AC chargers, which are substantially lower in cost compared to DC chargers. Smaller shopping centres spoken to had not yet installed any EV chargers and were hesitant to consider unless it had a clear value proposition for them.

6.7 Waste services

JJs Waste is a national waste removal company. The authors held a meeting with JJs Waste to discuss their work on reducing operating emissions. They are currently trialling some EV

waste trucks (rear loaders) that do municipal park waste pick-up services and are about to begin trials of some larger trucks, including a hydrogen model. They noted that while some city and smaller service operations are currently viable for BEV, kerbside door-to-door services are not currently feasible. This is due to the increased energy requirements associated with compactors and bin lifts. Distances to waste transfer stations are also a factor.

Opportunities to embed emission reductions via contract tender processes were identified. Ensuring feasible low-emission operations are supported and consideration for cost premiums for low-emission technology was highlighted by JJs Waste as being important for local government to understand.

6.8 Car share

Car share is important for reducing transport emissions in two-ways. First, increasing car share reduces overall car ownership and vehicle kilometres travelled. Second, converting car share vehicles to electric will further reduce transport emissions.

GoGet are a large car share company active in the north of Melbourne. They are supportive of reducing transport emissions and transitioning vehicles to electric. They are trialling EVs as part of their fleet. They have noted several barriers to greater numbers of EVs as part of their fleet. Increased costs for EVs versus ICE or hybrids is the main barrier. Operational challenges associated with charging is another. The charging bay must have a charger, and there is concern that previous borrowers may not plug the EV in to ensure sufficient charge for the next user. GoGet are likely to transition a greater portion of their fleet to EVs over time, however they noted that increasing use of car share will provide bigger emission reductions compared to people purchasing EVs for personal use. It was stated that each car share car replaces up to 10 privately owned vehicles and two-thirds of car share users report using active or public transport as part of their commutes.

Councils have a role to play in supporting car share growth by responding to demand for car share within their communities. Long lead times to setting up a car share bay and restrictions on locating bays in high-demand areas were noted as barriers to greater car share use. Councils are also able to benefit from car share directly. The City of Adelaide use car share in lieu of some pool vehicles, providing flexibility for peak demand for pool vehicles without the additional costs that come with a council pool vehicle. Consideration of car share as part of ESD planning permit requirements is another way councils can support car share.

6.9 Council alliances

The authors held discussions with several council alliances, on the work they have done to support EVs, EV charging, and transitioning to a zero-emission transport system. Most had already undertaken work to develop a public EV charging network, including via the State Government funded *Charging the Regions* program.

Difficulties with DNSPs and ongoing maintenance / availability of parts was noted as barriers to public EV charging.

Another challenge noted by council alliances was the increased workload on existing staff. This included customer service officers who receive increased calls about public EV chargers, despite those chargers being managed by a private company. Part of this was due to co-branding, but it is also the case that much of the public look to council as the first port of call for issues that arise in the public realm.

7. Travel patterns and land use

In this section, we have provided an overview of the relevant travel patterns and land uses across the project area and for each of the participating councils to better understand the relationship between existing transport networks, land use zoning, and EV charging requirements. These data have been used to inform the development of the public EV charging network recommendations in Section 9 of this report.

7.1.1 Land use map

Land use zoning has been used to determine the extent of neighbourhood activity centres for the public EV charging network.

There are ten categories used in identifying land use with the ABS Mesh block dataset. Activity centres shown in Figure 22, were identified from Vicmap plan zone data, then refined with observations made with aerial imagery on Nearmap and Googlemap.

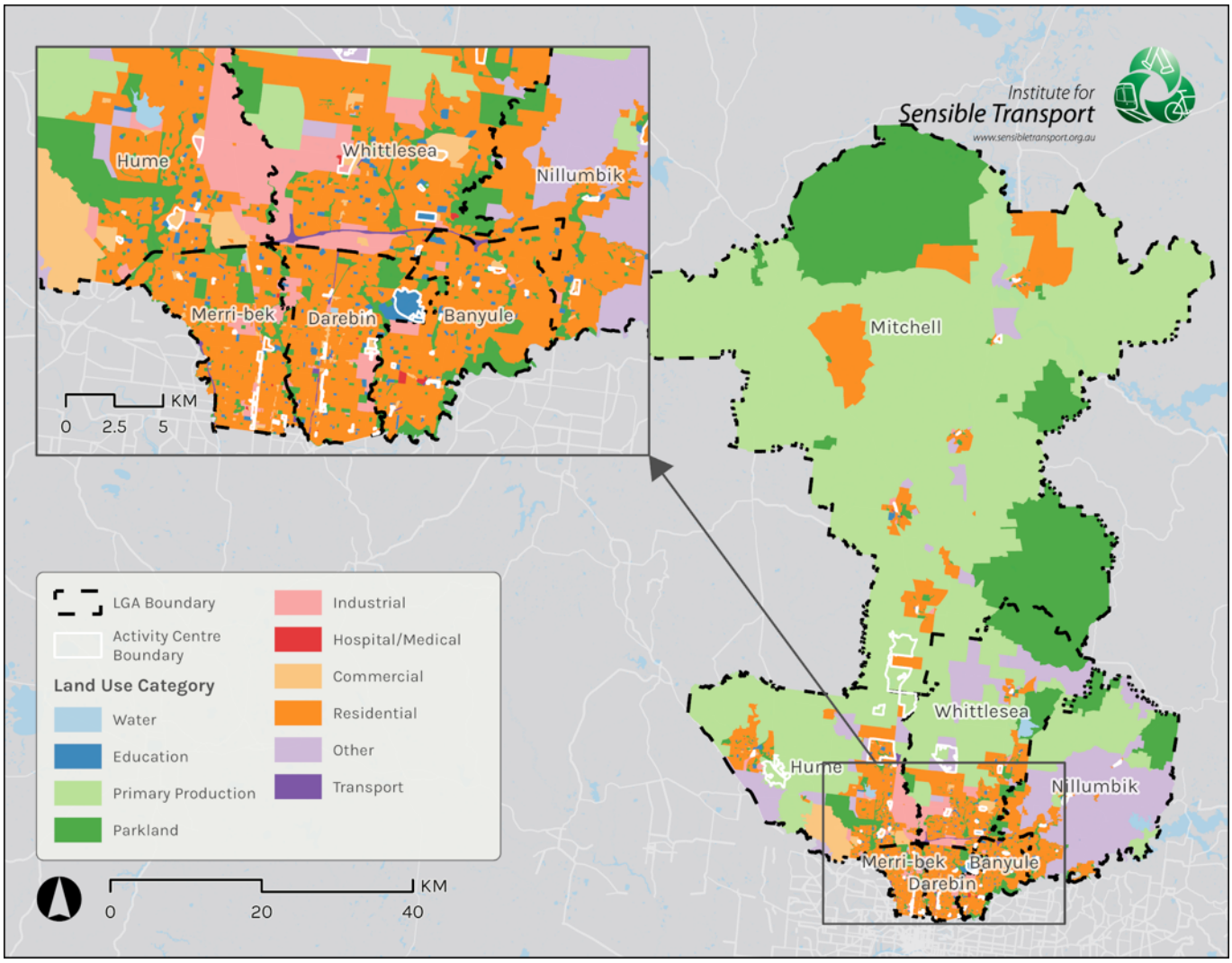


Figure 22 Land use with activity centre

Source: Land.Vic

7.1.2 EV ownership

Using the ABS Motor Vehicle Survey, a map showing the distribution of EVs by postcode within each municipality is shown in Figure 23. While there are greater EV numbers closer to the CBD, there remains pockets without any EV ownership. Out of the 79 postcodes analysed, less than 23% or just 18 postcodes recorded zero EV ownership.

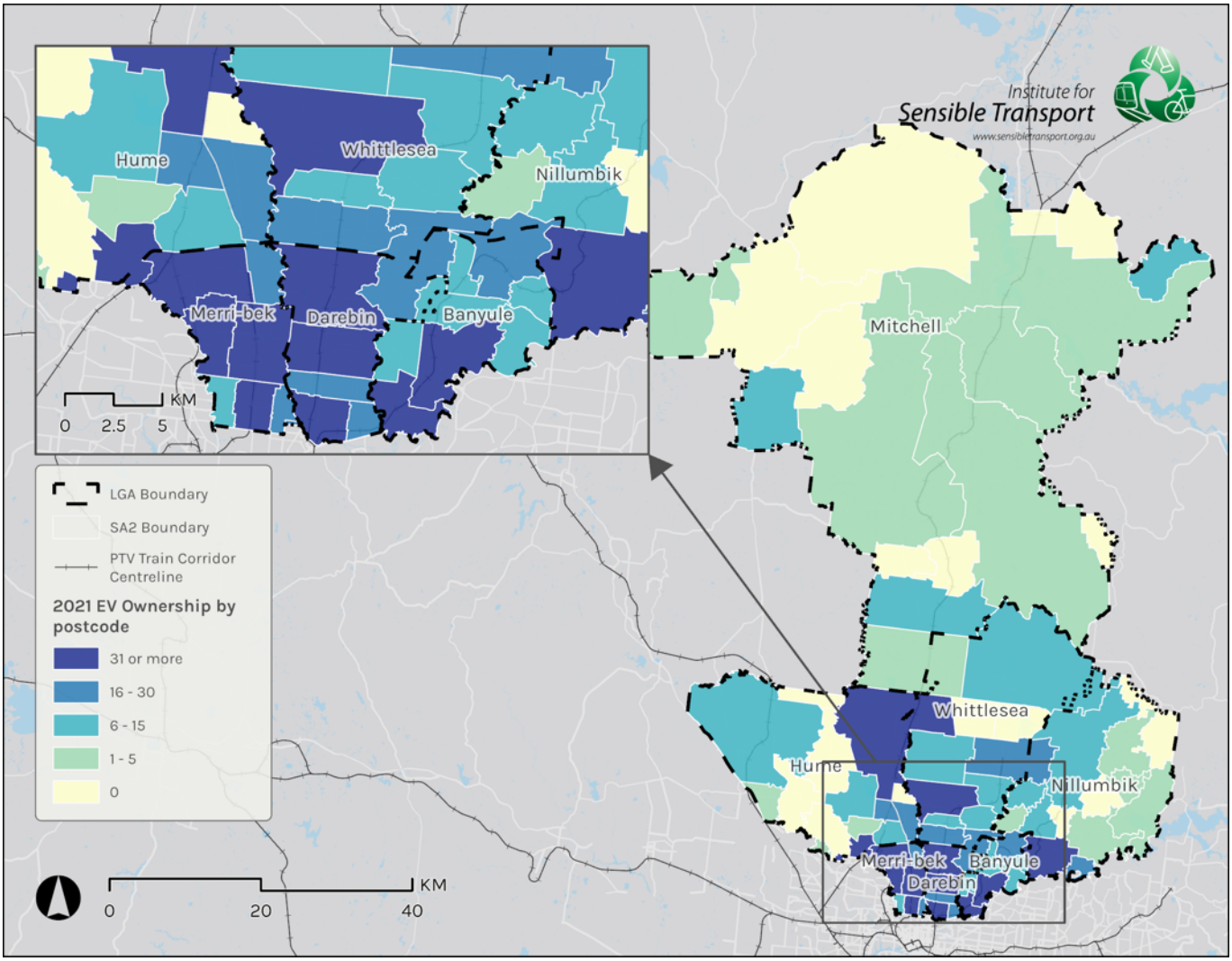


Figure 23 2021 EV ownership by postcode

Source: Institute for Sensible Transport, ABS Motor Vehicle Census

Among the seven councils in the Alliance, Hume recorded the highest EV ownership with Merri-bek following closely behind. Hume, Merri-bek, Darebin, Banyule and Nillumbik have experienced significant growth in 2020 and 2021, with ownership tripling or more as shown in Figure 24.

Prior to 2020, Whittlesea had the highest EV ownership, yet the growth seems to have stagnated with a decrease recorded in 2021. Mitchell Shire, without EV ownership in eight postcodes, recorded the lowest growth rate.

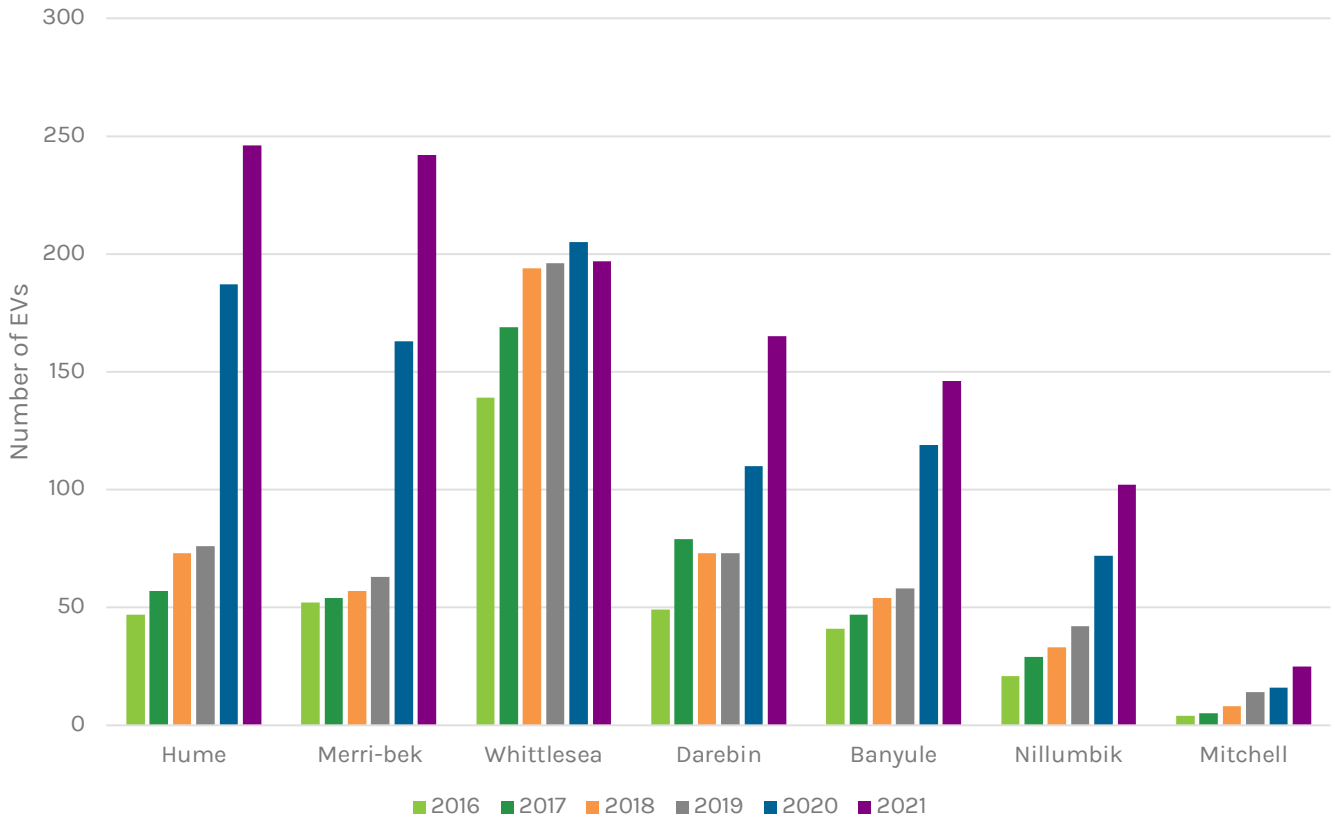


Figure 24 EV Ownership between 2016 – 2021

Source: ABS Motor Vehicle Census

While the previous map and graphs highlight the gross numbers of EVs, it can also be important to explore this data per unit of land (i.e. the concentration or density of EV ownership). The results from standardising the count of EV ownership to the size of each postcode area in square kilometres is shown in Figure 25.

The innermost suburbs record the highest density of EV ownership per square kilometres despite having greater access to other modes of transport.

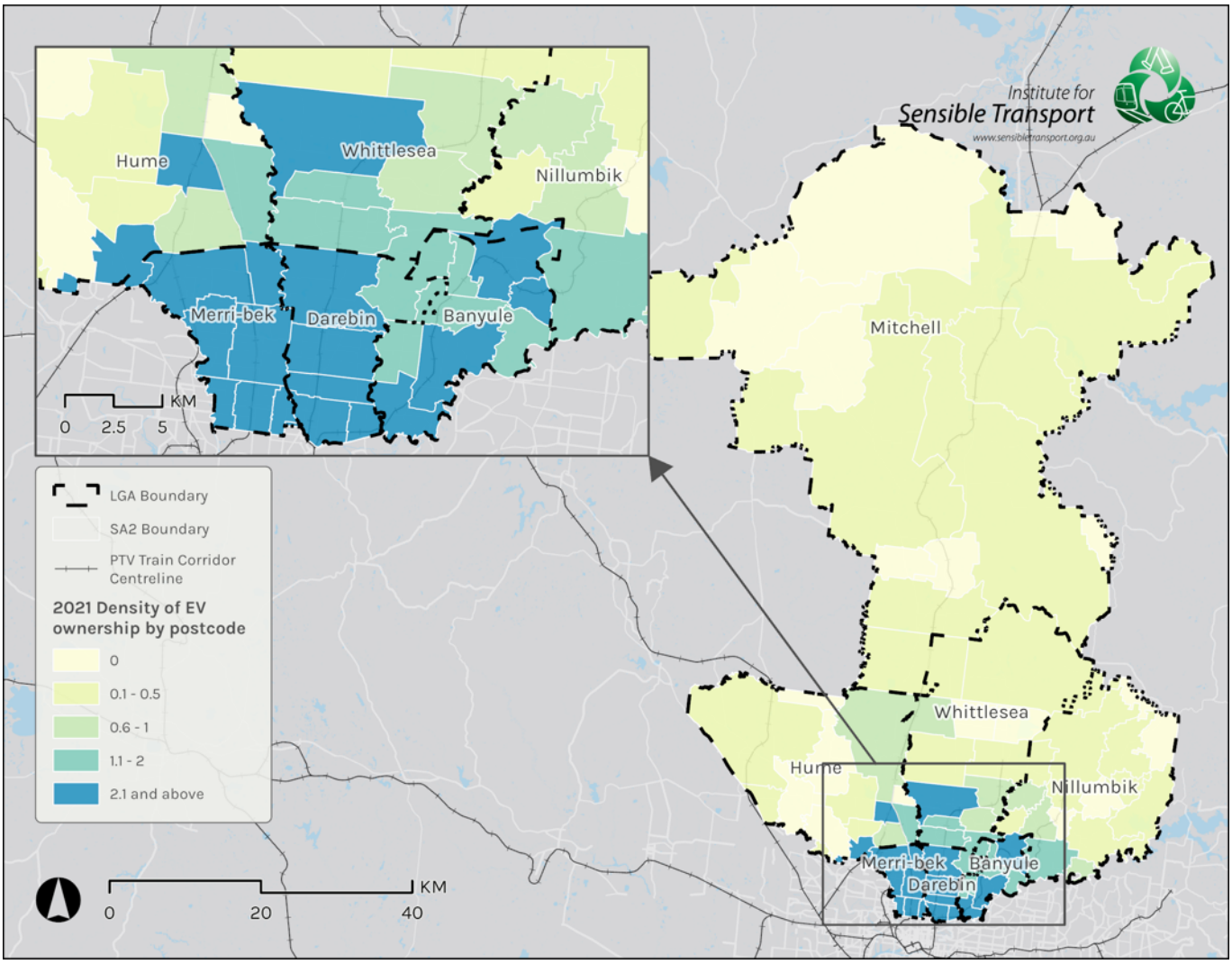


Figure 25 Density of 2021 EV ownership

Source: Institute for Sensible Transport, ABS Motor Vehicle Census

7.1.3 Traffic volume

The seven participating councils are serviced by the 6 arterial roads, namely the Calder Freeway, Citylink, Hume Freeway, Metropolitan Ring Road, Tullamarine Freeway and Western Ring Road.

The reason road traffic volume is important is because a road with higher levels of traffic will generally have higher latent demand for charging. This metric will be used in Section 9, describing how the selection of EV charging sites was undertaken.

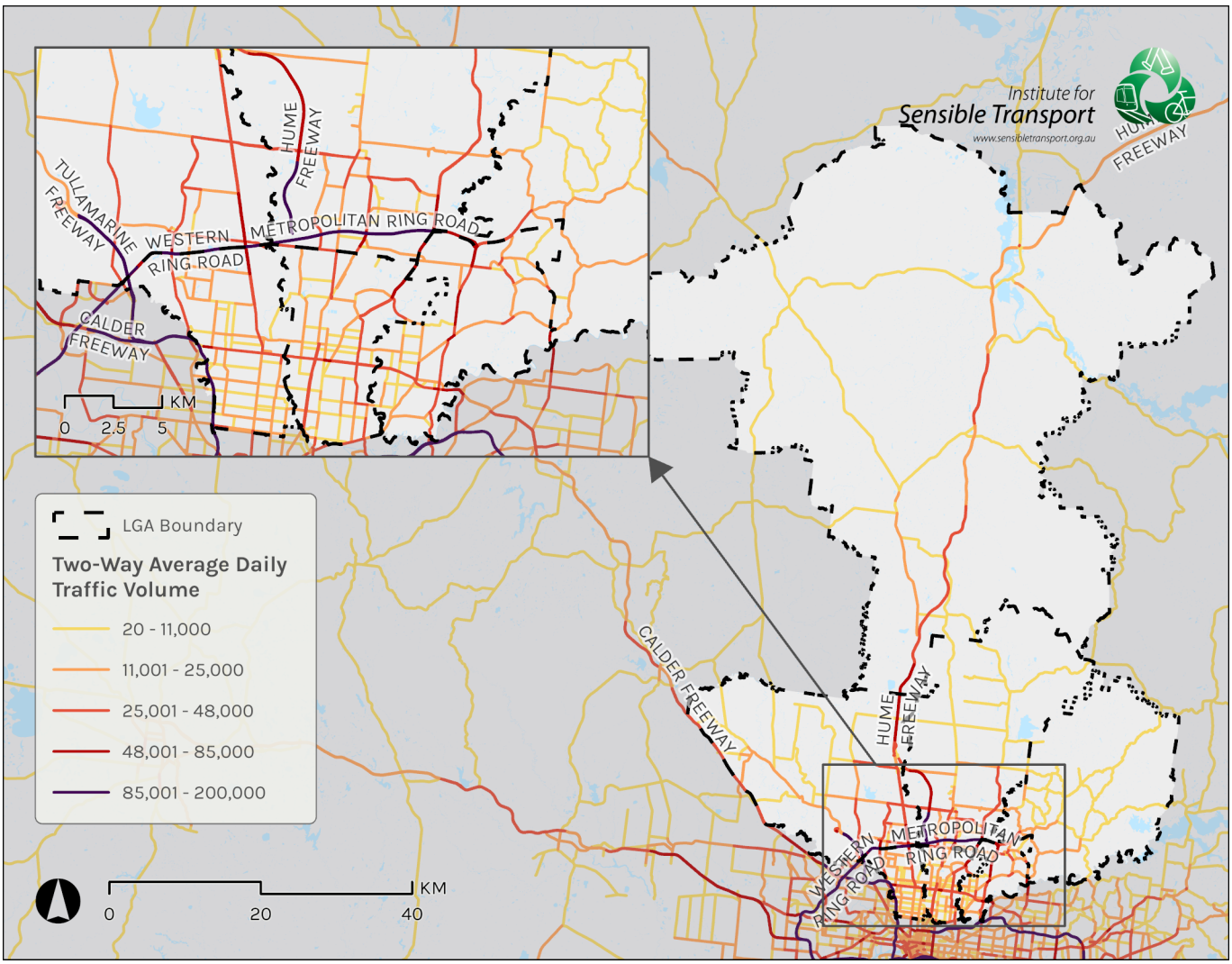


Figure 26 Two-way average traffic volume

Source: VicRoads[22]

[22] https://discover.data.vic.gov.au/dataset/traffic-volume

7.1.4 Dwelling

Using the count of dwelling structures at the SA1 level provided by the ABS, dwellings were re-categorised into three typologies for this study:

- Separate house
- Townhouse
- Apartment

Separate houses are deemed to have the easiest path to installing charging infrastructure onsite compared to multi-dwellings such as townhouses and apartments. This analysis is spatially represented on an indicative map shown in Figure 27. While clusters of dwellings can be found in the outer regions, the density of dwellings are focused towards the south side of the study area. Towards the city, the dwelling typology is also more diverse, with less separate houses, and more apartments and townhouses. The density of housing typically reflects population growth, and this will have a direct implication for the design of the EV charging network, as described in Section 9.

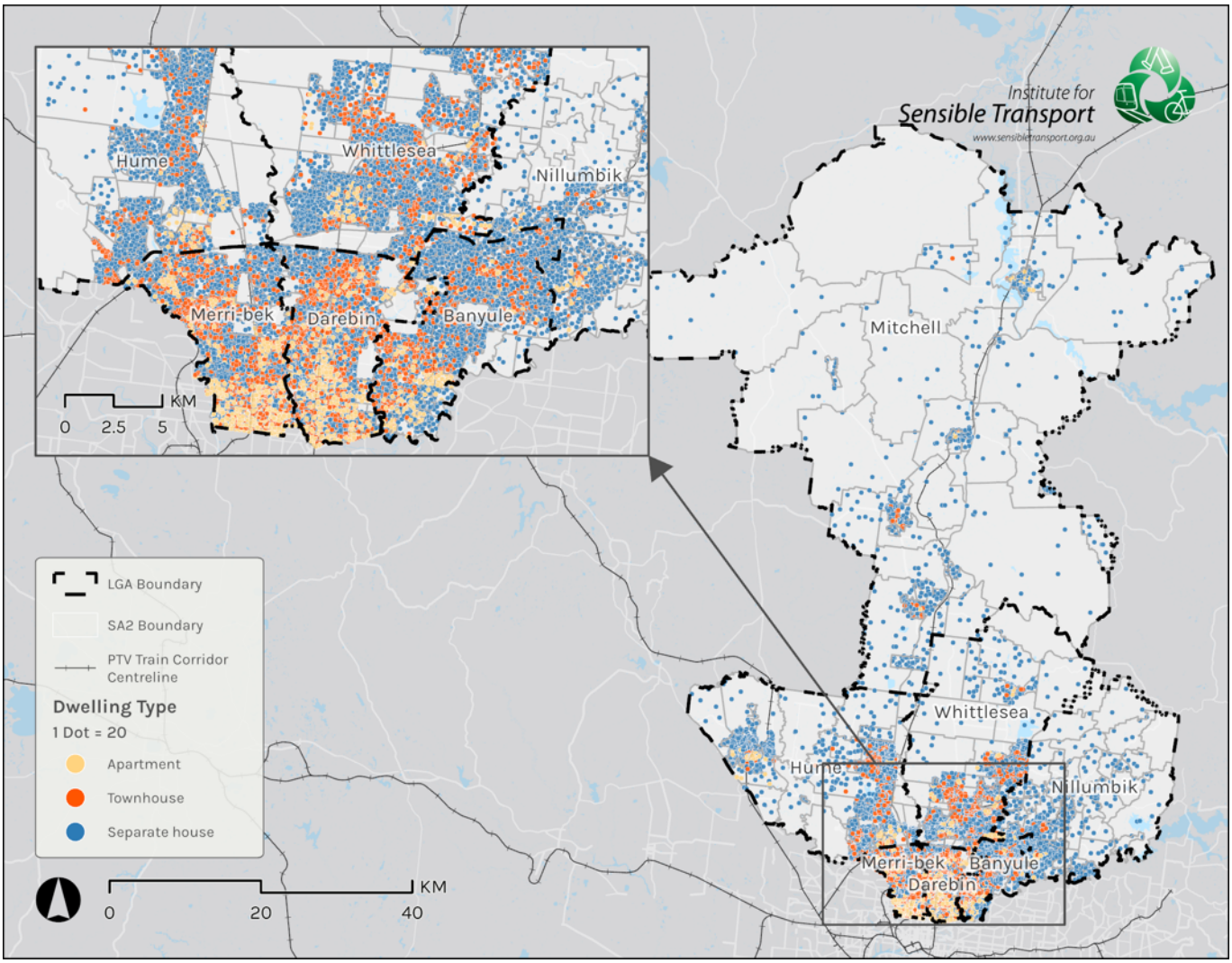


Figure 27 Dwelling type, participating LGAs

Source: ABS

Figure 28 shows the percentage of separated housing stock per LGA. This is relevant to the prioritisation of EV charging sites, as LGAs with a predominant residential built form of separate houses will generally have less need for public realm charging. Merri-bek and Darebin have the lowest proportion of separated dwellings, meaning that they have a higher proportion of terrace / townhouses and apartments (which have less opportunities to charge at home). These councils will have higher demand for public charging.

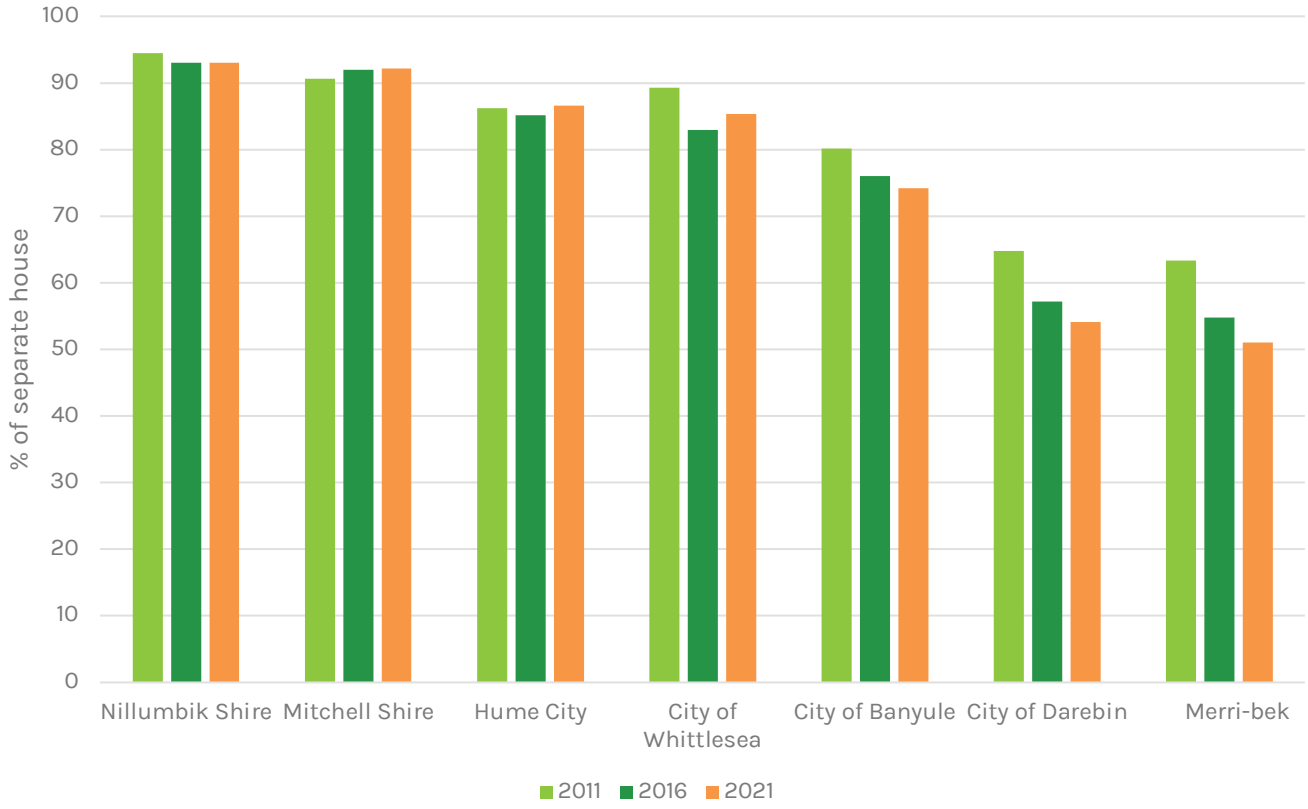


Figure 28 Percentage of separate housing stock per LGA

Source: ABS

7.2 Existing and Planned Charger Network

The number of EV chargers across the NCA area is growing rapidly. Figure 29 provides a map of these chargers. Existing chargers are listed by their charging capacity and were drawn from the public EV charging website PlugShare.com. Planned chargers were drawn from the relevant funding bodies ARENA and DCAV. These chargers are likely to be DC chargers.

A simplified version of Figure 29, where AC only chargers have been omitted, is available as an online interactive map here:

https://storymaps.arcgis.com/stories/8fc4488ecc4d4471b34707da82d70ef5

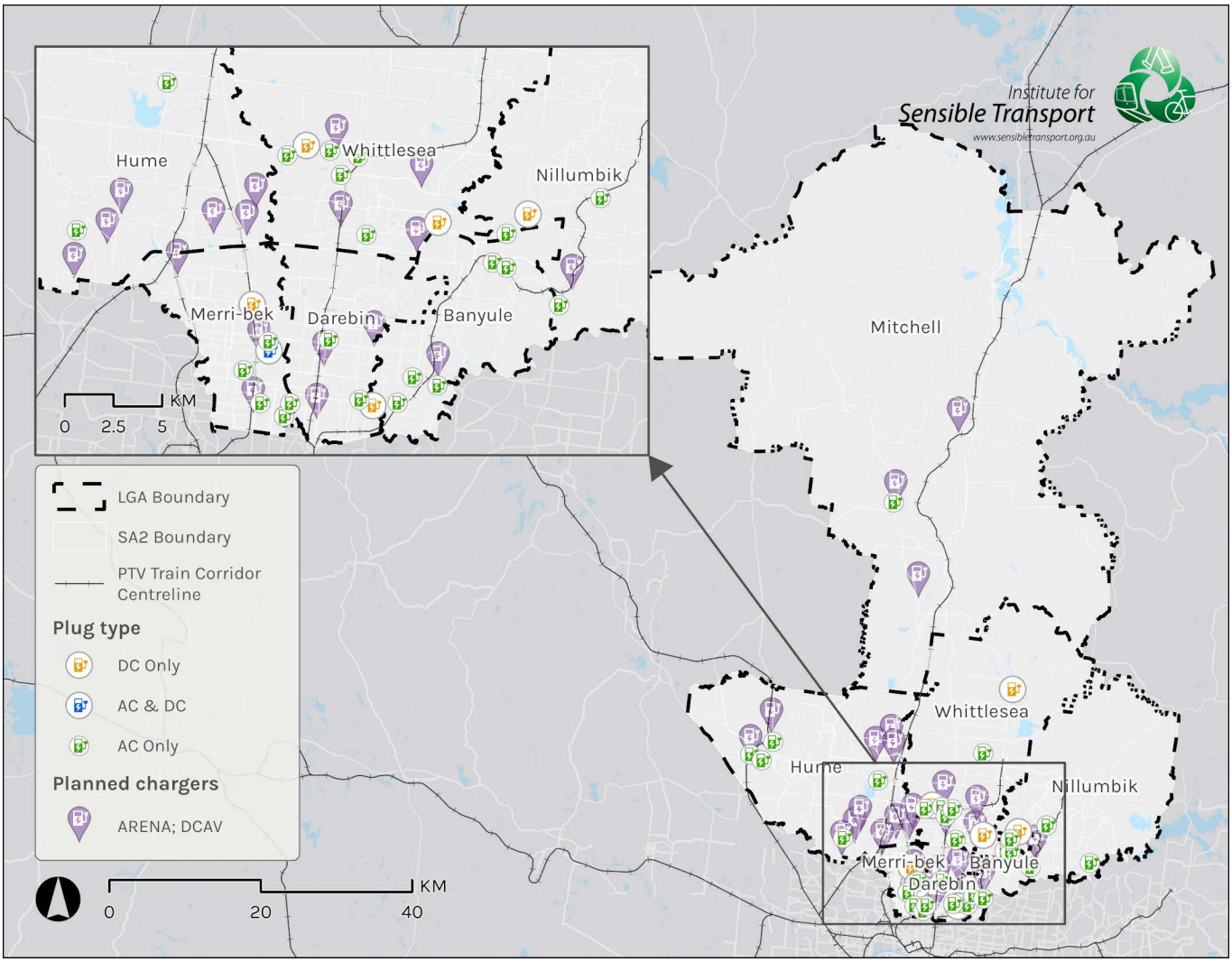


Figure 29 Existing and planned EV chargers

Source: Plugshare, ARENA, DCAV, Department of Transport

8. Forecasting EV ownership and charging use

An understanding of the current and future number of EVs expected to be on the road in the study area is necessary to inform the development of the EV charging network. As highlighted earlier, EV sales have been growing rapidly in Australia, albeit from a very low base. This section highlights forecasts for the EV market in Australia, to gain a stronger picture of current trends and market penetration over the medium term.

Australian EV sales are shown in Figure 30. It should be noted that the 2022 figures based on figures up to September 2022. Some commentators have identified that the slowing rate of new ICE vehicles and the sharp increase in EV sales may be described as an *Osborne Effect*, whereby people delay the purchase of a product they fear may become obsolete soon and are waiting for the new form of the product to be affordable. The announcements by many major vehicle manufacturers that they intend to stop producing ICE vehicles between 2025 and 2035 (e.g., GM, Ford, Volvo and VW) reinforces the notion that it is inevitable EVs will become the dominant form of drivetrain in the future, and may be influencing current trends.

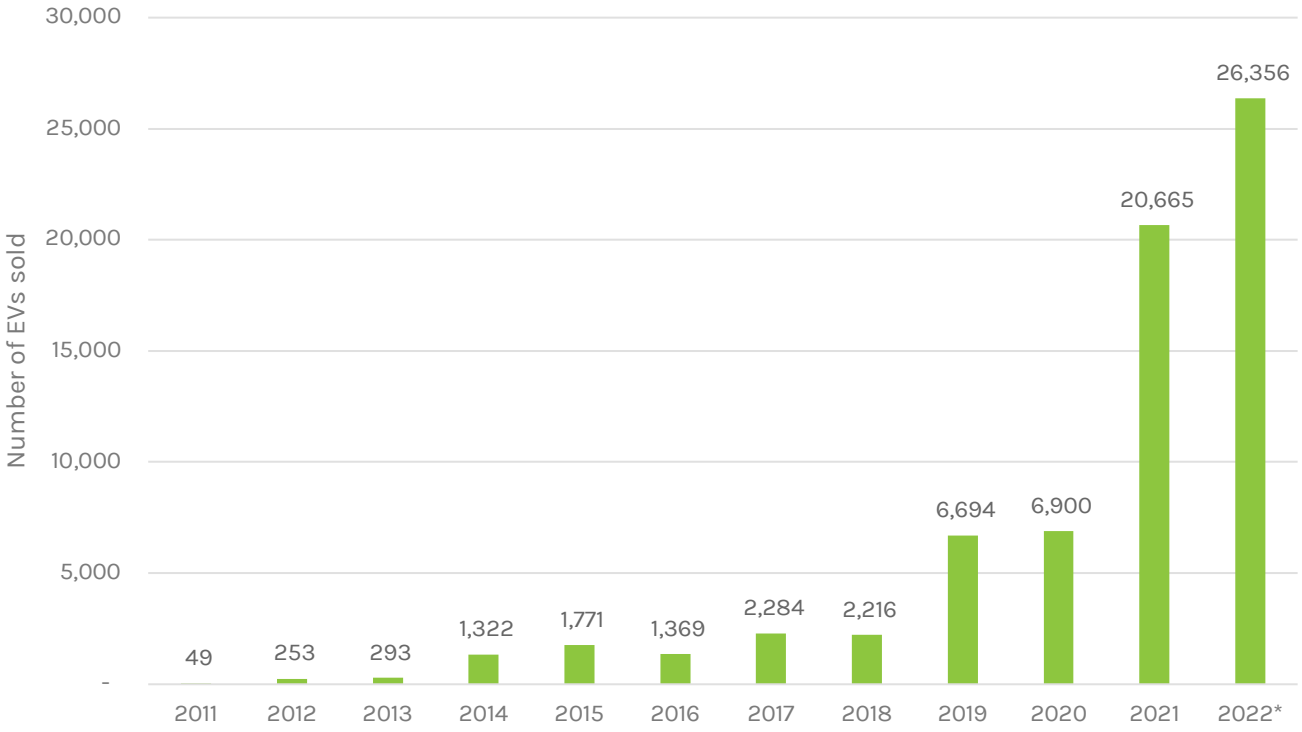


Figure 30 Battery electric vehicles sold

* Data is up until September.

Source: Electric vehicle Council "*State of EVs October 2022*"

8.1 Future EV uptake in Australia

The Australian Energy Market Operator (AEMO) commissioned the CSIRO in 2021 to forecast EV adoption rates in Australia.[23] Five scenarios were modelled:

1. Slow Growth
2. Current Trajectory
3. Sustainable Growth
4. Export Superpower
5. Rapid Decarbonisation.

Figure 31 illustrates the results from the CSIRO modelling, indicating that EVs are predicted to account for 50% of all sales by ~2027 in the *rapid decarbonisation scenario*, compared to 2044 in the *current trajectory scenario*. One might question this forecast given that most major vehicle manufacturers have indicated they will no longer produce ICE vehicle by 2030 – 2035.

As highlighted in the CSIRO report, it is not just the share of new vehicle sales that are important, but the projected share of the national fleet. Even in Norway, in which over 75% of new vehicles sold are EVs, only a minority of vehicles on the road are EVs, as it takes time for this to filter down to the vehicle inventory. The results from CSIRO, shown in Figure 32 forecast that all vehicles are estimated to be electric by 2045 in the *rapid decarbonisation scenario* and the *slow growth scenario* indicates that only ~40% of the fleet are expected to be EVs by 2055.

Finally, the CSIRO report forecasts the total number of EVs, across all vehicle types, for 2050, by scenario, as shown in Figure 33. This indicates that in the more ambitious scenarios, over 20m EVs are expected to be within the fleet by 2050, and just over 10m in the current trajectory scenario.

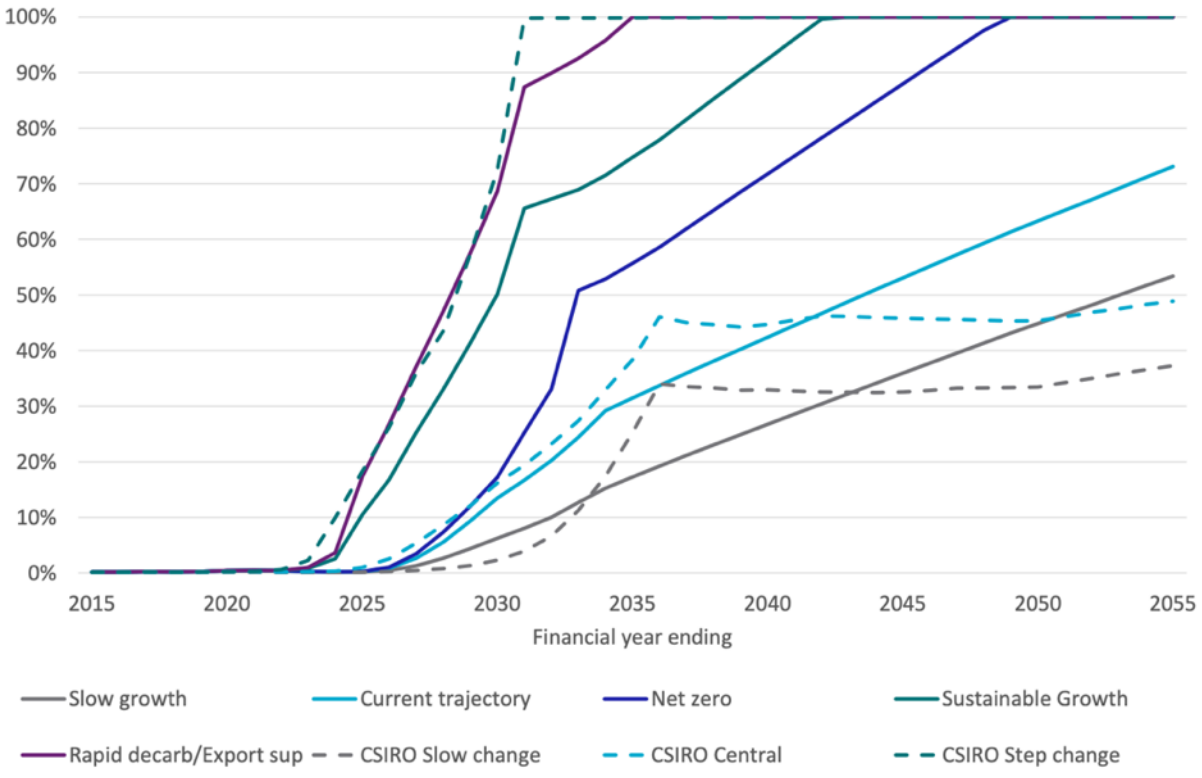


Figure 31 Projected sales share, all EVs, compared to selected 2020 projections

Source: CSIRO

[23] https://tinyurl.com/uj7yytxc

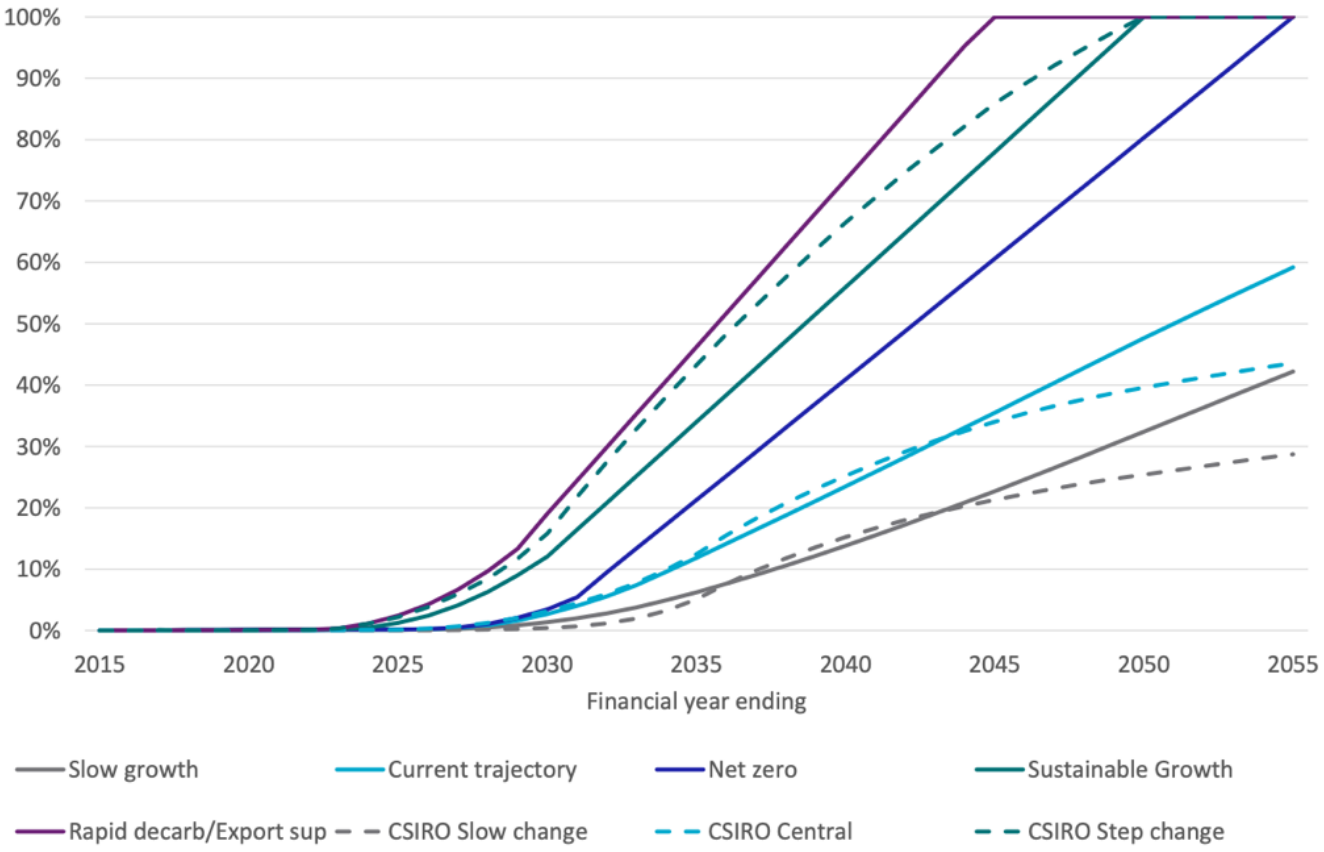


Figure 32 Projected fleet share, all EVs, compared to selected 2020 projections

Source: CSIRO

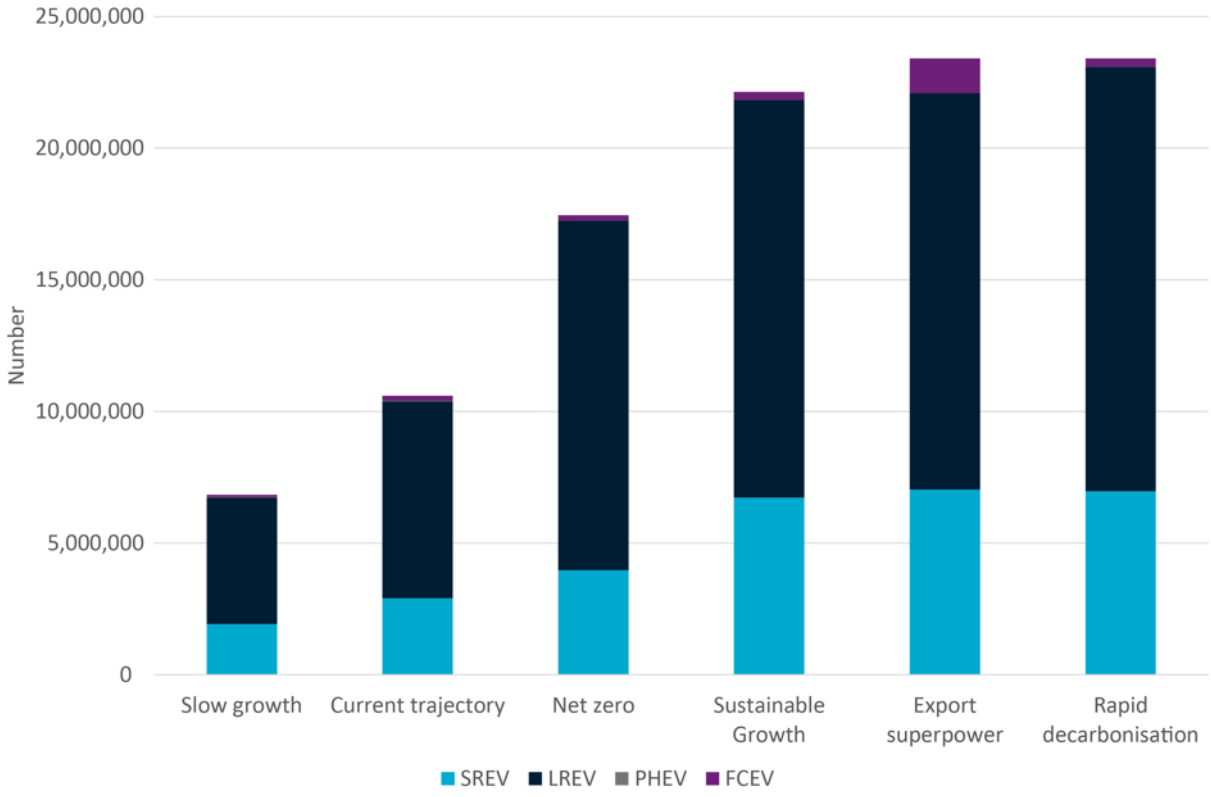


Figure 33 Projected number of EVs, of all types by 2050

Source: CSIRO

NB: SREV is Short Range Electric Vehicle, LREV is Long Range Electric Vehicle, PHEV is Plug In Electric Vehicle and FCEV is Fuel Cell Electric Vehicle

8.2 Estimated time of day charging patterns

The average daily charging profiles for light passenger EVs is shown in Figure 34. These are a mixture of public and private charging data sourced in Australia and internationally. The day and night profiles (constructed based on assumed consumer behaviour) are dependent on pricing signals to limit their charging to off-peak times. Most consumers still prefer to charge during the day, instead of at night. The *convenience* charging, derived from actual usage collected in Australia and internationally, is most pertinent for the NCA EV charging network, showing that most charging takes place at night. These pattens form the basis for most of the public chargers recommended (called *'opportunistic'* chargers in the network plan).

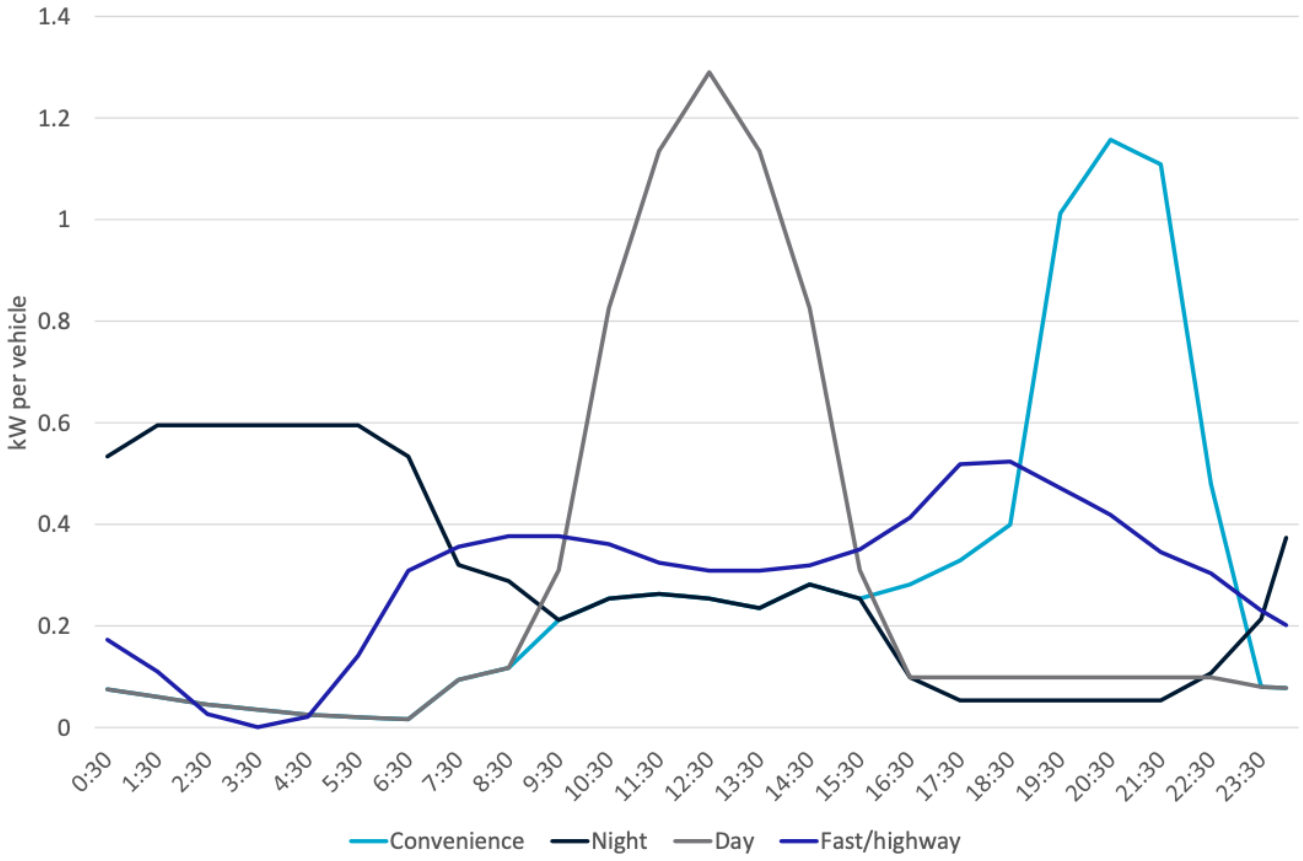


Figure 34 Average daily charging profiles for light passenger EVs

Source: CSIRO

8.3 Forecasting EV Ownership

We have developed a model that allows a plausible estimate of future EV ownership, on a council-by-council basis, using CSIRO/AEMO base forecasts.

As a starting point, we use the ABS Motor Vehicle Census[24] to sum EV ownership for each council between 2016 and 2021, as shown in Figure 35.

This allows us to estimate EV ownership in future years, either by the trend line of the preceding years or the CSIRO or AEMO forecast rates, shown in Table 8.

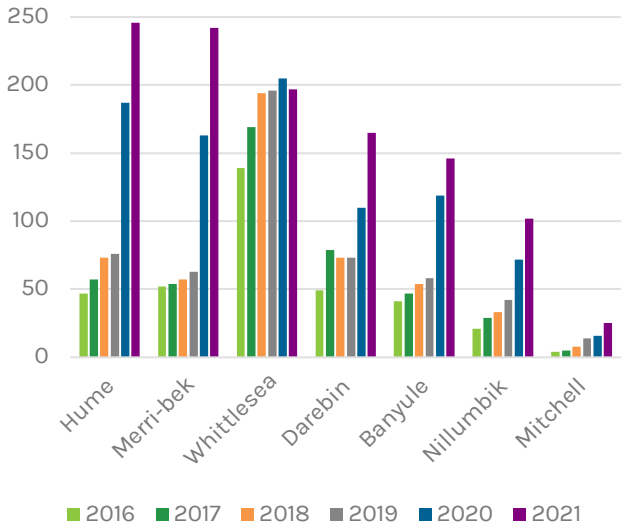


Figure 35 EV ownership by council

Source: ABS Motor Vehicle Census

Table 8 Forecast EV ownership

Council and forecast rate	2025	2026	2027	2028	2029	2030
Banyule - Trend	376	487	633	821	1,066	1,383
Banyule - AEMO Net Zero Steady Progress	2,596	3,559	4,688	5,987	7,461	9,114
Banyule - CSIRO rapid decarbonisation	5,782	8,066	10,764	13,886	17,443	21,447
Darebin - Trend	311	380	462	563	685	833
Darebin - AEMO Net Zero Steady Progress	2,940	4,058	5,371	6,892	8,627	10,585
Darebin - CSIRO rapid decarbonisation	6,549	9,197	12,333	15,984	20,169	24,908
Hume - Trend	367	502	685	936	1,279	1,746
Hume - AEMO Net Zero Steady Progress	4,709	6,550	8,771	11,378	14,393	17,839
Hume - CSIRO rapid decarbonisation	10,489	14,846	20,139	26,389	33,651	41,980
Mitchell - Trend	128	191	291	439	661	991
Mitchell - AEMO Net Zero Steady Progress	1,363	1,947	2,721	3,670	4,811	6,161
Mitchell - CSIRO rapid decarbonisation	3,035	4,413	6,248	8,512	11,248	14,499
Merri-bek - Trend	669	917	1,253	1,712	2,338	3,192
Merri-bek - AEMO Net Zero Steady Progress	3,019	4,169	5,515	7,072	8,847	10,848
Merri-bek - CSIRO rapid decarbonisation	6,725	9,450	12,664	16,402	20,683	25,528
Nillumbik - Trend	331	454	624	857	1,176	1,615
Nillumbik - AEMO Net Zero Steady Progress	1,442	1,980	2,611	3,338	4,164	5,092
Nillumbik - CSIRO rapid decarbonisation	3,212	4,487	5,995	7,742	9,735	11,983
Whittlesea - Trend	278	296	316	337	359	382
Whittlesea - AEMO Net Zero Steady Progress	4,571	6,373	8,549	11,108	14,074	17,470
Whittlesea - CSIRO rapid decarbonisation	10,181	14,445	19,629	25,763	32,905	41,111

Source: ABS, CSIRO, AEMO

[24] The Motor Vehicle Census 2021 was released by the ABS, subsequent releases will be by BITRE

Figure 36 shows the forecast EV ownership for the study area, based on AEMO's *Net Zero Steady Progress* forecast rate. In total, it is estimated that over 72,000 EVs will be registered within the NCA area.

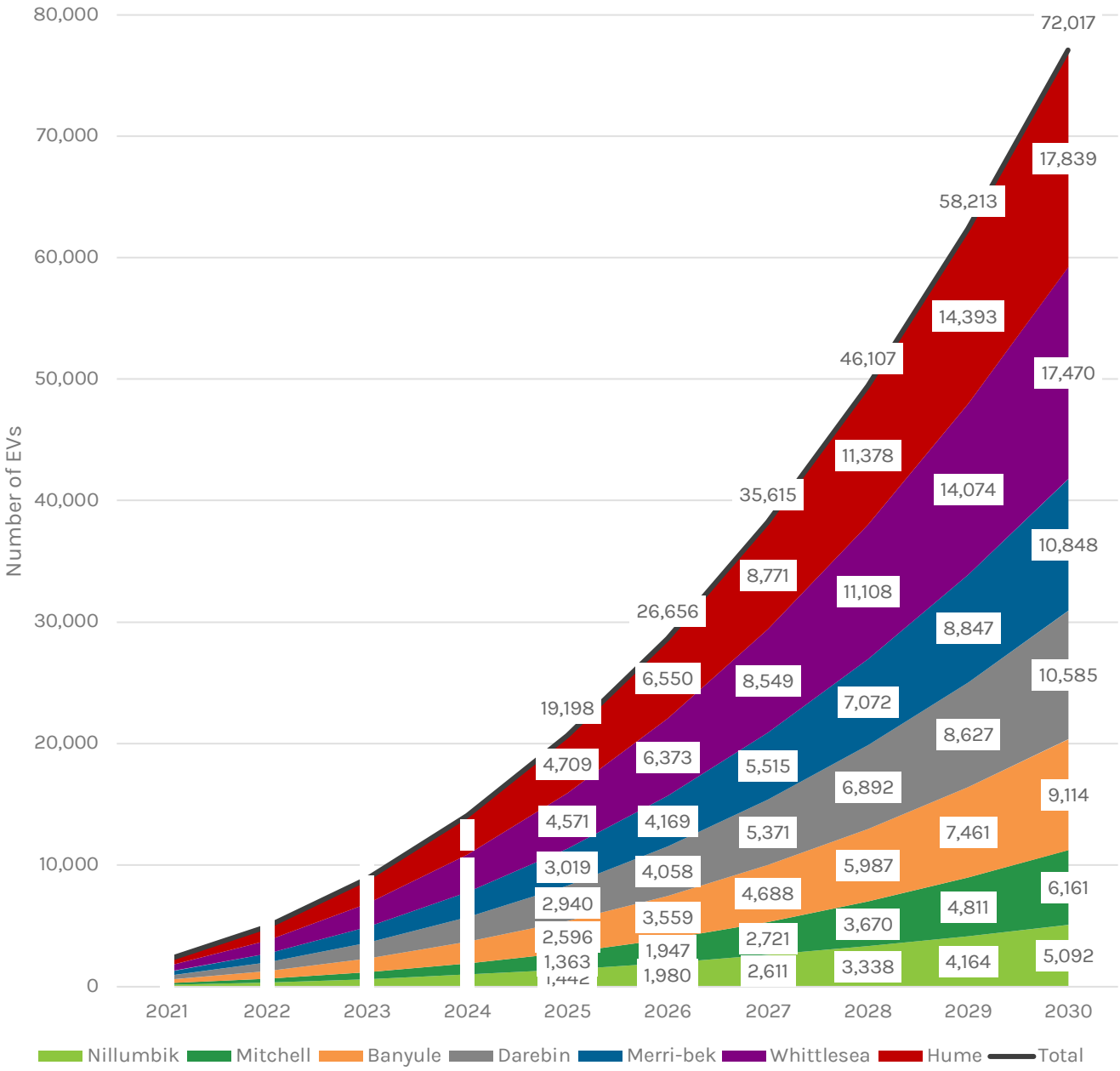


Figure 36 Forecast EV ownership

Nb. This uses the AEMO Net Zero Steady Progress forecast rate

8.4 Forecasting EV charging use

Councils will be provided with the Excel model that forecasts usage and this can then be adjusted in the future, without an additional contracting of consultants. Our forecasts contain a range of industry verified assumptions regarding:

- EVs in fleet
- EV usage and energy consumption
- Charging location, including percentage that charge at home vs. out of home charging and how this varies for different LGAs within the study area.

Detail on the above assumptions are included in the Excel model.

Our model will provide all seven councils with a detailed understanding of the number of charging sites expected to be required in 2025, 2028, and 2030, as well as ports required and charging sessions undertaken, as a daily average.

8.4.1 Forecast electricity demand

A map of estimated daily electricity demand from EVs on the power network is shown in Figure 37. This map has been done at the SA2 level and provides an estimate of the additional annual electricity demand from home EV charging by 2030, assuming AEMO's Net Zero Steady Progress model of EV ownership for each LGA (see Table 8).

Many parts of the NCA area, and especially those in regional areas, will likely require upgrades to the electricity network to accommodate the forecast growth in electricity demand.

These electricity demands are in addition to public EV charging demands.

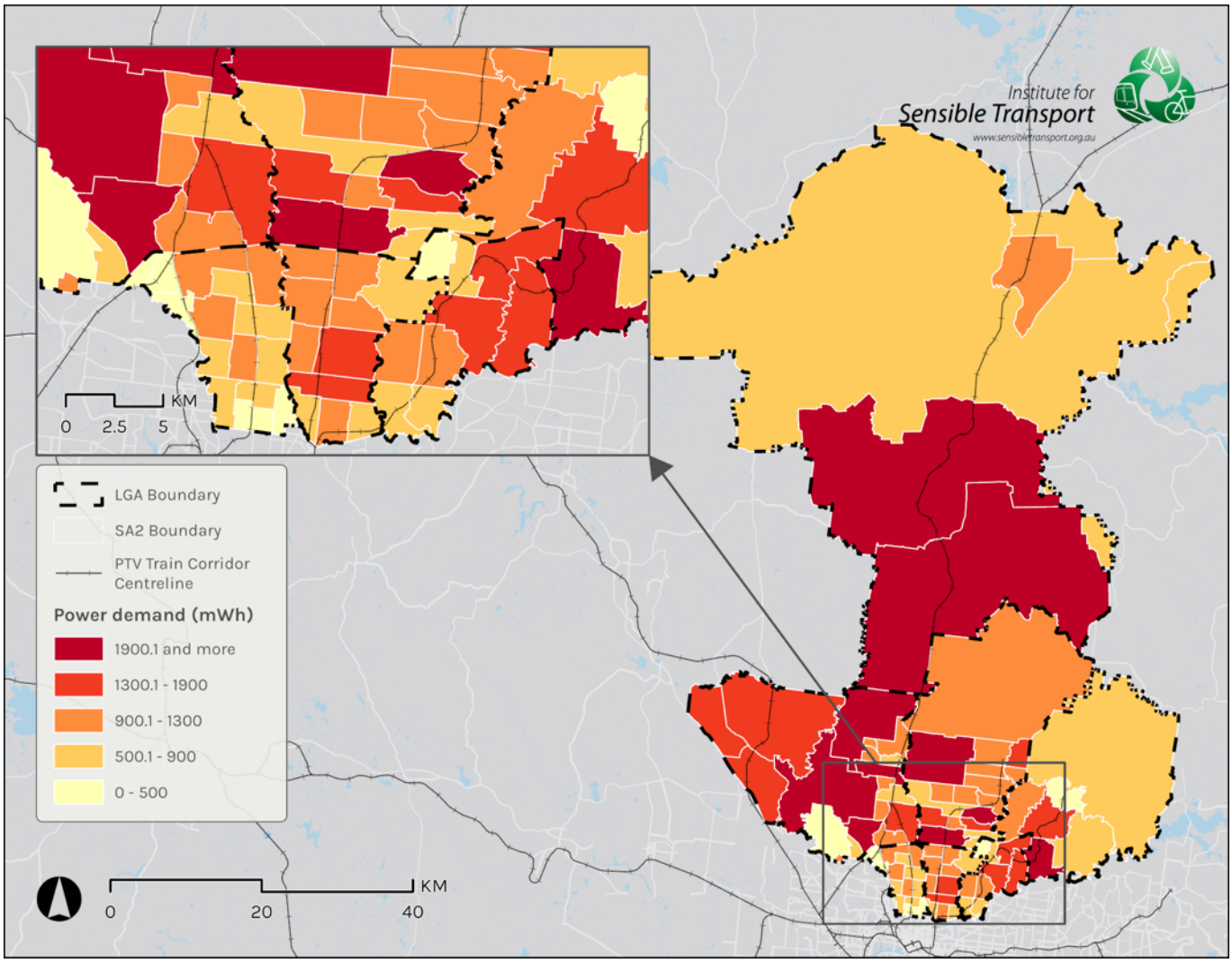
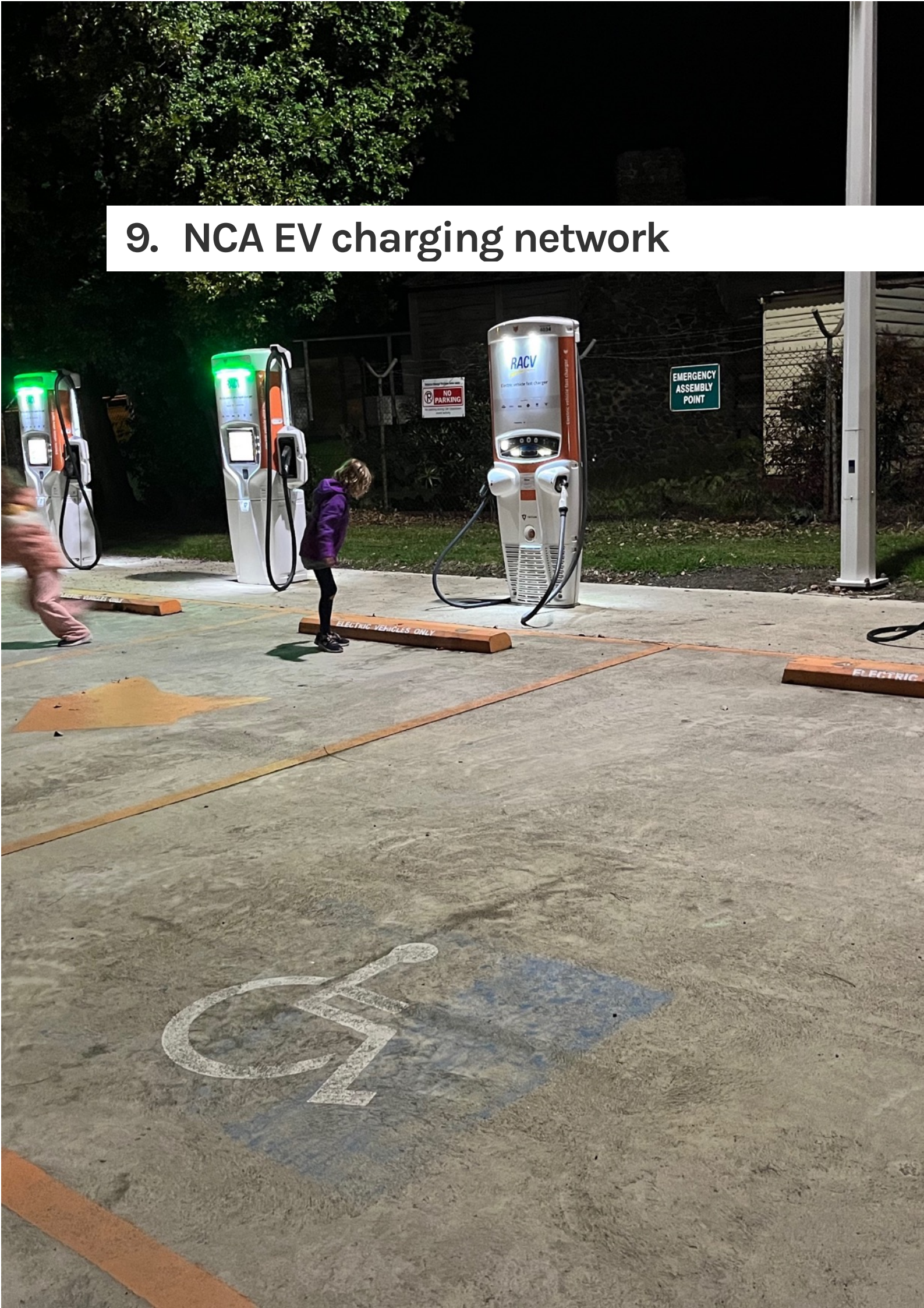


Figure 37 Forecast annual electricity demand from home EV charging by 2030

Source: Institute for Sensible Transport

9. NCA EV charging network



This section describes the prioritisation of charger locations across the NCA area. Three categories of charger have been recommended based on our earlier work segmenting the public charging market into three key categories (see Figure 16). The implementation period is 2022 – 2030. Given the speed with which the EV market is developing, it is recommended the network be reviewed regularly.

To support NCA's commitment to reducing emissions, it is recommended that public charging is installed in all Activity Centres by 2030. Prioritisation should be focused on those areas likely to be most heavily used and fill major gaps in the charging network.

The remainder of this section describes the approach to the development of the charging network, as well as proposed sites, implementation year and the type of charger proposed.

9.1 Methodology

A framework has been developed to inform the NCA EV charging plan. This includes the three categories of public charging identified below. Additionally, a description of this charging market segmentation was captured in Section 3.12.

1. Ultra-Fast Chargers (150kW DC+) catering to the *Passing Through Motorist*
2. Medium/Fast Chargers (25 – 50kW DC) catering to the *Opportunistic* charger
3. Slow Chargers (~7kW AC) catering to the resident lacking the ability to charge at their residence.

9.1.1 Ultra-Fast Chargers

Ultra-fast chargers are expensive and therefore must be used strategically. They should only be placed in areas that have significant passing through traffic and limited alternative fast charging sites.

The process of identifying suitable ultra-fast charging sites involved an analysis of the NCA catchment, focusing on locations scoring strongly on the criteria identified in Figure 38.

Figure 38 Passing through motorist EV charging site criteria

A manual scan of the study area was undertaken, with an overlay of road traffic volumes and existing or planned EV ultra-fast chargers. Victorian road traffic volume data[25] is collected by the state government, is relatively fine grained (compared to other transport data) and is of high quality.

9.1.2 Opportunistic Chargers

Opportunistic charging describes the charging that takes place when someone was going to that particular location anyway. The motorist takes the opportunity to top up, because of the availability of a charger.

The criteria used to prioritise sites for opportunistic chargers is shown in Figure 39.

[25] https://discover.data.vic.gov.au/dataset/traffic-volume

Figure 39 Opportunistic charger site criteria

Opportunistic chargers typically deliver 25 – 50kW DC charging, although it is possible to include 11 – 22 kW AC charging as a lower cost alternative. Commercial EV charging providers typically prefer DC charging, as the fee charged to motorists can be higher and more drivers are likely to take up the offer. State and Commonwealth funding is generally for DC chargers.

The prioritisation framework developed to inform the roll out of opportunistic chargers is based around Activity Centres. *Plan Melbourne* categorises Activity Centres into the categories (in order of importance):

1. Metropolitan
2. Major, and
3. Neighbourhood.

A freely available spatial dataset of Metropolitan and Major Activity Centres was used as the basis of this EV charging prioritisation framework.

Locations of neighbourhood activity centres are not specified by Plan Melbourne. Neighbourhood activity centres were then identified using Planning Zone information and Google Maps.

General boundaries were created for each Activity Centre within which an EV charging station could be installed. Generally, the boundary was drawn to include the Activity Centre's main commercial area as well as any significant nearby parks or reserves.

Identifying *areas,* not pin pointing locations

One of the strongest messages from the EV charging industry is that they find it problematic for government to pin-point precise exact locations for EV charging sites. By identifying and prioritising Activity Centres for EV charging, NCA are then able to allow the EV charging industry to focus their attention on the specific location within the Activity Centre to install chargers.

Box 3 Why the Roadmap does not identify exact locations

Due to the quality and completeness of available Activity Centre information, Neighbourhood Activity Centres had to be mapped manually, and thus the list has a level of subjectivity as to which were considered significant enough to be included in analysis. The boundary of each activity centre was also drawn manually. The polygon shapes were then converted to points for easier identification. The results are shown in Figure 40.

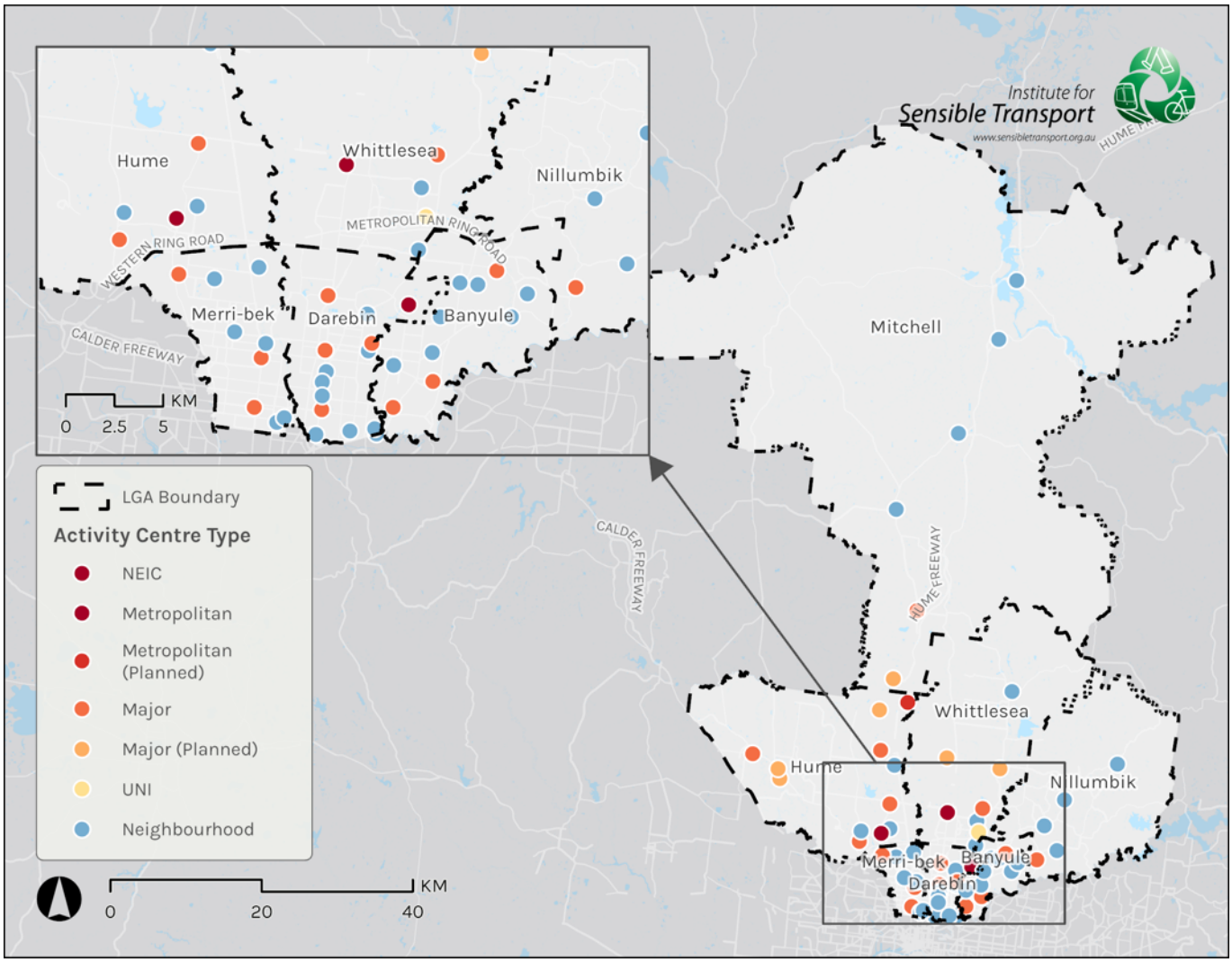


Figure 40 Activity centres by significance

Source: DELWP, VPA, Local government structure plans, Nearmap. Google Maps

9.1.3 Prioritising Activity Centres

The factors influencing activity centre priority have been identified as:

1. The *size*, *diversity* and *regional significance* of the Activity Centre - These are the three factors affecting the attractiveness of the Activity Centre for EV users. Charging duration is assumed to be between 30 mins and 2 hours, which is matched with typical stays for accessing services/destinations in close proximity to these locations.
2. Nearby traffic volume – Higher traffic volume near an Activity Centre is an indicator of the number of potential users.
3. Distance from nearest EV charger – Activity Centres that don't have another EV charger nearby are more likely to benefit from the installation of an EV charger. This process helps to avoid duplicating the burgeoning charging network.

The variables gathered for each Activity Centre are shown in Table 9.

Table 9 Variables for each Activity Centre within the Northern Climate Change Alliance

Variable	Relevant influencing factor	Value details
Plan Melbourne Activity Centre Type Designation	Regional significance of the Activity Centre	3 – NEIC and Metropolitan 2 – Major Activity Centre and University 1 – Neighbourhood Activity Centre 0 – Planned or Future Activity Centre
Amount of commercially zoned area within Activity Centre	Size of Activity Centre	Square metres of land zoned as: Activity Centre Zone (ACZ1 and ACZ2), Commercial Zone (C1Z and C2Z), Comprehensive Development Zone (CDZ, CDZ1 to CDZ6), Priority Development Zone (PDZ1 and PDZ2), Urban Growth Zone (UGZ, UGZ1 to UGZ12), Township Zone (TZ and TZ2)
WalkScore[26] in Activity Centre	Diversity of Activity Centre	WalkScore value (a proxy for diversity of destinations) at centroid of Activity Centre Polygon
Two-Way Average Daily Traffic	Nearby Traffic Volume	Highest volume segment of road within 500m of Activity Centre
Linear distance from nearest existing or planned charger	Distance from nearest EV charger	Distance in metres from nearest charger over 25kW. Existing chargers sourced from Plug Share, proposed chargers sourced from ARENA Future Fuels map and Vic government funded chargers

9.1.4 Method for standardising the variables

As variables represent different types of data, they need to be standardised into consistent variable scores between 0 and 1. Several methods were attempted to determine the best representation of Activity Centre priority.

Standard Linear Transformation

For each variable, this method transforms the highest value in the study area to 1, and the lowest to 0, with all values in between 'stretched' along this spectrum. For each variable value it can be calculated using:

$$S_i = \frac{X_i - X_{min}}{X_{max} - X_{min}}$$

Where:
S_i is the standardised variable score of original value X_i
X_{min} is the lowest original value in dataset X
X_{max} is the largest original value in dataset X
This is a simple method of standardisation, if the data contains large outliers, it can drastically affect the variable scores for the entire dataset.

Percentile Score

This method simply assigns a variable score based on the value's percentile. This method essentially ranks all values from highest to lowest and evenly distributes values between 0 and 1. While it removes the adverse effects of large outliers, it does not reflect the distribution of the data.

Middle 80% Linear Transformation

This method is essentially the same as a standard linear transformation, however instead of using the minimum and maximum values in the dataset, it uses the 10th and 90th percentile values as the limits for 0 and 1, respectively. Any values below the 10th percentile are given a zero, and any that are above 90th are given a 1. This method helps to remove some of the outliers at the high and low ends of the dataset, while still reflecting the overall distribution of values.

The results of all methods were assessed, particularly to see if any Activity Centres stood out as seemingly too high or too low. The result of this qualitative assessment was that the *Middle 80% Linear Transformation* method best standardised the variable values, as it was able to diminish the effects of outliers, while still reflecting the distribution of values.

[26] https://tinyurl.com/ye294cpu

It should be noted that it was not necessary to apply this method to the *WalkScore* or the *Plan Melbourne Activity Centre Type* variables, as they are not quantifiable, measurable values. WalkScore is already an index of walkability based on a number of factors, on a scale between 0 and 100. To fit it into the same scale as other variables, it was simply divided by 100. The Plan Melbourne Activity Centre Types were assigned arbitrary numbers based on importance, therefore no outliers exist, so the standard linear transformation was applied to this variable.

9.1.5 Weighting variables and creating a final prioritisation score

The variables were assigned a weighting, based on the estimated number of people going to an Activity Centre. Therefore, the amount of commercially zoned area and WalkScore were given a slightly higher weighting in the final score, as proxies for the relative number of people visiting the Activity Centre. Traffic volume was also given a higher weight as an indication of the number of motorists travelling near the Activity Centre. The weightings are shown in Table 10.

Table 10 Variable weightings

Variable	Weight
Plan Melbourne Activity Centre Type	0.125
Amount of commercially zoned area	0.25
WalkScore	0.25
Traffic Volume	0.25
Distance from nearest charger	0.125

The final Prioritisation Index Score was calculated using:

$$P = a \times 0.125 + b \times 0.25 + c \times 0.25 + d \times 0.25 + e \times 0.125$$

9.1.6 Calculating charging ports required

The estimated number of charging sites and the number of ports required at each site have been calculated based on the following indicators:

- Annual Vehicle Kilometres Travelled (VKT) – EV Fleet
- Annual kWh consumption from EV Fleet
- Annual electricity consumption from public charging.

We used ABS Survey of Motor Vehicle Use data to determine the average distance travelled per year. We also assume EVs use 142Wh per kilometre, as this is reflective of the current EV fleet. We then ratio the proportion of charging expected to occur in the public domain (as opposed to at home charging). These assumptions are in the associated Excel model provided as part of this project.

The fundamental characteristics of the activity centres located in each LGA (outlined in Sections 9.1.3, 9.1.4, 9.1.5) explain why some networks may be busier than others.

9.2 Results

This section describes the results of the prioritisation framework, for ultra-fast chargers (passing through motorists) and fast/medium chargers (opportunistic chargers).

9.2.1 Ultra-fast Chargers

The Calder Freeway and Hume Highway run through the NCA area, with both roads carrying substantial traffic volumes likely to be travelling large distances. The volume and travel patterns of vehicles using these roads make them appropriate corridors for future ultra-fast charging sites.

While the NCA may play a facilitation role in the development of ultra-fast charging sites, it will not be the priority provider, as the cost is beyond the role of local government. Instead, provision of such infrastructure will be a State or Commonwealth responsibility, in partnership with the EV charging industry. Put simply, they cost too much for local government to fund.

Figure 41 identifies the two recommended ultra fast charging sites, at Beveridge and Keilor. These are indicative sites and the actual location must be determined in consultation with higher levels of government, industry and DNSPs. The Beveridge site has an existing fast food restaurant, *Hungry Station*, located on Lithgow St, west of the Hume

Hwy. Major development is still underway in the area. A major activity centre is named in Plan Melbourne, and an intermodal freight terminal has also been proposed. Beveridge has a geographical advantage being situated before the Northern Hwy splinters off from the Hume Hwy.

Keilor is situated in the City of Brimbank, outside of the NCA study area. However, the suburb is better placed for motorists to exit from both sides of the Calder Fwy without significant deviation. Even though the charger will not be located within the boundaries of the NCA, it will still affect the overall EV charging network available to both passing motorists and residents.

Both charging stations should be designed to allow *drive thru* charging, for longer vehicles.

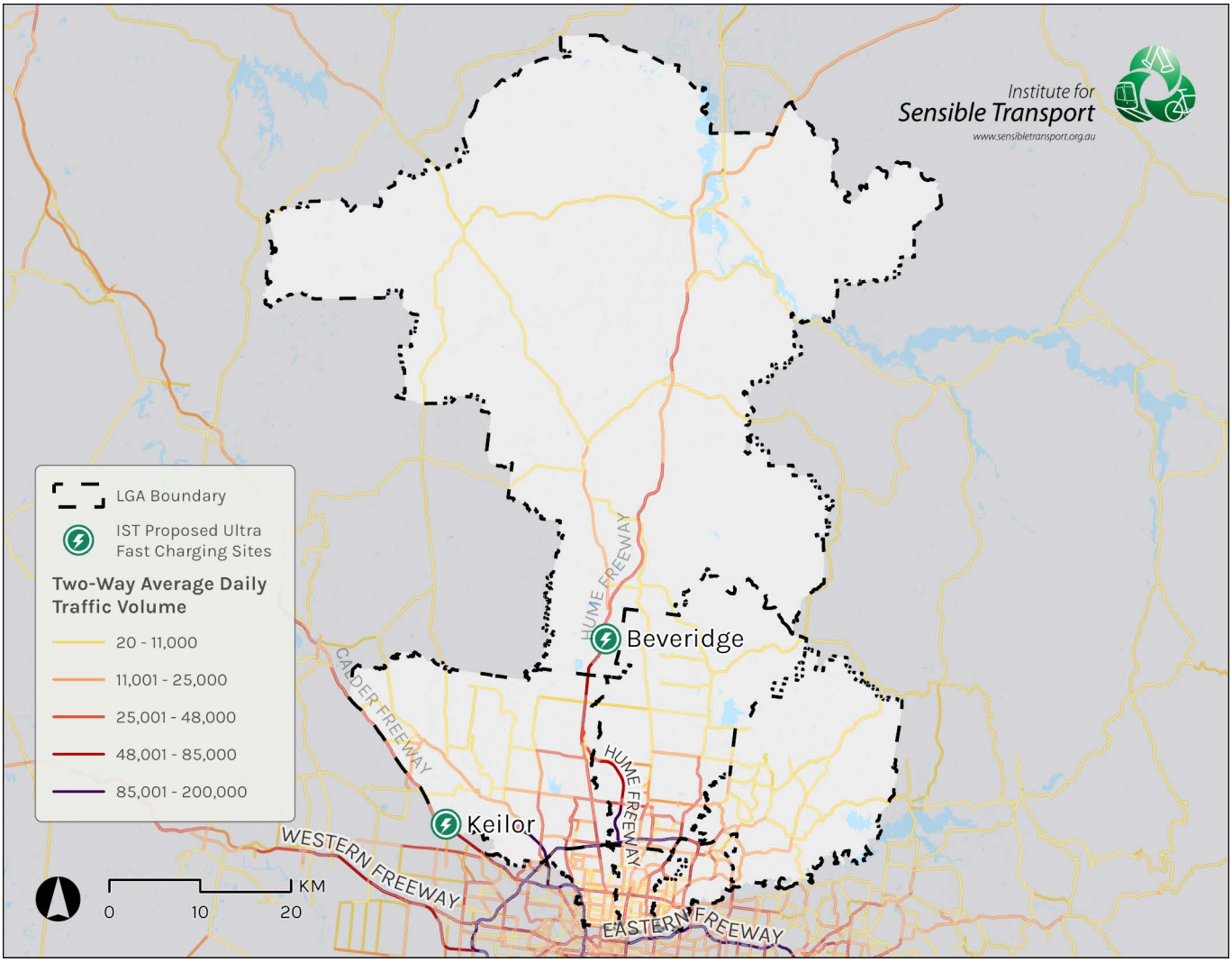


Figure 41 Proposed ultra-fast chargers

Source: Institute for Sensible Transport, Department of Transport

9.2.2 Opportunistic Chargers

The bulk of the proposed charging network consistent of *opportunistic chargers,* located in activity centres. As highlighted earlier, these chargers are intended for motorists already visiting the area. The results of the prioritisation framework have been simplified into a simple index shown in Figure 42. RMIT Bundoora, Gladstone Park MAC, Heidelberg MAC, Beveridge MAC, Coburg MAC, Preston MAC and the Hurtsbridge MAC are the highest scored activity centres in their respective municipality. A breakdown of the individual scores can be found in Table 11.

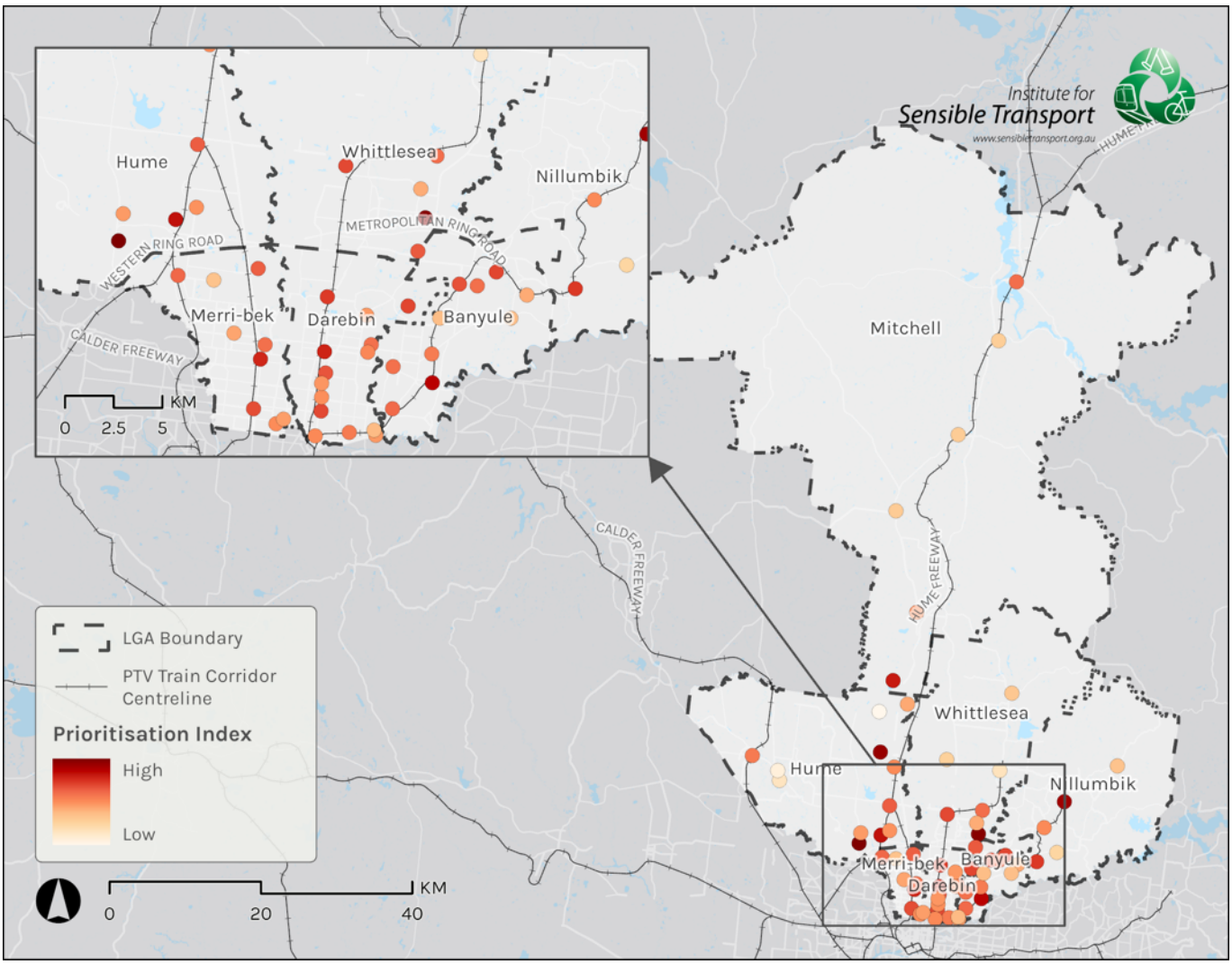


Figure 42 Prioritisation scores for activity centres

Source: Institute for Sensible Transport, Department of Transport

The scores of each activity centre were analysed using a custom-built tool that considered the demand for EV charging. The results for implementation are shown in Figure 43, and the total number of charging ports required for each activity centre by 2030 is provided in Table 11. Due to the uncertainty of the completion of planned activity centres, implementation of the EV charging infrastructure has been generally assumed for the latest period by 2030. However, all effort should be made to align the implementation of EV chargers alongside the delivery of an activity centre that is to be completed earlier than 2030.

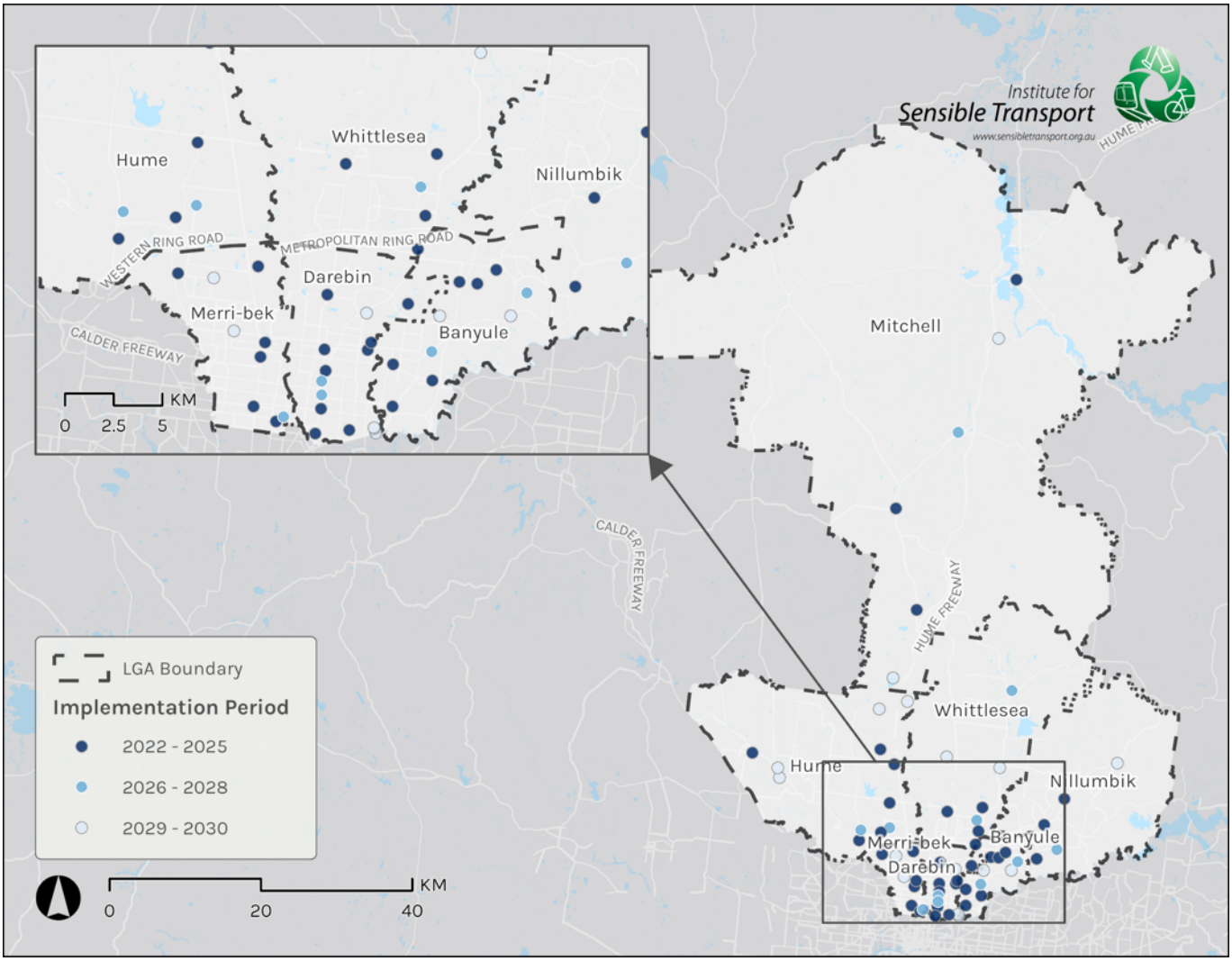


Figure 43 Implementation period for opportunistic chargers

Source: Institute for Sensible Transport

Of the 64 activity centres identified for opportunistic charging, a total of 548 charging ports are recommended to be installed by 2030. These chargers are recommended to be 50kW DC chargers. Further details are provided in Table 11 which lists the activity centres by their type, score and the recommended implementation schedule. Due to the uncertainty regarding the completion of planned activity centres, they have been placed in the latest implementation period. A separate *future* score based on the assumption where all planned activity centres have been built is available on an online map (link provided below).

Readers are encouraged to visit the online, interactive map at the following link for a more detailed look at the breakdown in prioritisation score and recommended number of ports required for each activity centre. The online map also provides the prioritisation score for planned activity centres based on their future type scores rather than their current score, which is zero based on our methodology explained in Table 9.

https://storymaps.arcgis.com/stories/8fc4488ecc4d4471b34707da82d70ef5

Table 11 Activity centre prioritisation scores and implementation period

LGA	Activity centre name	Activity centre type	Score	Implemented by	Total charging ports by 2030
BANYULE	Heidelberg	Major	0.47913371210	2025	8
BANYULE	Greensborough	Major	0.40308078762	2025	8
BANYULE	Watsonia	Neighbourhood	0.39037193147	2025	6
BANYULE	Ivanhoe	Major	0.35992825032	2025	6
BANYULE	Diamond VillageSC	Neighbourhood	0.35352616822	2025	6
BANYULE	The Mall	Neighbourhood	0.35106131263	2025	6
BANYULE	Rosanna Station	Neighbourhood	0.33380614100	2028	6
BANYULE	Montmorency	Neighbourhood	0.27097730472	2028	6
BANYULE	Macleod	Neighbourhood	0.24234950677	2030	4
BANYULE	LowerPlenty	Neighbourhood	0.23910728260	2030	4
DAREBIN	Preston	Major	0.44454468040	2025	12
DAREBIN	Reservoir	Major	0.41641048384	2025	12
DAREBIN	LaTrobeUni	NEIC	0.40325532046	2025	10
DAREBIN	Northcote (M)	Major	0.39982033286	2025	10
DAREBIN	Preston Junction	Neighbourhood	0.38624057950	2025	10
DAREBIN	Northland SC	Major	0.35074371504	2025	10
DAREBIN	Fairfield	Neighbourhood	0.33688631148	2025	10
DAREBIN	Northland Homemaker	Neighbourhood	0.31745355620	2025	8
DAREBIN	Westgarth	Neighbourhood	0.31537136018	2025	8
DAREBIN	Northcote (N)	Neighbourhood	0.30614080263	2028	8
DAREBIN	Thornbury Village	Neighbourhood	0.29644008551	2028	8
DAREBIN	Summerhill SC	Neighbourhood	0.29356980850	2030	8
DAREBIN	Alphington	Neighbourhood	0.29322451162	2030	8
DAREBIN	Alphington Village	Neighbourhood	0.24854415446	2030	8
HUME	Gladstone Park	Major	0.54778945147	2025	12
HUME	Craigieburn Central	Major	0.51927399396	2025	12
HUME	Broadmeadows	Metropolitan	0.46803074565	2025	10
HUME	Roxburgh Park	Major	0.37706553314	2025	8
HUME	Sunbury	Major	0.33846360227	2025	8
HUME	Craigieburn Plaza	Neighbourhood	0.31247564232	2025	8
HUME	Dallas	Neighbourhood	0.30260914857	2028	8
HUME	Westmeadows	Neighbourhood	0.29156171858	2028	6
HUME	Lockerbie	Metropolitan (Planned)	0.27274020362	2030	6

LGA	Activity centre name	Activity centre type	Score	Implemented by	Total charging ports by 2030
HUME	Sunbury South (South)	Major (Planned)	0.14041115075	2030	4
HUME	Sunbury South (North)	Major (Planned)	0.09736195997	2030	2
HUME	Mickleham	Major (Planned)	0.06978378508	2030	2
MITCHELL	Beveridge	Major (Planned)	0.45625887285	2030	6
MITCHELL	Seymour	Neighbourhood	0.35501019026	2025	4
MITCHELL	Wallan	Major	0.31091711206	2025	4
MITCHELL	Kilmore	Neighbourhood	0.21037933646	2025	4
MITCHELL	Broadford	Neighbourhood	0.20916666667	2028	4
MITCHELL	Tallarook	Neighbourhood	0.20238540416	2030	4
MERRI-BEK	Coburg	Major	0.44155927358	2025	20
MERRI-BEK	Brunswick - Sydney Road	Major	0.39672873122	2025	18
MERRI-BEK	Fawkner	Neighbourhood	0.37493520519	2025	16
MERRI-BEK	Glenroy	Major	0.36317866872	2025	16
MERRI-BEK	Pentridge	Neighbourhood	0.35201221628	2025	16
MERRI-BEK	Brunswick – Lygon Street	Neighbourhood	0.31062869109	2025	14
MERRI-BEK	East Brunswick Village	Neighbourhood	0.28701501225	2028	14
MERRI-BEK	Coburg North Village	Neighbourhood	0.27792565315	2030	12
MERRI-BEK	West Street	Neighbourhood	0.23131467391	2030	10
NILLUMBIK	Hurstbridge	Neighbourhood	0.51115526889	2025	6
NILLUMBIK	Eltham	Major	0.41897398236	2025	4
NILLUMBIK	Diamond Creek	Neighbourhood	0.31424770961	2025	4
NILLUMBIK	St Andrews	Neighbourhood	0.22919237466	2030	4
NILLUMBIK	Research	Neighbourhood	0.18343989669	2028	2
WHITTLESEA	RMIT Bundoora	UNI	0.53873142806	2025	18
WHITTLESEA	Epping	Metropolitan	0.39947304070	2025	14
WHITTLESEA	Bundoora	Neighbourhood	0.38012092845	2025	14
WHITTLESEA	South Morang	Major	0.35389821465	2025	12
WHITTLESEA	The Stables SC	Neighbourhood	0.26829667326	2028	10
WHITTLESEA	Whittlesea	Neighbourhood	0.21907798340	2028	8
WHITTLESEA	Wollert	Major (Planned)	0.19616616584	2030	8
WHITTLESEA	Mernda	Major (Planned)	0.14555091027	2030	6

9.3 Funding models and options

9.3.1 What is Council's role in the development of EV charging?

As highlighted earlier, the commercial EV charging sector in Australia is growing rapidly. The industry's appetite for investment is growing, due to increased Commonwealth and State funding opportunities, as well as the increase in the number of EVs themselves. The commercial sector has a demonstrated interest in funding and managing public EV charging equipment and services. As of October 2022, it is generally no longer necessary for councils to fund the provision of fast chargers.

Increasingly, the role of local government in charging will be one of *facilitation*. Councils often own or manage sites that have car parking, and these locations can be focal points for the community (e.g. libraries, commercial areas, town halls, leisure centres etc.), often in the heart of activity centres. Councils are therefore in a powerful position to engage with the EV charging industry to negotiate outcomes in which charging is provided by the private sector at little or no direct financial cost to the council. Indeed it is possible for some sites to attract rental payments from commercial EV charging providers.

In instances in which a charger is installed on non-council managed land, it is not necessary for council to be involved.

The question of whether councils should require users to pay a fee for using council managed or owned chargers is addressed in Box 4. Ultimately where councils choose to own a charger, they should apply a fee that reflects the capital and operational expenditure associated with a well-maintained network.

Guidance on fees for charging

Currently, councils can be broadly divided into those that apply a user fee for EV charging, and those that provide it for free. The rationale for free public charging is that councils wish to support people to transition from ICE vehicles to EVs and see free charging as one method of encouragement. Several councils in Melbourne have adopted this approach.

As more Australians purchase EVs and the cost of maintenance and repair of EV charging stations becomes clearer, councils that had offered free charging have begun to review their policy.

Council provided free charging have the following impacts:

- Reduces the commercial sector's willingness to develop the EV charging network. It becomes commercially unviable to compete with a supplier offering free charging. This reduces EV charging possibilities.
- Limits the funds available to properly maintain charging stations. Without a dedicated budget for maintenance and repair, EV charging stations can be out of order for long periods, frustrating potential users.
- Distorts the market and provides an incentive for people to drive further than they should, in order to receive free charging. Many users reside in another local government area, and this effectively means the NCA ratepayers are subsidising the electricity costs of others.

Ultimately, for the reasons identified above, where NCA choose to operate their own chargers, their objectives will be best supported by applying a fee that covers electricity, network and maintenance costs of the chargers. In general, this results in a fee of between 20 – 40 cents per kWh. Pricing at the lower end for AC and higher for DC charging reflects the cost of provision, electricity consumption and user benefit differences for these different types of chargers.

Box 4 Fees for charging - Guidance for NCA

9.3.2 What's the difference between the DC and AC market?

The DC charging market is fundamentally different from the AC market because DC:

- Offers much faster charging and can therefore charge many more vehicles per day.
- Consumers are more willing to pay higher usage charges, as it saves time.
- Is more expensive to install.
- Has greater interest from commercial investors (due to the first two points), as it is more capable of providing a return on investment in the long term.

Requiring users to pay a fee for slow/AC charging is not a viable business model, without some form of public subsidy.

9.3.3 Billing system management

Unlike petrol stations, EV charging stations have no on-site staff. Payment is done via cloud-based software, RFID cards, credit cards and mobile apps. Companies that have sought to create a billing system have encountered more difficulties with its execution than initially anticipated. This is leading to EV charging becoming an oligopoly or potentially a monopoly, as the work required to adapt systems to ever changing markets benefit from the economies of scale present in large operations. Developing and maintaining a system for a network of 500 charging points is often similar to doing this for a network of five charges. This is at the heart of why billing and customer interface operations is a natural monopoly/duopoly.

9.3.4 Exploring different ownership options

There are a number of different types of ownership for EV charging networks, and these are summarised below:

1. Full Council ownership, Council build and operate (Option A)
2. Council owned, 3rd party to build and operate under Council supervision (Option B)
3. Council contracts a 3rd party to build, own and operate charging infrastructure on leased council property (Option C)
4. Council leases out council property for a 3rd party to build, own and operate with minimal supervision (Option D).

9.3.4.1 Option A Council has Full Control

Under this option, Council undertakes the full process of determining scope, planning the project, technology selection, tendering for contractors, contracting, project management, marketing (including pricing, promoting, location), negotiation with electricity distributor and retailers, customer contact service/user interface/platform, billing and ongoing operation and maintenance.

This option gives Council maximum control and visibility. It provides flexibility to determine the siting, configuration, technology and all aspects of the user experience.

Council can also maintain complete control of the branding of each site without needing to adhere to any outside commercial imperatives.

On the downside, Option A has the highest demands on Council resources. It requires expertise and upskilling in a specific, technical industry and contains many complex facets with constant change. These employees will have to be recruited or re-allocated away from other services.

It is highly unlikely this model would work for DC charging, as the capital costs are too expensive for a council's existing budget. A dual port DC charger is estimated to cost ~$50,000 for the first charger where there is an adequate power supply. It is not uncommon to incur another $30,000-$40,000 in install costs. Moreover, the high number of transactions places too much pressure on billing and other interface issues, which Council has very limited experience with.

As the Council will pay for and own the charging assets, the scope of the offer will be limited by the available CAPEX dedicated to the project. As will be discussed later (Option C), the potential to leverage private investment may mean a larger charging network, as the investment is not limited to the CAPEX available to Council.

9.3.4.2 Option B Outsource Building and Operating

Option B retains ownership, but the building and operation of the charging infrastructure is outsourced. Council contracts a provider of charging infrastructure and operations to implement a stipulated technology, site selection, pricing and payment strategy. This aims to retain a high level of control, while outsourcing implementation and operation to a sector expert on a fee for service basis.

The benefits of this model are reduced risk and lower demand on Council resources, while maintaining a strong level of control and visibility. Ownership is also retained, giving access to potential future revenue streams.

The Council is the investor, and the commercial sector installs and operates the chargers. They are likely to charge around $1,000 - $2,000 per site for management/service fees (annual), and then around 5% of the transaction to manage the billing service.

Council still pays for the charging assets, limiting the scope of the charging network to the CAPEX Council can afford. While Council visibility is maintained, reputational risk is still present, along with slightly less control over the rollout, compared to Option A.

9.3.4.3 Option C Council Facilitated but not Owned

In this option a third party builds, owns and operates the charging infrastructure. Theoretically, this option has the private sector covering the CAPEX, with Council's role primarily one of facilitation, and the provision of the assets Council manage that are necessary for EV charging (land, parking spaces, street lighting poles, etc). The project proponent adheres to rollout requirements stipulated by Council. This option could potentially result in a larger charging network, as commercial developers may have greater incentive to leverage 3rd party revenue streams (see Section 9.3.5). This may offer good visibility for Council branding, minimised implementation risk and ongoing service KPIs.

Option C is considered suitable to the existing market for DC charging only. The authors are not aware of an instance in which the commercial sector has covered the CAPEX of an AC/slow charging network. The speed and higher fees associated with DC charging makes it commercially more compelling.

Downsides to this option include lower control, possibly less ability to require uneconomic installations for equity purposes, and limited but still required ongoing contract monitoring. In terms of equity, it is always possible for Council to provide a subsidy to cover losses. The key to success for this option is likely to be the correct selection and careful contracting of the implementation partner and ensuring incentivisation is tied to performance in meeting program objectives. Contingencies should the operator cease business need to be included in the Contract, both for this Option as well as the others for which a private sector partner is involved.

9.3.4.4 Option D Low Involvement

At the other end of the spectrum from a Council build, own and operate model is Option D, in which Council offers the market access to its assets for the purpose of providing EV charging. Bidders then offer different types and extents of service. This might be on the basis of Council contribution, or, depending on the appetite of the market, a bidder may wish to pay for access. It is unlikely slow charging will attract commercial providers without a subsidy, but for fast chargers, it is possible this could be commercial with minimal government subsidy, other than access to land.

It is unlikely slow charging will attract commercial providers without a subsidy, but for fast chargers, it is possible this could be commercial.

Under this configuration, there is a minimal impost on Council resources, financial and human, and reputational risk is minimised. The Council continues to be exposed to reputational risk in the event it is seen as unsuccessful, as Council are widely understood to 'control' parking, and therefore any initiative using parking space will be linked back to Council, even if it is a private provider. However, Council risk is minimised by the

fact that limited if any Council funds are dedicated to the installation of charging infrastructure.

Loss of control means Council's strategic goals are more difficult to prosecute, visibility of any success is held by the contractor rather than the Council, and revenue both from charging and other sources do not accrue to Council. Under this scenario, Council may lose complete control of where the charging infrastructure is placed (although they are able to deny access to any site with reasonable grounds).

It can be expected that the private sector will cherry pick the most lucrative locations, which means that in the future, Council will lose the ability to leverage these, more profitable spots to cross subsidise less profitable areas of the municipality (for equity reasons). Council may be able to charge rent for relatively lucrative locations, and no or low rent at less attractive sites (effectively a cross subsidy).

It should be noted that while reputational risk is minimised under option D, it is not eliminated, and could come from both implementation, management and opportunity costs (e.g. 3rd party revenue foregone).

A recommendation that spans all options; Council should apply scrutiny to bids/expressions of interest from the commercial sector, especially those without a significant, positive track record of running similar systems in Australia. The billing and user interface is fraught with a myriad of issues that are complex and ever changing. Software issues associated with billing, new cars, and new plugs makes reliability difficult and the less experience and market coverage the operator has, the more likely it is that there will be technical difficulties that undermine the usability of the system.

Table 12 provides a summary of all four options, their pros, cons, risks, financial costs, emissions impact potential and capacity for Council to demonstrate leadership.

9.3.5 3rd Party Revenue Streams

The implementation of an EV charging initiative may open up a number of potentially profitable revenue streams for project participants. The access to on-street points where electrical power and/or communications infrastructure (wired or over the air) is very valuable. This value can be parlayed into subsidisation for a more extensive charger rollout, other services to citizens and their service providers, and could become a model for Smart City infrastructure. Examples include:

- 5G base stations
- Public WIFI
- Backhaul communications for utilities (gas & water meters, solar and battery inverters, smart home hubs etc)
- Micro-weather and pollution monitoring devices
- Foot & vehicular traffic counting and monitoring
- Advertising.

Table 12 Public EV charging delivery options

	Pro	Con	Risks	Financial Costs	Leadership
Option A 100% council owned, built and operated	Absolute control Council seen to be exemplar for LG action on climate change Council seen to be providing a practical service Ability to subsidise uneconomic siting for equity reasons (to poorer households) Asset ownership enables council to access potential 3rd party revenue streams Potential for long term return if well managed	Limited capability (no economies of scale) Limited capacity (need to provide customer support) Size limited by CAPEX	Financial exposure Marketing risk structure of offer pricing placement of sites promotion of service Implementation risks leading to potential reputational damage: budget overrun milestone overrun OH&S Poor level of service/reliability	High	High
Option B 100% council owned, build and operation outsourced under council direction	High control Council seen to be exemplar in LG action in partnership with private sector Council seen to be providing a practical service Ability to subsidise uneconomic siting for equity reasons (to poorer households) Asset ownership enables council to access potential 3rd party revenue streams Potential for long term return if well managed	50% capability requirement 25% capacity requirement limited to manage private sector contracts Size still limited by council CAPEX budget	Financial exposure Marketing risk structure of offer pricing placement of sites promotion of service Reputation loss in case of failure Lower (75%) Implementation risks budget overrun milestone overrun OH&S Poor level of service/reliability	High	High
Option C Council sets project standards, outsources build and operation, leases access out,	Moderate control Greater capacity to attract 3rd party services smart city goals utility backhaul citizen WIFI	Loss of control Limited ability to require uneconomic siting of chargers Lower visibility of council involvement, potentially offset by larger potential size when cross-subsidised	Partner selection mistake Equity considerations may be more difficult to enforce (use subsidies as incentive)	Low	Med-High

	Pro	Con	Risks	Financial Costs	Leadership
does not own asset	5G base stations Dedicated & incentivised customer service offer Scale benefit of potential rollout to other council areas Size of offer not limited by council CAPEX, potential for cross-subsidisation of EV chargers by 3rd party revenue streams Lower financial, reputational and implementation risks	Difficult to upgrade Private sector contracts and partnerships still has to be managed and supervised by council			
Option D Council offers access to its assets (lease) and external parties bid in EVC offers	Low control Size of offer not limited by council CAPEX revenue streams Lowest financial, reputational and implementation risks	Loss of control, difficult to upgrade Limited ability to require uneconomic siting of chargers No visibility of council involvement Still potential for reputational risk	Tenderer selection mistake (long term contract) Lack of control leaves exposure to unknown factors (e.g. obsolescence) Opportunity costs of giving up control & ownership	Low	Low

Multiple approaches for different contexts

A given council doesn't have to take the same approach everywhere. As highlighted in Table 12, a range of approaches may be taken, such as:

- Own and operate on Council land (e.g., for own fleet vehicles and contracted overnight use by residents)
- Own and contract operations for chargers on Council land (for on street overnight charging for residents)
- Tender for providers to establish chargers on Council land on terms suitable to the Council but attractive enough to obtain providers (for fast chargers on council car parking areas)
- Provide incentives to private providers to establish chargers on private land.
- If on City land, Council may wish to maintain ownership of and contribute to the cost of long-lived infrastructure such as power supply upgrades and civil works.
- Organisations with a small portfolio of chargers (whether public or private sector) have a mixed record on maintaining a reliable charge network. If it is not their primary business, the issues that can arise will not always get the priority they require. This can lead to poorly maintained infrastructure and poor customer service with resulting dissatisfaction with both the charge service and the use of EVs in the public's eyes. On the other hand, doing it properly may take more resources than Council would choose. If based on a cost recovery model, it may also result in an expensive system for the user.
- Charge network operators, for whom this is their principal business, are more likely to have a large portfolio of chargers. Lessons learned about equipment and user issues are applied across a wider base. Customer support is necessary to maintain their own reputation. Operations have significant economies of scale. But not all operators offer the same quality or value for money, so selection is important.

In general, there are likely to be significant benefits in contracting out operations and maintenance as long as there is a well-structured contract to ensure specified standards are met. This may extend to contracting out supply and site design as well. One potential parallel between public realm EV charging bays and the experience of councils implementing car share pods relates potentially similar community reaction, Engaging with the community, particularly local residents, regarding the change in use that comes from converting a general access parking bay to an EV only parking bay may be important. Councils should consider their experience with car share when looking at converting to an EV only bay.

Box 5 Ownership and operational considerations

9.4 Data capture and management

The purpose of this section is to provide recommendations on data capture and management to enhance the effectiveness of monitoring and evaluation of publicly available EV chargers.

Smart, connected chargers can provide a rich source of information regarding their usage. All commercial charge network operators capture and monitor operating data to inform their network management and development. This is a necessary part of all chargers requiring payment. Free chargers may not have data monitoring and reporting capability. As highlighted throughout this report, it is not advised Councils provide charging for free.

Some information such as *chargers in use* at any time is made available on user apps by each network. More detailed information may be treated as commercial in confidence by operators. Where local government is the host site, it may be made a condition to operate on the site that certain data be shared with the local authority, even if agreed that certain detail is not provided publicly.

Some parameters potentially of interest include:

- Chargers currently in use (generally visible on each network app).
- Charger use frequency (e.g. average. no. of times per day). This may be regarded as confidential.
- Charge duration (dwell time can relate charging activity to context and inform charger power offered).
- Vehicle type (generally not recorded but potentially obtainable from customer confidential information).
- Energy consumed (totals generally provided but amount by site may be deemed confidential).
- $ spent, per charge, per charger etc (generally regarded as confidential).

Information that should be available publicly:

- Hours of charging per bay per day by charger postcode: gives a good indication of distribution of demand across LGAs without divulging commercially sensitive site information and can identify areas needing additional capacity. Four hours per day is typically a 'busy' charger.
- Hours per bay per day by charging type across the LGA: helps determine mix of demand by type and need for more capacity by certain types: AC chargers, low power DC (25kW or less), fast chargers (26-100kW), super-fast chargers (>100kW)
- Time-of-day and day-of-week demand curve (aggregate): can assist users to avoid peaks, help LGA plan parking use; also shows share of overnight charging at AC sites in residential areas.
- Total hours and total energy use: allows an estimate of the share of charging at public chargers of all EV charging. This is not meaningful at a small scale and may best be collated to at least the NCA region and probably for all of Metropolitan Melbourne or Victoria.
- Average cost per kWh to user by charger type: generally faster chargers cost more to provide than slow charging.
- Up-time: the percentage of time chargers are functioning and useable (should exceed 99.9% to be considered reliable).
- Frequency of queuing: how often users have to wait for a charger to become free. This is a parameter of interest to most users but is relatively hard to capture accurately. A proxy measure is the proportion of charge events at a bay that are separated by less than five minutes from the previous charge event.

Monthly data can be volatile and too much to report and process in detail for the extra value provided. Quarterly data can provide insights into seasonal variation. Annual data would be the minimum to provide insights into growth in use and other trends.

It is possible to export a .csv file, to enable further analysis, such as heatmaps of charger activity etc. Depending on account information the user is required to provide, it is also possible to analyse the percentage of vehicles that are registered at an address within the NCA region, compared to 'visiting' cars.

When working with the charging industry and other levels of government, NCA should identify its preferred data requirements captured by publicly available chargers.

Much of the information captured in the above dot points can be helpful metrics to inform future modelling activities; to estimate energy consumption, emissions and a comparison with a scenario in which the chargers were not provided. It is important to note however that public chargers are generally only responsible for around 2% - 10% of the electricity consumed by a typical EV. The overwhelming majority of charging occurs at non-public charging, mostly at home, but also at workplaces. The provision of public charging can help induce EV purchase, and therefore contribute to emissions reduction, even if only a minority of charging events occur at public chargers.

Finally, while much of the dashboard data identified above will generally need a log in, it is also possible to prepare a publicly available metrics dashboard, to enable the community to see the usage and impact of the charger network deployed in the NCA region.

9.5 Charging bay design

The following provides the recommended design of bays to accommodate the charging of EVs. It is recommended that, at least initially, 90-degree parking bays are most suitable. International experience shows that kerbside, on street charging is more expensive to install, and can cause complications with other utilities that occupy the space (e.g. water and gas pipes). While these on-street challenges are not insurmountable, it is easier to install at off street parking locations if possible. Particularly as EV chargers can potentially be in conflict with users of the existing street space.

To ensure that EV charging bays are accessible to all, it is recommended that they be designed to meet accessible parking design standards. These standards are found within AS 2890.5:2020 and have been adopted for Figure 44 and Figure 45. Furthermore, to ensure greater accessibility, having accessible parking flushed with the footpath would be ideal. Where this is not possible, kerb ramps should conform to AS 1428.1. Standardised signage for EV charging bays has recently been released by Austroads[27]. The design standards should be applied to signposts and painted onto the charging bays as well.

Charging bays should be 3.2m wide to accommodate the width of the car and disabled access. Driver or passenger side exit is a factor for the orientation of a disabled charging lot. For 90 degrees charging bays, normal charging lots can share a single charger with two ports in between them. Should the chargers be located at the end of the parking bay (in front of the nose or tail of the vehicle), wheel stops are not recommended to ensure adequate space is available for accessible movement between the charger and the port on the vehicle. Disabled lots should be paired with a shared area and a single charger as shown in Figure 44.

EV charging bays for parallel parking are constrained when considering the possibility of obstacles and trip hazards from charging cables. It is for this reason that a single charger with two ports cannot be applied. The size and clearance required for kerb ramps at the tail end of each lot further limits where a charger can be located. Even if the parking lot is flushed with the footpath, a kerb-out with a single charger and port at the nose of the car (see Figure 45) seems to be the only option without further consultation with disability design experts and stakeholders. Box 6 provides additional information on maintaining footpath access.

[27] https://austroads.com.au/publications/low-and-zero-emission-vehicles/ap-r667-22/media/AP-R667-22_Signage_and_Pavement_Symbols_for_LZEV.pdf

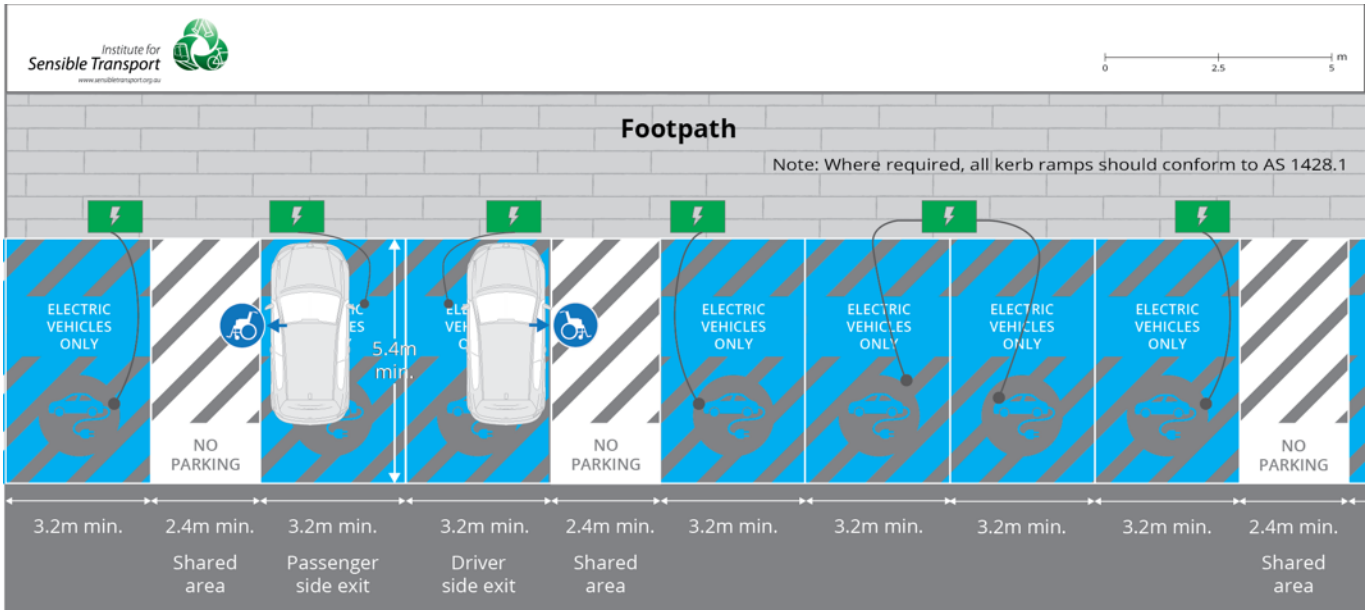


Figure 44 Proposed charging bay design for 90 degrees parking

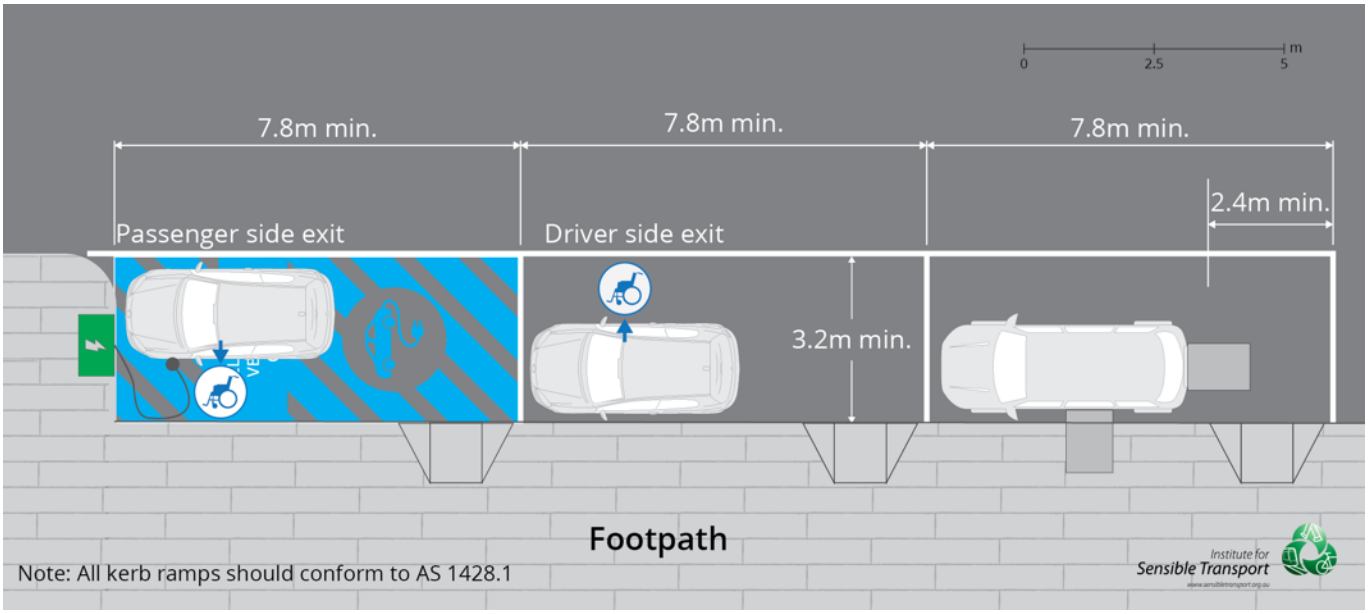


Figure 45 Proposed charging bay design for parallel parking

Protecting footpath accessibility

In instances where kerbside charging is installed, it is essential that they are designed in a manner that minimises any potential disruption to foot traffic. This includes avoiding installs in areas where the footpath is already narrow (i.e. less than 1.2m). Installing the charger in the furniture zone (i.e. where bins, utility poles, benches) are already located, eliminates the charger taking up additional functional space for the pedestrian.

Box 6 Minimising pedestrian obstruction

Where council and private sector have agreed on a space allowing for *drive thru* charging, Figure 46 can serve as a reference for the design. While the width of the bay should continue to maintain accessible parking standards, the length of the bay must allow for the single length of the longest vehicle using that section of road, along with its draw in and draw out requirements. In reality, due to the demands and constraints of these drive thru sites, it will be more practical building such infrastructure to service major highway and motorways.

Attention must also be given to the height of the charging station. The port and screen, if one is used, must be accessible at both sitting and standing heights to accommodate for different disabilities. Access to the screen and port, should not be restricted only from the front. The port in particular, should have enough space for a wheelchair to maneuverer and be positioned in a manner for the user to ably move the cable or connect it to the port. The EV charger should therefore not be located too close to street furniture.

While all care has been given to adhere to Australian standards, the designs proposed above are not place specific, and may therefore come up with issues not discussed in this report. The actual design and implementation should therefore be further deliberated with relevant stakeholders and experts when the parking space has been identified. The British Standards Institution released a new EV accessibility standard, PAS 1899:2022, for all EV charge points to adhere to henceforth. The document provides detailed considerations that should be taken when implementing new EV infrastructure. The standard is available at:

https://www.bsigroup.com/en-GB/standards/pas-1899/?utm_source=Twitter&utm_medium=Social&utm_campaign=SM-STAN-PRM-PAS-PAS1899-2210

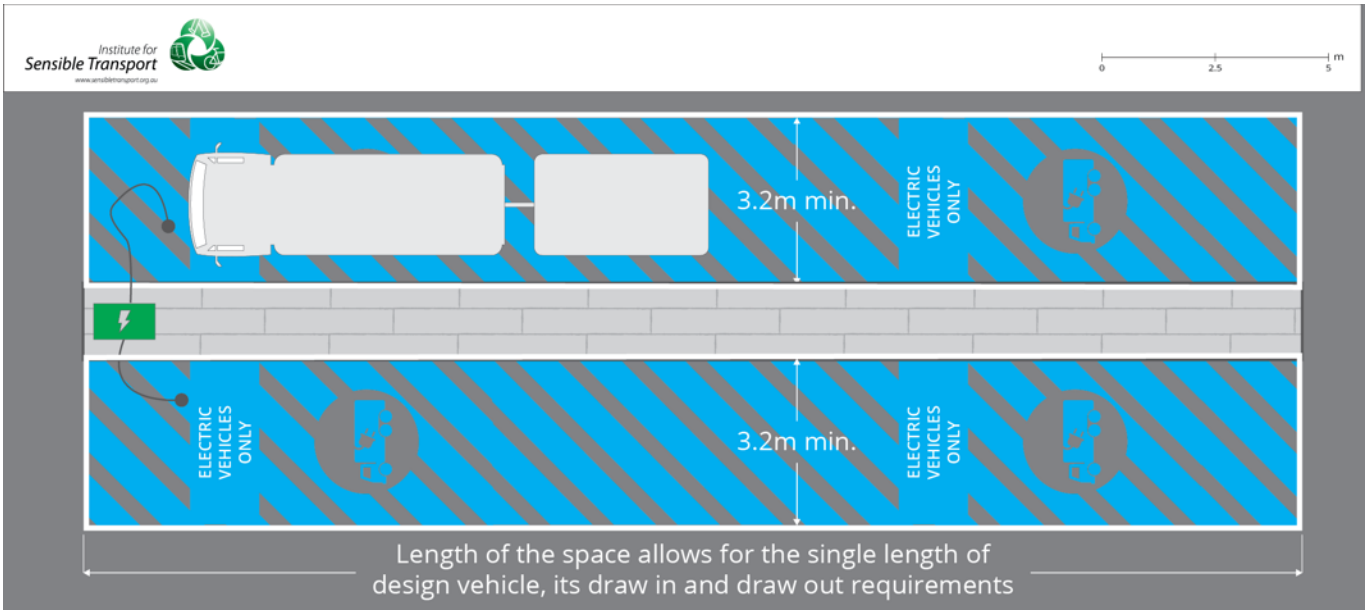


Figure 46 Proposed charging bay design for *drive thru* charging

Source: Institute for Sensible Transport

9.6 Site selection – What makes a good site?

This section provides an outline of the key characteristics that help to guide site location, based on the three charging contexts introduced in Figure 15.

9.6.1 Passing through motorist

A summary of the criteria for choosing EV charging sites aimed at passing through motorists is shown in Figure 38.

The following characteristics are important to identifying potential locations for chargers aimed at *passing through motorists*:

- Potential demand, based on road volume (traffic) data within the catchment of the proposed site. All other factors being equal, a site with 100,000 daily traffic movements within 500m of a site will generally attract more charging sessions than a site with 10,000 daily traffic movements.
- Adequate power supply. As highlighted earlier, passing through motorists generally prefer very fast/ultra fast chargers and can exert significant demands on the electricity network. It is therefore important to seek locations that have an adequate electricity supply, as the cost of network upgrades can be very high. Some ultra-fast charging sites have cost ~$700,000, due in part to the network upgrades required.
- Existing off-street parking. It is clearly preferable to have existing off-street parking to locate a fast/ultra-fast charger as opposed to developing new off-street parking which will incur significant costs and additional utilisation of space for parking that may otherwise serve alternative purposes. It is also helpful if these parking bays are not in a location with extremely high average occupancy (e.g. above 90%), as reserving high demand bays for EVs only when, at least in the early years, they are unlikely to be heavily occupied, can cause public resistance to additional EV charging locations.
- Finally, having the potential for expansion in future years is beneficial, to reduce the likelihood of motorists arriving to find all charging bays full. Cueing for EV charging is considered more frustrating than for petrol/diesel vehicles, as each charging session is generally longer. International experience suggests that ultimately, installing fast chargers with 4 – 6 bays is suitable to minimise the likelihood of demand exceeding supply. Starting with two charging bays initially, and then expanding is the general practice.
- Proximity to desirable amenities. One of the differences between EV charging and a filling session for an ICE vehicle is that the EV user can leave their car and do other things during the charging session. This, coupled with the fact that most EV charging sessions are longer than ICE filling means that it is convenient to co-locate fast chargers with amenities motorists may find useful while they wait for their charge to complete.
- Minimal installation work required. Each site will have its own set of complexities and sites that do not require extensive upgrades should be prioritised.
- Minimal cost to council. Increasingly, the commercial sector, often in conjunction with federal and state government financial support are willing to fund fast charging sites.

9.6.2 Opportunistic

The following characteristics make a good site for an EV charger targeting *opportunity charging*:

- The driver is going there anyway (to do something else, such as shopping, visiting a café etc)
- In close proximity (e.g. within 400m) to a diversity of destinations, such as a shopping centre, shopping strip, cafes, services etc.
- Has off street parking
- Located close to high volume roads
- Has a typical duration of stay between 30 min and 2 hrs.

Major shopping centres and Activity Centres are generally considered sites that have many, if not all the above characteristics.

9.6.3 Residential

A need for publicly available residential chargers can arise when dwellings do not allow for the install of charging facilities. This may be because the dwelling does not have an off-street car park, or because the off-street car parks are shared or in a difficult location.

Figure 47 outlines the characteristics important for councils to consider for the selection of publicly available chargers focused on *residents without off street parking*

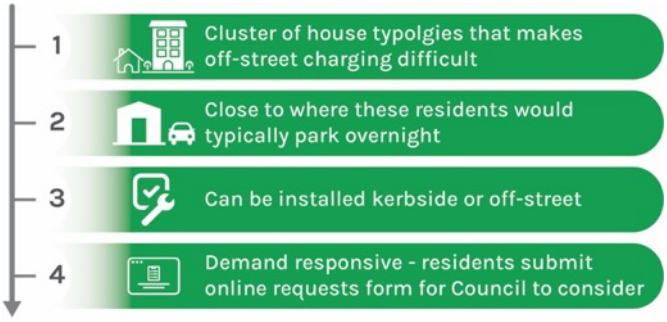


Figure 47 Residential charging, recommended approach

Older, pre-WWII suburbs can have a housing mix that typically do not include off street parking. Typical suburbs within the NCA that can have this type of housing include Brunswick, Coburg, Northcote, Thornbury etc. The demand responsive approach described in Section 5.2 is recommended as a method of providing charging opportunities where other options are not possible.

As highlighted earlier, residential chargers are easier to install but cannot service as many people as faster chargers. Residential charging can be installed either in kerbside on street parking, or in off street parking bays.

Box 7 provides a snapshot of the City of Port Phillip's trial of enabling householders without off street parking to charge on public land.

Box 8 offers a summary of what a selection of councils have done to support EV charging for residents without off street parking.

Port Phillip's EV charging trial

In an effort to enable residents without off street parking to own and charge an EV, the City of Port Phillip have initiated a trial in which residents are able to apply to be part of a program to have a charger installed on the kerbside. These chargers draw electricity from their home to charge their EV. The resident is required to pay around $5,600 for the charger. The resident is also required to pay a one-off bond payable to council, a $124 one off permit application fee and a $100 annual fee. An insurance cost of $2,500 - $3,000 per annum is also required to be paid by the resident.

Only the resident can use the charger, but anyone is able to use the parking bay.

The trial has had one household install a charger. It presents a poor use of financial and space resources, and sits low to the ground, representing a potential trip hazard. It is not recommended for NCA councils for the following reasons:

- Costly. ~$5,600 to install a charger represents a very high cost; this sum could buy 12,500kwh of electricity, providing 156 charging sessions (from 0%-100%), enabling the user to travel ~62,500km. This is the equivalent of 5 years of travel, for the average car. The insurance and other costs exacerbates these sums.
- Potentially creates tension between neighbours. It can be expected that when a non-EV parks in the bay the EV owner requires to charge their vehicle, the EV owner will feel aggrieved. To head off this, they may request no one else park in 'their' spot, as the cost gives them a sense of entitlement. The fact that the EV charger is private use only, while the parking bay that it is connected to is public use sets up a problematic arrangement.

Box 7 Trialling household charging on public land

What's been done elsewhere to support residents without off street parking to charge EVs?

This box provides a brief summary of what other jurisdictions have done to enable residents without the ability to charge an EV on their premises to transition to EV ownership.

Eastern Councils of Sydney (Waverly, Woollahra, and Randwick Councils)

This coalition of three councils work together to develop their EV charging network. Many of the residents in this area of Sydney do not have access to off street parking. While their AC charging program does not explicitly respond to individual charging needs for residents without off street parking, around one third of users are local. They began their AC charger network with six chargers, which has grown to 10 and expected to be 20 by the end of 2022. They are beginning to develop an EV Charging Strategy.

Merri-bek, VIC

Merri-bek provide a network of free, 7kW, 22kW AC and 50kW DC chargers for residents to use, as well as those outside of the municipality. This program began eight years ago as part of the Victorian Government's Electric Vehicle Trial. A total of sixteen chargers are offered, capable of charging fourteen cars simultaneously. Merri-bek will be looking at the performance of the City of Port Phillip trial before deciding whether to proceed with something similar.

Oslo, Norway

Norway is recognised as the global leader in EV ownership, with around 85% of new cars being EV. Oslo has a large percentage of its housing stock without off street parking. In the early days of Oslo's transition to EVs, there was one charger for every four EVs. The ratio is now around 1:10 and the City of Oslo is seeking increase the number of chargers, as it is recognised to be a barrier to further EV adoption. There are currently around 1,300 public charging points, on street, in Oslo, with a goal to grow this by 600 per year. While the majority of their AC charge points have been at the kerbside, the council have also subsidised 8,000 charging points in apartments, which is around 8 – 10 times cheaper than kerbside installs, according to figures provided to the authors.

London, UK

London has a wide variety of initiatives designed to speed the transition towards EVs. On street chargers are commonplace in London, and these are either standalone devices, or provided as part of other electrical infrastructure, like lamp posts. As the transition matures, an increasing number of commercial businesses are providing off street charging opportunities to their staff and customers, which will in time help to lower the demand for additional kerbside chargers.

Box 8 Snapshot of how councils seek to offer EV charging for residents without off street parking

9.6.4 Risks, liabilities, vandalism and enforcement

The introduction of publicly available EV charging infrastructure comes with a set of risks. While a well-planned EV charging plan will not eliminate these risks, their identification is necessary to a) mitigate against them and b) create an operational model that ensures a timely response to any interruption of quality service. 'ICE-ing' refers to an internal combustion engine vehicle blocking access to an EV charger. Table 13 provides an outline of common risks, and mitigation measures.

Table 13 Risks and mitigation issues

Risks	Description	Mitigation
Vandalism	Intentional damage to equipment; highest occurrence where poor public oversight, near pubs and late-night venues.	Good public oversight (passive surveillance). Avoid areas near pubs, late night venues. CCTV cameras (with signs), unremarkable hardware to reduce appeal/attention.
Accidental damage	Most often vehicle impacts, running over cords or connectors not returned to holders.	Bollards carefully placed to avoid reducing accessibility to those with mobility issues. Equipment designed to bill customer until charger replaced to holder. Design of charger and holder to minimise misuse.
Denial of access by blocking charger (ICE-ing)	Cars not charging denying access to EVs needing a charge; may include non-charging EVs as well as ICE vehicles.	Use vehicle detector in pavement and link to charge status indicator; if a vehicle is present but not connected, alert an enforcement officer after 5 minutes; charge vehicles for connected time whether charging or not; Intense enforcement for short periods will lead to compliance with low level of effort on average.
Obsolescence	Chargers no longer used as not compatible or more desirable equipment is available.	Replace chargers with newer models; ensure power supply can provide useful charging rates even if initial charger not using the full capacity; buy over-capable equipment in expectation of users seeking higher rates in future (e.g. three phase 32A chargers even if few cars can use now) as additional cost is low.
Low utilisation rate	Chargers installed but unused leading to frustration at being unable to use car parking space and complaints.	Transitional signs: “Please park elsewhere if space available if not charging”; “5/10/15 minute parking if not charging” (in an otherwise one or two-hour zone); put chargers in low demand parts of a parking area to reduce annoyance; don’t over-invest early in parking spaces.
Very high utilisation rate	Chargers always busy causing frustration for users	Raise the price; charge per minute, not per half hour or longer period; install chargers in groups making it easier to find a free charger, more likely that someone in the group will leave soon; have a time based charge that increases the price per minute for longer charge sessions; if profitable, install more chargers and encourage private providers to do so.
Ongoing costs	Maintenance, insurance, and billing costs are higher than expected	Plan and budget for all costs up front and price accordingly (if for a fee) or ensure sufficient budget available (if free). Monitor costs closely and adjust as required; if not competitive with other suppliers of charging services, allow traffic to go to others and gradually close sites down.

Electric vehicles and road safety risks

In addition to the well-established risks to road safety by conventional (ICE) motor vehicles, there are potentially some added risks associated with EV use. These may be associated with the lower noise levels at low speeds, and the faster acceleration, which other road users may not anticipate. Additionally, EVs tend to be heavier, and this can result in greater injury severity for other road users.

Shared spaces, where speed limits are often at 10km/h, may be perceived as more dangerous and therefore less desirable for visually impaired people. EV chargers, when located on the kerbside, is another addition to street furniture that adds to the complexity of navigating footpaths for the blind and visually impaired.

It is therefore recommended councils:

- Advocate to the Commonwealth government for mandatory EV sound generation at speeds below 30km/h. Many EVs already do this, but it is important that a uniform sound be used, to provide more clarity to all road users.
- Advocate to the State government that all police reports involving crashes on Victorian roads include a tick box for whether a crash involved an EV. This will help create a database that can be used by researchers to understand if EVs are disproportionately involved in crashes, and whether there are any patterns to these crashes. This may help inform future road safety policies.

Box 9 Electric vehicles and safety

10. Supporting the development of an EV charging system

This section outlines the measures recommended to support the development of an EV charging network.

10.1 Apply for ARENA funding

The Australian Renewable Energy Agency's (ARENA) *Future Fuels Program* includes funding for EV charging infrastructure.

The program eligibility includes Australian local governments who seek to install EV charging infrastructure. The NCA should consider applying for grant funding to deliver the proposed EV charging network in this strategy.

10.2 Working with the State Government and DNSPs

Working with Distribution Network Service Providers (DNSPs) was highlighted in the stakeholder engagement as one of the biggest barriers for rolling out a public EV charging network. High application fees, solely on a site-by-site basis, no ability to discuss plans outside the application process, no public knowledge of an area's electricity capacity, and no public plans to consider public EV charging holistically were listed as key barriers by councils when engaging with DNSPs.

There is an opportunity to work constructively and strategically with the State Government and DNSPs to drive innovation in public EV charging, improve processes, and to deliver a public EV charging network. There is currently a process underway at the national level to streamline connection processes and ensure greater consistency across state jurisdictions/DNSPs.

Advocate to the existing DELWP Energy working group to improve processes for assessment/approval of new chargers into the grid. Helping to identify opportunities to drive innovation in EVs, EV charging, and electricity grid resilience should be a focus of this advocacy.

Smart chargers

It is recommended all chargers installed for public access be smart chargers, in which their output can be controlled remotely by the electricity network manager. This will assist in maintaining the grid during times of high demand. Additionally, for the same reason, there is a strong argument for mandating smart chargers for domestic/business use as well.

10.3 Planning Scheme Amendments to support EV Charging

Changes to the Victorian Planning Scheme are required to ensure that EV charging is adequately considered as part of new developments. This should include requirements that all new dwellings have access to electric charging infrastructure.

While changes to the National Construction Code (Section 5.1) go some way towards facilitating EV provision in new developments, not all land uses or building types are included in those changes.

There are several avenues councils could pursue in accomplishing these changes.

- Adopting Local Policies in planning schemes. This is the simplest change, which a council could make individually. However, local policies are less powerful that planning requirements (e.g., within schedules to zones or overlays) and are therefore less likely to be as effective as other planning amendments.
- Individual council scheme amendments. This could include implementation of a parking overlay, which mandates minimum standards for EV charging infrastructure, for example, that 20% of all parking spaces in commercial offices be fitted with charging infrastructure.
- Collective council amendments, such as through the CASBE led Elevation ESD Targets Stage Two. which 24 councils are currently involved in negotiating.
- Lastly, advocating for a state-wide Amendment. While more complex, this is felt to be the approach to incorporating EV chargers into the

Planning Scheme, rather an individual council amendment, as it will set uniform rules across Victoria.

10.4 NCA EV working group

With the rate of development in EVs and EV charging underway, knowledge sharing and institutional cooperation is important to ensuring transport emissions are minimised.

Relevant NCA and council staff should form a working group that meets monthly (or quarterly) to discuss developments in EVs and EV charging, to share knowledge, lessons learned, and coordinate plans to increase uptake in EVs for council and the community, and to deliver a regional EV charging network.

Such a group could evolve over time, shifting from building out a public EV charging network to other transport emission challenges.

10.5 Upskill staff that intersect with EVs

Fleet managers, customer service staff, planning officers should all be upskilled so they understand the basics of EVs and charging infrastructure. This is important for all people that are likely to provide information to the public and those who are required to make decisions relating to EVs and EV charging infrastructure.

Fact sheets, frequently asked questions, and access to professional development sessions on EVs and EV charging are some examples for upskilling staff. If councils have EVs and EV chargers for their fleet, ensuring staff have a sufficient understanding of how they work will further improve their knowledge base.

11. Facilitating council transition

Reducing the emissions produced by council vehicle fleets is an important step in the transition to a more sustainable future.

A concurrent project, as part of NAGA, has focused on transition council fleets. However, further opportunities exist to reduce council transport emissions. This section outlines those opportunities.

11.1 Reducing transport emissions from staff commuting

Councils have large numbers of staff with consistent commuting patterns. Council offices are often located near public and active transport networks. Developing and implementing *green travel plans* encourage staff to travel by sustainable means is a practical method of lowing emissions associated with staff travel. Enhancing the network of walking and cycling infrastructure is also important and helps both staff, as well as the wider community integrate sustainable mobility into their travel patterns.

Each council should review their travel options to work for council staff, including the incentives and disincentives to travel to work by foot, bicycle and public transport

We recommend the following actions:

- Green travel plans for each council site. This should include material for all new employees that include mapping possibilities to commute by active or public transport, and the programs available to assist their commutes.
- Review the vehicle options available via salary sacrificing to ensure that zero emission options are available and are given preferential access over models with higher emissions. This should include e-bikes.[28]

11.2 Reducing emissions from work-related trips

Councils, and council staff, undertake a range of transport trips as part of their work. For example, staff visiting another council office for a meeting or a maternal and child health nurse visiting a patient at their home. Many of these trips could be reviewed to reduce the transport emissions associated with those trips.

11.2.1 Council e-bike fleets

Many councils now include a fleet of e-bikes to support internal staff trips. These bikes can be added to the fleet vehicle booking system and preference given to them for short trips.

Box 10 outlines an approach the City of Yarra is taking to change travel practices for maternal and child health (MCH) nurses.

City of Yarra Maternity Health Nurses

The City of Yarra have a fleet of e-bikes that are exclusively used maternity and child health nurses at Council. These bikes are used to make outpatient visits. They allow staff to get to patients homes faster than in a car and without the added time spent trying to find a car park.

Box 10 e-bikes for MCH nurses

11.2.2 A sustainable fleet booking system

Almost all councils now use fleet booking systems to manage requests from staff to use pool vehicles. This system can also be used to guide staff towards the most sustainable option that also meets their transport needs.

Review the fleet booking system to ensure it best matches a staff members transport needs with the least carbon footprint possible. Automatically select hybrids / EVs, suggest car pooling to meetings, or encourage e-bike use instead.

11.3 Supporting contractors reduce transport emissions

Many council services are now contracted out to private companies. There are many opportunities for councils to work with these organisations to reduce their emissions footprint, including from their transport operations. The concurrent *Part B* of the wider EV project relates to fleet emissions and

[28] E.g. see https://www.sparque.au/

particular coverage is provided within that report on methods of decreasing emissions from contracted services.

CityWide and Good Cycles

CityWide and Good Cycles have partnered for over four years to provide employment opportunities for at-risk youth while reducing transport emissions associated with council-contracted operations. Via a Memorandum of Understanding, Good Cycles provides waste services for the City of Melbourne, in partnership with CityWide.

Source: CityWide

Councils may wish to partner with a contracted organisation where there are clear mutual benefits. Another approach could be to embed sustainability into the tendering process.

11.4 Plant machinery

It is recommended councils consider electric alternatives for replacing common plant equipment that are petrol powered. While each council will need to make decisions that best meet the needs of their organisation, it is recommended:

1. Council share information about their experiences of battery electric plant equipment to establish which models/options are fit for council work.
2. Council select the battery electric option whenever a fit for purpose model exist.
3. Council maintain and update a shared list of equipment considered and/or procured annually. the information provided in annually, as it is expected significant advances will be made to the performance of small plant battery electric options over the next five years.

11.5 Local government partnerships

Councils should work together to identify opportunities to drive change by working collectively. The Northern Council Alliance (NCA), Municipal Association of Victoria (MAV) and other council alliance groups are ideal groups to work collectively to drive institutional change towards low and zero-emission practices beyond that which is possible for an individual council to achieve.

For example, mandating sustainability targets within a tender is difficult on a council-by-council basis. However, working collectively to implement changes in tender requirements can drive institutional change. For instance, it may not be worthwhile for a waste operator to audit their transport emissions to bid on a single council tender, but if an emissions audit was required for all local government tenders, then the additional work to undertake that audit and to work towards reducing emissions becomes financially viable.

12. Facilitating community transition

This section outlines the measures possible to support the residential community in the NCA area to transition to EVs. It includes the opportunities beyond the development of an EV charger network to support the community reduce their transport emissions.

12.1 Encourage walking and cycling

Councils, in combination with other levels of government are responsible for the provision of the walking and cycling network. A lack of suitable infrastructure is the main reason more people do not consider cycling a viable option, even for trips within a cyclable distance. As highlighted earlier, around 50% of car trips are less than 5km in Melbourne and therefore significant opportunity exist to convert some of these car trips to walking and cycling. As demonstrated in Figure 3 and Figure 4, walking and cycling are not just proven ways to reduce carbon emissions, they also work to enhance population health, reduce congestion, as well as provide a lower cost form of transport.

It is recommended the NCA work to develop an integrated, area wide walking and cycling strategy to ensure more trips can completed by active travel.

12.2 Increasing community awareness

12.2.1 Tracking community transport emissions

In Auckland, data sources have been combined with interactive dashboards to raise awareness for reducing transport emissions under various scenarios. The transport2030.org dashboard outlines transport emissions in 2018 (the year the tool was completed) and forecast emissions in 2030. First, a baseline 'business as usual' forecast is provided while a second scenario changes based on user input. The inputs that can be changed include increasing cycling investment, bringing a range of public transport projects online, electrifying passenger vehicles, among others. The dashboard provides a convincing argument that reducing transport emissions cannot be done by converting to EVs along. A holistic approach that considers all modes of transport is required.

Replicating such a dashboard could be possible for a group of councils, though it would be more compelling to expand such a tool to Greater Melbourne.

12.2.2 Updating Green Vehicle Guide

Advocating to the Commonwealth to update the Green Vehicle Guide to better inform consumers about the whole of life costs (combining capital expenditure with operating expenditure). BY including this feature, people would be in a better position to make informed decisions that can account for the higher upfront but lower operating costs of EVs. Without this figure, it is likely that people focus more on capital costs and less on operating costs, which works to the disadvantage of EVs.

12.2.3 Sustainable transport festival

A NCA sustainable transport festival, or a sustainable living festival that included transport as a key focus would help to enhance people's awareness of sustainable mobility options. It could be located at a site such as La Trobe University. It could include stalls for EV companies and other groups such as Good Car Co. A *come-and-try* element where people can get a ride in an EV may also be beneficial. Other businesses that may be interested include EV charging installers. Broadening the commercial element to include e-bike and cargo bike companies would help to create a multi-modal aspect that widens the effectiveness and appeal of such an event.

12.2.4 Electric car share

Car share is an important program for supporting low and no car households. They have been found to overall decrease car ownership and total kilometres travelled. This has positive economic and environmental outcomes for car share users.

An electric car share scheme would further reduce transport emissions. It would also provide an opportunity for the community to interact with, or try out an EV for everyday transport trips.

Shared mobility hubs

To assist Amsterdam residents' reduce their transport emissions and increase their travel choices, the city has begun investing in shared mobility hubs, like the one shown in Figure 48. In these neighbourhood hubs, electric bikes, cargo bikes, mopeds, and cars are co-located and available for rent.

More information about the European Union funded initiative can be found here:

https://www.nweurope.eu/projects/project-search/ehubs-smart-shared-green-mobility-hubs/

Figure 48 An Amsterdam e-mobility hub
Source: City of Amsterdam / Sanne Couprie

Box 11 Neighbourhood shared mobility hubs

In Melbourne, residents at Home-Southbank, a build-to-rent apartment building, have access to a shared EV provided by Origin Energy. The EV car sharing service, called Origin 360 EV Car Share, is available to tenants via a booking app, and has a dedicated EV charger on the property. A Tesla Model 3 can be booked for $20 an hour including insurance, with discount for whole-day use and at weekends[29].

More information about the Origin Energy initiative can be found here:

https://www.originzero.com.au/energy-solutions/360-ev-e-mobility/ev-car-share/

12.3 Electric micro-mobility share schemes

Supporting the community to transition to electric cars will help reduce emissions but will not address any other negative effects of car use. On the other hand, reducing car use will greatly help to reduce both emissions and other negative effects of car use.

Electric micro-mobility has the potential to decrease car use by giving the community more transport choice. Indeed, many trips which are under 5km are ideal for e-bikes, while shorter trips of around 1-2km are ideal for e-scooters.

There is a numerous micro-mobility share schemes operating elsewhere in Melbourne. NCA Councils should investigate options for supporting companies to provide electric shared micro-mobility in the study area. This will require advocacy to State Government to expand the e-scooter area following the end of the trial currently underway.

12.3.1.1 Charging of micro mobility batteries in the public realm

Given micro-mobility devices rely on standard power supply, Council could support micro-mobility charging at a range of public places they own and manage with limited investment requirements (e.g. libraries, community facilities and parks). This could simply be a sign saying *'e-bike battery charging welcome here'.*

12.4 Embed emissions reductions into strategic plans

Councils are responsible for producing strategic transport documents, such as Integrated Transport Strategies. These documents are the right place for outlining the role for transport emissions to be reduced. Many strategic transport plans implicitly do this already by advocating for a more diverse transport mix.

Including emission reduction targets and requisite capital expenditure funding for the infrastructure changes required would better ensure those transport emission targets are met. Transport

[29] https://www.theaustralian.com.au/life/motoring/residents-able-to-book-through-the-360-ev-share-app-for-around-20-per-hour/news-story/dfcc13eef5bffbbd15abbd21d9237c8a

mode share targets should also be embedded into climate change strategies.

12.5 Supporting community bulk-buys

Collaborating with other councils to participate in community bulk-buys for EVs will help reduce the main barrier to EV adoption, *cost.* The Good Car Co is the most prominent community bulk-buy organisation in Australia, offering second hand EVs to the public.

Previous bulk-buy programs have included event days, information nights, and workshops on EVs that have helped bust myths and bring prospective EV buyers up to speed on the ins and outs of owning and operating an EV.

Some councils in the NCA are currently working with Good Car Co for a community bulk-buy of EVs.

12.6 Financial incentives

Many jurisdictions, local and international, provide financial incentives to help people reduce their transport emissions. Most in Australia provide rebates or zero-interest loans to help people buy an EV. Internationally, these schemes are often opened up to electric mopeds, e-motor bikes, electric bikes and cargo bikes.[30]

Increasing financial support for these other transport modes, where existing support in Australia excludes those options, would address a gap in support for these other transport modes to reduce transport emissions (and at a lower cost to both government and households).

City of Adelaide

The City of Adelaide offers financial incentives for sustainable technology installation through its *Sustainability Incentives Scheme*. Council effectively co-funds these projects between 25% to 50% of the total costs and can be applied for residential and commercial properties.

- 50% up to $5,000 for EV charging equipment (cars and bikes)
- 25% up to $1,000 for a stand-alone EV charging Station Demand Management system
- 50% up to $10,000 for advanced EV charging technology providing virtual power plant capability

More about the scheme can be found at:

- https://www.cityofadelaide.com.au/about-council/grants-sponsorship-incentives/sustainability-incentives-scheme/

12.7 Delivering active transport networks

It must be recognised that the effectiveness of these financial incentives, and the success of any electric micro-mobility share scheme, is based on having a transport network that supports their use.

The state cycling strategy, Victoria's Cycling Strategy has shown that while many Victorians are interested in cycling, a lack of safe infrastructure is a major barrier. [31] The Strategy has recognised that the prioritised the development of a safe cycling network is necessary to increase cycling participation.

Councils must improve the cycling networks within their control, working with the state government, to deliver an active transport network which supports increased walking, cycling, and scooting.

12.8 Supporting renters

While homeowners, particularly those in separated housing, will be able to install EV chargers easily, those who rent will face an additional barrier to being able to get an EV charger installed.

Advocating to the State Government for specific support for renters and landlords to allow the installation of EV chargers is recommended.

12.9 Support retrofitting existing buildings

Many existing buildings, particularly multi-dwelling units and multi-level commercial buildings will have consolidated off-street parking associated with those buildings. They often have multiple

[30] https://www.weride.org.au/wp-content/uploads/2022/04/WeRide_e-Bike_Subsidy_Report_FINAL-lores.pdf
[31] https://transport.vic.gov.au/-/media/tfv-documents/walking-and-cycling/victorian-cycling-strategy-2018-28.pdf

owners with varying levels of interest in the building (owner-occupier, landlord, investor, etc).

These complex ownership structures, in addition to the complexity in retrofitting a building, pose barriers to installing EV chargers.

The NSW Government (Section 4.1.5) have provided a reference guide to help strata managers, and those who have an interest in one of these buildings to plan and implement such a retrofit.

The NSW Government is also providing $10 million in co-funding for medium-large apartment buildings to make the necessary electricity upgrades to facilitate EV charging in their car parks.[32]

NCA should work with the State Government to develop a similar reference guide for Victoria. Additional barriers should also be investigated, such as when strata or body corporate management decide against EV charging upgrades and the impact that may have on EV uptake.

12.10 Elevating ESD Targets

The CASBE led Elevating ESD Targets amendments, involving 24 Councils across Victoria, has the potential to assist in supporting renters and supporting retrofitting of existing buildings.

Councils should continue to advocate for amendments to the planning scheme which provide guidance and support in ensuring that dwellings are able to provide charging infrastructure to all members of the community.

12.11 Leveraging council transitions

Councils have the potential to leverage their transition to provide broader community benefit. There are two key ways which this could happen, by providing lower cost EVs through their own fleets and through the co-location of charging infrastructure.

12.11.1 Second hand EVs

There is currently a shortage of EVs in the Australian market. This is true for new vehicles and for second hand vehicles. Councils generally use vehicles for five years or less before selling them on the used car market. This means that Council electric vehicle transitions will increase the number of used cars in the EV market. Councils therefore have a key role in supplying electric vehicles to the second hand car market, which will assist in accessibility of electric vehicles for middle income households.

12.11.2 Charging infrastructure

Councils will need to install charging infrastructure at council locations to support the charging of their electric vehicles (these requirements are discussed in Part B of this project).

For most cases, it is best to have council charging infrastructure available only to council vehicles. The reasons for this are twofold. Firstly, as council vehicles are stored overnight, they can be charged overnight and this allows for slower chargers to be used, lowering cost and demand on the electricity network. Secondly, charging equipment which is used only by council does not require any form of payment mechanism, again lowering costs.

Having charging equipment which is available only for council vehicles will reduce costs on installation and maintaining the equipment, while also reducing the costs of electricity upgrades.

However, there will be some circumstances where it makes sense to have publicly available charging infrastructure on council land, which is used to charge council vehicles. These sites could include council offices and town/city halls in activity centres which are identified in this report for public charging infrastructure.

In these sites councils should investigate the potential to install higher capacity (50kW of larger) DC chargers with payment facilities. This would allow council vehicles to be charged quickly, and for the public to pay a fee and charge. To ensure that council vehicles are able to charge, public access should be restricted at certain times of the day (e.g., only council vehicles may use the charger between 9am and midday, Monday to Friday).

Co-locating council chargers and public chargers may also open new funding channels, such as government grants.

[32] https://www.nsw.gov.au/media-releases/nsw-takes-lead-ev-charger-boost

13. Facilitating business transition

This section provides an outline of recommended measures to assist businesses transition to a zero emission fleet.

13.1 Encouraging commercial fleet transition

Many businesses have large vehicle fleets. This could include delivery companies whose core business includes the use of vehicles, or an office-based business that use fleet vehicles to move between offices.

Councils have detailed data on their own fleet transitions that may help businesses with their plans. In particular, helping businesses identify vehicles with a suitable EV alternative would help reduce business costs and reduce their transport emissions.

Highlighting case studies where businesses have successfully transitioned their vehicles to electric and the benefits associated with the transition can help businesses make the first step towards a cleaner fleet. Additionally, case studies where business practices changed to move away from vehicle use, such as transitioning to an e-bike fleet, would highlight the importance that other modes of transports have for reducing transport emissions and reducing business costs.

13.2 Commercial EV expo

NCA should work with other levels of government to bring a commercial EV expo to Victoria. This expo would include the major OEMs with their current and near-market EV offerings. Additionally, involvement from EV industry representatives would be useful, to provide information to commercial operators on the financial and environmental benefits of switching to EVs.

The expo should include commercial vans, light trucks, and heavy trucks. It should also include the ability to test drive these vehicles and case study examples from successful overseas examples.

13.3 Support the development of a commercial green car guide

The Green Car Guide is an important resource for individuals and households to make informed purchases for new cars based on environmental performance. A similar tool is recommended to improve peoples' understanding of light commercial and heavy vehicles environmental and economic performance.

It is recommended NCA advocate to the Commonwealth Government for the development of a tool that allowed users to input their driving needs, such as distance travelled per day, carrying capacity, vehicle type and then be provided with low and zero emission vehicle options. It should provide an estimate of the upfront capital costs as well as whole of life costs. Whole of life costs are the key comparison for EVs as they have higher upfront costs but lower operating costs.

Such as tool could allow fleet managers at commercial and industrial businesses manage the transition of their vehicles to electric, reducing transport emissions and overall costs for the organisation.

13.4 Support EV chargers at key hubs

Vehicle and goods transfer hubs are locations where an array of private delivery organisations drive to and from. These include freight hubs, waste transfer stations, and food and product distribution hubs.

For example, the Melbourne Market in Epping sees many different delivery vehicles load and unload goods. These organisations' ability to transfer to EVs is dependent on the Market having sufficient EV charging facilities to ensure that delivery trucks and vans have the necessary range to complete their deliveries for the day. Facilitating the installation of chargers at these points will overcome a barrier for wider adoption of commercial EVs.

13.5 Supporting business through Environmental Upgrade Finance agreements

Councils in Victoria may offer finance to business for energy and sustainability upgrades through Environmental Upgrade Finance agreements.

Businesses are able to access funding for building upgrades which improve the buildings environmental performance. These include renewable energy (e.g., solar panels), efficiently improvements, waste reduction and modifications to adapt to climate change. Projects must be a minimum of $15,000 and can have repayment periods of 4 to 15 years. In these agreements, businesses receive project funding from a finance provider and make repayments through the council rating system, as shown in Figure 49.

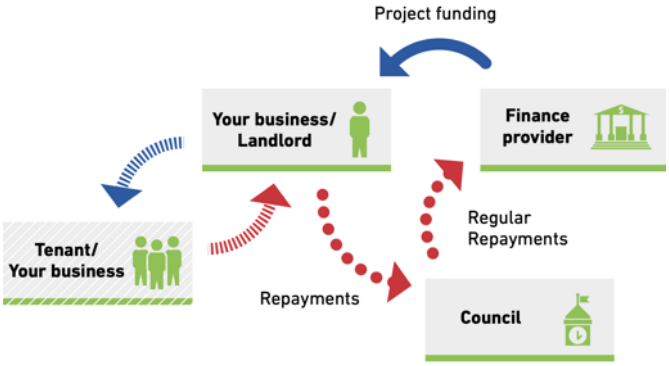


Figure 49 Environmental Upgrade Finance agreement mechanism

Source: Sustainability Victoria[33]

NCA Councils could use Environmental Upgrade Finance agreements to support businesses to transition to electric vehicles by supporting the installation of charging equipment. Further benefit would be realised if projects to install charging equipment included solar panels. Solar panels provide the most energy during the day, while vehicles are at work. This means that participating businesses would be able to access the cheapest form of power – behind the meter solar power – to recharge their vehicles. This will provide environmental and economic benefits to businesses.

[33] https://www.sustainability.vic.gov.au/energy-efficiency-and-reducing-emissions/in-a-business/finance-energy-upgrades-in-you-business/environmental-upgrade-finance-for-business#

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