# Electric Vehicle Charging Roadmap

**Prepared for SECCCA**

Final Report, May 2022

Institute for Sensible Transport

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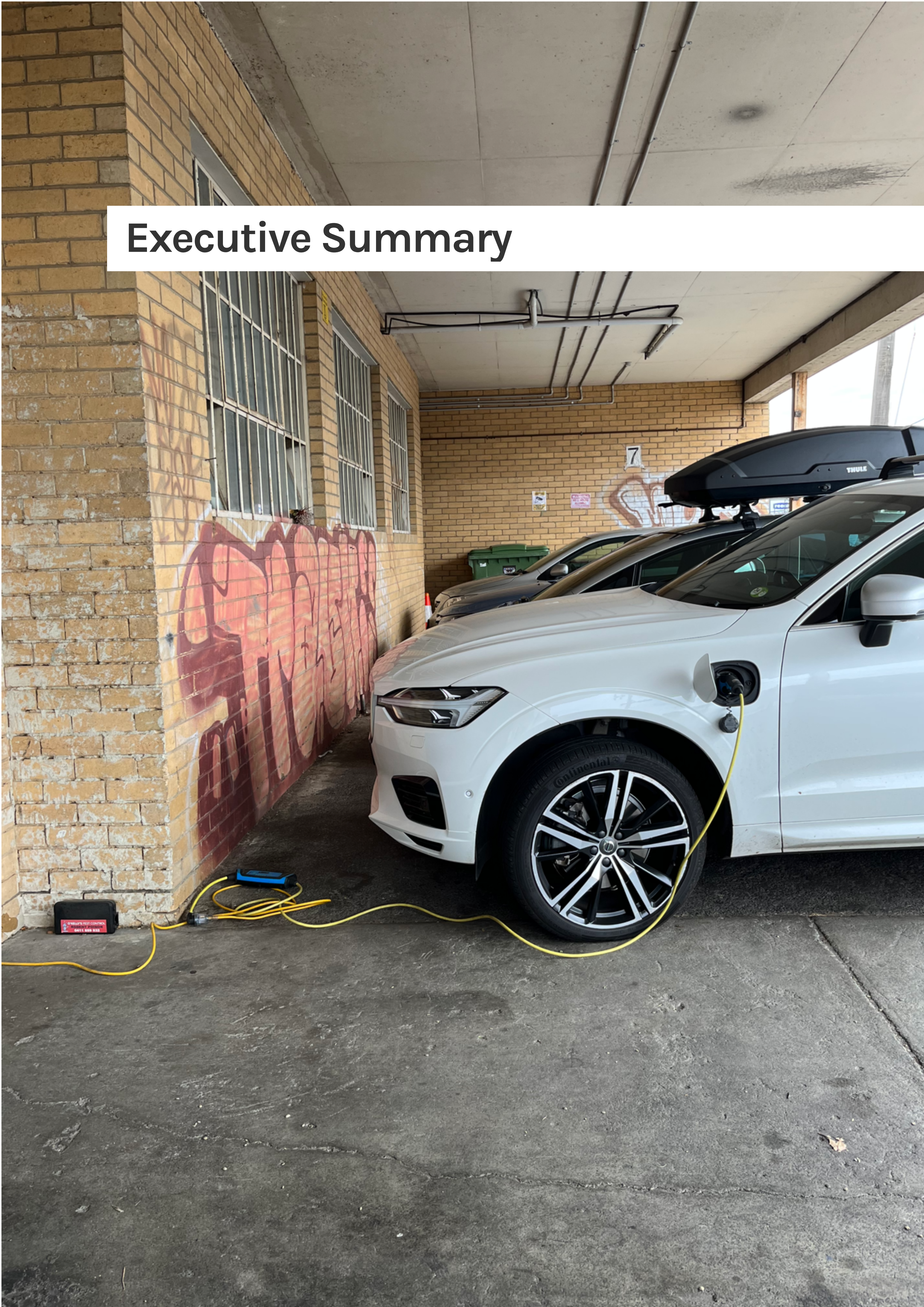


**This report delivers a plan for a South East Councils Climate Change Alliance (SECCCA) *EV Charging Roadmap.* Commissioned by SECCCA, and developed by the Institute for Sensible Transport with the assistance of Point Advisory, this report:**

**A) Identifies optimal locations for puiblicly available charging**

**B) Details the key issues to consider in the development of an implementation plan, delivered by 2030, for each SECCCA local council participating in this project.**

Five of the nine SECCCA councils have participated in this project, including:

- Cardinia
- Casey
- Frankston
- Kingston
- Mornington Peninsula.

## What does this report do?

This report has:

- Provided an overview and introduction to electric vehicles and charging infrastructure
- Developed a framework for informing decisions on where to locate electric vehicle chargers
- Analysed electric vehicle uptake within the study area and provided forecast uptake each year between 2022 and 2030, based on a variety of plausible scenarios
- Proposed an EV Charging Roadmap, prioritising areas based on the results of a geo-spatial evaluation framework applied across the study area, including an online map[1]
- Estimated emission reduction impacts of the EV charging network
- Provided advice to SECCCA on funding options that minimise the capital and operational expenditure to local government.

**While around 90% of all EV charging is expected to occur at home, public charging provides an essential service for motorists some distance from home or when a home cannot be fitted with a charger.**

### Forecasting EV uptake to 2030

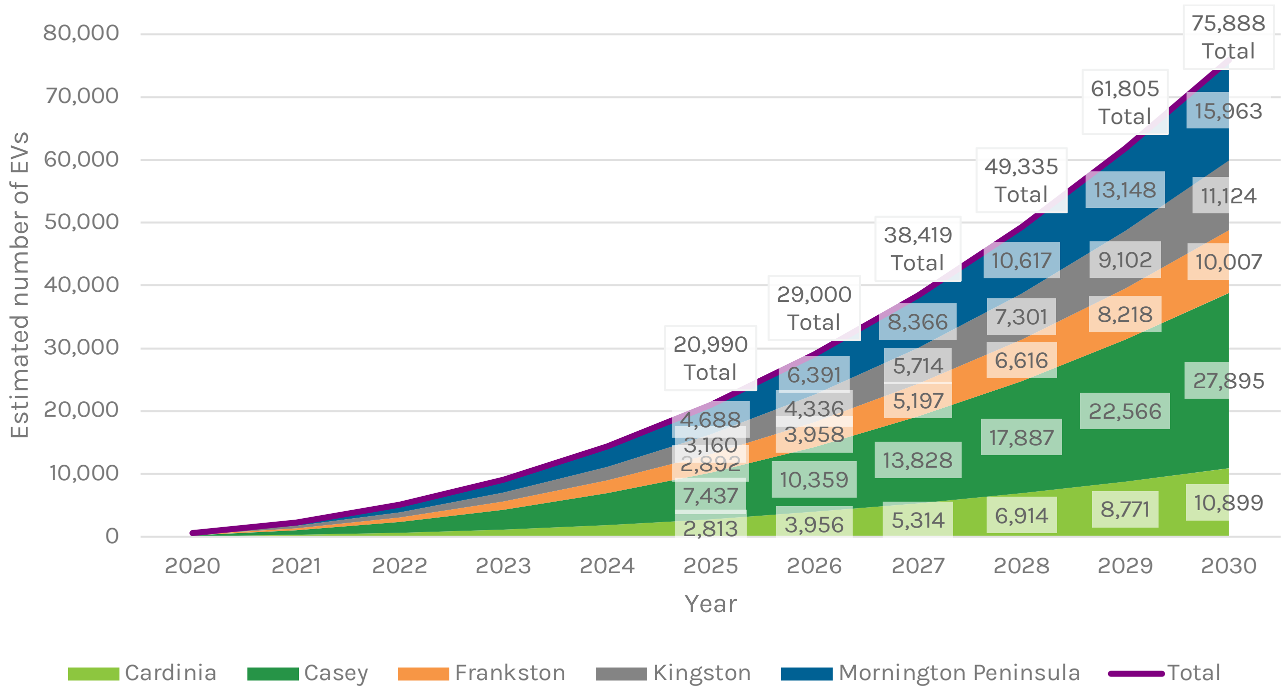
It can be expected that between 5% - 20% of all passenger cars owned by SECCCA residents will be EVs by 2030.

It is assumed that 8.5% of the fleet will be EV by 2030, based on the AEMO *Net Zero 2050* and *Steady Progress* scenario projection[2], with a curved growth rate applying, scaling from less than 1% to 8.5% in a non-linear way (i.e., powered or exponential).

It is estimated that there will be 20,990 EVs in the LGAs by 2025, rising to 75,888 EVs in 2030, as shown in the figure below.

[1] https://driverless01.carto.com/viz/b172610f-81e9-463d-ae6f-29dde22d2e52/map

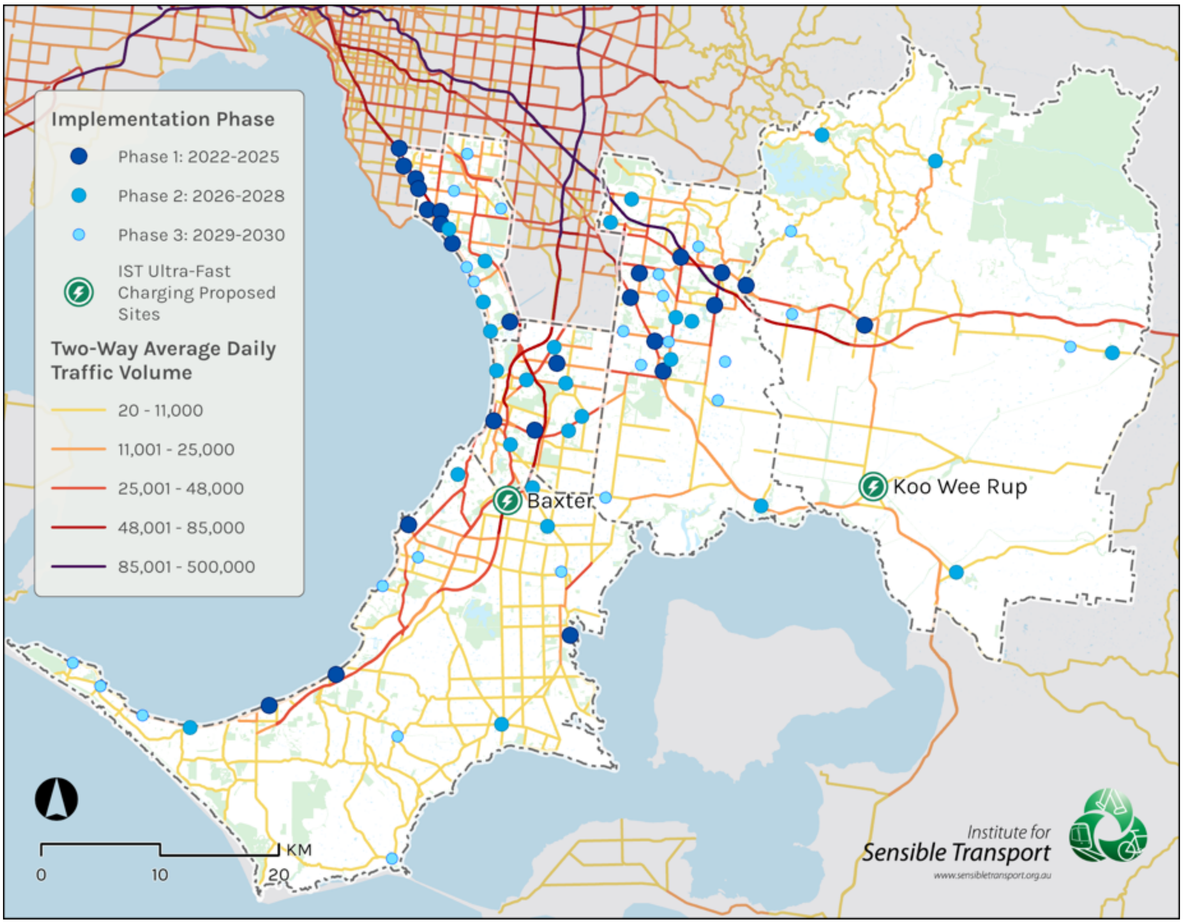
[2] https://aemo.com.au/-/media/files/major-publications/isp/2021/2021-inputs-assumptions-and-scenarios-report.pdf?la=en




*Estimated EV uptake across SECCCA participating councils*

## The Roadmap

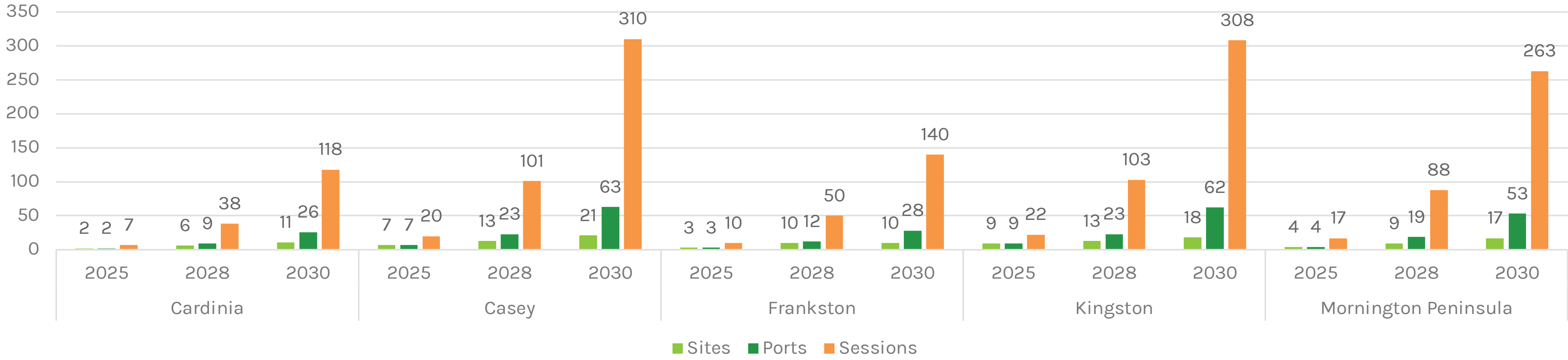
The map below identifies the chargers recommended as part of this Roadmap. In most cases, chargers are prioritised based on their proximity to high road traffic volumes, as well as a number of other factors.




*Proposed charger locations and implementation phases*

### Number of charging sites and ports required

This report has applied a methodology to estimate the number of charging stations and ports required to support the future EV fleet. This is based on an estimation of the number of kilometres the EV fleet is expected to travel, and how this varies by year and across the different LGAs. It accounts for the fact that much of the charging will take at home and includes population growth factors for each council. The graph below details the charging sites, ports required and estimated number of charging sessions, for the years 2025, 2028 and 2030.




*Number of charging sites, ports and estimated number of charging sessions*

**It is recommended councils avoid offering 'free' charging, as this can limit the willingness of the private sector to invest in the charging network. Currently, there is strong commercial interest in providing fast chargers in public settings without any significant costs to councils.**

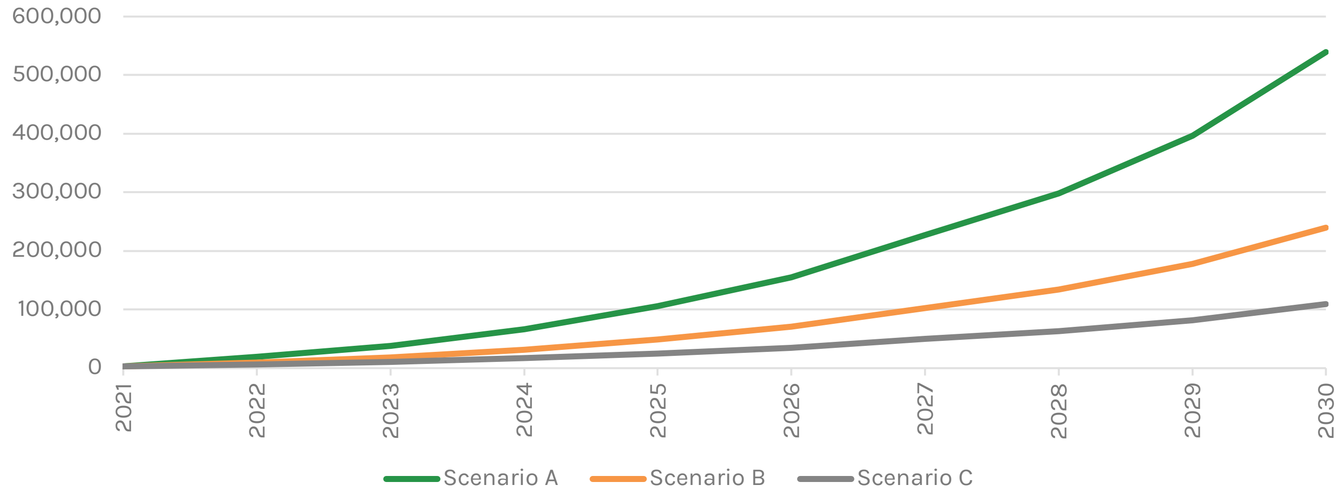
## Emissions impact

Three scenarios have been developed to explore the potential emissions impact of the EV Charging Roadmap. The scenarios are identified in the table below. Grid emissions projections have also been applied, as the EVs will at least be partially reliant on the carbon intensity of the Grid.

*Three emission reduction scenarios*

| Model parameter | Scenario A | Scenario B | Scenario C |
|---|---|---|---|
| **Rate of EV uptake (exponential growth to 2030)** | 22% EV uptake by 2030 | 10% EV uptake by 2030 | 5% EV uptake by 2030 |
| **Projected improvement to ICE efficiency** | No improvement (i.e., 2030 ICE fuel efficiency = today's efficiency)3 | No improvement | Extension of historical ICE improvements (2000 – 2018, ABS) |

The net emissions savings under the three scenarios are shown in the graph below.




*Net savings of emissions (tCO2-e per year) under three scenarios (across participating councils)*

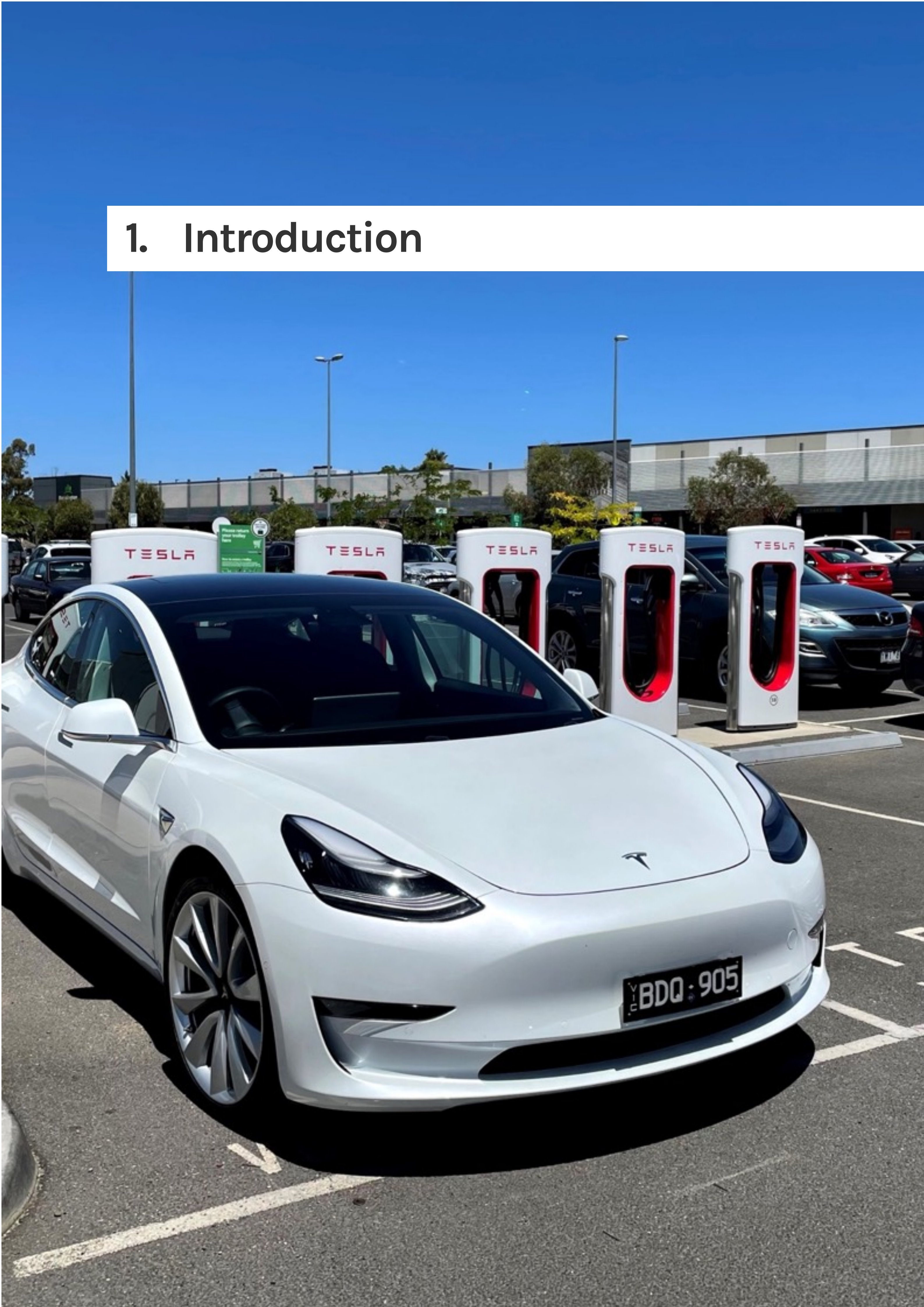
## Next steps

It is recommended SECCCA and its participating member councils take the proposed actions to bring this EV Charging Roadmap towards implementation:

1. Review funding options from the Victorian and Commonwealth for implementing EV charging infrastructure
2. Develop an Expression of Interest process for the EV charging industry to offer detailed proposals for installing public charging infrastructure. This should include essential requirements from proponents, such as a commitment to 100% renewable energy supply.
3. Develop policies and planning guidance for charging infrastructure requirements in new residential and commercial developments
4. Promote electric mobility options (e-bike and EVs) within the community, including *'come and try days'* and information for businesses and residents to make more informed decisions regarding electric transport.

[3] This is due to the announcement from a number OEMs that they will cease their work on improvements to ICE technology.

# 1. Introduction



**South East Councils Climate Change Alliance (SECCCA) have commissioned this report to plan a future electric vehicle (EV) charging roadmap. In addition, this project has provided separate reports focused on policy guidance and a snapshot of future trends in the EV market.**

**This report details the *EV Charging Roadmap*, and highlights a set of recommended EV charging sites across the SECCCA participating council areas.**

## 1.1 Brief background

SECCCA's vision is *'The south east of Melbourne is a thriving and productive region that has a safe and sustainable climate'*. There are a number of important reasons for the commissioning of this project:

- SECCCA has declared a climate emergency and have recognised that approximately 25% of emissions are transport related across the SECCCA region.
- Community sentiment on EVs is evolving rapidly, and some member councils have begun to receive requests from residents and other community members for public EV charging.
- EV charging equipment suppliers have approached councils seeking to install chargers on public land and clearer policy guidance is required to consistently manage these requests.
- A stronger understanding is required on where future charging infrastructure should be placed, using a data-led approach.
- A clear, robust plan for publicly available charging infrastructure will provide a strong foundation for SECCCA members to apply for funding to have chargers installed in their LGAs.

## 1.2 What this project involves – in brief

In essence, there are three key deliverables to achieve the objectives of this project, as illustrated in Figure 1. This report is focused on the first component, the EV Charging *Roadmap.* The *Discussion Paper and Policy Template* and *Future Scan* have been produced prior to the development of this Roadmap and have been used to help inform the Roadmap.

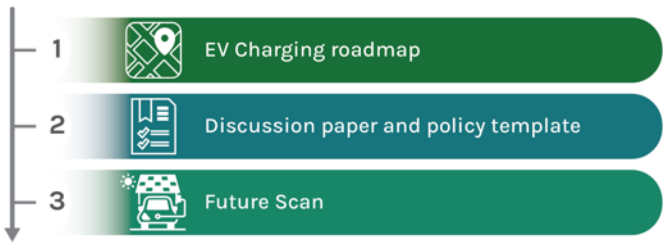



**Figure 1 Key project components**

The Roadmap presented in this report:

a. Identifies optimal locations for publicly available charging

b. Details the key issues to consider in the development of an implementation plan, delivered in 2030, for each LGA, to create a regional network.

Figure 2 provides a map of the SECCCA region and its member councils. As each member council is at a different stage of their EV journey, five of the nine SECCCA member councils are participating in this project (Cardinia, Casey, Frankston, Kingston, Mornington Peninsula).

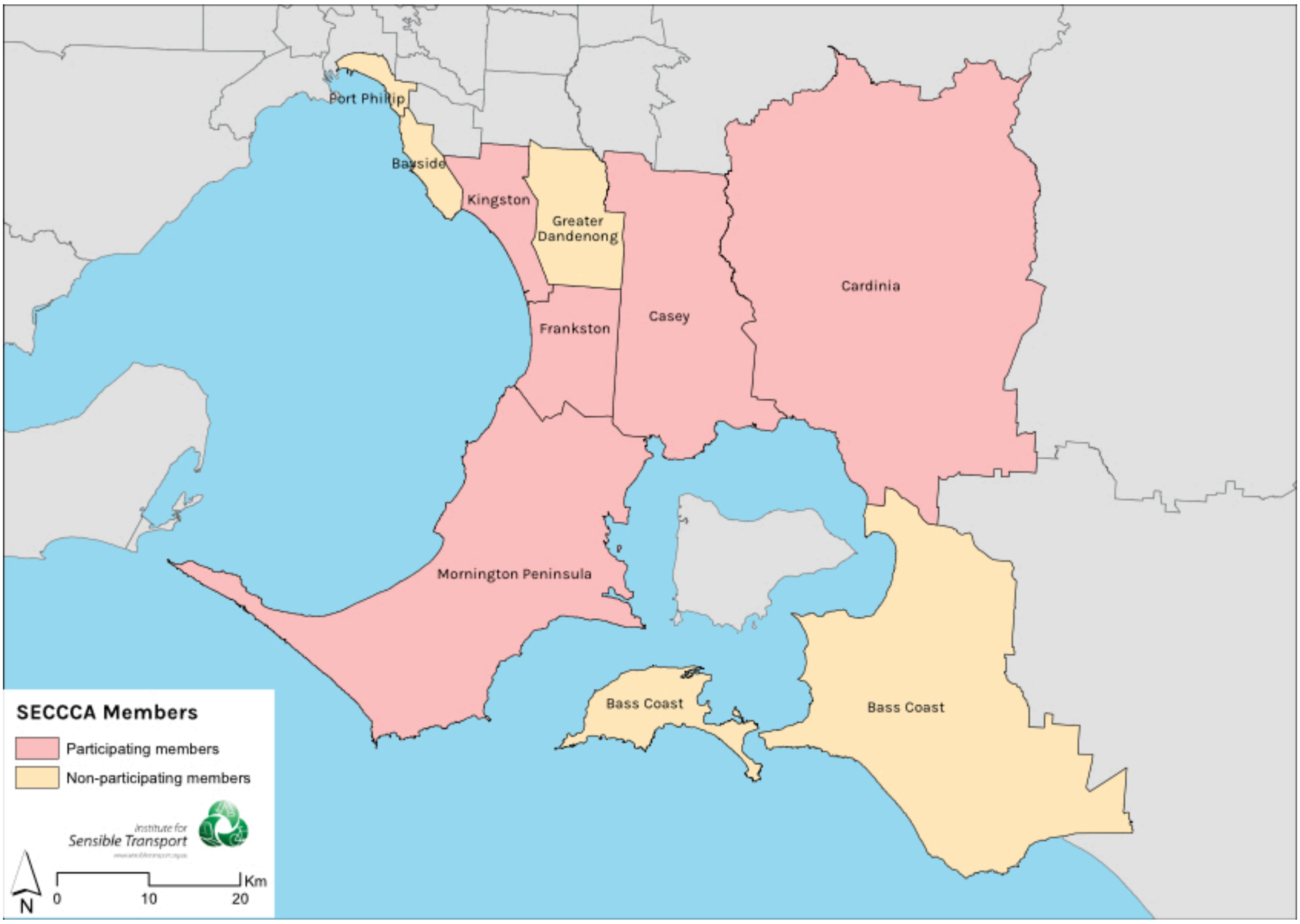
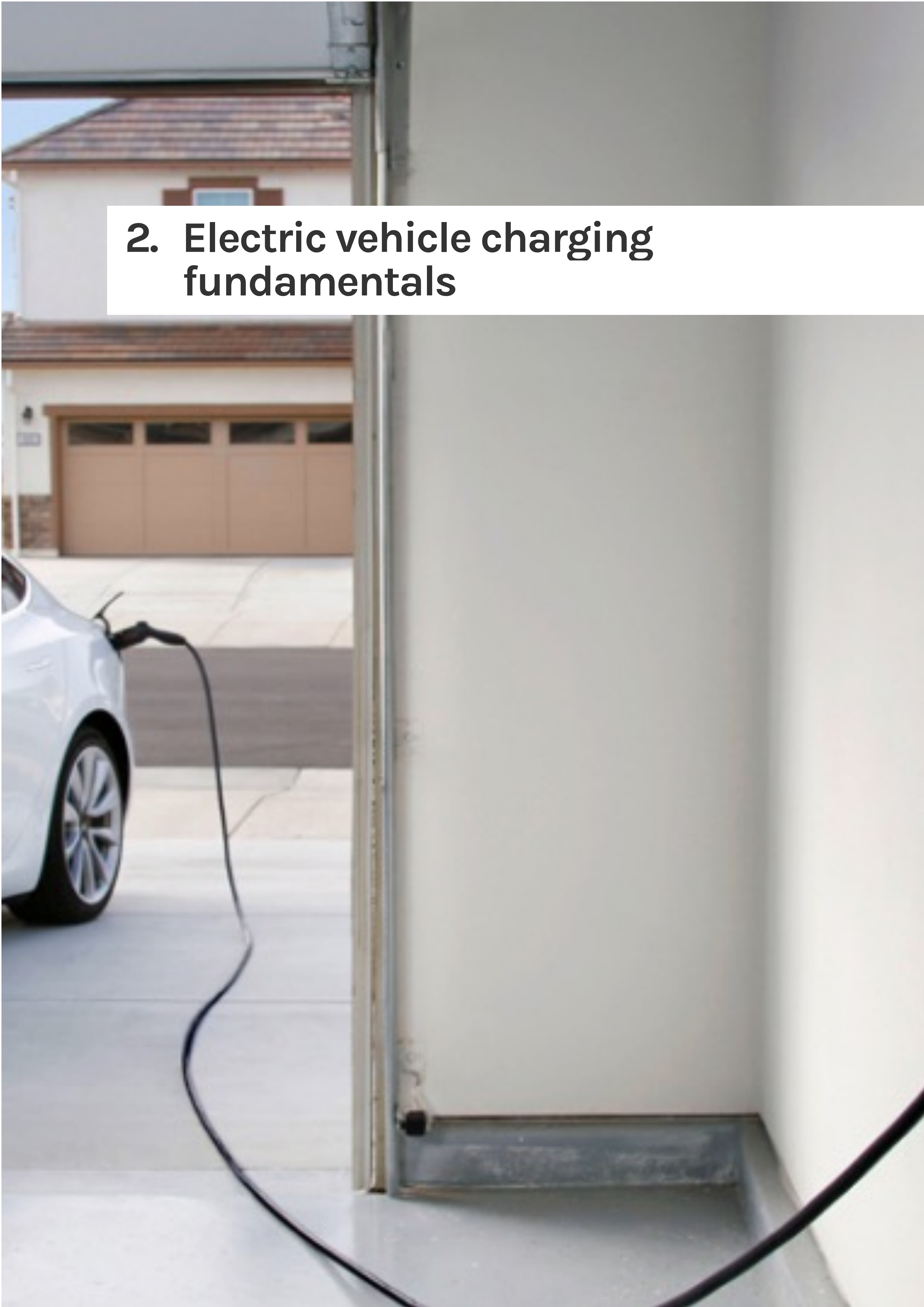



Figure 2 SECCCA region

# 2. Electric vehicle charging fundamentals



**Prior to identifying preferred locations for EV charging sites, it is important to briefly describe some introductory concepts on EV 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.**

## 2.1 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 3.

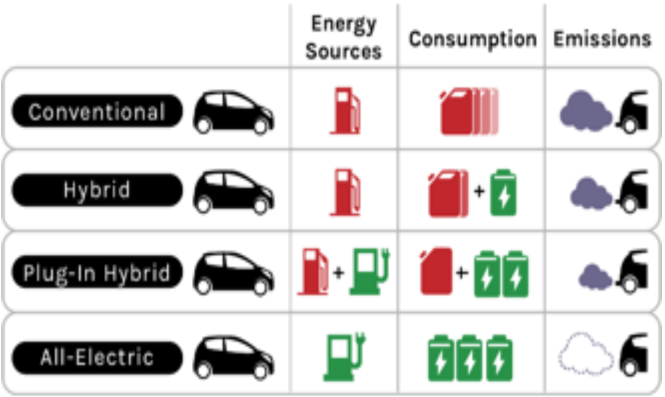



**Figure 3 Different types of consumption and electric vehicles**

Source: Adapted from Adnan et al (2017)

The following provides a brief description of each of the vehicle categories listed in Figure 3.

- *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.
- *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.

## 2.2 Why is it important to reduce transport emissions?

Transport is the fastest rising source of emissions in Australia. Unlike other sectors, which have been reducing their carbon intensity, transport emissions have proved more difficult to combat.

There are four key methods through which transport emissions can be lowered, as identified in Figure 4. Conversion to EVs is one key method for reducing emissions, but other pathways are also available. Figure 4 serves to contextualise the role EVs play in reducing transport emissions, within the broader scope of actions.

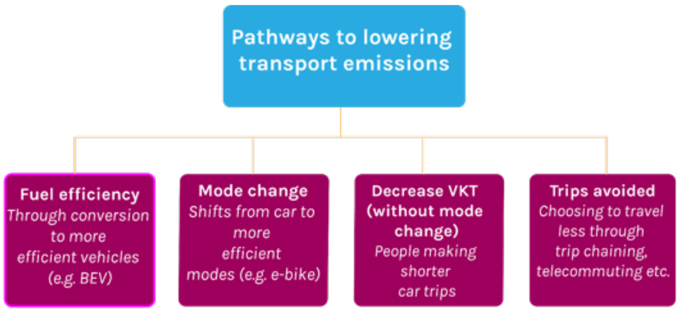



**Figure 4 Pathways for lowering emissions**

NB: VKT stands for Vehicle Kilometres Travelled

Source: Institute for Sensible Transport

Figure 5 provides a representation of the *emissions intensity* and *space consumption* of different modes of transport, drawn from Victorian data. One implication from this work is the importance of a clean, renewable electricity supply to maximise the benefits of EVs. In addition, it also shows how mode shift to e-bikes 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. Many EV charging network providers have committed to a 100% renewable supply of electricity.

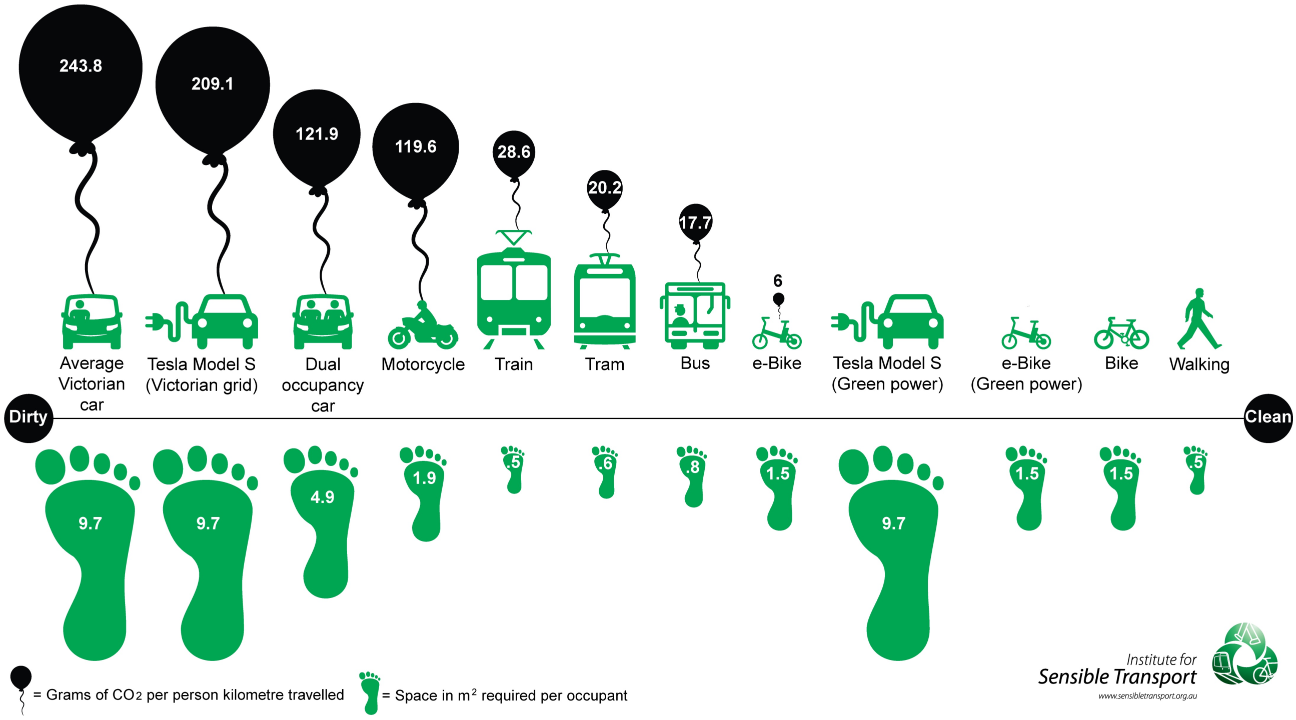



**Figure 5 Emissions intensity and space consumption of different transport modes**

## 2.3 Electric vehicles in Australia

While Australia has among the lowest levels of EV adoption in the OECD, at around 1.5% of new vehicle sales for the first half of 2021, this has doubled from a year earlier. Figure 6 captures the latest EV sales in Australia, both in total and as a percentage of light vehicle sales.

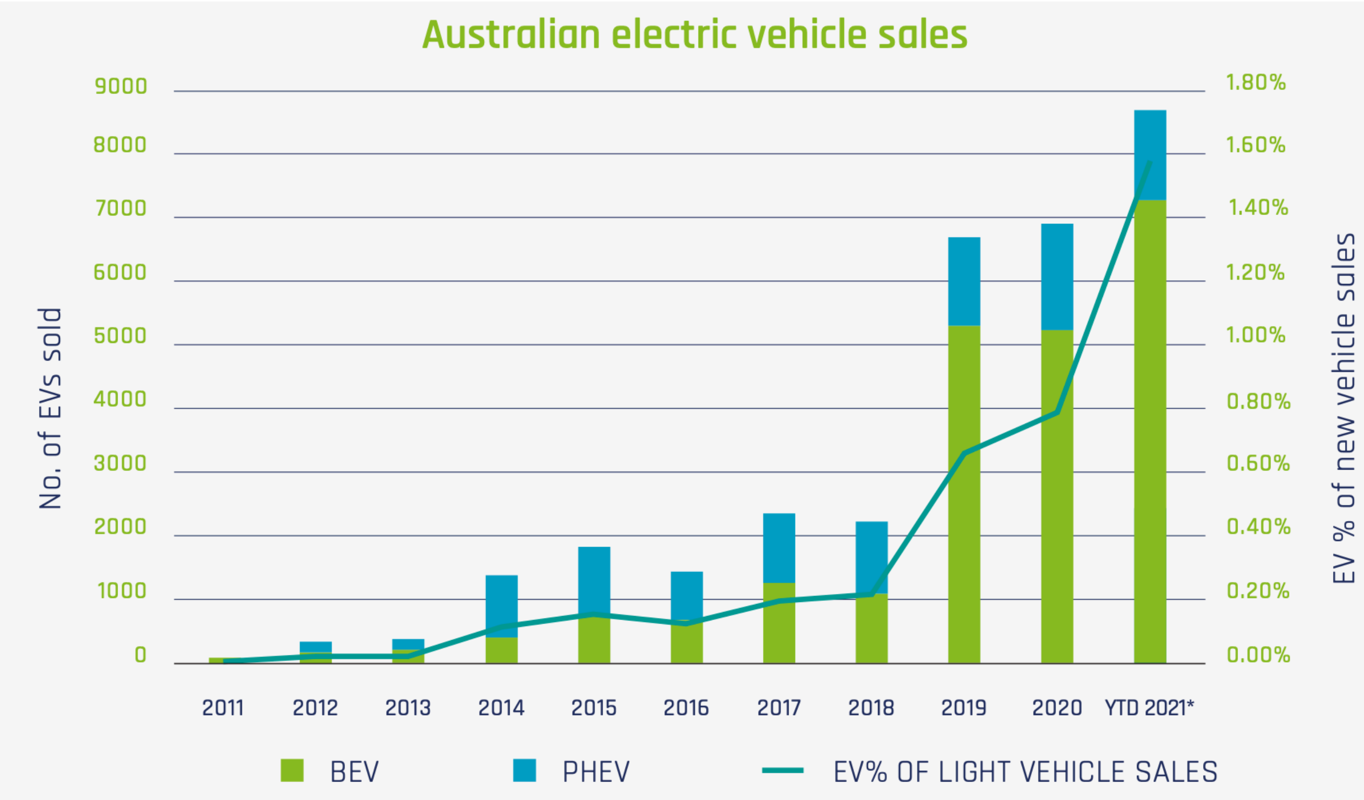



**Figure 6 EV sales in Australia**

Source: Australian Electric Vehicle Council

A number of surveys have found around 50% of consumers are considering an EV for their next vehicle purchase.[4] In March, 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 SECCCA 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.**

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

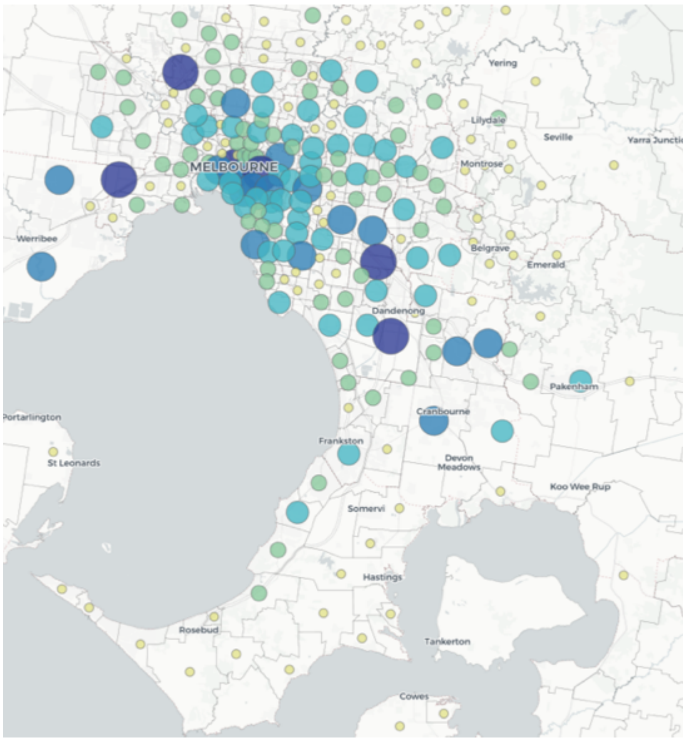



**Figure 7 EV ownership in Melbourne**

Source: Institute for Sensible Transport, using ABS data

## 2.4 Electric vehicle benefits

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
- Offer longer battery range, and
- Are available in a wider variety of vehicle types.

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.

Electric vehicles are important because they:

- Improve local air quality
- Eliminate tailpipe GHG emissions
- Reduce noise pollution
- Reduce vehicle running costs.

## 2.5 Assessment of EV adoption factors

Figure 8 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 8 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 Internal Combustion Engine 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.

**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[5]):

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 1 EV adoption factors**

## 2.6 Victorian policy context

The Victorian government's policies on EVs have evolved rapidly in 2021. 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 46 DC Fast Charging sites in Victoria and 316 standard chargers available for public use. There are around eight EVs for every public charger in Victoria.

More information on Victorian government EV policy can be found in the *Discussion Paper Report.*

[5] Australian Electric Vehicle Association Inc.

## 2.7 Key trends

Several trends are identified that are important to consider in the development of the SECCCA Roadmap and associated activities, 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 have been considered in the development of the Roadmap and a more detailed discussion of future trends is contained in the *Future Scan Report.*

## 2.8 EV Chargers

The project commissioned by SECCCA is focused on planning the rollout of an EV charging network across the region. 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 may require on-street overnight chargers, whereas this is unlikely to be helpful in areas where off-street parking is the norm.

**Table 1 EV Charging types[6]**

| | 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 | Regional near highways, motorways and key routes |
| **Level 4 - super-fast charge (public)** | 120kW | 400 - 500km range / hour | 20 - 40 mins | Regional near highways, motorways and key routes |
| **Ultra fast charge (public)** | 350kW | 1,000+ km range / hour | 10 - 15 mins | 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.**

### 2.8.1 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.

**Table 2 EV chargers - CapEx costs (approx.)**

| Charger type | $A 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. Figure 9 identifies the proposed locations for Melbourne, including more than a dozen dual port chargers within the SECCCA region. Each of these charging stations will provide a minimum of 50kW per port. Our team have taken into account these and other commitments when designing the Roadmap. Indeed these indicative locations proposed by ARENA have been integrated into the maps shown in Figure 19.

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

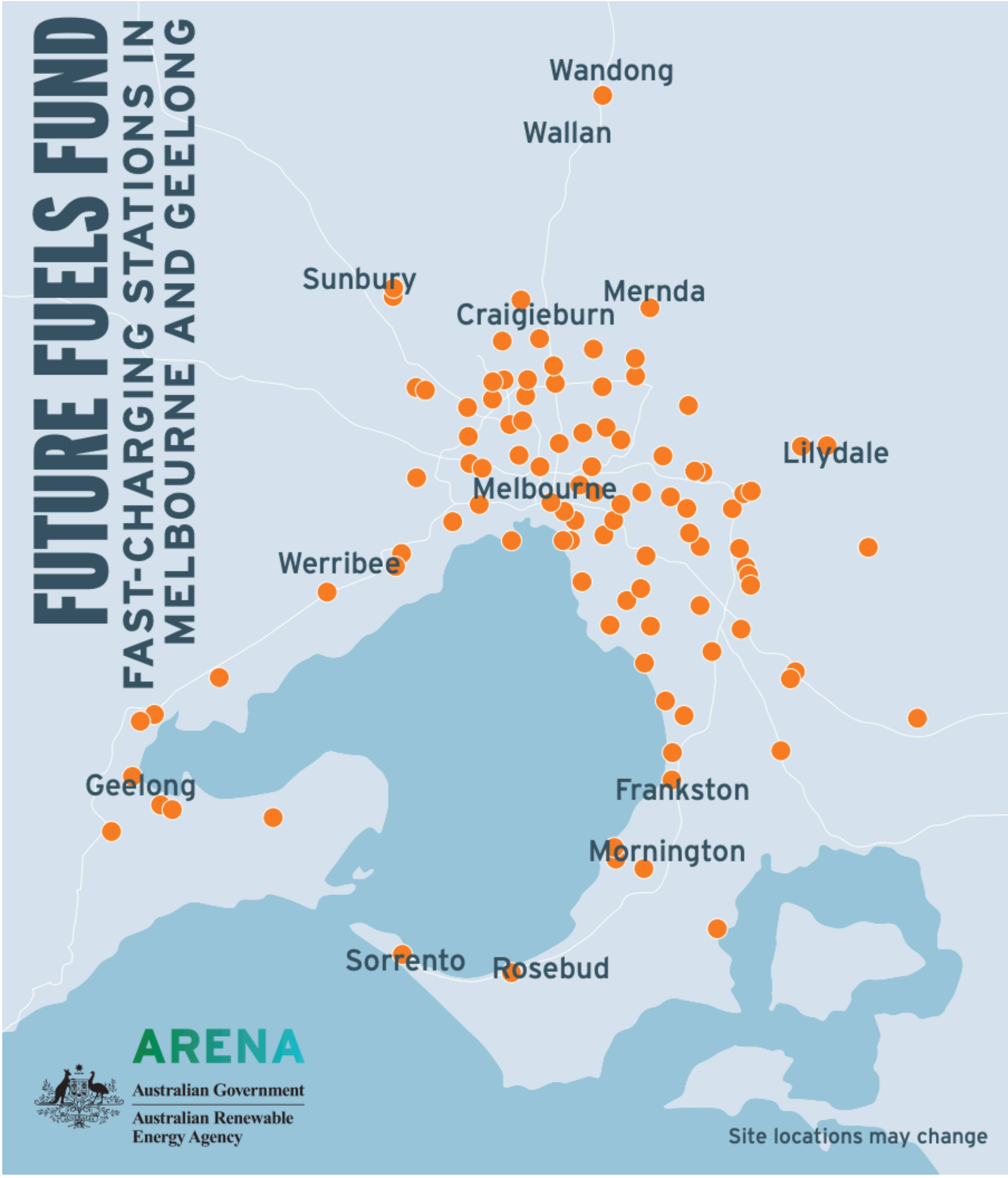



**Figure 9 Future fast charger locations (proposed)**

Source: https://arena.gov.au/

## 2.9 Differentiating the charging market

It can be helpful to categorise how EV users differ in terms of their charging needs. Figure 10 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.

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.

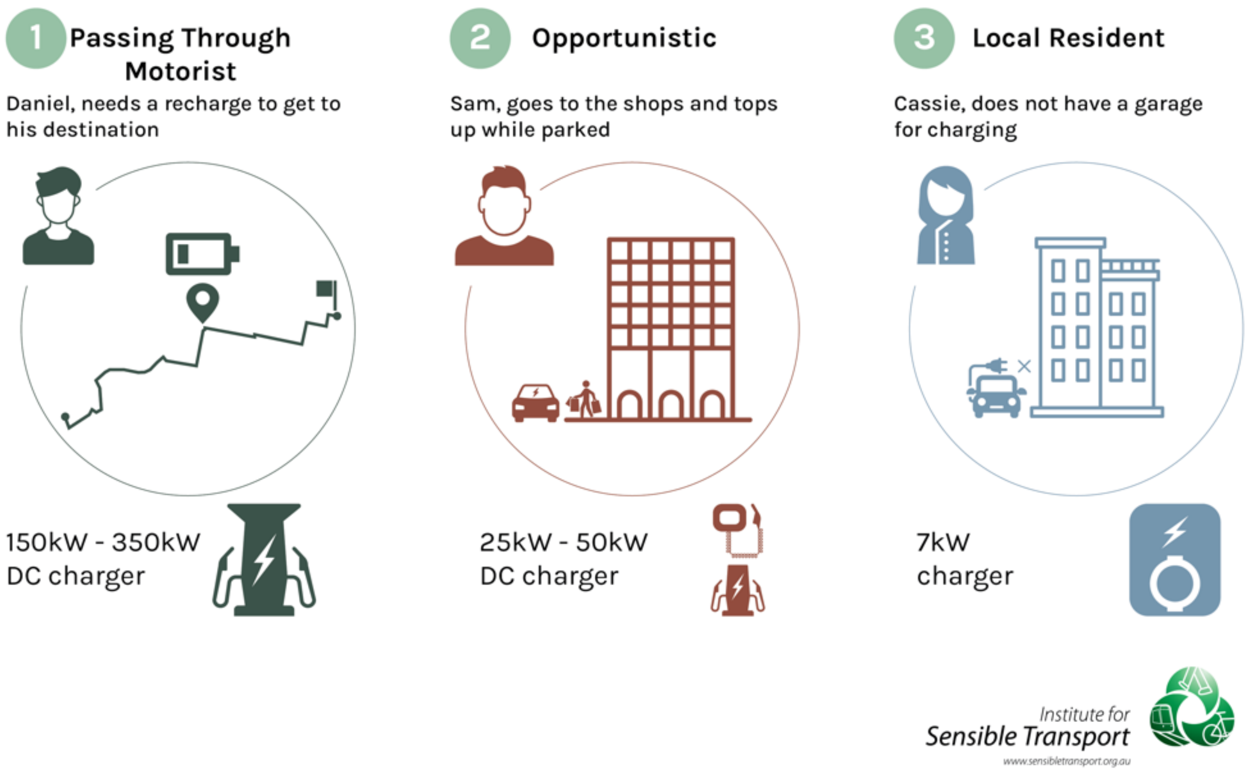



Figure 10 Three types of chargers

Figure 11 matches different charging locations with typical duration of visit for these locations. For instance, a residential street with many dwellings that lack off street parking may be a suitable site for an on-street charger, but because the user generally stays overnight, there is no need to offer anything other than a charger that takes 8 – 10 hours to fully charge an EV.

| Charging Locations | Average Visit Duration | Suitable Charger |
|---|---|---|
| Residential Street | 8+ hrs | 7kW AC |
| Parks & Reserves | 30mins - 2 hrs | 25kW DC<br>50kW DC |
| Cafe<br>Town Centre<br>Shopping Centre | 30 mins - 1hr | 7 kW AC<br>25 - 50kW DC<br>50kW DC |
| Business Parks | 1 - 4 hrs | 25kW DC |
| Petrol Stations<br>Fast Food Outlet | 8 - 15 mins | 150kW - 350kW DC |

**Figure 11 Matching locations with typical duration of visit with suitable charger speeds**

## 2.10 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 10.

### 2.10.1 Passing through motorist

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 have a preference for 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.

### 2.10.2 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.

### 2.10.3 Residential

The following characteristics are important to consider for the selection of publicly available chargers focused on residents.

- A location in which there is a cluster of housing types that make off sheet charging difficult (e.g. large number of houses without off street parking, or multi dwelling units in which available parking does not lend itself to the installation of chargers. Older, pre-WWII suburbs can have a housing mix that typically does not include off street parking

- A location close to where these residents would typically park overnight

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.

The next section provides some high-level information on the EV charging market.

# 3. Understanding electric vehicle ownership

**An understanding of the current and future number of EVs expected to be on the road is necessary to inform the development of the EV Charging Roadmap. 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 figures are shown in Figure 12. It should be noted that the 2021 figures are an estimate, based on figures from the early part of 2021. 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.

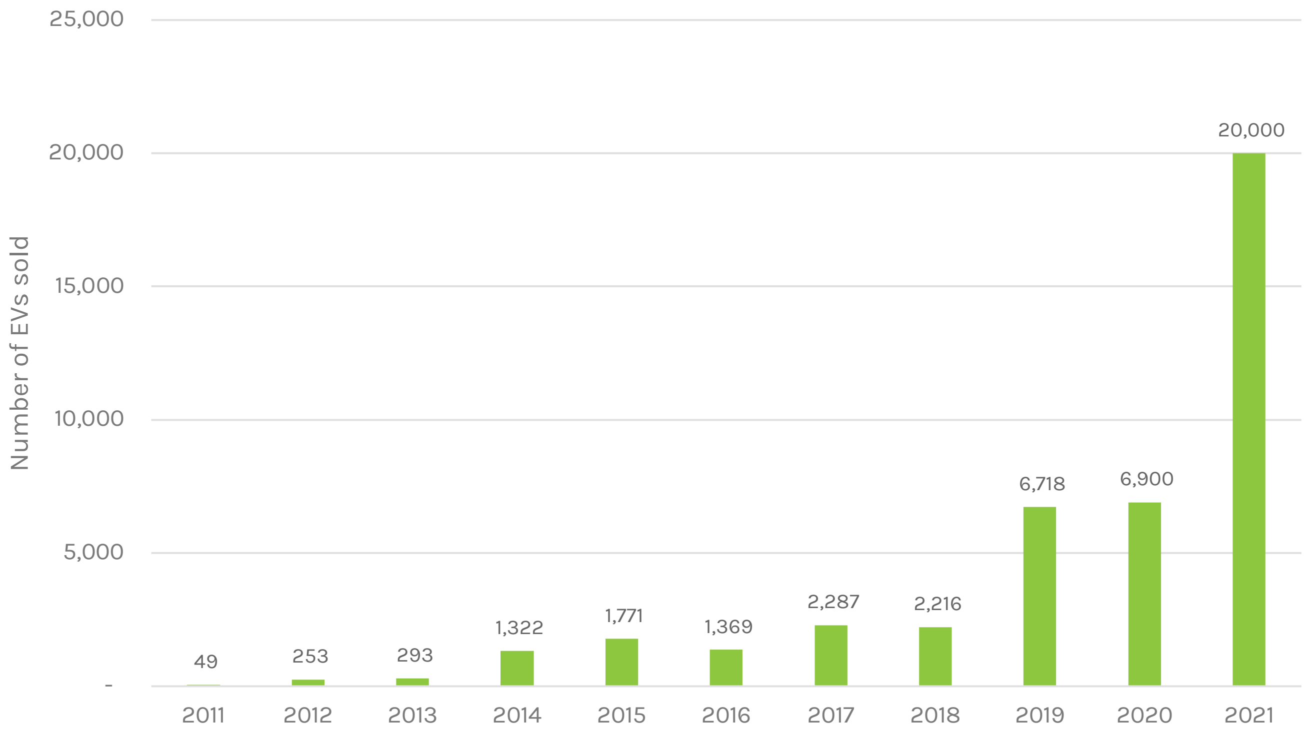



**Figure 12 Battery electric vehicles sold**

Source: *Renew*, taken from a combination of VFACTS data and estimates of Tesla sales.

## 3.1 Future EV uptake in Australia

The Australian Energy Market Operator (AEMO) commissioned the CSIRO in 2021 to forecast EV adoption rates in Australia.[7] Five scenarios were modelled:

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

Figure 13 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 14 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 15. 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.

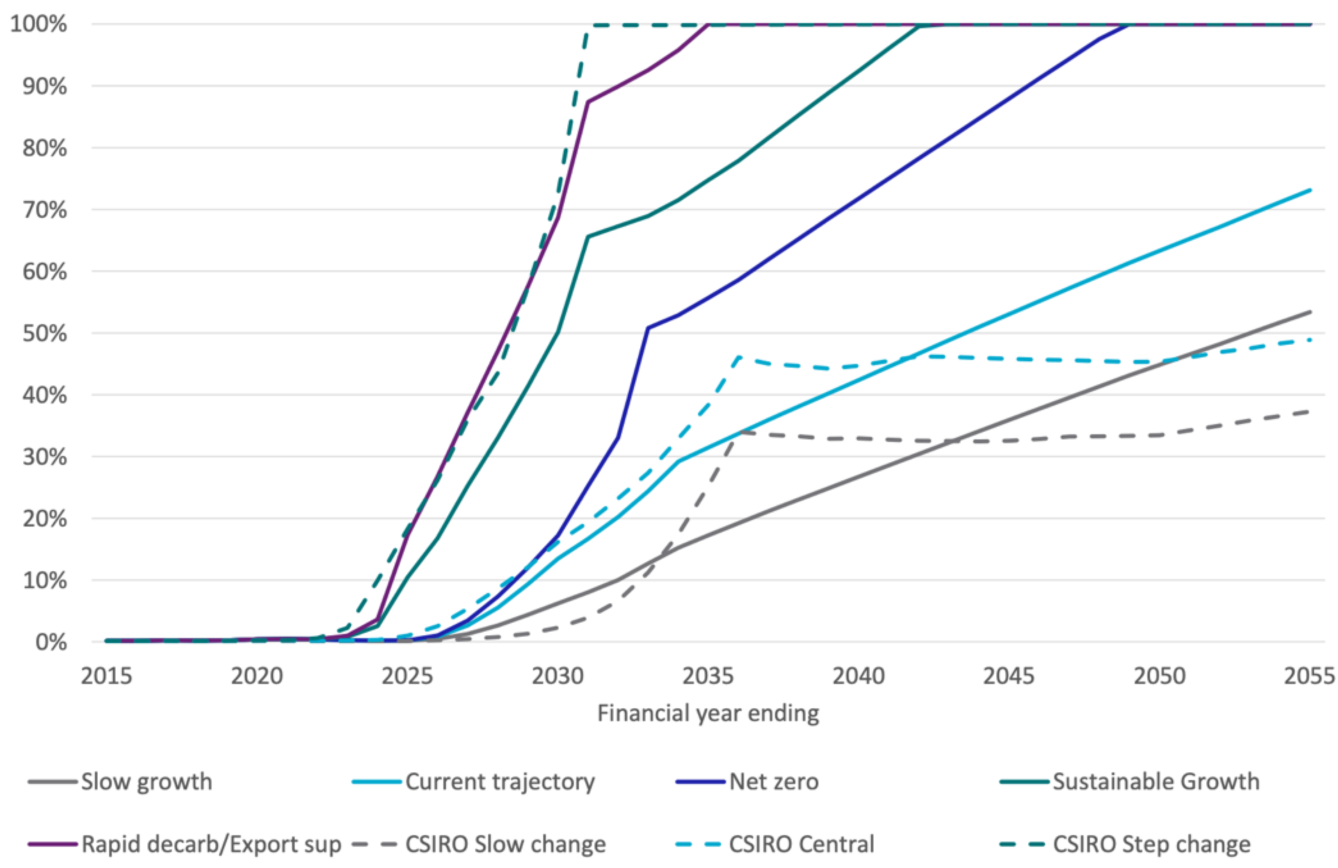



**Figure 13 Projected sales share, all EVs, compared to selected 2020 projections**

Source: CSIRO

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

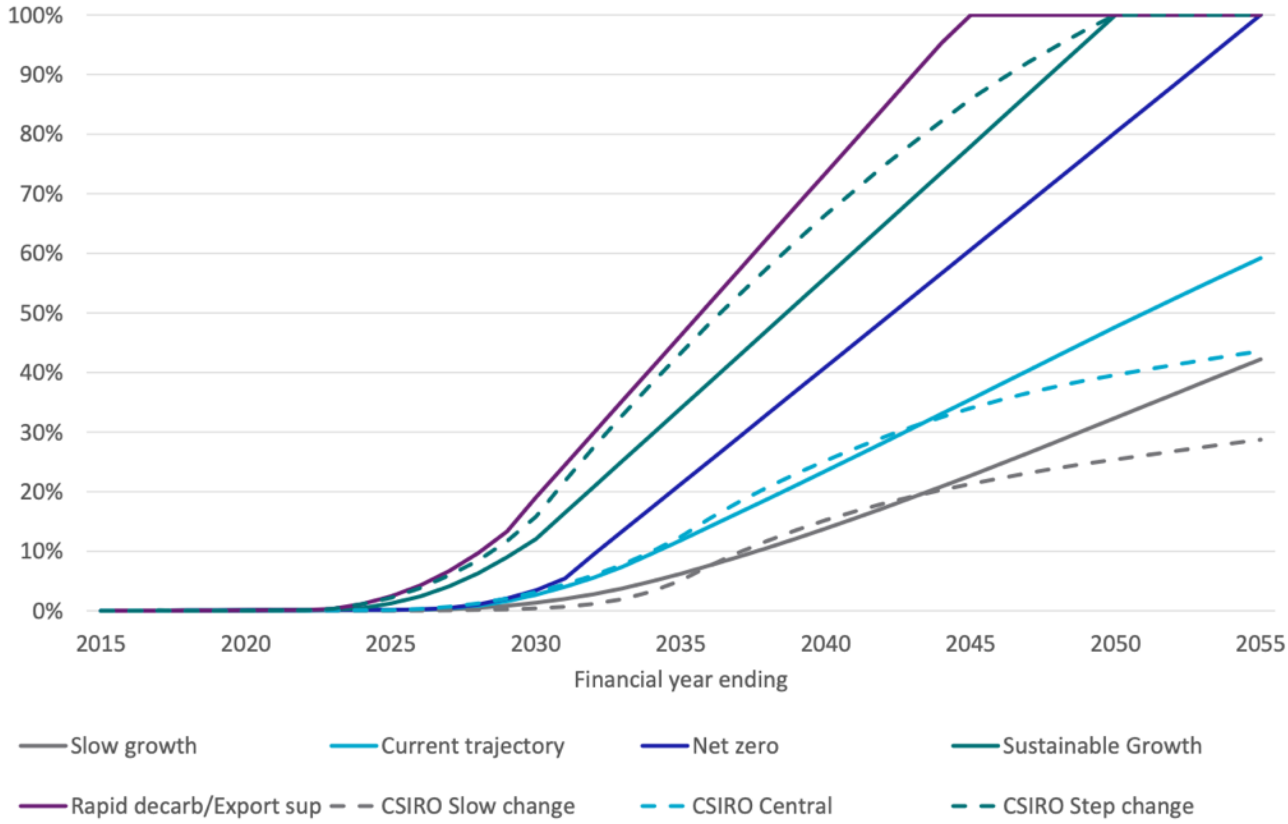



**Figure 14 Projected fleet share, all EVs, compared to selected 2020 projections**

Source: CSIRO

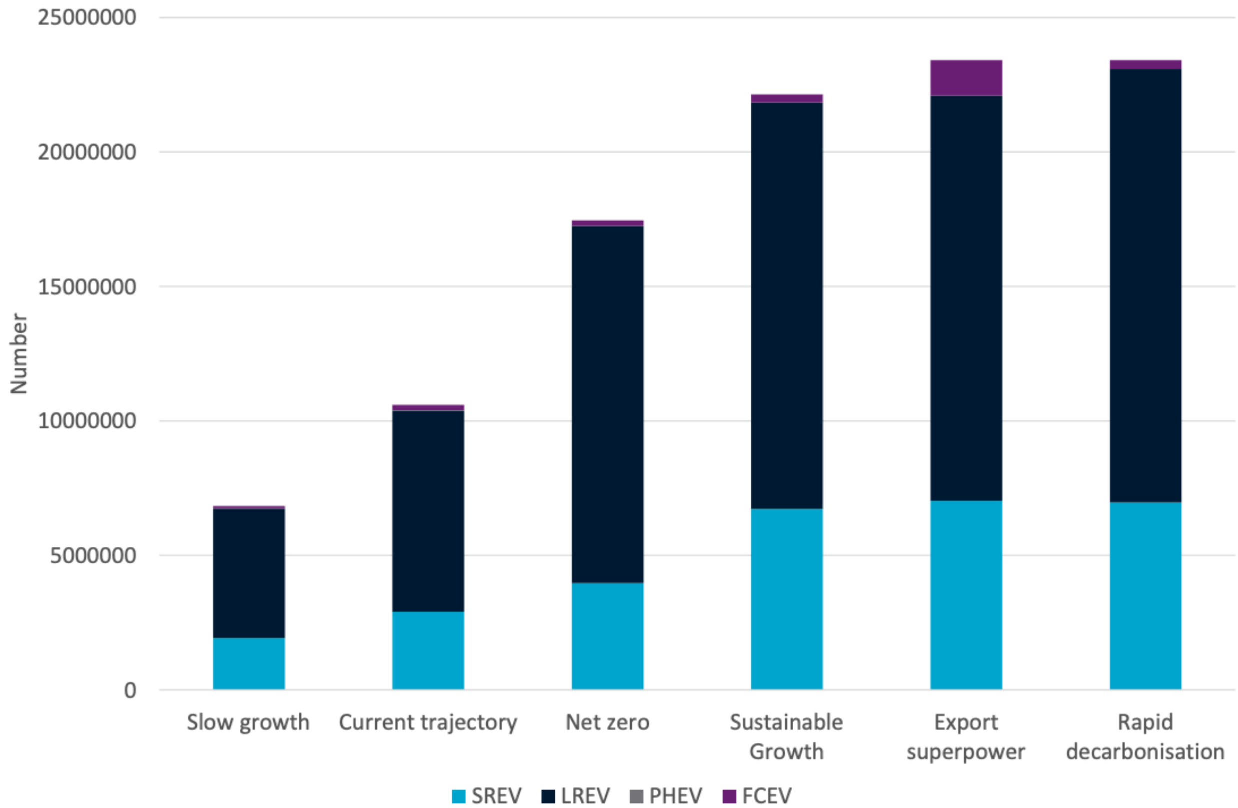



**Figure 15 Projected number of EVs, of all types by 2050**

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

## 3.2 Estimated time of day charging patterns

The average daily charging profiles for light passenger EVs is shown in Figure 16. The day and night profiles are dependent on pricing signals to limit their charging to off-peak times. The *convenience* charging is most pertinent for the SECCCA Roadmap, as these form the basis for most of the public chargers recommended (called *'opportunistic'* chargers in the SECCCA Roadmap).

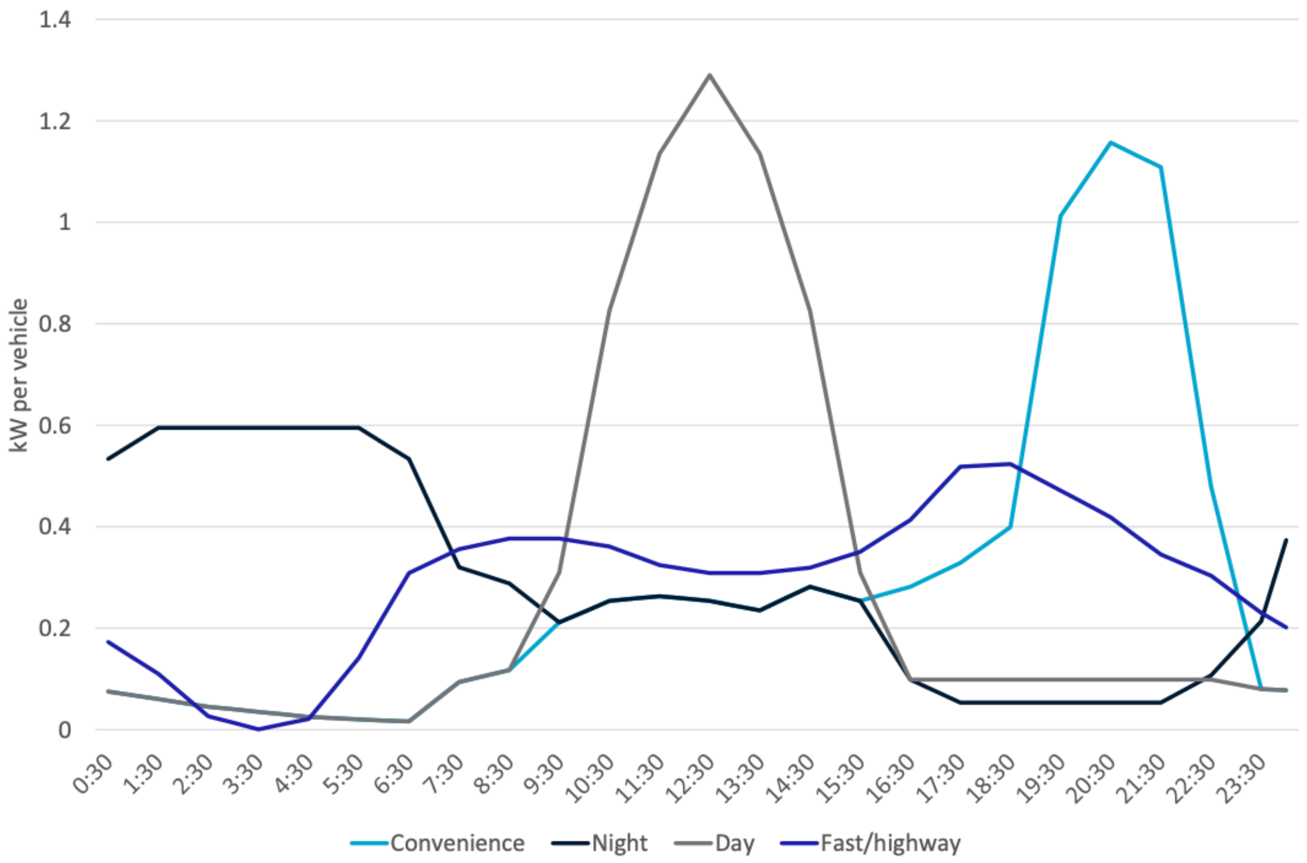



**Figure 16 Average daily charging profiles for light passenger EVs**

Source: CSIRO

## 3.3 Current EV ownership in SECCCA

According to the Australian Bureau of Statistics Motor Vehicle 2021 Census, there were approximately 582 EVs in postcodes that make up the SECCCA study area. Figure 17 indicates the number of EVs registered to each of the LGAs participating in this project.

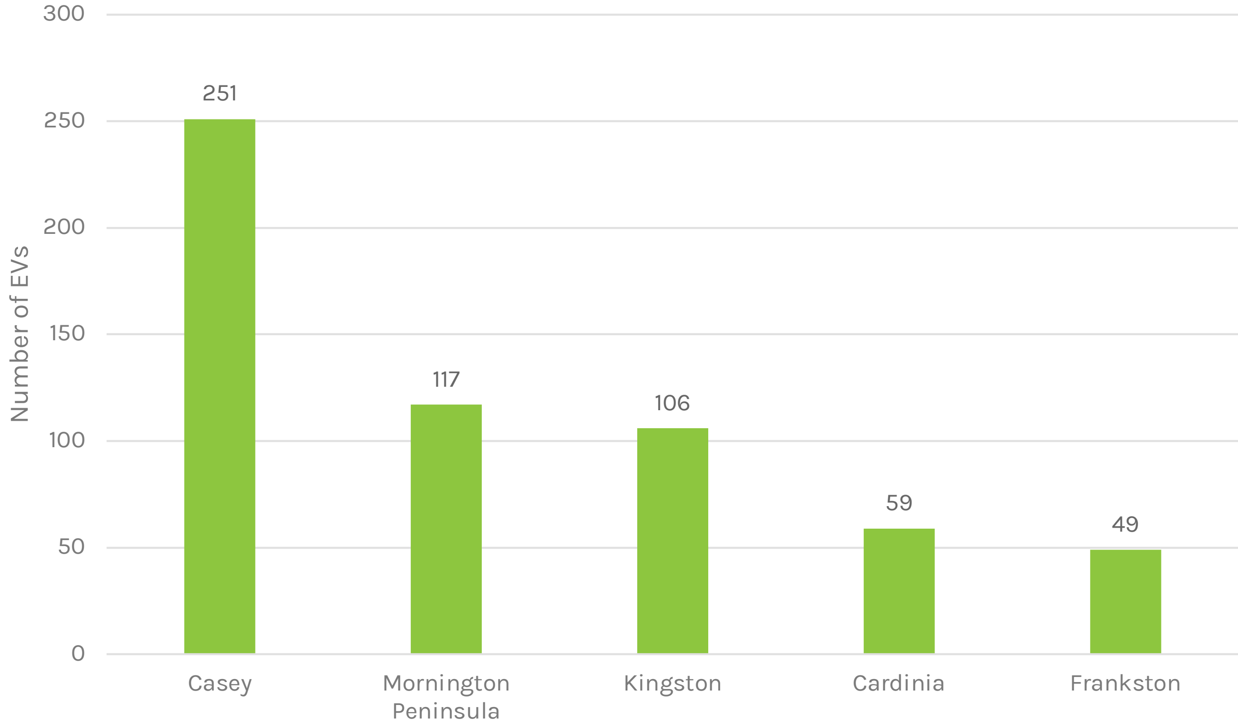



**Figure 17 EVs registered to addresses within the SECCCA study area, 2021**

Source: Australian Bureau of Statistics

An interactive map of EV ownership, in SECCCA, and other parts of Australia can be found in Figure 7.

## 3.4 Estimating future EV uptake in SECCCA

The data shown earlier in this section makes it clear that there will be significantly more EVs in the SECCCA region by 2030. It can be expected that between 5% - 20% of all passenger cars owned by SECCCA residents will be EVs. There is considerable uncertainty on these figures, which is why the range is so large. As highlighted earlier, the automotive sector is undergoing a rapid transformation and many of the largest car manufactures have a stated goal of ceasing internal combustion engine vehicles by 2025+ – 2035. Thus, it is plausible that by 2030, EVs may constitute 50% or more of total vehicle sales and this is the Victorian government target. As has been the case in Norway, strong EV sales do take many years to have a major impact on *total fleet composition*, and thus even achieving 50% of new vehicle sales as EV by 2030 may mean only 5% - 10% of the entire fleet is EV.

**there will be significantly more EVs in the SECCCA region by 2030.**

Given the vast majority of dwellings within SECCCA have off street parking as part of a detached or semi detached dwelling, it can be expected that more than 90% of all charging for EVs owned by SECCCA residents will take place at home or work. This minimises the role of local government in providing charging infrastructure, compared to an urban form in which most overnight parking occurs on public land.

**it can be expected that more than 90% of all charging for EVs owned by SECCCA residents will take place at home or work**

Estimates of EV fleets per LGA have been made, as shown in Figure 18. There are a variety of assumptions which underpin these estimates. Firstly, it is assumed that there will be a growth in dwellings in the LGAs, in line with projections by *id. consulting*. Secondly, it is assumed that current vehicle ownership rates per dwelling will remain stable. Lastly, it is assumed that 8.5% of the fleet will be EV by 2030, based on the AEMO *Net Zero 2050* and *Steady Progress* scenario projection[8], with a curved growth rate applying, scaling from less than 1% to 8.5% in a non-linear way (i.e., powered or exponential).

As shown in Figure 18, it is estimated that there will be 20,990 EVs in the LGAs by 2025, rising to 75,888 EVs in 2030. The results shown in Figure 18 will be used in subsequent components of this project, particularly the estimated demand for the EV chargers recommended in the Roadmap, and their impact on transport emissions.

[8] https://aemo.com.au/-/media/files/major-publications/isp/2021/2021-inputs-assumptions-and-scenarios-report.pdf?la=en

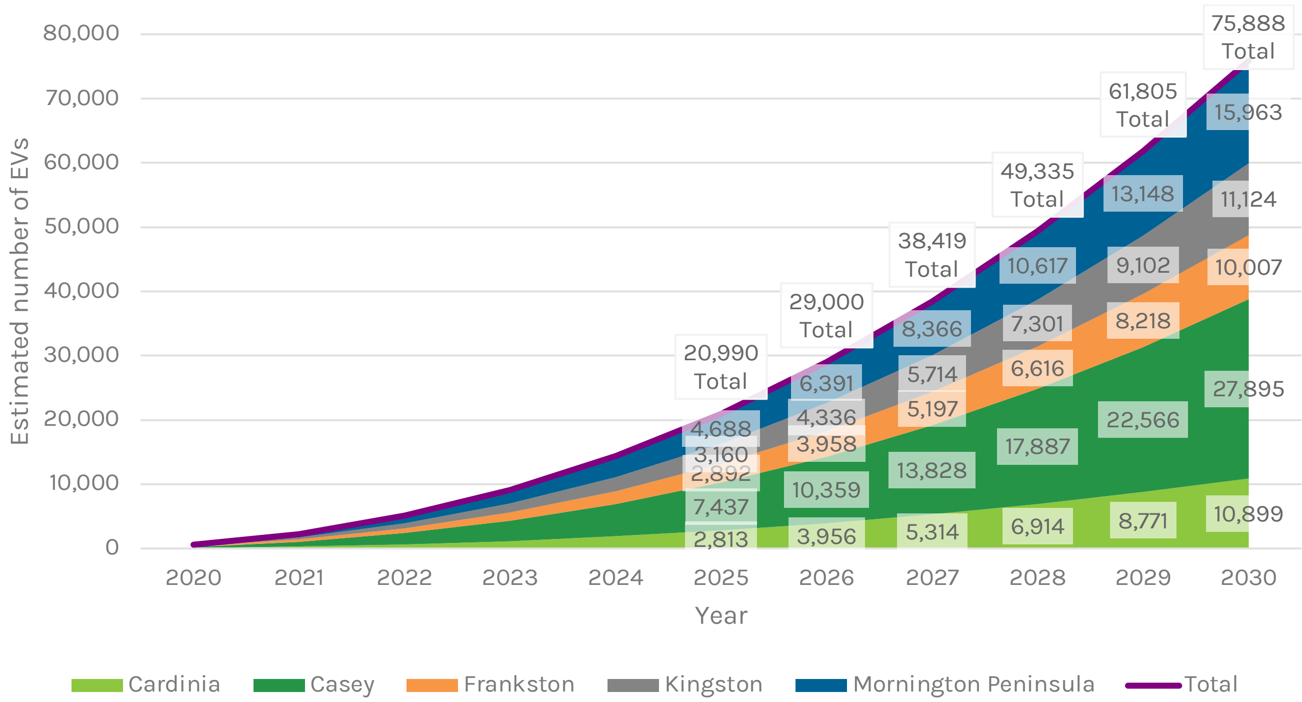



**Figure 18 Estimated EVs per LGA by 2030**

# 4. Existing and planned charging sites

**This section identifies the publicly available charging that currently exists, as well as those sites that have had Victorian or Commonwealth funding committed.**

**Many of the maps included in this section also include daily average road traffic volumes. As highlighted earlier, locating chargers on higher volume roads increases the likelihood of use and is a well-accepted industry metric used in site selection.**

## 4.1 Existing and planned (funded) EV charging locations

Figure 19 provides a map of existing publicly available chargers with at least a 3.5kW charge. This map has been created using data from plugshare.com, which is the most widely used platform for EV users to find charging sites. What this shows is that the north western parts of the study area have a reasonably good coverage of fast chargers, while the southern and eastern areas current have some significant gaps in coverage.

Figure 19 also includes the proposed fast charges funded through the ARENA first round *Future Fuels Fund*. It is clear from Figure 19 that some of the ARENA funded proposed sites overlap one another, especially around Mornington, where three fast chargers are all proposed to be within 3 – 5km of each other. No chargers within this Mornington cluster appear to be located on the most heavily trafficked roads. It is important to note that exact location of the ARENA funded chargers may change.

The State government's *Charging the regions* program included $4.3 million in grant funding across regional Victoria and $650,000 in metropolitan Melbourne. Several successful grants were included within the SECCCA catchment.[9] These locations include:

- San Remo
- Cowes
- Wonthaggi
- Inverloch
- Grantville
- Portsea
- Red Hill
- Rosebud
- Mordialloc
- Moorabbin.

**Tesla Chargers and the SECCCA EV Charging Roadmap**

Tesla have a network of their own chargers. These are either '*destination chargers'* (offering AC charging), as well as *'Super Chargers'* providing between 120 – 250kW DC charging. At the time of writing, only Tesla vehicles can use these chargers. In a small selection of other countries, Tesla has begun to open its Super Charger network to other EVs. There is no indication of when all EVs will be able to use the Tesla network in Australia, and it cannot be relied upon that an open Tesla network is inevitable. This Roadmap has been developed under the assumption that:

- Tesla may not open their network for an extended period.
- The fee charged to non-Tesla users will be substantially higher than it costs Tesla owners.
- The proportion of EVs that are Tesla diminishes as new models from other companies become available.

Given the above considerations, the Tesla network has not been considered when identifying and prioritising locations for future EV charging. Ultimately, the SECCCA charging network is designed to support people regardless of their brand of EV.

**Box 2 Tesla Chargers and the implications for planning the SECCCA network**

Figure 19 also provides a 10km buffer, by network distance, to provide an indication of the concentration of chargers. It should be noted that

[9] https://www.energy.vic.gov.au/grants/destination-charging-across-victoria-grant-program

for ultra-fast chargers, it is likely the catchment is much larger than 10km.

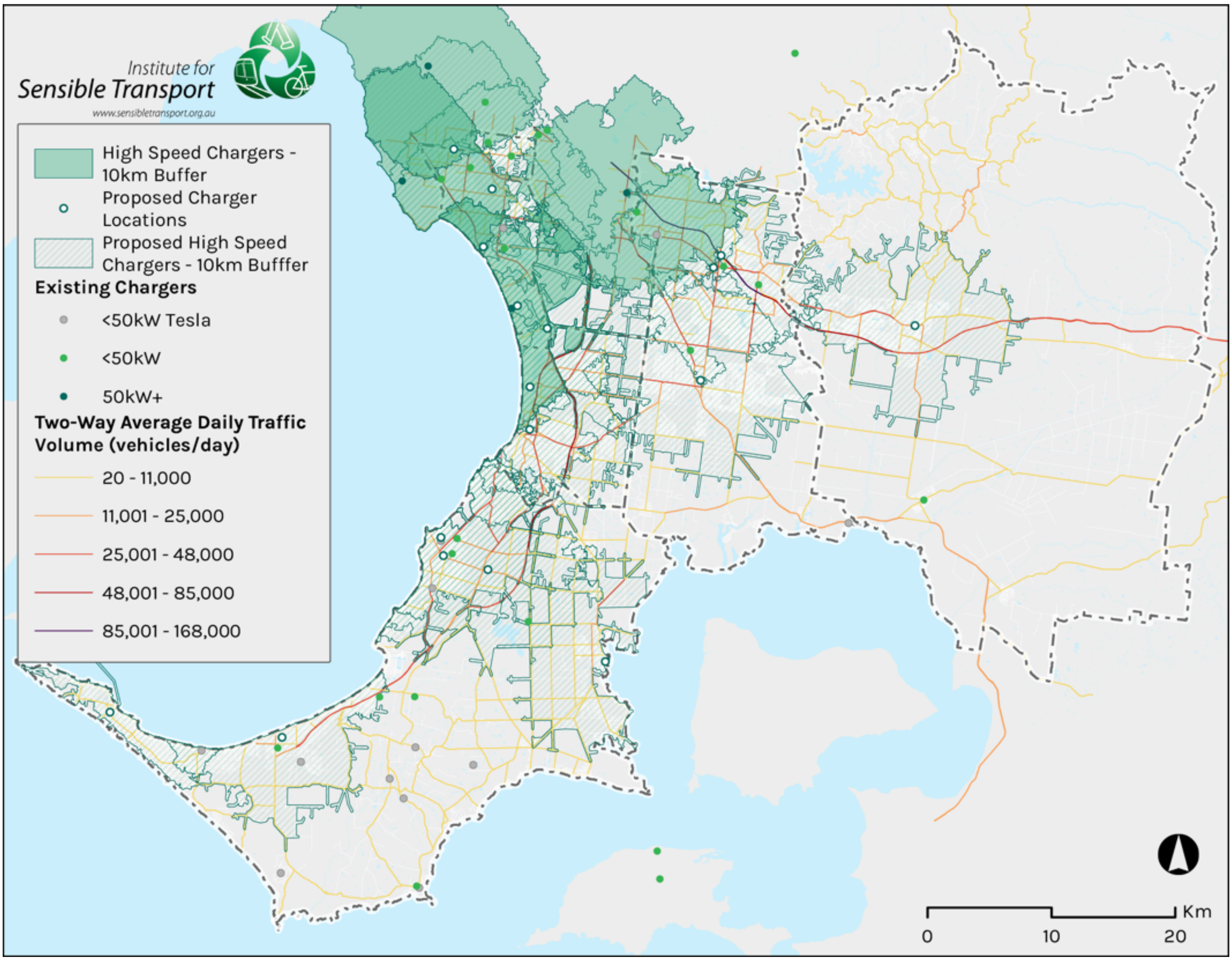



**Figure 19 Existing and proposed EV chargers 3.5kW+**

Source: Plugshare.com and ARENA

NB: The exact locations of the proposed fast chargers are not known, and should be viewed as indicative.

### 4.1.1 Slow chargers – catchment analysis

Slow chargers are likely to have a smaller catchment (i.e. the distance people are willing to drive to access a slow charger will be shorter than for faster chargers). In Figure 20, a network distance buffer of 2km has been used, and this shows there are considerable gaps in the network of slow chargers. This is not however something that should be considered a problem, or barrier to EV ownership and use, given that the vast majority, if not the entire area includes houses that have off street parking. Any home with an off street car park and an electricity supply will be able to charge an EV. It is recognised that some short term, day visitors to the SECCCA area may not have access to a house, and in these circumstances, it will be the network of fast chargers that are likely to be used, if a charging session is required. For completeness, chargers up to 50kW DC have also been included, to allow for an assessment of the slow chargers in relation to existing faster chargers.

The next section describes the chargers proposed as part of the SECCCA EV Charging Roadmap.

**Any home with an off street car park and an electricity supply will be able to charge an EV**

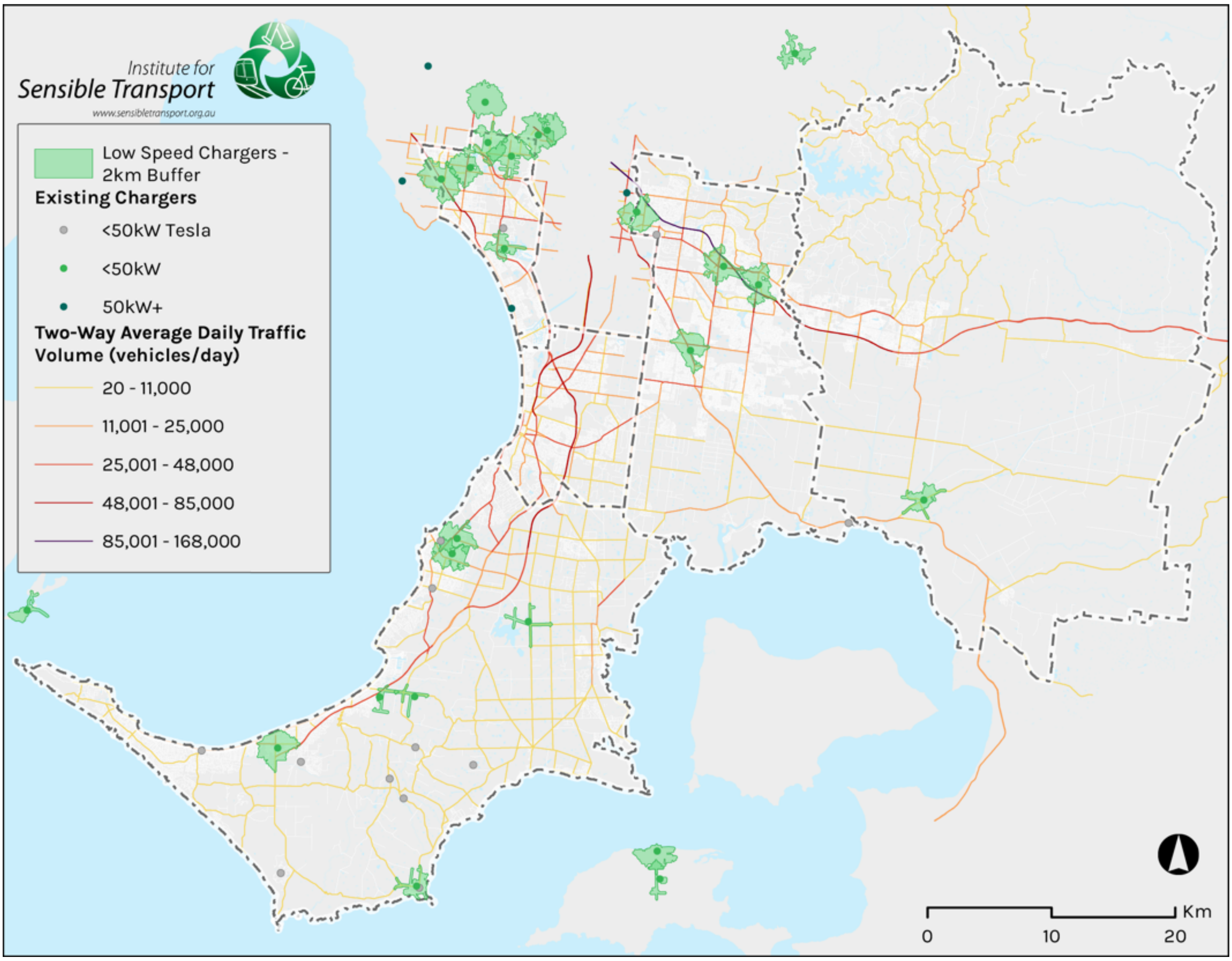
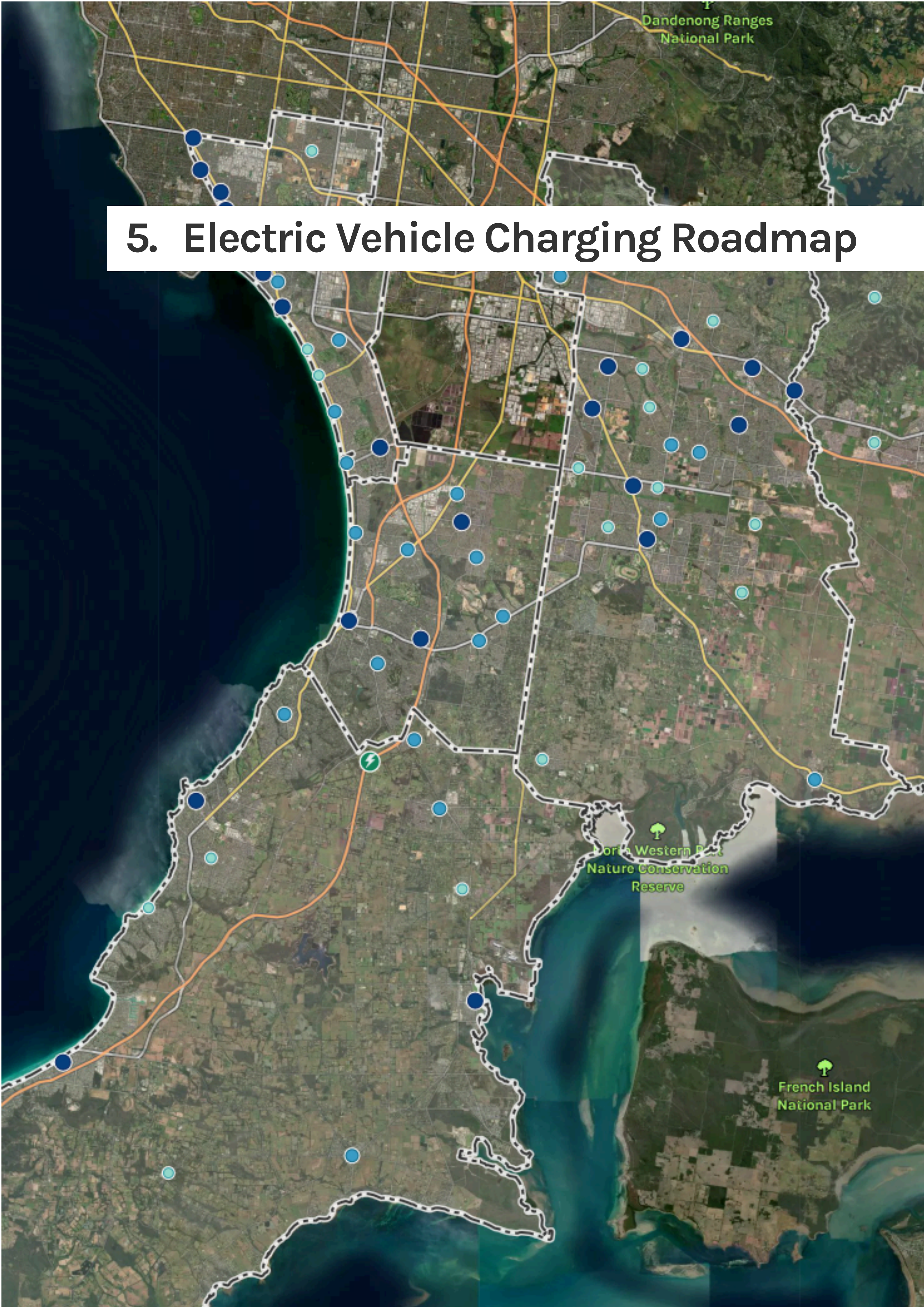



Figure 20 Existing slow charger catchments and charger locations up to 50kW

# 5. Electric Vehicle Charging Roadmap



**This section describes the locations in which EV charging is recommended as part of the SECCCA EV Charging Roadmap. Three categories of charger have been recommended based on our earlier work segmenting the public charging market into three key categories (see Figure 10). The implementation period is 2022 – 2030, and the Roadmap will need to be reviewed regularly given the fast pace at which the EV sector is developing.**

**Given SECCCA's commitment to reducing emissions associated with transport, this Roadmap provides public charging in all Activity Centres by 2030, and prioritises 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 Roadmap, as well as proposed sites, implementation year and the type of charger proposed.**

## 5.1 Methodology

A framework was developed to inform the SECCCA EV Charging Roadmap. This included the three categories of public charging, as identified below. Additionally, a description of this charging market segmentation is captured in Figure 10.

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.

### 5.1.1 Ultra-Fast Chargers

Ultra-fast chargers are expensive and therefore it is necessary to use them strategically, at places that have significant passing through traffic and limited alternatives to gain a significant charge in a short period of time, as the users' priority is to continue their journey.

The process of identifying suitable ultra-fast charging sites involved an analysis of the SECCCA area, focusing on locations scoring strongly on the criteria identified in Figure 21.

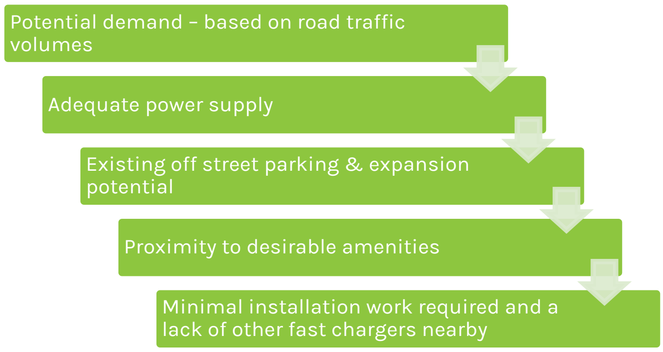



**Figure 21 Passing through motorist EV charging site criteria**

A manual scan of the SECCCA catchment was undertaken, with an overlay of road traffic volumes and existing or planned EV ultra-fast chargers. Victorian road traffic volume data[10] is collected by the state government, is relatively fine grained (compared to other transport data) and is of high quality.

The results of this exercise can be seen in Section 5.2.1.

### 5.1.2 Opportunistic Chargers

As highlighted earlier, *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 22.

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


**Figure 22 Opportunistic charger site criteria**

As highlighted in Figure 10, 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 Roadmap; however, locations of neighbourhood activity centres are not specified by Plan Melbourne. Neighbourhood activity centres were then identified using Planning Zone information and Google Maps.

Within the participating SECCCA LGAs, the Activity Centre dataset currently contains two Metropolitan, 20 Major and 55 Neighbourhood Activity Centres.

General boundaries were created for each Activity Centre, to be considered the area 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 industry workshop conducted as part of this project was that industry have a strong preference for government to identify *areas,* not exact latitude and longitudes for proposed EV charging sites. By identifying and prioritising Activity Centres for EV charging, SECCCA 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**

It should be noted that 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 in which Neighbourhood Activity Centres were considered significant enough to be included in analysis. The boundary of each activity centre was also drawn manually.

#### 5.1.2.1 Prioritising Activity Centres

The factors influencing activity centre priority have been identified as:

- 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.
- Nearby traffic volume – Higher traffic volumes near an Activity Centre is an indicator of the number of people driving to the Activity Centre.
- 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 due to the added convenience for EV users already going to the activity centre.

The variables gathered for each Activity Centre are shown in Table 3.

Table 3 Variables for each Activity Centre within SECCCA study area

| Variable | Relevant influencing factor | Value details |
|---|---|---|
| **Plan Melbourne Activity Centre Type Designation** | Regional significance of the Activity Centre | 3 – Metropolitan<br>2 – Major<br>1 – Neighbourhood<br>0 – Future Activity Centres (Clyde & Clyde North) |
| **Amount of commercially zoned area within Activity Centre** | Size of Activity Centre | Square metres of land zoned as: Activity Centre Zone (ACZ1, ACZ2, ACZ3), Mixed Use Zone (MUZ) or Commercial Zone (C1Z, C2Z) |
| **WalkScore[11] 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 proposed 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, and includes fast chargers proposed by IST |

### 5.1.2.2 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

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

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.

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.

A simple application of the prioritisation framework can be seen in the example shown in Figure 23 from the Frankston Metropolitan Activity Centre. Five possible sites have been selected, and a simple *Yes/No* score applied across each of the factors shown on the left hand column of the scorecard.


### Activity Centre Example Frankston

As a metropolitan activity centre, central Frankston provides a diverse range of activites, making it a clear candidate for opportunistic EV charging. While there is a proposed fast charger for somewhere in Frankston, the City of Frankston currently has no public EV charging.

Institute for Sensible Transport

| Five Possible Sites | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Diversity of nearby amenities | ✗ | ✓ | ✓ | ✓ | ✓ |
| People already going there | ✓ | ✓ | ✓ | ✓ | ✓ |
| Off Street Parking | ✓ | ✓ | ✓ | ✗ | ✓ |
| Near high volume road | ✗ | ✓ | ✓ | ✓ | ✓ |
| Typical Duration of stay 1/2 - 3 hrs | ✓ | ✓ | ✗ | ✓ | ✓ |

**Figure 23 Applying the framework, simplified example**

#### 5.1.2.3 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 4.

**Table 4 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:

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

### 5.1.3 Residential Chargers

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.

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 (~200m) to where users would have parked anyway and are intended to provide a charging opportunity for those that lack the ability to charge at their dwelling/off street.

The approach to selecting residential charging sites differed markedly from the passing through and opportunistic sites, as it is proposed to be *demand driven* (i.e. Councils establish an online form residents can use to request a charging site). The proposed approach is summarised in Figure 24.

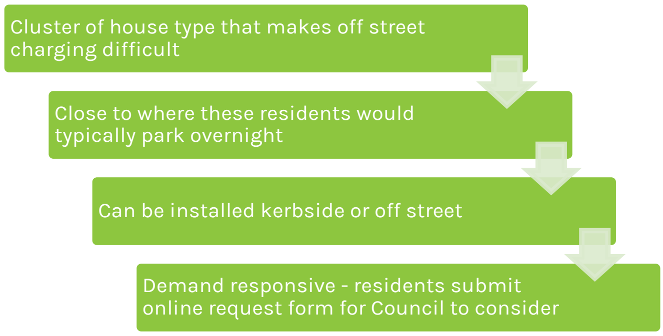



**Figure 24 Residential charging, recommended approach**

Once a request has been received, Council can determine the veracity of the request (i.e. they are a resident, and lack the potential to charge off-street). In contrast to fast chargers, residential slow chargers are not at the point of being commercial (i.e. their cost to install and operate is higher than their revenue). For this reason, slow chargers continue to be a charger type that Councils may be expected to cover the cost of install, potentially subsidised by the vehicle owners making the request. While they can be managed by a commercial, pure play EV charging network operator (for billing, maintenance, customer service), the market appetite is not sufficient to attract the commercial sector without a significant proportion of funding from government.

## 5.2 Results

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

### 5.2.1 Ultra-fast Chargers

Two ultra-fast charging sites have been identified as having strong potential to fill an existing gap and support EV ownership enabling easier long-distance driving. The two sites are at Koo Wee Rup (Cardinia) and Baxter (Mornington Peninsula), as both sites satisfy the criteria identified in Section 5.1.1. Designs that allow for towing vehicles will be important to allow a diversity of vehicle types to access at least a portion of the ultra-fast charging bays. A normal parking bay is about 6m long but a vehicle that is towing, or a large vehicle (like a truck) will not be able to easy fit in one of these bays. Thus, designing some of the bays to be drive thru (like a petrol station) will allow a diversity of vehicle types to access the EV chargers easily.

#### 5.2.1.1 Baxter

The proposed Baxter site is the twin BP Service Station on Peninsula Link, as shown in Figure 25. While it is proposed that both service stations receive two ultra-fast charging bays, the inbound station should be prioritised if only one side is implemented. Vehicles travelling back to Melbourne are more likely to require a charge, whereas much of the outbound traffic is originated from Melbourne (where EVs are more likely to begin their journey with a higher charge level).


**Figure 25 Proposed ultra-fast charging site at Baxter**

#### 5.2.1.2 Koo Wee Rup

The Koo Wee Rup Ultra Fast Charger is proposed for the Town Centre, in the Woolworths car park (see Figure 26). This site is within the Koo Wee Rup Town Centre, while still being close to high volume roads such as the South Gippsland Highway. It provides an important charging opportunity for longer distance travellers to or from Gippsland. The charging site is a short walk to many businesses, services and other amenities attractive to the passing through motorist.


Figure 26 Proposed ultra fast charging site at Koo Wee Rup

### 5.2.2 Opportunistic Chargers

This section presents the results of the prioritisation process across each of the LGAs that make up the SECCCA participating councils, across each of the variables introduced in Section 5.1.2. Figure 27 presents the overall results for opportunistic charging sites, categorised by recommended implementation phase, based on their prioritisation score. The subsequent tables identify the individual scoring across all variables for each Activity Centre, with each LGA presented on its own table. The application of the prioritisation framework can also be viewed as an online, interactive map.

The two *ultra-fast chargers,* as discussed in Section 5.2.1 are proposed for Baxter (Mornington Peninsula) and Koo Wee Rup (Cardinia). These are also indicated in Figure 27.

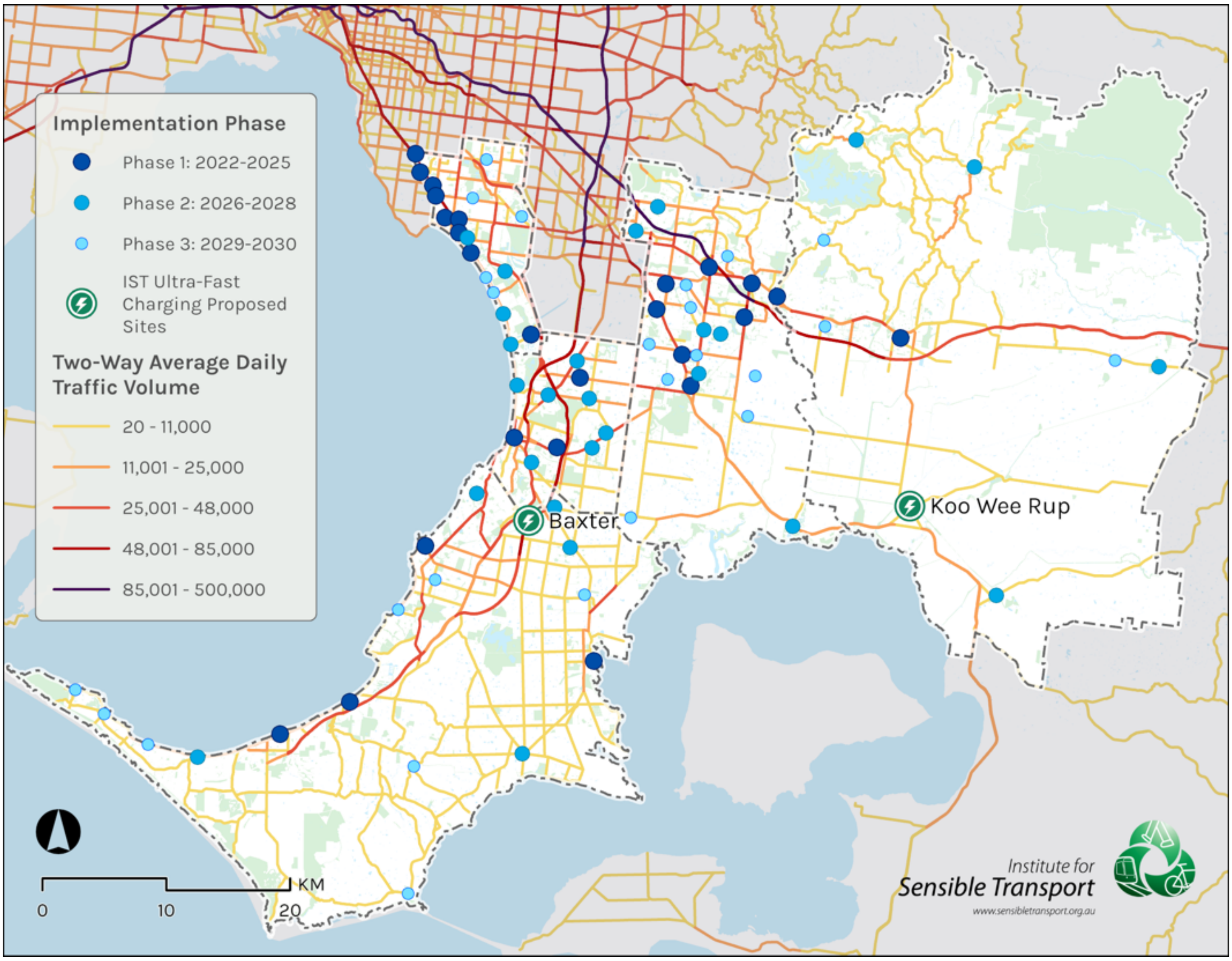



**Figure 27 Opportunistic ultra-fast charger implementation phase based on prioritisation score**

Table 5 Activity Centre Opportunistic Charger Standardised Scores, Cardinia

| Name | Type | AC Type | Commercial Zone Area | WalkScore | Traffic Volume | Charger Distance | Prioritisation Score |
|---|---|---|---|---|---|---|---|
| **Pakenham** | Major | 0.667 | 1.000 | 0.84 | 0.281 | 0.000 | 0.614 |
| **Beaconsfield** | Neighbourhood | 0.333 | 0.371 | 0.76 | 0.281 | 0.620 | 0.472 |
| **Emerald** | Neighbourhood | 0.333 | 0.390 | 0.63 | 0.133 | 1.000 | 0.455 |
| **Gembrook** | Neighbourhood | 0.333 | 0.204 | 0.39 | 0.133 | 1.000 | 0.348 |
| **Lang Lang** | Neighbourhood | 0.333 | 0.186 | 0.40 | 0.000 | 1.000 | 0.313 |
| **Bunyip** | Neighbourhood | 0.333 | 0.214 | 0.36 | 0.000 | 1.000 | 0.310 |
| **Garfield** | Neighbourhood | 0.333 | 0.184 | 0.35 | 0.000 | 1.000 | 0.300 |
| **Koo Wee Rup*** | Neighbourhood | 0.333 | 0.406 | 0.55 | 0.020 | 0.000 | 0.286 |
| **Officer** | Major | 0.667 | 0.000 | 0.06 | 0.356 | 0.651 | 0.269 |
| **Beaconsfield Upper** | Neighbourhood | 0.333 | 0.013 | 0.32 | 0.002 | 0.986 | 0.249 |

*Ultra-fast charger, as identified in Section 5.1.1

Table 6 Activity Centre Opportunistic Charger Standardised Scores, Casey

| Name | Type | AC Type | Commercial Zone Area | WalkScore | Traffic Volume | Charger Distance | Prioritisation Score |
|---|---|---|---|---|---|---|---|
| Fountain Gate-Narre Warren | Metropolitan | 1.000 | 1.000 | 0.76 | 1.000 | 0.000 | 0.815 |
| Berwick | Major | 0.667 | 0.711 | 0.83 | 1.000 | 0.371 | 0.765 |
| Cranbourne | Major | 0.667 | 1.000 | 0.73 | 0.522 | 0.000 | 0.646 |
| Cranbourne North | Neighbourhood | 0.333 | 0.935 | 0.57 | 0.596 | 0.252 | 0.599 |
| Hampton Park | Major | 0.667 | 0.560 | 0.71 | 0.522 | 0.346 | 0.575 |
| Eden Rise-Berwick | Neighbourhood | 0.333 | 0.234 | 0.63 | 0.819 | 0.473 | 0.521 |
| Lynbrook Village | Neighbourhood | 0.333 | 0.129 | 0.69 | 0.707 | 0.523 | 0.489 |
| Endeavour Hills | Major | 0.667 | 0.458 | 0.75 | 0.152 | 0.330 | 0.464 |
| Casey Central | Major | 0.667 | 0.485 | 0.44 | 0.337 | 0.457 | 0.456 |
| Cranbourne East | Neighbourhood | 0.333 | 0.315 | 0.52 | 0.300 | 0.109 | 0.339 |
| Tooradin | Neighbourhood | 0.333 | 0.159 | 0.36 | 0.152 | 1.000 | 0.334 |
| Eve Central-Cranbourne South | Neighbourhood | 0.333 | 0.003 | 0.51 | 0.337 | 0.504 | 0.317 |
| Autumn Place-Doveton | Neighbourhood | 0.333 | 0.022 | 0.75 | 0.115 | 0.307 | 0.302 |
| Cranbourne West | Neighbourhood | 0.333 | 0.024 | 0.51 | 0.374 | 0.219 | 0.296 |
| Springhill-Cranbourne | Neighbourhood | 0.333 | 0.072 | 0.30 | 0.430 | 0.262 | 0.275 |
| Lyndhurst | Neighbourhood | 0.333 | 0.000 | 0.40 | 0.244 | 0.505 | 0.266 |
| Parkhill Plaza-Berwick | Neighbourhood | 0.333 | 0.120 | 0.56 | 0.096 | 0.140 | 0.253 |
| Pearcedale | Neighbourhood | 0.333 | 0.009 | 0.38 | 0.011 | 0.873 | 0.251 |
| Amberley Park-Narre Warren South | Neighbourhood | 0.333 | 0.071 | 0.49 | 0.000 | 0.304 | 0.220 |
| Lakala Close-Hampton Park | Neighbourhood | 0.333 | 0.090 | 0.32 | 0.189 | 0.194 | 0.216 |
| Clyde North | Future Major | 0.000 | 0.000 | 0.00 | 0.133 | 0.519 | 0.098 |
| Clyde | Future Major | 0.000 | 0.000 | 0.04 | 0.000 | 0.495 | 0.072 |

Table 7 Activity Centre Opportunistic Charger Standardised Scores, Frankston

| Name | Type | AC Type | Commercial Zone Area | WalkScore | Traffic Volume | Charger Distance | Prioritisation Score |
|---|---|---|---|---|---|---|---|
| **Karingal** | Major | 0.667 | 1.000 | 0.76 | 1.000 | 0.309 | 0.812 |
| **Frankston** | Metropolitan | 1.000 | 1.000 | 0.89 | 0.615 | 0.000 | 0.751 |
| **Carrum Downs** | Neighbourhood | 0.333 | 0.746 | 0.77 | 0.263 | 0.526 | 0.552 |
| **Belvedere Park-Seaford** | Neighbourhood | 0.333 | 0.000 | 0.63 | 0.893 | 0.264 | 0.455 |
| **Langwarrin-The Gateway** | Neighbourhood | 0.333 | 0.260 | 0.65 | 0.411 | 0.656 | 0.454 |
| **Towerhill-Frankston** | Neighbourhood | 0.333 | 0.019 | 0.58 | 0.633 | 0.242 | 0.380 |
| **Langwarrin Plaza** | Neighbourhood | 0.333 | 0.071 | 0.54 | 0.337 | 0.769 | 0.375 |
| **Ballarto Rd-Carrum Downs** | Neighbourhood | 0.333 | 0.142 | 0.60 | 0.226 | 0.623 | 0.362 |
| **Local Village-Carrum Downs** | Neighbourhood | 0.333 | 0.034 | 0.50 | 0.393 | 0.431 | 0.327 |
| **Seaford** | Neighbourhood | 0.333 | 0.168 | 0.70 | 0.244 | 0.000 | 0.320 |

Table 8 Activity Centre Opportunistic Charger Standardised Scores, Kingston

| Name | Type | AC Type | Commercial Zone Area | WalkScore | Traffic Volume | Charger Distance | Prioritisation Score |
|---|---|---|---|---|---|---|---|
| **Cheltenham** | Major | 0.667 | 1.000 | 0.92 | 1.000 | 0.322 | 0.854 |
| **Mentone** | Major | 0.667 | 1.000 | 0.84 | 0.930 | 0.348 | 0.819 |
| **Cheltenham-Southland** | Major | 0.667 | 0.807 | 0.96 | 1.000 | 0.254 | 0.807 |
| **Moorabbin** | Major | 0.667 | 0.902 | 0.87 | 1.000 | 0.219 | 0.804 |
| **Highett** | Major | 0.667 | 0.081 | 0.82 | 1.000 | 0.241 | 0.589 |
| **Thrift Park-Mentone** | Neighbourhood | 0.333 | 0.109 | 0.78 | 0.930 | 0.290 | 0.533 |
| **Patterson Lakes** | Neighbourhood | 0.333 | 0.167 | 0.71 | 1.000 | 0.000 | 0.511 |
| **Mordialloc** | Major | 0.667 | 0.303 | 0.82 | 0.578 | 0.000 | 0.509 |
| **Parkdale** | Neighbourhood | 0.333 | 0.219 | 0.72 | 0.819 | 0.188 | 0.505 |
| **Parkdale Plaza** | Neighbourhood | 0.333 | 0.073 | 0.71 | 0.819 | 0.122 | 0.457 |
| **Chelsea** | Major | 0.667 | 0.332 | 0.75 | 0.263 | 0.000 | 0.420 |
| **Aspendale Gardens** | Neighbourhood | 0.333 | 0.062 | 0.47 | 0.522 | 0.320 | 0.345 |
| **Carrum** | Neighbourhood | 0.333 | 0.155 | 0.61 | 0.263 | 0.208 | 0.325 |
| **Edithvale** | Neighbourhood | 0.333 | 0.069 | 0.56 | 0.263 | 0.183 | 0.288 |
| **DFO-Moorabbin Airport** | Neighbourhood | 0.333 | 0.000 | 0.60 | 0.319 | 0.069 | 0.280 |
| **Aspendale** | Neighbourhood | 0.333 | 0.029 | 0.58 | 0.189 | 0.222 | 0.269 |
| **Dingley Village** | Neighbourhood | 0.333 | 0.080 | 0.59 | 0.059 | 0.353 | 0.268 |
| **Clarinda** | Neighbourhood | 0.333 | 0.108 | 0.47 | 0.096 | 0.307 | 0.249 |

Table 9 Activity Centre Opportunistic Charger Standardised Scores, Mornington Peninsula

| Name | Type | AC Type | Commercial Zone Area | WalkScore | Traffic Volume | Charger Distance | Prioritisation Score |
|---|---|---|---|---|---|---|---|
| **Mornington** | Major | 0.667 | 0.987 | 0.97 | 0.393 | 0.000 | 0.671 |
| **Rosebud** | Major | 0.667 | 1.000 | 0.64 | 0.226 | 0.000 | 0.550 |
| **Dromana** | Neighbourhood | 0.333 | 0.341 | 0.66 | 0.559 | 0.702 | 0.519 |
| **Hastings** | Major | 0.667 | 0.773 | 0.76 | 0.152 | 0.000 | 0.505 |
| **Somerville** | Neighbourhood | 0.333 | 0.707 | 0.71 | 0.059 | 0.394 | 0.460 |
| **Baxter*** | Neighbourhood | 0.333 | 0.032 | 0.44 | 0.985 | 0.241 | 0.436 |
| **Mount Eliza** | Neighbourhood | 0.333 | 0.205 | 0.77 | 0.337 | 0.479 | 0.430 |
| **Rye** | Neighbourhood | 0.333 | 0.320 | 0.58 | 0.244 | 0.608 | 0.404 |
| **Balnarring** | Neighbourhood | 0.333 | 0.237 | 0.50 | 0.000 | 0.996 | 0.350 |
| **Sorrento** | Neighbourhood | 0.333 | 0.370 | 0.63 | 0.000 | 0.000 | 0.292 |
| **Flinders** | Neighbourhood | 0.333 | 0.068 | 0.36 | 0.000 | 1.000 | 0.274 |
| **Red Hill** | Neighbourhood | 0.333 | 0.015 | 0.39 | 0.000 | 1.000 | 0.268 |
| **Mornington-Bentons Square** | Neighbourhood | 0.333 | 0.173 | 0.62 | 0.020 | 0.139 | 0.262 |
| **Mount Martha** | Neighbourhood | 0.333 | 0.019 | 0.50 | 0.078 | 0.494 | 0.253 |
| **Tyabb** | Neighbourhood | 0.333 | 0.026 | 0.51 | 0.041 | 0.520 | 0.251 |
| **Blairgowrie** | Neighbourhood | 0.333 | 0.000 | 0.36 | 0.115 | 0.460 | 0.218 |
| **Portsea** | Neighbourhood | 0.333 | 0.000 | 0.13 | 0.000 | 0.318 | 0.114 |

*Ultra-fast charger, as identified in Section 5.1.1

The following series of maps identifies the implementation Roadmap for each of the SECCCA participating councils. Figure 28 identifies the Roadmap for opportunistic charging across Cardinia. The ultra-fast charger proposed for Koo Wee Rup is also shown in Figure 28.

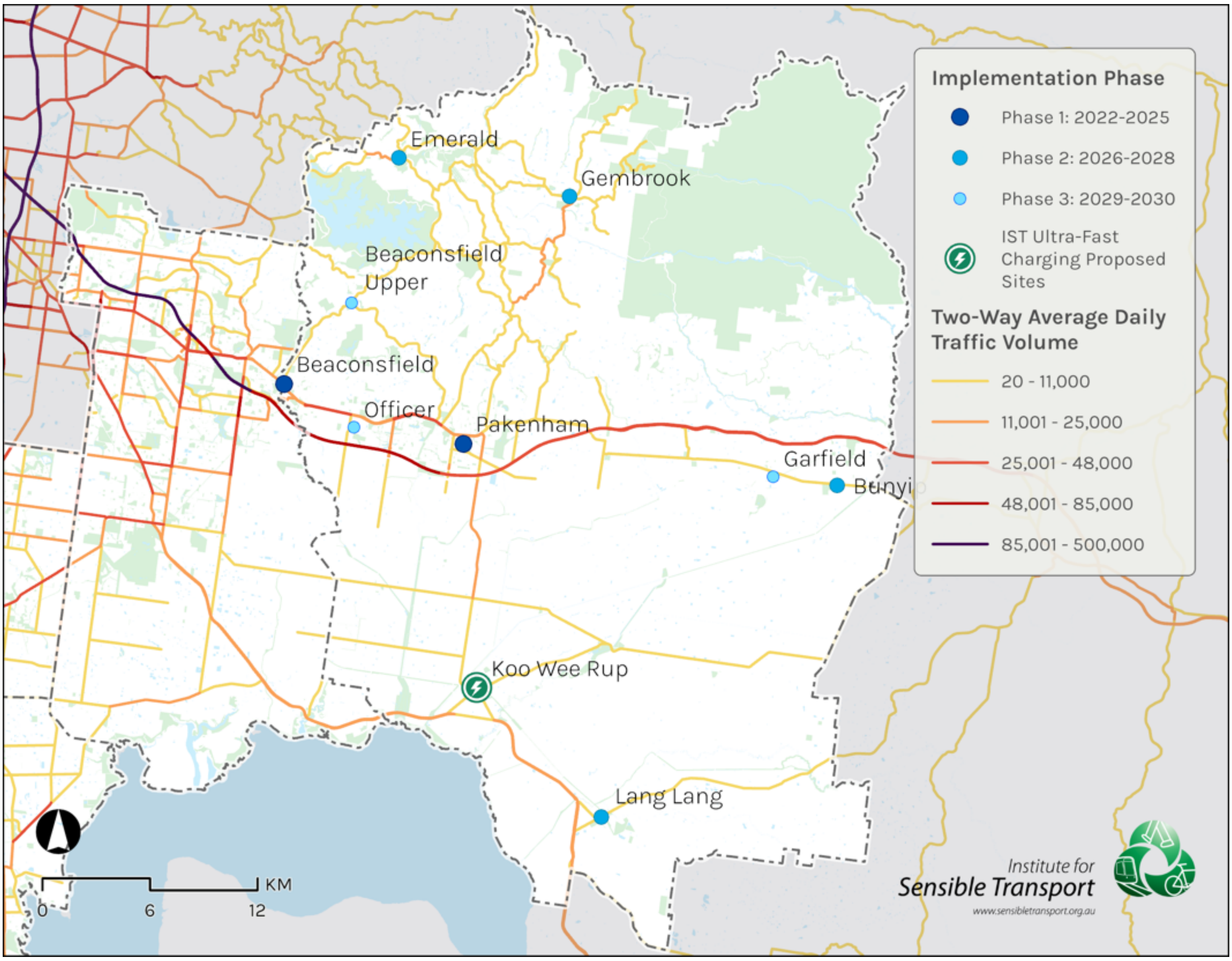



**Figure 28 Opportunistic and ultra-fast charging implementation Roadmap, Cardinia**

Figure 29 identifies the Roadmap for opportunistic charging across Casey.

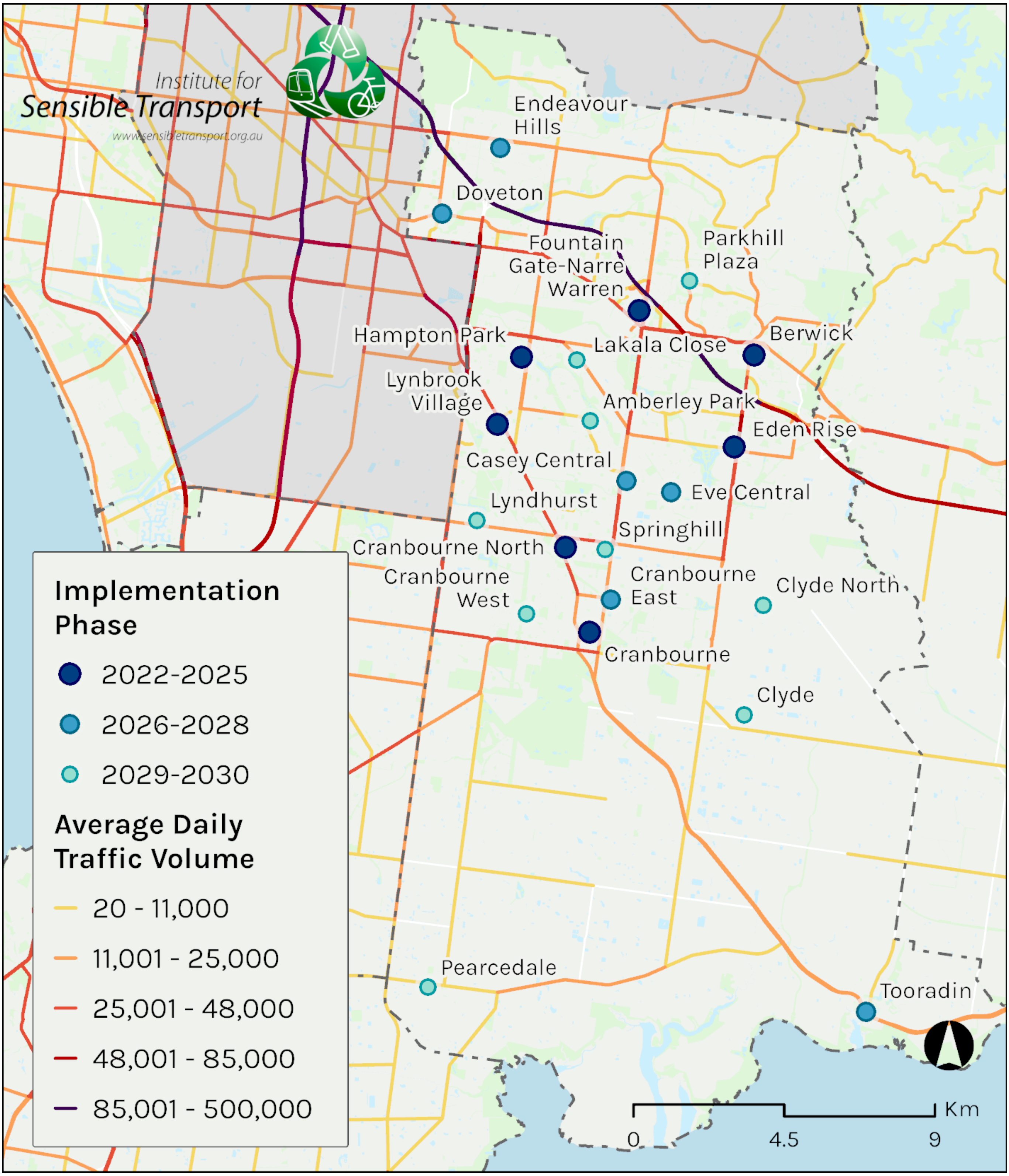



**Figure 29 Opportunistic charging implementation Roadmap, Casey**

Figure 30 identifies the Roadmap for opportunistic charging across Frankston City.

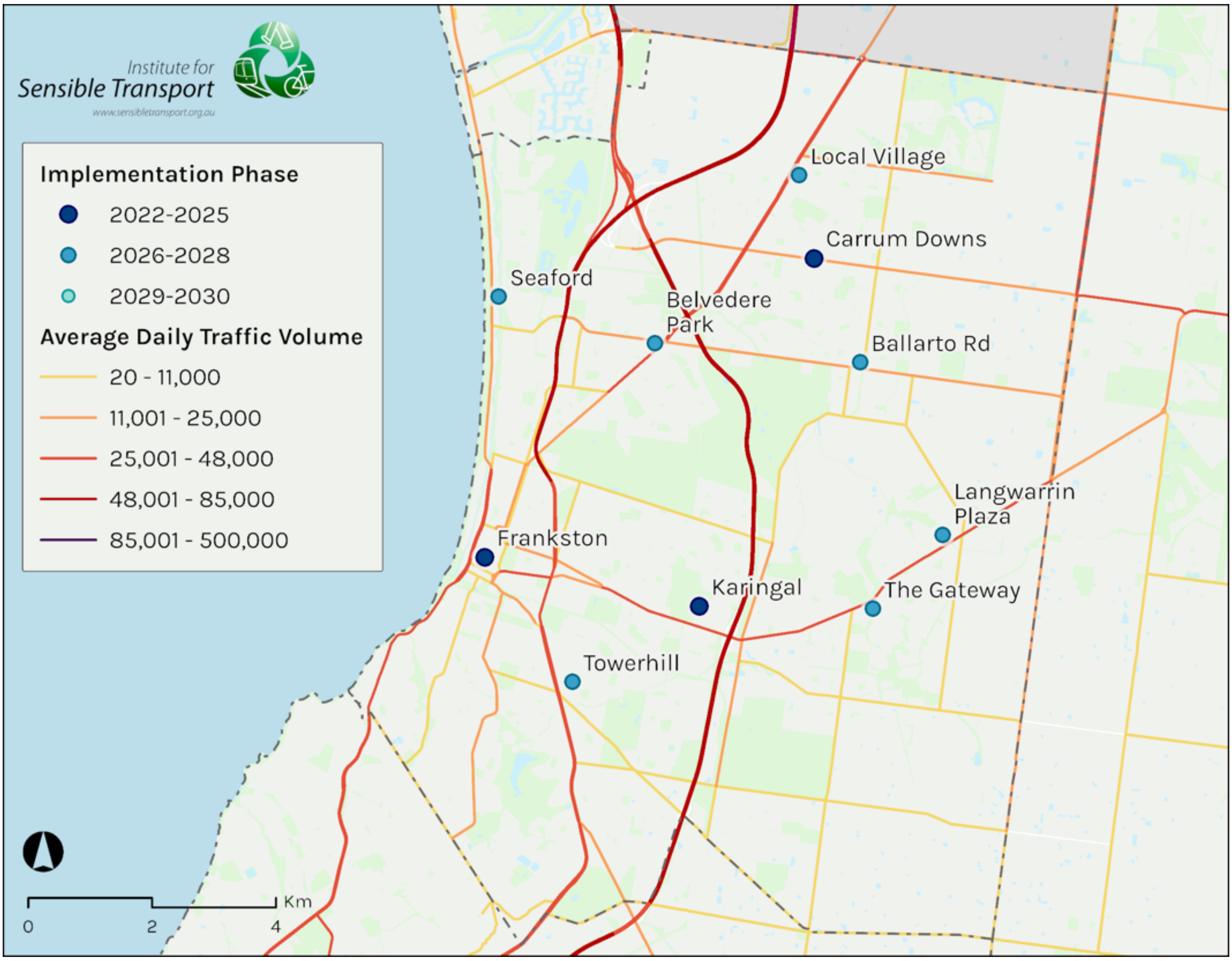



**Figure 30 Opportunistic charging implementation Roadmap, Frankston**

Figure 31 identifies the Roadmap for opportunistic charging across Kingston.

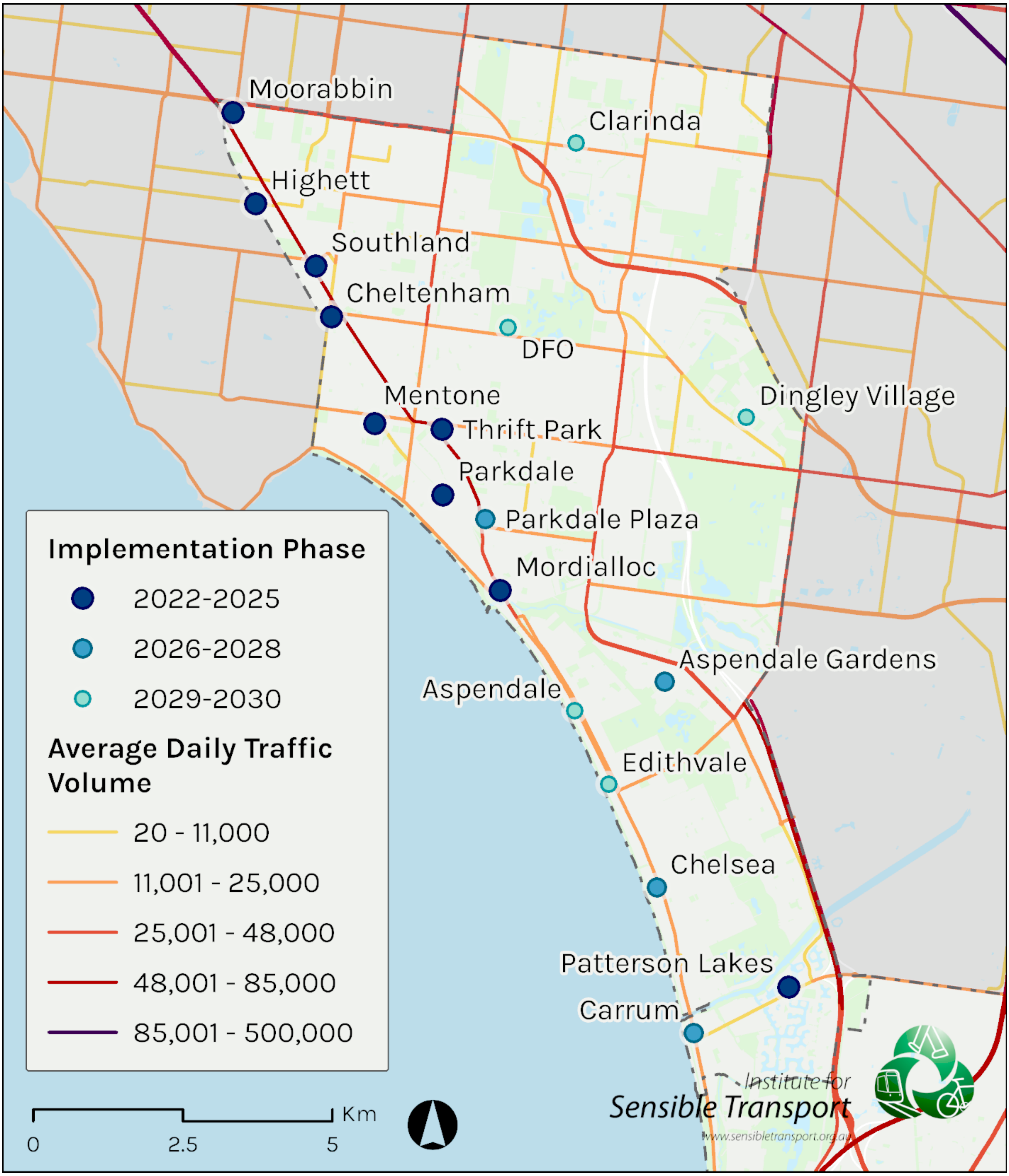



Figure 31 Opportunistic charging implementation Roadmap, Kingston

Figure 32 identifies the Roadmap for opportunistic charging across the Mornington Peninsula. The ultra-fast charger proposed for Baxter is also shown in Figure 32.

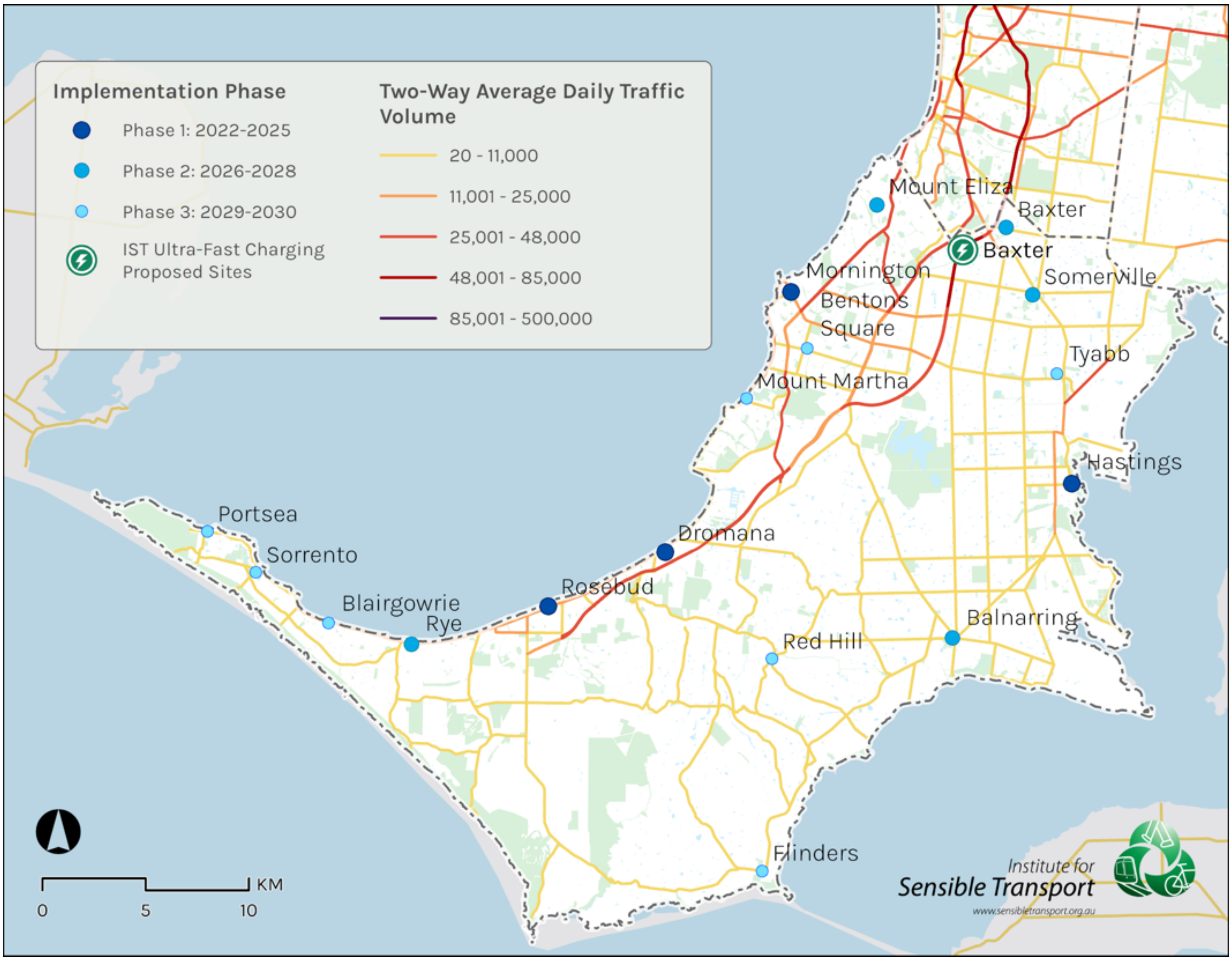
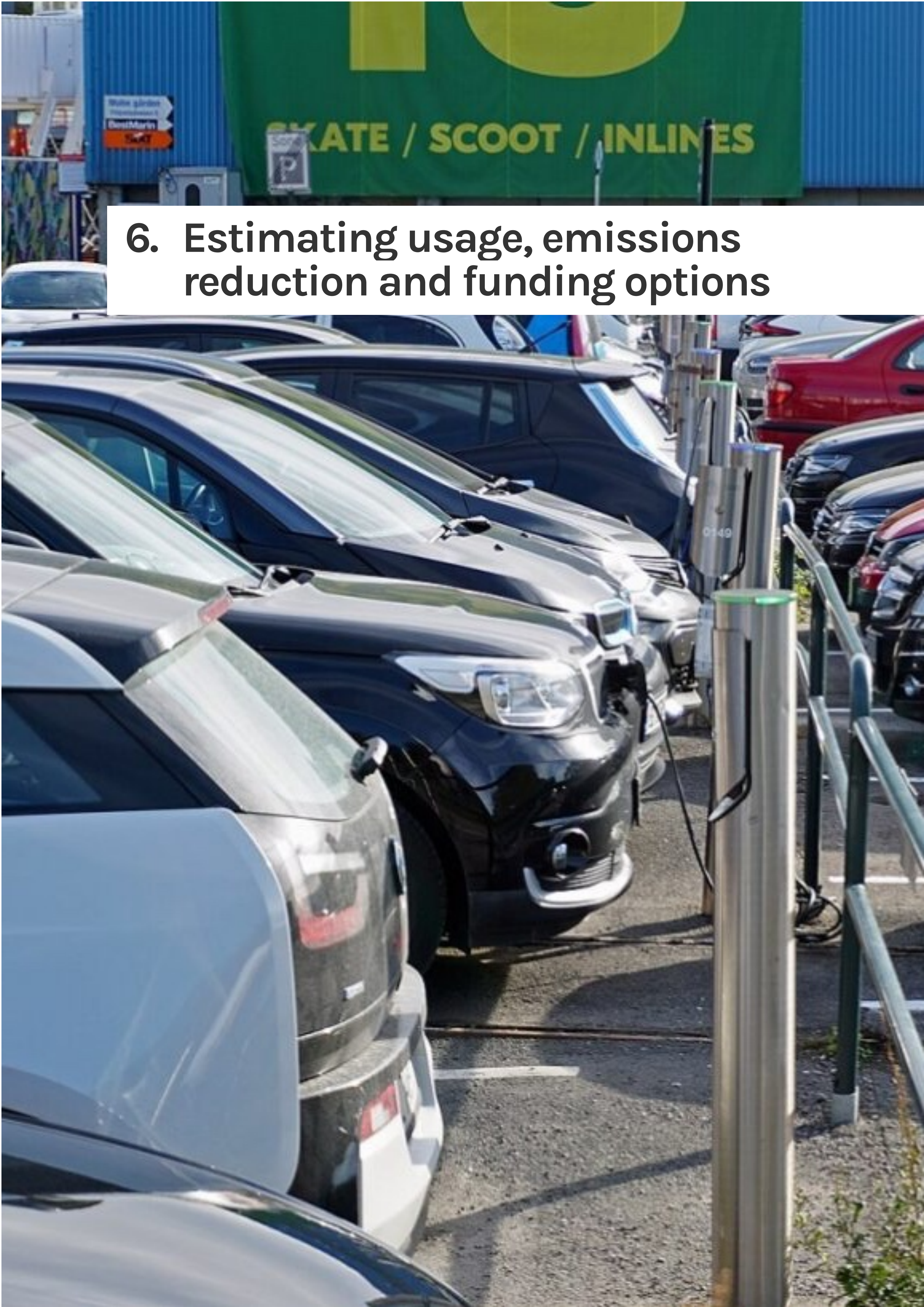



**Figure 32 Opportunistic and ultra-fast charging implementation Roadmap, Mornington Peninsula**

# 6. Estimating usage, emissions reduction and funding options



**This section estimates usage, impact on emissions and funding options for the SECCCA EV Charging Roadmap.**

## 6.1 Estimating EV charging usage

This section provides a usage estimate of the EV charging stations included in this Roadmap. Our methodology is described, followed by an overview of our results.

### 6.1.1 Methodology

Our method of estimating EV charger usage relies on the EV fleet adoption forecasts described in Section 3. An accompanying Excel tool enables SECCCA councils to alter key assumptions, which automatically adjusts the results to reflect new assumptions.

#### 6.1.1.1 Fleet assumptions

Key fleet assumptions are shown in Table 10. It is assumed that 10% of the fleet will be EV by 2030, which is in line with the AEMO/CSIRO figures described in Section 3. We base our assumptions on the annual distance travelled per vehicle on the ABS Motor vehicle Census, and the consumption of electricity per kilometre on the industry average. These assumptions are critical to developing an understanding of the overall quantity of electricity that the EV fleet in SECCCA will require by 2030.

**Table 10 Fleet Assumptions**

| | |
|---|---|
| **EV fleet composition in 2030** | 10% |
| **Annual kilometres travelled** | 11,400km |
| **Average energy per km (Wh)** | 142 Wh |

#### 6.1.1.2 Charging site assumptions

The second step in the development of estimated charging usage is to establish assumptions on the acceptable level of charging bay occupancy, and the amount of electricity transferred per charge. For the purposes of our modelling, we have assumed sites are provided with a 50kW DC charger, as this is the predominant charger output recommended in the Roadmap.

Table 11 outlines the assumptions built into the model regarding charging sites. Four hours of charging per day, per port is the general industry standard of acceptability, beyond which, the possibility of EVs arriving with charging bays occupied becomes too high. As highlighted earlier, because charging sessions are much longer than petrol refilling, arriving to charge an EV when all ports are in use will typically result in much longer wait times (especially for stations with only one or two ports).

**Table 11 Charging site assumptions**

| | |
|---|---|
| **Acceptable daily hours of use per site, per port** | 4 hours |
| **Port average power output (% of total output)** | 70% |
| **Average charging session** | 25 kWh |

#### 6.1.1.3 Charging behaviour assumptions

The third step is to set out assumptions regarding how EV owners will charge their vehicles; in particular, the balance between charging at home/work versus public charging. This is important because as highlighted earlier, some 90 – 95% of all EV charging occurs either at home or work, and this has implications for the demand on public charging.

Table 12 highlights the assumptions for the percentage of homes with EV charging capability for different LGAs. Almost all homes in Cardinia are detached or semi-detached homes with private off street parking (and thus can install EV charging), whereas in Kingston around 15% of homes are multi-dwelling apartments in which the installation of EV charging is difficult and in some cases not possible.

Table 12 also includes an assumption on the percentage of public charging that occurs from those with, and without home charging. These values can be altered in the Excel tool as well.

**Table 12 Charging behaviour assumptions**

| | | |
|---|---|---|
| **Homes with EV charging capability** | Cardinia | 98.9% |
| | Casey | 98.5% |
| | Frankston | 96.3% |
| | Kingston | 85.6% |
| | Mornington | 94.2% |
| **Charging done on the public charging network** | For cars at homes with charging | 5% |
| | For cars at homes without charging | 75% |

## 6.2 Results

The following tables present the results, which combine the EV fleet adoption assumptions in Section 3 with the assumptions included in Section 6.1.1.

### 6.2.1 Total vehicle and EV fleet

Table 13 provides the model assumptions for the total vehicle fleet (of all fuel types), based on a combination of ABS Motor Vehicle Census, combined with estimated growth in dwellings, across each of the LGAs.

**Table 13 Total vehicles in fleet (EV and ICE vehicles), 2022 - 2030**

| Area | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|
| Cardinia | 97,769 | 101,843 | 105,917 | 109,991 | 114,065 | 117,608 | 121,151 | 124,693 | 128,236 |
| Casey | 267,349 | 275,176 | 283,004 | 290,831 | 298,658 | 306,045 | 313,432 | 320,819 | 328,206 |
| Frankston | 109,964 | 111,002 | 112,041 | 113,080 | 114,118 | 115,025 | 115,931 | 116,837 | 117,744 |
| Kingston | 119,274 | 120,705 | 122,135 | 123,566 | 124,997 | 126,467 | 127,937 | 129,407 | 130,877 |
| Mornington Peninsula | 180,553 | 181,480 | 182,408 | 183,336 | 184,264 | 185,151 | 186,039 | 186,926 | 187,814 |
| Total | 774,909 | 790,206 | 805,505 | 820,804 | 836,102 | 850,296 | 864,490 | 878,682 | 892,877 |

Table 14 illustrates the number of EVs expected to be within the fleet, for each LGA, between 2022 and 2030.

**Table 14 EV Vehicle Fleet, 2022 - 2030**

| | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|
| EV share of total fleet | 0.1% | 0.2% | 0.3% | 0.5% | 0.9% | 1.6% | 2.8% | 4.9% | 8.5% |
| Cardinia | 101 | 183 | 331 | 596 | 1,072 | 1,917 | 3,425 | 6,112 | 10,900 |
| Casey | 278 | 496 | 885 | 1,577 | 2,808 | 4,990 | 8,861 | 15,727 | 27,897 |
| Frankston | 114 | 200 | 350 | 613 | 1,073 | 1,875 | 3,277 | 5,727 | 10,008 |
| Kingston | 124 | 217 | 382 | 670 | 1,175 | 2,062 | 3,617 | 6,343 | 11,124 |
| Mornington Peninsula | 187 | 327 | 570 | 994 | 1,732 | 3,018 | 5,259 | 9,163 | 15,964 |
| Total | 804 | 1,423 | 2,518 | 4,450 | 7,860 | 13,862 | 24,439 | 43,072 | 75,893 |

### 6.2.2 Estimated distance travelled and electricity consumption by EV fleet

An important element in the development of an EV charging network designed to support the fleet is the estimation of the number of kilometres the EV fleet is expected to travel, and how this varies by year and across the different LGAs. These results have been generated by combining average vehicle travel per year with the forecasted number of EVs in the fleet. The estimated EV travel is shown in Table 15.

**Table 15 Annual Vehicle Kilometres Travelled (VKT) - EV Fleet**

| Area | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|
| **Cardinia** | 1,151,400 | 2,086,200 | 3,773,400 | 6,794,400 | 12,220,800 | 21,853,800 | 39,045,000 | 69,676,800 | 124,260,000 |
| **Casey** | 3,169,200 | 5,654,400 | 10,089,000 | 17,977,800 | 32,011,200 | 56,886,000 | 101,015,400 | 179,287,800 | 318,025,800 |
| **Frankston** | 1,299,600 | 2,280,000 | 3,990,000 | 6,988,200 | 12,232,200 | 21,375,000 | 37,357,800 | 65,287,800 | 114,091,200 |
| **Kingston** | 1,413,600 | 2,473,800 | 4,354,800 | 7,638,000 | 13,395,000 | 23,506,800 | 41,233,800 | 72,310,200 | 126,813,600 |
| **Mornington Peninsula** | 2,131,800 | 3,727,800 | 6,498,000 | 11,331,600 | 19,744,800 | 34,405,200 | 59,952,600 | 104,458,200 | 181,989,600 |
| **Total** | 9,165,600 | 16,222,200 | 28,705,200 | 50,730,000 | 89,604,000 | 158,026,800 | 278,604,600 | 491,020,800 | 865,180,200 |

The electricity estimated to be consumed through EV travel is calculated by combining VKT with average EV power consumption, on a per kilometre basis. The results of this exercise is shown in Table 16.

**Table 16 Annual kWh consumption from EV Fleet**

| Area | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|
| **Cardinia** | 163,499 | 296,240 | 535,823 | 964,805 | 1,735,354 | 3,103,240 | 5,544,390 | 9,894,106 | 17,644,920 |
| **Casey** | 450,026 | 802,925 | 1,432,638 | 2,552,848 | 4,545,590 | 8,077,812 | 14,344,187 | 25,458,868 | 45,159,664 |
| **Frankston** | 184,543 | 323,760 | 566,580 | 992,324 | 1,736,972 | 3,035,250 | 5,304,808 | 9,270,868 | 16,200,950 |
| **Kingston** | 200,731 | 351,280 | 618,382 | 1,084,596 | 1,902,090 | 3,337,966 | 5,855,200 | 10,268,048 | 18,007,531 |
| **Mornington Peninsula** | 302,716 | 529,348 | 922,716 | 1,609,087 | 2,803,762 | 4,885,538 | 8,513,269 | 14,833,064 | 25,842,523 |
| **Total** | 1,301,515 | 2,303,552 | 4,076,138 | 7,203,660 | 12,723,768 | 22,439,806 | 39,561,853 | 69,724,954 | 122,855,588 |

As highlighted earlier, given that only a small percentage of charging overall will occur on the publicly available EV charging network, we have used the assumptions contained in Table 12 to calculate the quantity of electricity (kWh) we estimate will be consumed on the public charging network, as shown in Table 17.

Table 17 Annual electricity consumption from public charging (kWh)

| Area | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|
| **Cardinia** | 9,434 | 17,093 | 30,917 | 55,669 | 100,130 | 179,057 | 319,911 | 570,890 | 1,018,112 |
| **Casey** | 27,227 | 48,577 | 86,675 | 154,447 | 275,008 | 488,708 | 867,823 | 1,540,261 | 2,732,160 |
| **Frankston** | 14,007 | 24,573 | 43,003 | 75,317 | 131,836 | 230,375 | 402,635 | 703,659 | 1,229,652 |
| **Kingston** | 30,270 | 52,973 | 93,252 | 163,557 | 286,835 | 503,365 | 882,964 | 1,548,422 | 2,715,536 |
| **Mornington Peninsula** | 27,426 | 47,959 | 83,598 | 145,783 | 254,021 | 442,630 | 771,302 | 1,343,876 | 2,341,333 |
| **Total** | 108,364 | 191,175 | 337,445 | 594,774 | 1,047,830 | 1,844,135 | 3,244,636 | 5,707,108 | 10,036,792 |

## 6.2.3 Estimated charging sites and ports required to support future EV fleet

The estimated number of charging sites and the number of ports required at each site have been calculated, based on the data presented above. A high-level overview is provided, LGA by LGA (see Figure 33), and this is followed by an itemised list, according to the charging network prioritisation process described in Section 5.2. The reason some LGAs have busier networks than others is due to the fundamental characteristics of the activity centres located in each LGA, as outlined in Section 5.

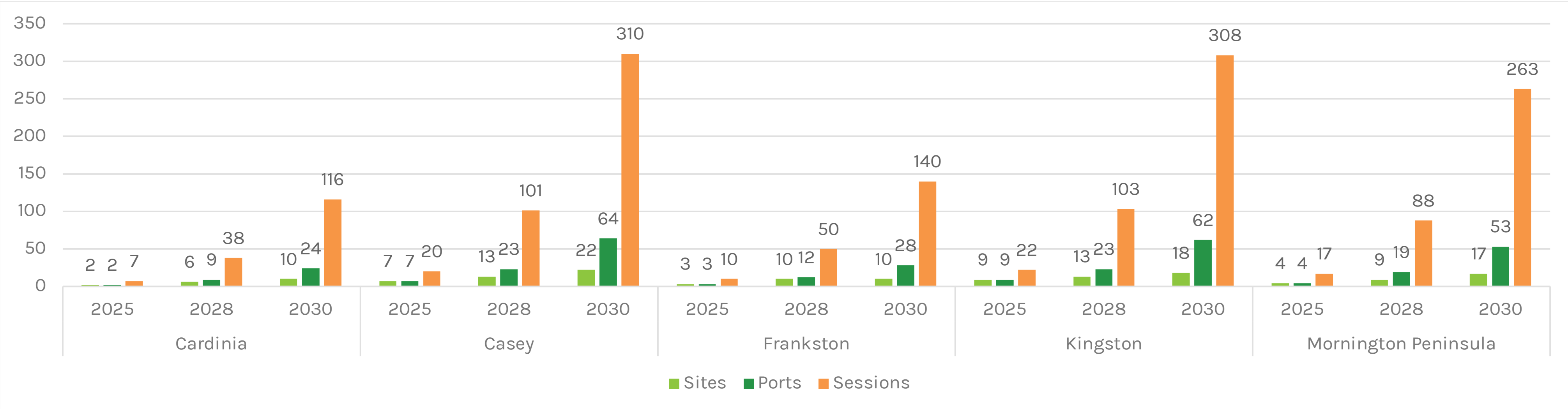



Figure 33 Estimated charging sites, ports and sessions

### 6.2.4 Estimated cost of equipment

Table 18 presents estimated costs for the equipment and installation, per install period. It is important to note:

- Installation costs can vary significantly from site to site and individual site inspections will be required to gain a more accurate figure.
- As highlighted earlier, it is not expected councils will typically be responsible for the costs shown in Table 18, as this can be met by the private market in most if not all instances.
- Due to the installation approach of only installing ports in pairs, there may be a slight discrepancy between the number of ports shown in Table 18 and earlier tables.
- For the purposes of estimating costs, a 50kW DC dual port charger has been used as the default charger type.

**Table 18 Estimated EV charging equipment costs**

| Area | 2022 to 2025 | | | 2026 to 2028 | | | 2029 to 2030 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Stations | Ports | Cost | Stations | Ports | Cost | Stations | Ports | Cost |
| Cardinia | 2 | 4 | $100,000 | 4 | 8 | $200,000 | 6 | 12 | $300,000 |
| Casey | 7 | 14 | $350,000 | 6 | 12 | $300,000 | 19 | 38 | $950,000 |
| Frankston | 3 | 6 | $150,000 | 7 | 14 | $350,000 | 4 | 8 | $200,000 |
| Kingston | 9 | 18 | $450,000 | 4 | 8 | $200,000 | 18 | 36 | $900,000 |
| Mornington Peninsula | 4 | 8 | $200,000 | 6 | 12 | $300,000 | 17 | 34 | $850,000 |
| **Total** | **25** | **50** | **$1,250,000** | **27** | **54** | **$1,350,000** | **64** | **128** | **$3,200,000** |

Finally, the two *ultra-fast* chargers, proposed for Peninsula Link at Baxter and Koo Wee Rup are not included in Table 18, as their costs cannot be estimated without a detailed assessment of possible upgrades to the electricity network. Each ultra-fast charger can cost anywhere between $200,000 and 700,000.

### 6.2.5 Cardinia – charger usage and ports required

Table 19 outlines the model's results for each of the activity centres in Cardinia, ordered by the prioritisation score it received (as described in Section 5). The electricity consumption and number of charging ports required are presented, and how this varies between 2022 and 2030, based on increases in EV ownership over time.

**Table 19 Cardinia - charger usage and ports required**

| Name | Prioritisation Score | Implementation year | kWh per day | | | | | | | | | Ports required | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| **Pakenham** | 0.614 | 2025 | 0 | 0 | 0 | 86 | 155 | 277 | 214 | 382 | 474 | 0 | 0 | 0 | 1 | 2 | 2 | 2 | 3 | 4 |
| **Beaconsfield** | 0.472 | 2025 | 0 | 0 | 0 | 66 | 119 | 213 | 165 | 294 | 364 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 3 |
| **Emerald** | 0.455 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 159 | 283 | 351 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 |
| **Gembrook** | 0.348 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 121 | 217 | 268 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| **Lang Lang** | 0.313 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 109 | 195 | 241 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| **Bunyip** | 0.31 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 108 | 193 | 239 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| **Garfield** | 0.3 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 231 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Koo Wee Rup** | 0.286 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 221 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Officer** | 0.269 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 208 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Beaconsfield Upper** | 0.249 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 192 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |

Average usage and average number of users per day has been presented in Table 20.

**Table 20 Hourly use and average number of users per day, Cardinia**

| Name | Average usage per day in hours, per port | | | | | | | | | Average users per day (based on minutes) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| **Pakenham** | - | - | - | 2.5 | 2.2 | 4.0 | 3.1 | 3.6 | 3.4 | 0 | 0 | 0 | 4 | 7 | 12 | 9 | 16 | 19 |
| **Beaconsfield** | - | - | - | 1.9 | 3.4 | 3.0 | 2.4 | 2.8 | 3.5 | 0 | 0 | 0 | 3 | 5 | 9 | 7 | 12 | 15 |
| **Emerald** | - | - | - | - | - | - | 2.3 | 2.7 | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 12 | 15 |
| **Gembrook** | - | - | - | - | - | - | 3.5 | 3.1 | 3.8 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 9 | 11 |
| **Lang Lang** | - | - | - | - | - | - | 3.1 | 2.8 | 3.4 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 8 | 10 |
| **Bunyip** | - | - | - | - | - | - | 3.1 | 2.8 | 3.4 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 8 | 10 |
| **Garfield** | - | - | - | - | - | - | - | - | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| **Koo Wee Rup** | - | - | - | - | - | - | - | - | 3.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| **Officer** | - | - | - | - | - | - | - | - | 3.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| **Beaconsfield Upper** | - | - | - | - | - | - | - | - | 2.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |

### 6.2.6 Casey – charger usage and ports required

Table 21 outlines the model's results for each of the activity centres in Casey, ordered by the prioritisation score it received (as described in Section 5). The electricity consumption and number of charging ports required are presented, and how this varies between 2022 and 2030, based on increases in EV ownership over time.

**Table 21 Casey - charger usage and ports required**

| Name | Prioritisation Score | Implementation year | kWh per day | | | | | | | | | Ports required | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| Fountain Gate-Narre Warren | 0.815 | 2025 | 0 | 0 | 0 | 78 | 139 | 247 | 293 | 519 | 712 | 0 | 0 | 0 | 1 | 1 | 2 | 3 | 4 | 6 |
| Berwick | 0.765 | 2025 | 0 | 0 | 0 | 73 | 131 | 232 | 275 | 487 | 668 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 4 | 5 |
| Cranbourne | 0.646 | 2025 | 0 | 0 | 0 | 62 | 110 | 196 | 232 | 412 | 564 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 5 |
| Cranbourne North | 0.599 | 2025 | 0 | 0 | 0 | 57 | 102 | 182 | 215 | 382 | 523 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 4 |
| Hampton Park | 0.575 | 2025 | 0 | 0 | 0 | 55 | 98 | 175 | 206 | 366 | 502 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 4 |
| Eden Rise-Berwick | 0.521 | 2025 | 0 | 0 | 0 | 50 | 89 | 158 | 187 | 332 | 455 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 4 |
| Lynbrook Village | 0.489 | 2025 | 0 | 0 | 0 | 47 | 84 | 148 | 176 | 312 | 427 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 4 |
| Endeavour Hills | 0.464 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 167 | 296 | 405 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 |
| Casey Central | 0.456 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 164 | 291 | 398 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 |
| Cranbourne East | 0.339 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 122 | 216 | 296 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 |
| Tooradin | 0.334 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 120 | 213 | 292 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 |
| Eve Central-Cranbourne South | 0.317 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 114 | 202 | 277 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |

| Name | Prioritisation Score | Implementation year | kWh per day | | | | | | | | | Ports required | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| **Autumn Place-Doveton** | 0.302 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 108 | 192 | 264 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| **Cranbourne West** | 0.296 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 259 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Springhill-Cranbourne** | 0.275 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Lyndhurst** | 0.266 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 232 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Parkhill Plaza-Berwick** | 0.253 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 221 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Pearcedale** | 0.251 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 219 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Amberley Park-Narre Warren South** | 0.22 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 192 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Lakala Close-Hampton Park** | 0.216 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 189 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Clyde North** | 0.098 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| **Clyde** | 0.072 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

Average usage and average number of users per day has been presented in Table 22.

**Table 22 Hourly use and average number of users per day, Casey**

| Name | Average usage per day in hours, per port | | | | | | | | | Average users per day (based on minutes) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| Fountain Gate-Narre Warren | - | - | - | 2.2 | 4.0 | 3.5 | 2.8 | 3.7 | 3.4 | 0 | 0 | 0 | 4 | 6 | 10 | 12 | 21 | 29 |
| Berwick | - | - | - | 2.1 | 3.7 | 3.3 | 3.9 | 3.5 | 3.8 | 0 | 0 | 0 | 3 | 6 | 10 | 11 | 20 | 27 |
| Cranbourne | - | - | - | 1.8 | 3.2 | 2.8 | 3.3 | 3.9 | 3.2 | 0 | 0 | 0 | 3 | 5 | 8 | 10 | 17 | 23 |
| Cranbourne North | - | - | - | 1.6 | 2.9 | 2.6 | 3.1 | 3.6 | 3.7 | 0 | 0 | 0 | 3 | 5 | 8 | 9 | 16 | 21 |
| Hampton Park | - | - | - | 1.6 | 2.8 | 2.5 | 2.9 | 3.5 | 3.6 | 0 | 0 | 0 | 3 | 4 | 7 | 9 | 15 | 21 |
| Eden Rise-Berwick | - | - | - | 1.4 | 2.5 | 2.3 | 2.7 | 3.2 | 3.3 | 0 | 0 | 0 | 2 | 4 | 7 | 8 | 14 | 19 |
| Lynbrook Village | - | - | - | 1.3 | 2.4 | 2.1 | 2.5 | 3.0 | 3.1 | 0 | 0 | 0 | 2 | 4 | 6 | 8 | 13 | 18 |
| Endeavour Hills | - | - | - | - | - | - | 2.4 | 2.8 | 3.9 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 12 | 17 |
| Casey Central | - | - | - | - | - | - | 2.3 | 2.8 | 3.8 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 12 | 16 |
| Cranbourne East | - | - | - | - | - | - | 3.5 | 3.1 | 2.8 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 9 | 12 |
| Tooradin | - | - | - | - | - | - | 3.4 | 3.0 | 2.8 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 9 | 12 |
| Eve Central-Cranbourne South | - | - | - | - | - | - | 3.3 | 2.9 | 4.0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 9 | 12 |
| Autumn Place-Doveton | - | - | - | - | - | - | 3.1 | 2.7 | 3.8 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 8 | 11 |
| Cranbourne West | - | - | - | - | - | - | - | - | 3.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Springhill-Cranbourne | - | - | - | - | - | - | - | - | 3.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Lyndhurst | - | - | - | - | - | - | - | - | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Parkhill Plaza-Berwick | - | - | - | - | - | - | - | - | 3.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Pearcedale | - | - | - | - | - | - | - | - | 3.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Amberley Park-Narre Warren South | - | - | - | - | - | - | - | - | 2.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Lakala Close-Hampton Park | - | - | - | - | - | - | - | - | 2.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Clyde North | - | - | - | - | - | - | - | - | 2.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Clyde | - | - | - | - | - | - | - | - | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |

### 6.2.7 Frankston – charger use and ports required

Table 23 outlines the model's results for each of the activity centres in Frankston, ordered by the prioritisation score it received (as described in Section 5). The electricity consumption and number of charging ports required are presented, and how this varies between 2022 and 2030, based on increases in EV ownership over time.

Table 23 Frankston - charger usage and ports required

| Name | Prioritisation Score | Implementation year | kWh per day | | | | | | | | | Ports required | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| Karingal | 0.812 | 2025 | 0 | 0 | 0 | 79 | 139 | 242 | 187 | 327 | 571 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 5 |
| Frankston | 0.751 | 2025 | 0 | 0 | 0 | 73 | 128 | 224 | 173 | 302 | 528 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 4 |
| Carrum Downs | 0.552 | 2025 | 0 | 0 | 0 | 54 | 94 | 165 | 127 | 222 | 388 | 0 | 0 | 0 | 1 | 1 | 2 | 1 | 2 | 3 |
| Belvedere Park-Seaford | 0.455 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 183 | 320 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 |
| Langwarrin-The Gateway | 0.454 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 183 | 319 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 |
| Towerhill-Frankston | 0.38 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 88 | 153 | 267 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| Langwarrin Plaza | 0.375 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 86 | 151 | 264 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| Ballarto Rd-Carrum Downs | 0.362 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 83 | 146 | 255 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| Local Village-Carrum Downs | 0.327 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 75 | 132 | 230 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| Seaford | 0.32 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 74 | 129 | 225 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |

Average usage and average number of users per day has been presented in Table 24.

**Table 24 Hourly use and average number of users per day, Frankston**

| Name | Average usage per day in hours, per port | | | | | | | | | Average users per day (based on minutes) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| Karingal | - | - | - | 2.3 | 4.0 | 3.5 | 2.7 | 3.1 | 3.3 | 0 | 0 | 0 | 4 | 6 | 10 | 8 | 14 | 23 |
| Frankston | - | - | - | 2.1 | 3.7 | 3.2 | 2.5 | 2.9 | 3.8 | 0 | 0 | 0 | 3 | 6 | 9 | 7 | 13 | 22 |
| Carrum Downs | - | - | - | 1.5 | 2.7 | 2.4 | 3.6 | 3.2 | 3.7 | 0 | 0 | 0 | 3 | 4 | 7 | 6 | 9 | 16 |
| Belvedere Park-Seaford | - | - | - | - | - | - | 3.0 | 2.6 | 3.0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 8 | 13 |
| Langwarrin-The Gateway | - | - | - | - | - | - | 3.0 | 2.6 | 3.0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 8 | 13 |
| Towerhill-Frankston | - | - | - | - | - | - | 2.5 | 2.2 | 3.8 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 7 | 11 |
| Langwarrin Plaza | - | - | - | - | - | - | 2.5 | 2.2 | 3.8 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 7 | 11 |
| Ballarto Rd-Carrum Downs | - | - | - | - | - | - | 2.4 | 2.1 | 3.6 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 6 | 11 |
| Local Village-Carrum Downs | - | - | - | - | - | - | 2.2 | 3.8 | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 6 | 10 |
| Seaford | - | - | - | - | - | - | 2.1 | 3.7 | 3.2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 10 |

### 6.2.8 Kingston – charger usage and ports required

Table 25 outlines the model's results for each of the activity centres in Kingston, ordered by the prioritisation score it received (as described in Section 5). The electricity consumption and number of charging ports required are presented, and how this varies between 2022 and 2030, based on increases in EV ownership over time.

**Table 25 Kingston - charger usage and ports required**

| Name | Prioritisation Score | Implementation year | kWh per day | | | | | | | | | Ports required | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| Cheltenham | 0.854 | 2025 | 0 | 0 | 0 | 65 | 113 | 199 | 276 | 484 | 719 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 4 | 6 |
| Mentone | 0.819 | 2025 | 0 | 0 | 0 | 62 | 109 | 190 | 265 | 465 | 690 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 4 | 5 |
| Cheltenham-Southland | 0.807 | 2025 | 0 | 0 | 0 | 61 | 107 | 188 | 261 | 458 | 680 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 4 | 5 |
| Moorabbin | 0.804 | 2025 | 0 | 0 | 0 | 61 | 107 | 187 | 260 | 456 | 677 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 4 | 5 |
| Highett | 0.589 | 2025 | 0 | 0 | 0 | 45 | 78 | 137 | 191 | 334 | 496 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 3 | 4 |
| Thrift Park-Mentone | 0.533 | 2025 | 0 | 0 | 0 | 40 | 71 | 124 | 172 | 302 | 449 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 3 | 4 |
| Patterson Lakes | 0.511 | 2025 | 0 | 0 | 0 | 39 | 68 | 119 | 165 | 290 | 430 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 3 | 4 |
| Mordialloc | 0.509 | 2025 | 0 | 0 | 0 | 38 | 67 | 118 | 165 | 289 | 429 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 3 | 4 |
| Parkdale | 0.505 | 2025 | 0 | 0 | 0 | 38 | 67 | 117 | 163 | 286 | 425 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 3 | 4 |
| Parkdale Plaza | 0.457 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 148 | 259 | 385 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 3 |
| Chelsea | 0.42 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 136 | 238 | 354 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 |
| Aspendale Gardens | 0.345 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 112 | 196 | 291 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 |
| Carrum | 0.325 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 105 | 184 | 274 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| Edithvale | 0.288 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 243 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| DFO-Moorabbin Airport | 0.28 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 236 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Aspendale | 0.269 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 227 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Dingley Village | 0.268 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 226 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Clarinda | 0.249 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 210 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |

Average usage and average number of users per day has been presented in Table 26.

**Table 26 Hourly use and average number of users per day, Kingston**

| Name | Average usage per day in hours, per port | | | | | | | | | Average users per day (based in minutes) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| Cheltenham | - | - | - | 1.8 | 3.2 | 2.8 | 3.9 | 3.5 | 3.4 | 0 | 0 | 0 | 3 | 5 | 8 | 12 | 20 | 29 |
| Mentone | - | - | - | 1.8 | 3.1 | 2.7 | 3.8 | 3.3 | 3.9 | 0 | 0 | 0 | 3 | 5 | 8 | 11 | 19 | 28 |
| Cheltenham-Southland | - | - | - | 1.7 | 3.1 | 2.7 | 3.7 | 3.3 | 3.9 | 0 | 0 | 0 | 3 | 5 | 8 | 11 | 19 | 28 |
| Moorabbin | - | - | - | 1.7 | 3.0 | 2.7 | 3.7 | 3.3 | 3.9 | 0 | 0 | 0 | 3 | 5 | 8 | 11 | 19 | 28 |
| Highett | - | - | - | 1.3 | 2.2 | 3.9 | 2.7 | 3.2 | 3.5 | 0 | 0 | 0 | 2 | 4 | 6 | 8 | 14 | 20 |
| Thrift Park-Mentone | - | - | - | 1.2 | 2.0 | 3.5 | 2.5 | 2.9 | 3.2 | 0 | 0 | 0 | 2 | 3 | 5 | 7 | 13 | 18 |
| Patterson Lakes | - | - | - | 1.1 | 1.9 | 3.4 | 2.4 | 2.8 | 3.1 | 0 | 0 | 0 | 2 | 3 | 5 | 7 | 12 | 18 |
| Mordialloc | - | - | - | 1.1 | 1.9 | 3.4 | 2.4 | 2.8 | 3.1 | 0 | 0 | 0 | 2 | 3 | 5 | 7 | 12 | 18 |
| Parkdale | - | - | - | 1.1 | 1.9 | 3.4 | 2.3 | 2.7 | 3.0 | 0 | 0 | 0 | 2 | 3 | 5 | 7 | 12 | 18 |
| Parkdale Plaza | - | - | - | - | - | - | 2.1 | 3.7 | 3.7 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 11 | 16 |
| Chelsea | - | - | - | - | - | - | 3.9 | 3.4 | 3.4 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 10 | 15 |
| Aspendale Gardens | - | - | - | - | - | - | 3.2 | 2.8 | 2.8 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 8 | 12 |
| Carrum | - | - | - | - | - | - | 3.0 | 2.6 | 3.9 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 8 | 11 |
| Edithvale | - | - | - | - | - | - | - | - | 3.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| DFO-Moorabbin Airport | - | - | - | - | - | - | - | - | 3.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Aspendale | - | - | - | - | - | - | - | - | 3.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Dingley Village | - | - | - | - | - | - | - | - | 3.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Clarinda | - | - | - | - | - | - | - | - | 3.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |

### 6.2.9 Mornington – charger usage and ports required

Table 27 outlines the model's results for each of the activity centres in Mornington, ordered by the prioritisation score it received (as described in Section 5). The electricity consumption and number of charging ports required are presented, and how this varies between 2022 and 2030, based on increases in EV ownership over time.

**Table 27 Mornington - charger usage and ports required**

| Name | Prioritisation Score | Implementation year | kWh per day | | | | | | | | | Ports required | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| Mornington | 0.671 | 2025 | 0 | 0 | 0 | 119 | 208 | 362 | 328 | 571 | 688 | 0 | 0 | 0 | 1 | 2 | 3 | 3 | 5 | 5 |
| Rosebud | 0.55 | 2025 | 0 | 0 | 0 | 98 | 170 | 297 | 269 | 468 | 564 | 0 | 0 | 0 | 1 | 2 | 3 | 2 | 4 | 5 |
| Dromana | 0.519 | 2025 | 0 | 0 | 0 | 92 | 161 | 280 | 254 | 442 | 532 | 0 | 0 | 0 | 1 | 2 | 3 | 2 | 4 | 4 |
| Hastings | 0.505 | 2025 | 0 | 0 | 0 | 90 | 157 | 273 | 247 | 430 | 518 | 0 | 0 | 0 | 1 | 2 | 2 | 2 | 4 | 4 |
| Somerville | 0.46 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 225 | 392 | 472 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 4 |
| Baxter | 0.436 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 213 | 371 | 447 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 4 |
| Mount Eliza | 0.43 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 210 | 366 | 441 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 4 |
| Rye | 0.404 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 197 | 344 | 414 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 |
| Balnarring | 0.35 | 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 171 | 298 | 359 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 |
| Sorrento | 0.292 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 299 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Flinders | 0.274 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 281 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Red Hill | 0.268 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 275 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Mornington-Bentons Square | 0.262 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 269 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Mount Martha | 0.253 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 259 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Tyabb | 0.251 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 257 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Blairgowrie | 0.218 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 223 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Portsea | 0.114 | 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 117 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

Average usage and average number of users per day has been presented in Table 28.

**Table 28 Hourly use and average number of users per day, Mornington**

| Name | Average usage per day in hours, per port | | | | | | | | | Average users per day (based in minutes) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| Mornington | - | - | - | 3.4 | 3.0 | 3.5 | 3.1 | 3.3 | 3.9 | 0 | 0 | 0 | 5 | 9 | 15 | 14 | 23 | 28 |
| Rosebud | - | - | - | 2.8 | 2.4 | 2.8 | 3.8 | 3.3 | 3.2 | 0 | 0 | 0 | 4 | 7 | 12 | 11 | 19 | 23 |
| Dromana | - | - | - | 2.6 | 2.3 | 2.7 | 3.6 | 3.2 | 3.8 | 0 | 0 | 0 | 4 | 7 | 12 | 11 | 18 | 22 |
| Hastings | - | - | - | 2.6 | 2.2 | 3.9 | 3.5 | 3.1 | 3.7 | 0 | 0 | 0 | 4 | 7 | 11 | 10 | 18 | 21 |
| Somerville | - | - | - | - | - | - | 3.2 | 3.7 | 3.4 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 16 | 19 |
| Baxter | - | - | - | - | - | - | 3.0 | 3.5 | 3.2 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 15 | 18 |
| Mount Eliza | - | - | - | - | - | - | 3.0 | 3.5 | 3.1 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 15 | 18 |
| Rye | - | - | - | - | - | - | 2.8 | 3.3 | 3.9 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 14 | 17 |
| Balnarring | - | - | - | - | - | - | 2.4 | 2.8 | 3.4 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 12 | 15 |
| Sorrento | - | - | - | - | - | - | - | - | 2.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Flinders | - | - | - | - | - | - | - | - | 2.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Red Hill | - | - | - | - | - | - | - | - | 3.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Mornington-Bentons Square | - | - | - | - | - | - | - | - | 3.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Mount Martha | - | - | - | - | - | - | - | - | 3.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Tyabb | - | - | - | - | - | - | - | - | 3.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Blairgowrie | - | - | - | - | - | - | - | - | 3.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Portsea | - | - | - | - | - | - | - | - | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |

## 6.3 Potential emissions reduction

### 6.3.1 Introduction

Point Advisory have built a model to estimate future emissions savings due to the electrification of vehicles. The model compares emissions savings under different scenarios and shows the impact of different variables on emissions savings. The modelling of emissions has been developed into an Excel tool that will also be delivered to the client, to enable adjustment over time.

### 6.3.2 Model limitations

Due to the complexity and uncertainty of future scenarios, estimates of emissions and abatement are subject to a high level of uncertainty, as demonstrated by the variability between the different modelled scenarios. An Excel model was built so that specific factors can be updated over time to enable the model to remain relevant.

EV uptake, the share of EV charging that is done at public stations and the extent of renewable energy powering these stations are parameters that can be adjusted based on SECCCA's assumptions. Conversely, SECCCA has no influence on several of the model's other parameters including ICE and EV future fuel efficiencies, and electricity grid decarbonisation; the defined range of values for these parameters are intended to reflect different plausible futures.

Finally, the model does not consider the possible impact of the EV Roadmap boosting levels of EV adoption, as it is assumed a growth in charger availability is already built into the CSIRO/AEMO model; the various EV adoption uptake options are intended to include this impact within various other macro factors that are outside of SECCCA's control.

### 6.3.3 Methodology

The model estimated future use of private vehicles by applying forecasted dwellings growth (from forecast.id) onto the current drive need (vehicle kilometres travelled from the Victorian Integrated Survey of Travel and Activity).

Another key parameter is the share of on-road vehicles being EVs (i.e., EV uptake) – a highly variable assumption. The possible values for this parameter were informed by a combination of estimated vehicle life and the growth of annual EV sales in various countries (theICCT.org).

Current ICE fuel efficiencies were compiled from the Australian Bureau of Statistics Survey of Motor Vehicle Use (2020) and EV efficiencies were sourced from economy vehicles listed in the Green Vehicle Guide and projected into the future based on historic trends over 2000-2018.

The following external sources were used to calculate avoided fuel and electricity demand, and convert them into emissions:

- Projected electricity grid emissions factors were sourced from RepuTex.
- Assumptions on renewable energy at public and private sites, as well as the share of EV charging done at public sites, were co-created with the Institute for Sensible Transport.
- Scope 3 emissions[12] for fuel & electricity transmission were sourced/estimated from DISER's National Greenhouse Accounts Factors.

### 6.3.4 Scenarios

Model results presented below are based on the combination of variables, determined via discussion with the Institute for Sensible Transport and the SECCCA Project Control Group.

The three scenarios modelled only differed on two of the parameters as described below in Table 29. The two parameters are assumed to be somewhat correlated, as a high uptake in EV is likely to result in ICE vehicle manufacturers abandoning all effort to improve the vehicle efficiency

[12] https://ghgprotocol.org/sites/default/files/standards_supporting/FAQ.pdf

TRITIUM
CHARGING
THE REGIONS
Station ID
CV013A
1
2
FOREST ST
COUNT TRADERS
Specialising In....
NEW & 2ND HAND
OFFICE FURNITURE
2,3 & 4 DRAWER
FILING CABINETS
DESKS
CHAIRS
SECURITY DOORS
PINE
BUNKS & BEDS
BOOKSHELVES
TALLBOYS
KITCHEN
DRESSERS
OUTDOOR
SETTINGS
41
START
THE SALVATION ARMY
INE THRIFT SHO
MAIN SWITCHBOARD

**Table 29 Model parameters**

| Model parameter | Scenario A | Scenario B | Scenario C |
|---|---|---|---|
| **Rate of EV uptake (exponential growth to 2030)** | 22% EV uptake by 2030 | 10% EV uptake by 2030 | 5% EV uptake by 2030 |
| **Projected improvement to ICE efficiency** | No improvement (i.e., 2030 ICE fuel efficiency = today's efficiency)13 | No improvement | Extension of historical ICE improvements (2000 – 2018, ABS) |

All three scenarios assumed the same levels for the other variables (which the model nevertheless allows to test for sensitivity):

- Share of EV charging performed at public stations: 5%
- %-renewable-energy used at public stations: 100% renewable; at-home charging is 100% grid-based
- Future improvement to EV travel efficiency: similar to historical improvements to ICE efficiencies over 2000-2018
- Grid decarbonisation rate: Fast Transition (e.g., reducing from 0.8 to 0.3 kg CO2-e per kWh by 2030; net zero by 2033), as shown in Table 30.


[13] This is due to the announcement from a number OEMs that they will cease their work on improvements to ICE technology.

Table 30 Grid emissions projections, 2021 to 2030

| Financial Year | kg CO2-e per kWh |
|---|---|
| **2021** | 0.98 |
| **2022** | 0.81 |
| **2023** | 0.78 |
| **2024** | 0.74 |
| **2025** | 0.67 |
| **2026** | 0.63 |
| **2027** | 0.53 |
| **2028** | 0.52 |
| **2029** | 0.45 |
| **2030** | 0.31 |

### 6.3.5 Results

Model results presented below are based on the combination of variables highlighted earlier.

The graphs below depict key outcomes from these scenarios:

- Figure 34 shows the *expected vehicle emissions* per year for each scenario, across all participating Councils.
- Figure 35 compares the *net emissions savings* per year for each scenario, across all participating Councils.
- Figure 36 shows the *amount of fuel in litres which is not consumed* due to conversion from ICE to EVs.
- Figure 37 shows the *emission savings per year* (today and for 2030) by switching an ICE vehicle to an EV, in the context of scenario A (note: all scenarios will reflect the same results for 2022).

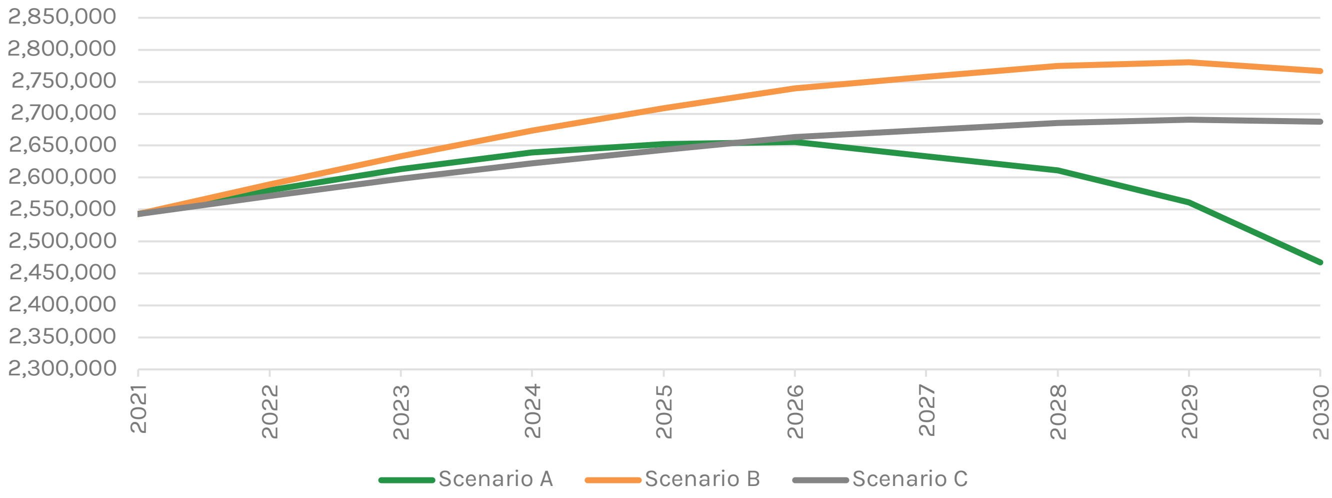



**Figure 34 Total vehicle emissions per year ($tCO_2$-e) under three scenarios (EVs + remaining ICE vehicles across participating councils)**

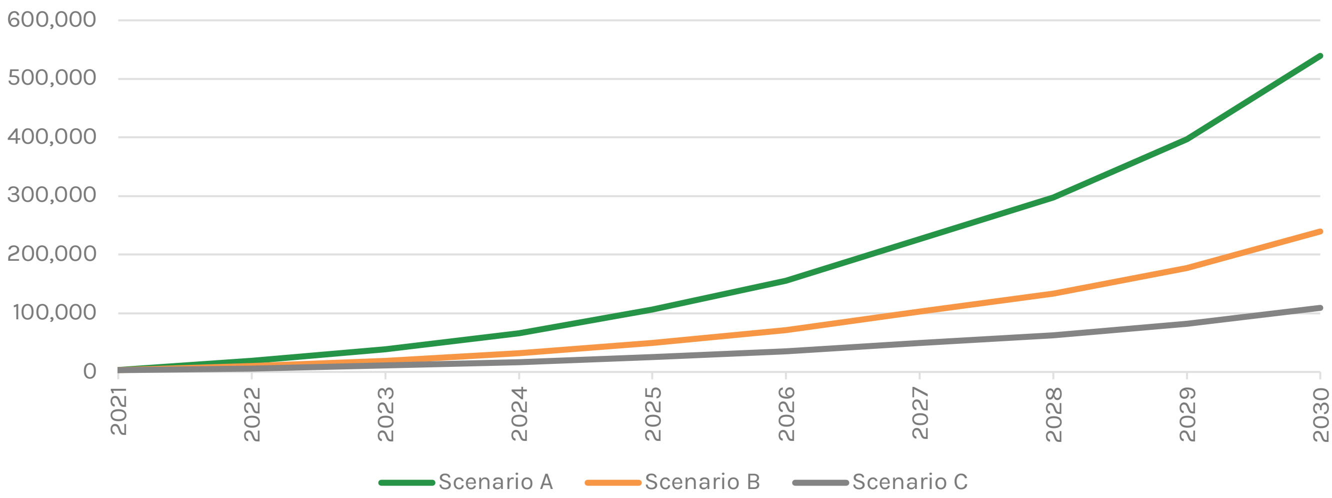



**Figure 35 Net savings of emissions ($tCO_2$-e per year) under three scenarios (across participating councils)**

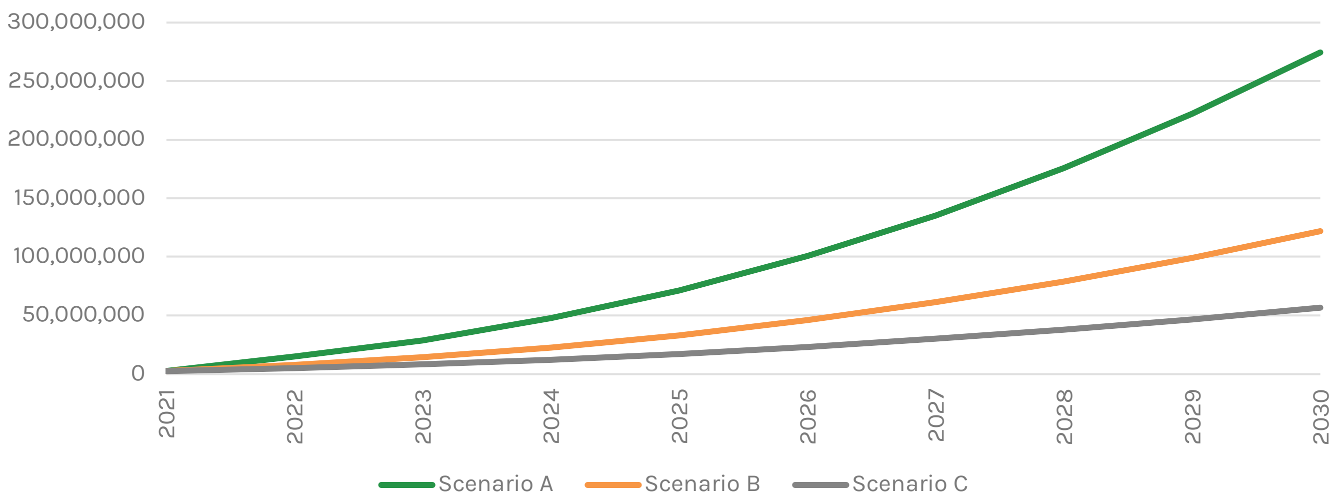



**Figure 36 Abated fuel consumption from ICE vehicles in litres**

Figure 37 presents the emissions estimated to be saved, per EV, compared to an ICE vehicle. This shows a 52% reduction in emissions for 2022 and an 80% reduction in emissions by 2030.

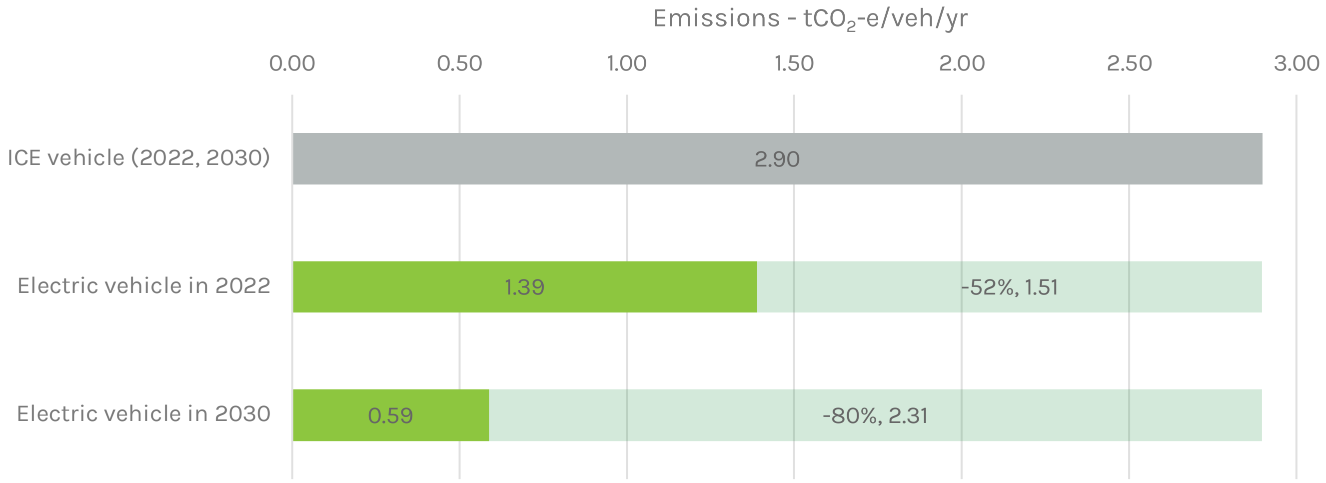



**Figure 37 Emissions saved per EV compared to an ICE vehicle (Scenario A)**

### 6.3.5.1 Results by LGA

The estimated net savings in emission per annum for each participating LGA are shown in the figures below.

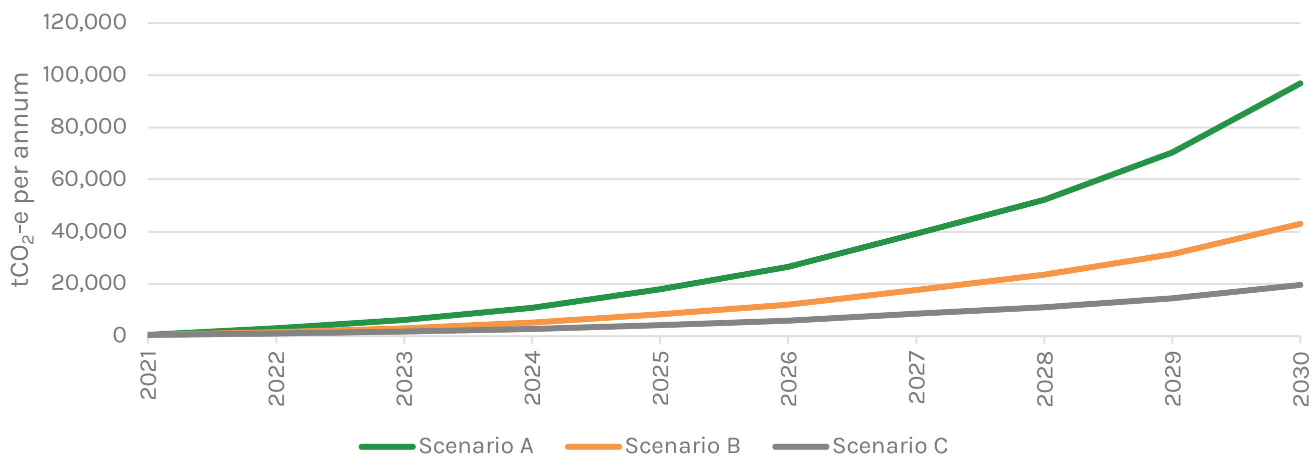



**Figure 38 Net savings of emissions ($tCO_2$-e per year) under three scenarios for Cardinia**

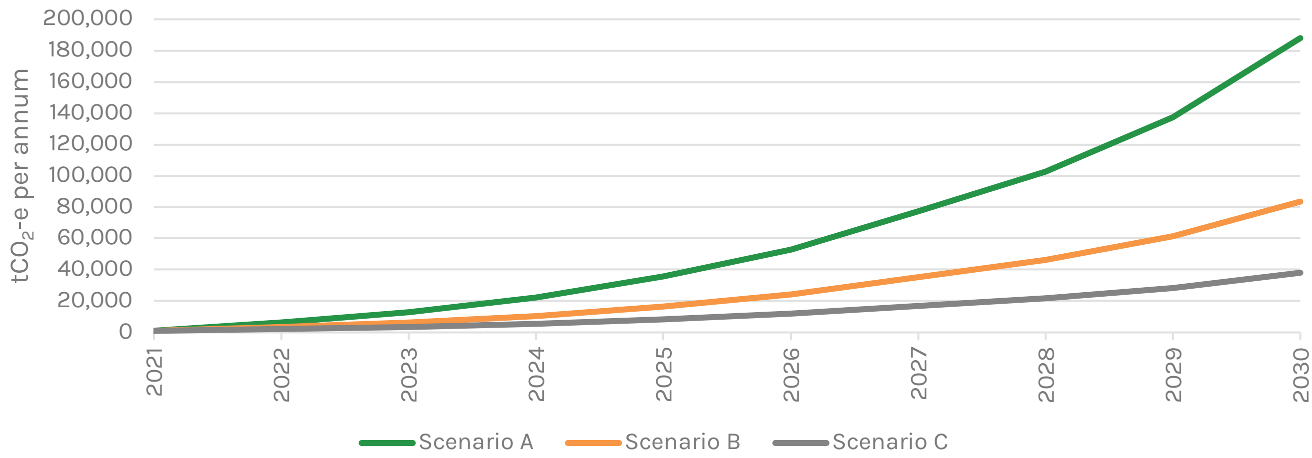



**Figure 39 Net savings of emissions ($tCO_2$-e per year) under three scenarios for Casey**

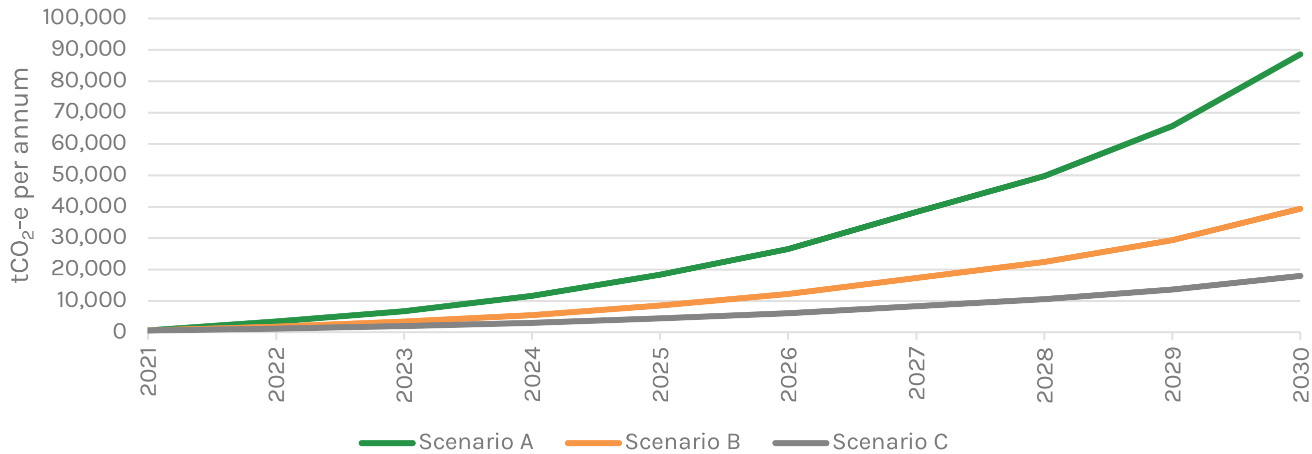



**Figure 40 Net savings of emissions ($tCO_2$-e per year) under three scenarios for Frankston**

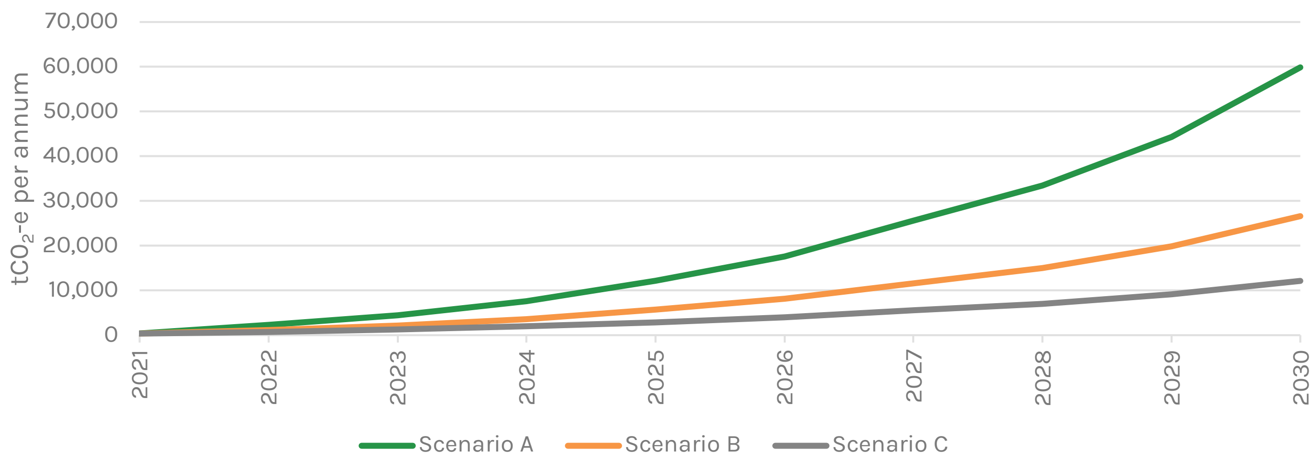



**Figure 41 Net savings of emissions ($tCO_2$-e per year) under three scenarios for Kingston**

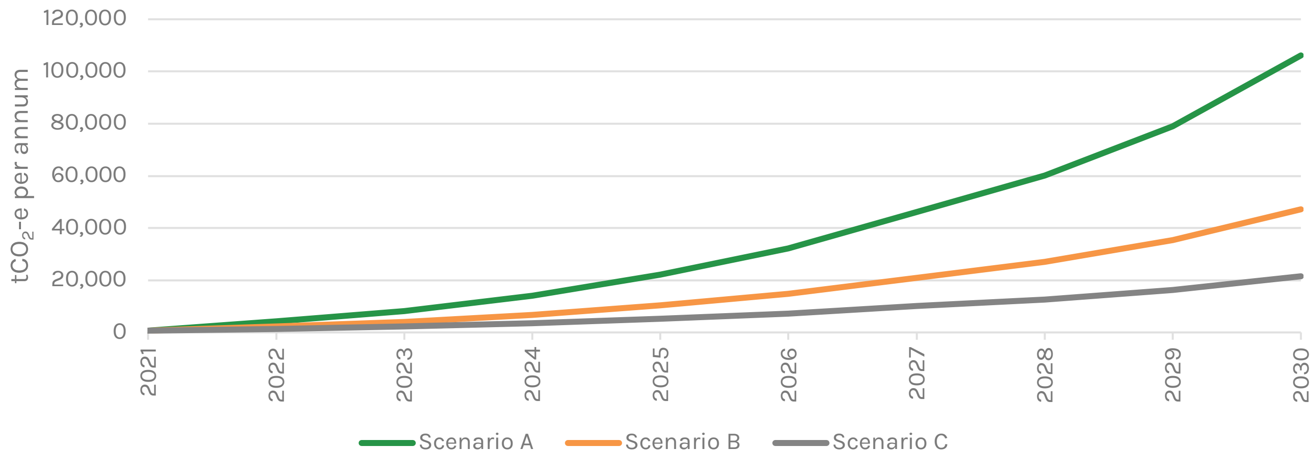



**Figure 42 Net savings of emissions (t$CO_2$-e per year) under three scenarios for Mornington Peninsula**

The Excel tool produced for the emissions modelling component of this project allows the user to generate more specific outputs and alter key parameters to better understand the potential emissions impact of the EV Charging Roadmap.

### 6.3.6 Conclusion

This process has found that the rate of EV adoption has a major influence on the emissions impact of SECCCA's EV Charging Roadmap and that there are many factors impacting EV adoption that are outside SECCCA's control. This model attempts to illustrate the range of outcomes and what could be most realistically expected.

The rate of uptake of EVs has the largest impact on transport emissions abated in 2030, since this is being helped by the continued decarbonisation of Victoria's electricity grid. Other factors such as fuel efficiency improvement and grid decarbonisation have a smaller impact. For instance, even in the most pessimistic scenario (where EVs constitute only 5% of vehicles by 2030, participating Councils could avoid over 200 million litres of fossil fuels between 2022-2030; however this could be as high as one billion litres if EV uptake reaches 22% by 2030. This corresponds to between 100 and 550 kilotonnes CO2-e avoided by 2030 for participating councils (a 4-23% decline from current emissions of 2.4 million tonnes CO2-e ); cumulative emissions savings from 2022-2030 would amount to 400 & 1,800 kilotonnes of CO2-e in these scenarios, respectively.

Even today, swapping an ICE vehicle for an EV can save approximately 1.5 tonnes CO2-e emissions per year, for an average year of driving (~12,000km)[14]. Per-vehicle annual savings may improve as much as 50% over the next few years due to further EV efficiency improvements and electricity decarbonisation. Furthermore, the incremental increase in uptake in prior years could compound in later years and further hasten full-scale EV adoption.

Ensuring the use of renewable energy used for public charging stations (as included in the model already) and encouraging home charging to use renewable energy (e.g. through rooftop solar PV) are two ways SECCCA can help reduce emissions further.

[14] Assuming grid electricity for home charging (95% of all charging) and 100% renewable for public charging.

### 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 (see Figure 5). 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 the SECCCA councils' 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 4 The importance of renewable energy

## 6.4 Funding models and options

### 6.4.1 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 the growth of Commonwealth and State funding opportunities, as well as the increase in the number of EVs themselves. It has become increasingly clear during the course of this project that the commercial sector has a demonstrated interest in funding and managing public EV charging equipment and services. As of 2022, it is generally no longer necessary for councils to fund the provision of fast chargers at sites that have relative high forecast demand.

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 at focal points for the community (e.g. libraries, town halls, leisure centres etc.), often in the heart of activity centres. Councils are therefore in 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.

Many of the SECCCA participating councils have requested advice on whether fees should be applied to the use of EV chargers. Box 5 provides some guidance on this issue, and ultimately recommends that 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 vehicle to EV 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, as 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 driver further than they should, in order to receive free charging. Many users reside in another local government area, and this effectively means the local ratepayers are subsidising the electricity costs of others.

Ultimately, for the reasons identified above, where councils 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 5 Fees for charging - Guidance for councils**

### 6.4.2 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) for installing to directly raise revenue from charging.[15]

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

### 6.4.3 Billing system management

Unlike petrol stations, EV charging stations have no on site staff and 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 benefits 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, and this is at the heart of why billing and customer interface operations is a natural monopoly/ duopoly.

### 6.4.4 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)

[15] Site hosts (e.g. local businesses) seeking to attract customers are more likely to put in lower powered AC chargers.

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).

#### *6.4.4.1* 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. 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.

#### *6.4.4.2* 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.

#### *6.4.4.3* 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 6.4.5). 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 something that is market ready.

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.

#### *6.4.4.4* 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 close to 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 31 provides a summary of all four options, their pros, cons, risks, financial costs, emissions impact potential and capacity for Council to demonstrate leadership.

### 6.4.5 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.

Figure 43 offers an illustration of the type of infrastructure cities are now beginning to explore that offer a wide range of services, in addition to energy efficient LED street lighting.

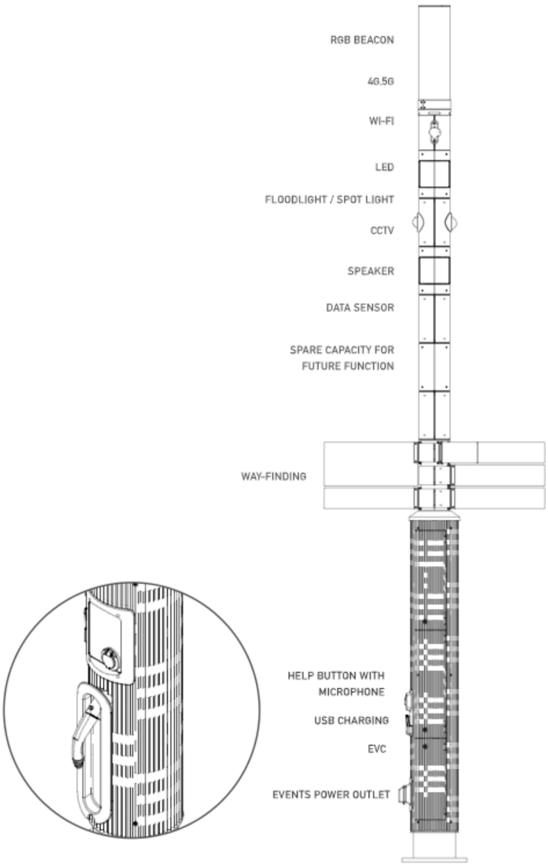



**Figure 43 EV charging linked to Smart City technology pole**

Source: http://ene-hub.com/smartnode/

| | Pro | Con | Risks | Financial Costs | Leadership |
|---|---|---|---|---|---|
| **Option A**<br>**100% council owned, built and operated** | Absolute control<br>Council seen to be exemplar for LG action on climate change<br>Council seen to be providing a practical service<br>Ability to subsidise uneconomic siting for equity reasons (to poorer households)<br>Asset ownership enables council to access potential 3rd party revenue streams<br>Potential for long term return if well managed | Limited capability (no economies of scale)<br>Limited capacity (need to provide customer support)<br>Size limited by CAPEX | Financial exposure<br>Marketing risk<br>structure of offer<br>pricing<br>placement of sites<br>promotion of service<br>Implementation risks leading to potential reputational damage:<br>budget overrun<br>milestone overrun<br>OH&S<br>Poor level of service/reliability | High | High |
| **Option B**<br>**100% council owned, build and operation outsourced under council direction** | High control<br>Council seen to be exemplar in LG action in partnership with private sector<br>Council seen to be providing a practical service<br>Ability to subsidise uneconomic siting for equity reasons (to poorer households)<br>Asset ownership enables council to access potential 3rd party revenue streams<br>Potential for long term return if well managed | 50% capability requirement<br>25% capacity requirement limited to manage private sector contracts<br>Size still limited by council CAPEX budget | Financial exposure<br>Marketing risk<br>structure of offer<br>pricing<br>placement of sites<br>promotion of service<br>Reputation loss in case of failure<br>Lower (75%) Implementation risks<br>budget overrun<br>milestone overrun<br>OH&S<br>Poor level of service/reliability | High | High |
| **Option C**<br>**Council sets project standards, outsources build and operation, leases access out, does not own asset** | Moderate control<br>Greater capacity to attract 3rd party services<br>smart city goals<br>utility backhaul<br>citizen WIFI<br>5G base stations<br>Dedicated & incentivised customer service offer<br>Scale benefit of potential rollout to other council areas<br>Size of offer not limited by council CAPEX, potential for cross-subsidisation of EV chargers by 3rd party revenue streams<br>Lower financial, reputational and implementation risks | Loss of control<br>Limited ability to require uneconomic siting of chargers<br>Lower visibility of council involvement, potentially offset by larger potential size when cross-subsidised<br>Difficult to upgrade<br>Private sector contracts and partnerships still has to be managed and supervised by council | Partner selection mistake<br>Equity considerations may be more difficult to enforce (use subsidies as incentive) | Low | Med-High |
| **Option D**<br>**Council offers access to its assets (lease) and external parties bid in EVC offers** | Low control<br>Size of offer not limited by council CAPEX revenue streams<br>Lowest financial, reputational and implementation risks | Loss of control, difficult to upgrade<br>Limited ability to require uneconomic siting of chargers<br>No visibility of council involvement<br>Still potential for reputational risk | Tenderer selection mistake (long term contract)<br>Lack of control leaves exposure to unknown factors (e.g. obsolescence)<br>Opportunity costs of giving up control & ownership | Low | Low |

**Table 31 Accessing EV charging delivery options**

#### Multiple approaches for different contexts

Council doesn't have to take the same approach everywhere. As highlighted in Table 31, 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 (could be of any kind for any or no particular target group).

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.

#### Multiple approaches for different contexts

- 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.

**Box 6 Ownership and operational considerations**

### 6.4.6 Victorian government support

The following provides a set of Victorian government EV related programs:

- Zero Emissions Vehicle Roadmap: https://www.energy.vic.gov.au/renewable-energy/zero-emissions-vehicles
- Zero Emissions Vehicles Commercial Sector Innovation Fund: https://business.vic.gov.au/grants-and-programs/zero-emissions-vehicles-commercial-sector-innovation-fund
- Electric Vehicle Subsidy Program: https://www.solar.vic.gov.au/zero-emissions-vehicle-subsidy
- Destination Charging Across Victoria Program: https://www.energy.vic.gov.au/grants/destination-charging-across-victoria-grant-program
- EV Charging for Business Fleets Program[16] (DELWP Grant), for which applications closed 4th February 2022: https://www.energy.vic.gov.au/grants/ev-charging-business-fleets
- EV Charging for Council Fleets[17], for which applications closed 4th February, 2022:

[16] https://www.energy.vic.gov.au/grants/ev-charging-business-fleets

[17] https://www.energy.vic.gov.au/grants/ev-charging-council-fleets

https://www.energy.vic.gov.au/grants/ev-charging-council-fleets

### 6.4.7 Commonwealth government support

The following provides a set of Commonwealth government EV related programs:

Future Fuels Program
https://arena.gov.au/funding/future-fuels-program/#step-2-prepare-your-response

This funding round opened on the 21st February, 2022 and will close when all funds have been exhausted.

Additional rounds of Commonwealth funding are expected to be announced in 2022 intended for public charging. This is of direct relevance to SECCCA.

### 6.4.8 Private sector

The Australian EV charging sector is growing rapidly and is increasingly seeing opportunities for installing fast charging stations at no or low cost to local government. Indeed some providers are willing to pay councils a monthly fee for the right to provide a charging station at certain (usually high value) locations.

In additional to traditional models, whereby a charging network installs a charger with the intention of covering their costs via a fee, there are other models that rely on advertising. JOLT is one such business, whereby the initial electricity consumption is offered at no cost to the vehicle owner. JOLT seek to draw revenue from advertising. It may be important to ensure the correct incentives are available to ensure such operators are focused on maximising the use of their charger, rather than simply relying on advertising revenue as their principal source of income.

# 7. Appendix 1 EV Charging Case Studies


Oslo, Norway. Photo: Mario Roberto Duran Ortiz

**This section provides a series of case studies on EV charging, from other local government areas, in Australia and abroad.**

Councils and other agencies are beginning to recognise the need to provide publicly available charging infrastructure. While some 95-98% of charging is typically done at the vehicle owner's home or workplace, there will be situations in which publicly available chargers will be required. This includes people away from their home charger and those without the capacity to park their car off street. This section focuses on what other councils are doing to help overcome the barrier to EV ownership caused by a lack of charging infrastructure.

A number of countries have begun developing charging networks at the national level, with a host of smaller, city scale programs having been implemented over recent years. The International Energy Agency have identified that while the very early adopters of EVs generally have their own private parking bay (off street parking), as the market broadens, there will be an increasing need to supply publicly available charging locations (International Energy Agency 2018). This view was confirmed in stakeholder consultation conducted as part of this project with the EV charging industry.

## 7.1 London boroughs

*Transport for London* require that 20% of all parking places in new developments must include an EV charging point. Importantly, EVs are viewed through the lens of London's aspiration for a lower level of car use, and their Transport Strategy includes restrictions in the development of new car parks.

In London, Local Authorities (LAs) are essential to the development of EV charging infrastructure, as they are most commonly the responsible authority managing on-street car parking (as is the case in Australia). London Boroughs have benefited from Central Government funds such as the *Go Ultra Low Cities Scheme* which provides information to assist people shift towards low emissions transport.

Electric vehicles are also exempt from the London *Congestion Charge*, which is currently $A28.17 per day.

A zoomed in map of London charging locations is shown in Figure 44. There are many fast chargers in central London, usually in larger, off-street car parks.

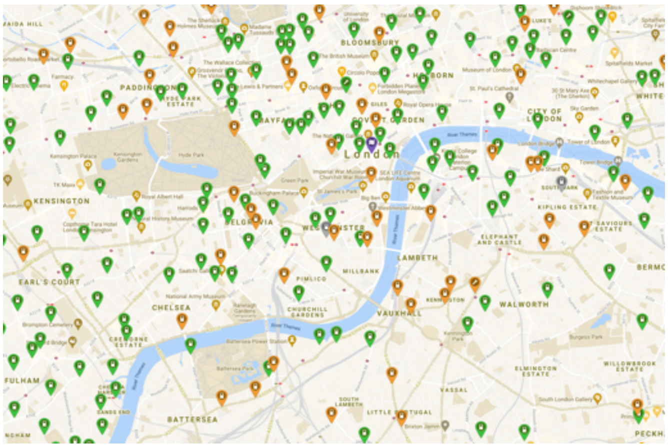



**Figure 44 EV charging locations, inner London**

Source: Plugshare

One of the many kerbside EV charging bays located in London is shown in Figure 45.


**Figure 45 Kerbside EV charging, London**

Source: Plugshare

The regulation of time limits and fees is somewhat more complicated for EVs than for ICE vehicles, because EVs consume both *space* and *energy* and it is important to apply a price to both. Figure 46 illustrates how Southwick Council in London communicates its regulation of EV charging. As with all policies, it must strike a balance between something that is both *fair* and *easily comprehensible.*

**The regulation of time limits and fees is somewhat more complicated for EVs than for ICE vehicles, because EVs consume both *space* and *energy* and it is important to apply a price to both.**


**Figure 46 Regulating the use of kerbside EV charging in central London**

Source: Plugshare

### 7.1.1.1 Hackney Council, London

The previous *Air Quality Action Plan* that ran between 2015-2019, has successfully implemented emissions-based parking across the majority of Hackney, and transitioned 12.3% of the council's total fleet to EVs. With Hackney declaring a Climate Emergency in 2019, the management of air quality issues will be in the updated *Air Quality Action Plan* 2020-2025. Hackney Council has adopted the following key priorities adopted to support the use of EVs:

- Assess potential impact of installing Ultra-Low Emission Vehicle (ULEV) infrastructure (e.g. EV charging points, rapid EV charging points)
- Increase uptake of EVs and ensure charging infrastructure is commensurate with growth in the Borough's Fleet.
- Assess the air quality benefits of the actions in *Rebuilding a Greener Hackney: Emergency Transport Plan*, the *Transport Strategy 2015 - 2025* and the *Local Implementation Plan 2019 – 2022*.

Due to the improvements in vehicle emission standards and the uptake of EVs, the Ultra-Low Emission Zone (ULEZ) will be expanded to encompass the whole of Hackney borough from October 2021. The ULEZ is implemented by Transport for London and is in operation at all times with the only exception of Christmas Day. £12.50 is charged daily for vehicles that do not meet ULEZ emission standards when they enter the zone.

Hackney is currently in partnership with the surrounding London Boroughs to expand the EV charging network on local residential streets.

Hackney has worked with external stakeholders to create a borough-wide network called *Source London*. For residential houses, it aims to provide a fast EV charge point no more than 500m from the residents' address.

There are currently 64 lamp column chargers, 22 free standing fast chargers and 11 free standing rapid charge points located in Hackney with a total of 296 chargers expected to be installed by the end of 2021[18].

**Hackney Ultra Low Emission Vehicle (ULEV) Streets**

Hackney City Council have launched two zones in the City Fringe that, during peak hours, will be restricted to walking, cycling, and low emissions vehicles only (vehicles that emit less than 75g/km of CO2). Petrol, diesel, and older hybrid vehicles will not be permitted on the streets during these hours.

ULEV streets will be in operation Monday to Friday, 7-10 am and 4-7 pm. Petrol, diesel, or older hybrid vehicles which aren't registered for an exemption aren't permitted to enter the streets during the operating times. These vehicles will be identified by camera and issued with a penalty charge notice.

**Box 7 Ultra low emission zones**

Source: https://hackney.gov.uk/ulev-streets

[18] https://news.hackney.gov.uk/3000-electric-vehicle-chargers-in-hackney-by-2030/

*Source London* is one of the EV providers in Hackney. They charge a flat fee for annual membership and offer a Pay-As-You-Go option.

It is envisaged that, in the long-term, Hackney aims to charge for parking in all EV charging points during Controlled Parking Zone (CPZ) hours, to discourage local car journeys.

Hackney was the first borough to install publicly accessible on-street rapid EV charging points for residents. Hackney currently have three 50kw rapid EV chargers. The following charges apply:

- Initial registration fee is £20, thereafter £20 annually
- Connection fee per charging session: £1.80 incl. VAT
- Usage fee: £0.30p incl. VAT per kilowatt-hour.

Residents and local businesses who own an EV will require a parking permit to park in their home zone area. The cost of a permit with no local emissions is £10 for 12 months, compared to £214 for vehicles emitting 226gCO$^2$/km or above.

In terms of improving the emissions performance of Hackney's organisational fleet, the Council was awarded £380,000 from the Mayor of London's Air Quality Fund (MAQF) to assist with the greening of the fleet. To support this, the Council will (Hackney Council 2015):

- Undertake a review of the potential and cost-effectiveness of equipping Hackney with one of the lowest emission Council fleets in London
- Identify realistic targets to reduce the size of the Council's fleet and increase the proportion of cycle freight, electric vehicles, and hybrid vehicles for the vehicles with highest utilisation
- Review the use of parking permits for private vehicles and essential car usage across the Council
- Ensure there is sufficient provision to charge EVs at all Council buildings and key destinations
- Explore opportunities to pilot and introduce hydrogen-powered vehicles into the fleet
- Continue the progress of the Council's *Workplace Travel Plan* and increase sustainable travel options for staff e.g. through a bike hire scheme.

#### 7.1.1.2 London Borough of Hounslow

Much of the housing stock in Hounslow, London lacks off-street parking. In order to overcome the barrier that this might present would-be owners of EVs, the Borough of Hounslow began a trial of retrofitting EV charge points on lamp posts. An excerpt from Hounslow's communication to residents regarding EV charging is shown below.

**Charging points for residents without off-street parking**

Hounslow are committed to providing EV charge points for residents who own an EV or are considering buying one but do not have off-street parking available. As the majority of electric / hybrid owners usually charge their cars overnight on a driveway, the Borough recognise that residents without off-street parking might be put-off purchasing an electric or hybrid vehicle because they do not have access to nearby charge points.

**Eligibility requirements**

In order to be eligible for the scheme residents need to:

- demonstrate they already own an EV or plug in hybrid or have committed to purchasing one
- have no off-street parking on their property

Applicants make a financial contribution of £500 towards the cost of the charge cable.

**Box 8 EV Charging for residents without off-street parking**

Source: London Borough of Hounslow. See https://www.hounslow.gov.uk/xfp/form/331

Hounslow have partnered up with Shell subsidiary *Ubitricity* to install streetlamps with energy efficient LEDs (see Figure 47). While this firm does not currently operate in Australia, it is investigating options for establishing a presence in Australian cities.

Fees for the energy used is determined by the supplier and the amount consumed and is billed to the user of the smart cable.

As of 2020, EV charge points outnumber petrol stations in Hounslow two to one.

**Figure 47 Lamp post charging, London**

Source: https://www.ubitricity.co.uk

### 7.1.1.3 Westminster City Council, London

In Westminster there are over 1000 on-street 3kw or 7kw charging points. There are dedicated charging bays where you can charge for up to 4 hours from 8.30am to 6.30pm every day, as well as points fitted into lamp posts, alongside existing resident or pay-to-park bays. Figure 48 provides an indication of the different charging opportunities in Westminster.

In terms of the operators of the charging points, this is done by a number of third-party providers, including *Source London*, *Chargemaster*, *PodPoint*, *ESB (for taxis only)* and *Ubitricity*.

In an initiative launched in May 2021, Westminster City Council and Ubitricity partnered to repurpose EV charging bollards into a power supply for market stallholders at Tachbrook Street Market[19]. Such evolving technology demonstrates the possibilities for EV charging infrastructure to be multifunctional.

Overall, London has benefitted from a range of factors that work to encourage the use of EVs over ICE vehicles: The *Congestion Charge* helps to improve the cost competitiveness of EVs over ICE vehicles; the ULEZ enhances the accessibility of EVs over ICE vehicles; and, the proliferation of publicly available charging locations gives drivers the confidence they need regarding battery recharge. Finally, the progress London has made regarding EVs could not have come about without strong leadership and funding availability and policy support from Transport for London.

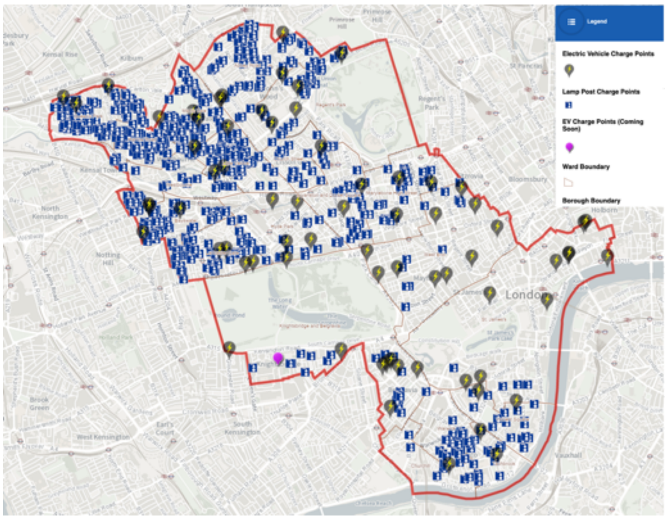


**Figure 48 Westminster EV charging**

Source: https://tinyurl.com/36cp9ta8

## 7.2 Norway

It is well recognised that Norway leads the world on EV policy. It has the highest take up of EVs. In November 2021, sales data shows that 73.8% of all new vehicles sold were EVs[20]. The Norwegian government has set a goal for all cars sold by 2025 to be zero-emission vehicles and have implemented the following policies to encourage the take up of EVs (Lorentzen 2017, Norsk ElbilForening 2020):

- No purchase/import tax (1990)
- Exemption from 25% VAT on purchase (2001)
- Low annual road tax (1996), road tax was replaced by motor insurance tax in 2018
- No motor insurance tax (2018)

[19] https://www.ubitricity.com/westminster-installs-ubitricity-charge-points-to-solve-power-supply-for-street-markets/

[20] https://ofv.no/bilsalget/bilsalget-i-november-2021

- No charges on toll roads or ferries (1997/2009 - 2017)
- '50% rule' so fee for ferries, tolls and public parking is 50% cheaper for EVs compared to ICE vehicles
- Free municipal parking (1999-2019)
- Access to bus lanes (2005), amended to only allow EVs carrying two or more people on specific corridors during peak periods (2017)
- 50% reduced company car tax (2000)
- Exemption from 25% VAT on leasing (2015).

Data from the Norwegian EV consumer survey shows that almost all charging is done at home and fast chargers are only used 13 – 16 times per year, on average (Institute for Transport Economics 2016).

The Norwegian Centre for Transport Research also notes that Norway has some suitable characteristics for EVs, including:

- Clean, low cost electricity – 98% hydroelectric
- High taxes on vehicles and fuels since the 1960s
- No vehicle manufacturers
- >75% can park on own property
- Strong electrical grids, as electricity is used for heating.

### 7.2.1.1 Pricing comparison

Three models of a popular car (VW Golf) are presented in Figure 49 to demonstrate the impact of the various financial incentives in place in Norway. This demonstrates that when taxes are applied to the ICE models, the EV becomes the cheapest of the three options

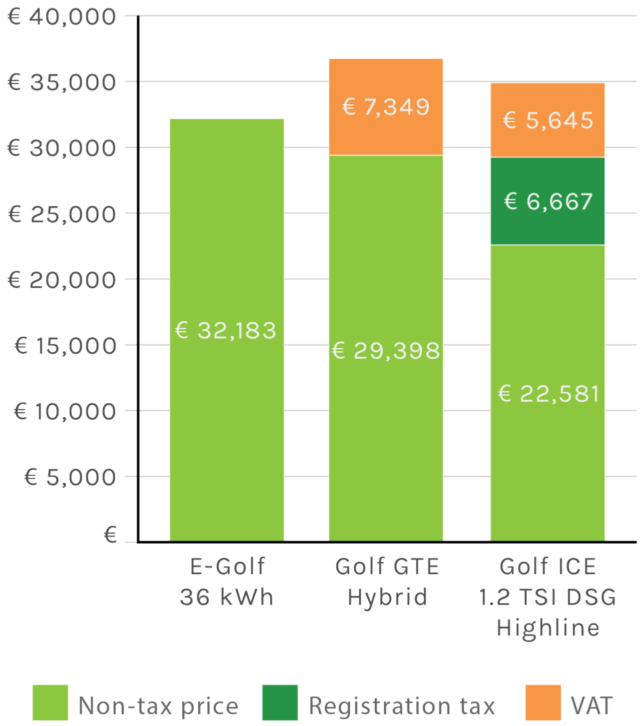



**Figure 49 Golf price comparison, Norway**

Source: Beate Inger Hovi, Norwegian Centre for Transport Research

The financial benefits for EVs is amplified when considering the annual cost of ownership of an EV, compared to an equivalent model ICE car, as demonstrated in Figure 50.

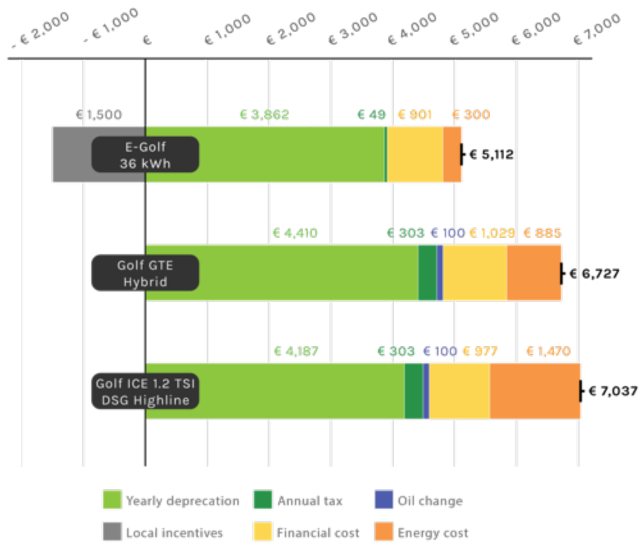



**Figure 50 Annual cost of ownership, Norway**

Source: Beate Inger Hovi, Norwegian Centre for Transport Research

The local incentives shown in Figure 50 above include access to bus lanes, reduced ferry rates, free parking, and free toll roads. As adoption of EVs in Norway continues to increase, it is expected that many of these local incentives will be reduced, and some already have been.

A national fast charge support program which has been in operation since 2011 provides two 50kW chargers per 50km on all main roads. Municipalities/provinces offer regional support for charging.

The widespread take up of EVs has led the private sector to begin offering a large EV fast charging network. For instance, the convenience store chain *CircleK* now provide a network of EV chargers, including 350kW ultra-fast chargers at its chain of convenience stores linked to petrol stations and motorways. One of the learning experiences has been to avoid placing only one or two chargers in isolation, for public, mid-point chargers. These chargers are avoided by customers as it is seen as a risk to drive to one that is occupied. CircleK now only provides banks of at least six chargers. In 2020, there were almost 17,000 charging stations in the country, with over 3,300 of those being fast chargers[21].

In terms of the different types of chargers available in Norway (and other European countries), Table 32 provides a summary of the type, the time it takes to charge and the costs of the charger itself. As highlighted in other areas of this report, the faster the charge rate, the higher the capital costs for installation.

**Table 32 Charging types in Norway**

| TYPE | POWER OUTPUT | KILOMETRES PER 10 MINUTES OF CHARGE | TYPICAL LOCATIONS | COST FOR A SINGLE CHARGING POINT* |
|---|---|---|---|---|
| AC Mode 2 Home | up to 11kW | 1-2 | Home | < Euro (EUR) 800 |
| AC Mode 2 Commercial | up to 19.4kW | 3.2 | Private, Workplace, and Public | <EUR 2,000 |
| AC Mode 3 Fast Charging | 22kW or 43kW | 21 | Public, Private | EUR 1,000-4,000 |
| DC fast charging (standard) | 20-50kW | 64 | Public, Private | EUR 20,000 |
| DC high power fast charging | 100-400kW | 90 | Public | EUR 40,000-60,000 |

Source: Spöttle et al (2018)

*Note: this is only the purchase cost of the charger itself, not the installation, grid connection or operational costs.

In terms of the location of fast charges, the overwhelming majority are located on major transport corridors. Figure 51 shows one new ultra-fast charging station launched by *CircleK* off a motorway.


**Figure 51 350kW ultra fast charger, Norway**

Source: CircleK

### 7.2.1.2 Charging initiatives in Oslo

Oslo is at the centre of Norway's transition towards EVs. As indicated earlier, there are a range of incentives designed to encourage residents to adopt EVs, and charging is one of them. According to the Vice Mayor for Environment and Transport in Oslo, Lan Marie Nguyen Berg, there was initially a ratio of one charger for every four EVs. Due to the increased take up of EVs, there is now one charger for every 10 EVs. To respond to this imbalance, Oslo is ramping up the provision of EV charging infrastructure.

The City of Oslo through the Agency for Urban Environment allocated €540,000 per year for four years to establish 400 chargers in 2008-11 (URBACT 2015). Oslo determined that a lack of charging infrastructure is a major barrier for increasing EVs.

Oslo currently has over 1,300 charging points with a goal of increasing this by 600 chargers per year between 2018 and 2021. The city will install at least 400 new semi-fast chargers, 200 regular chargers, and 6 fast chargers in addition to subsidising 8,000 charging points in apartment buildings due to a high public demand (Nguyen Berg 2018).

The following process was used to determine where these charges will be installed:

1. Collaboration with the EV Association of Norway.

[21] https://www.visitnorway.com/plan-your-trip/getting-around/by-car/electric-cars/

2. Oslo residents were surveyed via local paper receiving feedback from both current EV owners and potential customers.
3. Field research to note and map where EVs were currently parked and if they had charging opportunities.
4. Determine where established sources of electricity exist.

Oslo also created a subsidy program for apartments, stores, private companies, and shopping malls in the event the city could not act due to site jurisdiction. The subsidies could be up to €1200 per charging point to cover the purchase and installation cost of a charging point (URBACT 2015). This allowed for 350 additional charging points to be implemented from 2008-2015.

As of March 2019, fees have been introduced in public stations to improve turnover of spaces. The fee is based on *time spent charging,* not *kWh usage*. The question of whether to charge based on time spent in space or electricity consumption is a common issue for cities installing publicly accessible EV charging. In 2020, a hike in fees announced by European electric fast charging network Ionity[22], drew a backlash from the Norwegian EV association. The previously fixed rate of A$12.90 was replaced by a price-per-kWh rate of A$1.37/kWh. The new pricing structure favoured subscription services to the different car manufacturers for a discounted rate[23].

### The cost of using EV chargers: Applying fees for time, energy consumption or both?

One consideration for SECCCA relates to what is more valuable; *space* or *electricity*? Not all EVs can accept kwh at the same rate, and therefore a time-based charge may favour high end vehicles. For fast chargers, it is appropriate to charge for both *space* and *electricity* usage. A time charge pays for the equipment, and an energy fee pays for the electricity used.

For chargers delivering 7kW or less, the cost of electricity dominates and the cost of the charger is negligible. However, a time charge encourages turnover, and can be set at a level that recovers energy cost too, as charge rates do not vary as much between vehicles. Ideally, both time charge and energy charge should vary over the day to reflect relative demand and costs, as per the Oslo time example below.

Depending on location, the fees for charging at Oslo municipality owned chargers are A$2.33 or $1.55 per hour from 9am to 8pm and for the rest of the day it is A$0.82 per hour. Fees have been kept low because a majority of EV users charge at home or at work, whereas public charging stations are typically used for short charges. In 2017, one critique regarding the payment came from the EV Association, which advocated for fees based on kWh and not time because fast chargers consume more power. Nonetheless they support fees to encourage commercial development of charging stations and believe the city needs to radically increase the number of charging stations since there is currently only one public charger for every ten EVs (not counting home chargers).

Since 2015, the Norwegian EV Association has provided a universal charging tag to all their members. This tag can be registered with many of the charging operators for easier access and payments. According to an 2017 member survey, the tag is the most important service provided by the association (Lorentzen 2017).

[22] https://ionity.eu/_Resources/Persistent/a/7/c/7/a7c7cece094e15da7bfc2864a74e62b51c8d829a/_20200116_IONITY_PRICING_EN_.pdf

[23] https://thedriven.io/2020/01/20/norway-horrified-as-new-rates-make-ev-charging-prices-higher-than-petrol/

#### 7.2.1.3 Taxis

Taxis typically drive between 10 and 25 times more than the typical private car (Davies and Fishman 2018). As such, the City of Oslo has partnered with the taxi industry via the creation of moderate and fast charging stations that are dedicated to taxis. Other examples of private enterprise participating in EV charging projects include a real estate firm (Aspelin Ramm), creating a parking garage with 102 charging points where parking is free for EVs in the evening and overnight. Two chargers are DC fast chargers and the remaining are AC slow chargers.

#### 7.2.1.4 City of Oslo – organisational fleet

As SECCCA participating members have a strong ambition to lower transport emissions, it is useful to explore what the City of Oslo has done to help its transition to EVs within its organisational fleet. Oslo's current goal is to reduce by 95% the city's emissions by 2030, from 2009 levels. To help achieve this, Oslo conducted a purchasing agreement of 1,000 EVs. The program costs €6.2 million and provides interest-free loans to its various agencies to make the switch.

**What Oslo, and Norway generally, have been able to demonstrate is that with a range of financial and convenience incentives in place, people are willing to make the transition to EVs.**

What Oslo, and Norway generally, have been able to demonstrate is that with a range of financial and convenience incentives in place, people are willing to make the transition to EVs. By providing access to bus lanes and high occupancy vehicle lanes, free access to toll roads, lower cost parking and purpose price incentives, people choose EVs. The fact that EVs now outstrip ICE vehicles in Norway is proof that that given the right mix of carrots (for EVs) and sticks, such as high cost of petrol (for ICE vehicles), EVs have become a compelling value proposition.

## 7.3 Vancouver, Canada

The City of Vancouver has committed to encourage a shift in the fleet mix in favour of EVs. The framework used to guide Vancouver's EV-related initiatives is captured in the *EV Ecosystem Strategy* (City of Vancouver 2016). There are three primary goals of the Strategy:

1. *Accessibility*: Improve access to charging infrastructure.
2. *Affordability*: Reduce the barrier presented by upfront cost.
3. *Economic opportunity*: Develop a market large enough to support the private sector to operate charging infrastructure.

While Vancouver may use different terminology, a similar spectrum of strategic approaches were applied in Norway.

The *EV Ecosystem Strategy* takes place over five years and has been allocated $3M to cover:

- $2M for fast charging infrastructure
- $500,000 for Level 2 expansion in recreation centres or parks
- $500,000 for a multi-family building/workplace retrofit program.

The City of Vancouver (City of Vancouver 2018) ran a *Curbside [sic] Electric Vehicle Pilot Program* which residential and non-residential property owners can participate. Only 15 stations were budgeted for in the pilot program. One of the conditions of participation was that the applicant could not have access to an off-street parking location. Pilot project users were prohibited from the resale of electricity and from charging a fee. An additional five stations were included under the pilot project for non-residential applicants, at kerbside locations (City of Vancouver 2018). The pilot program was concluded in 2019, and in 2020, the *Climate Emergency Action Plan* was adopted with a goal to cut carbon emissions in half by 2030. A target of 50% of the km driven on Vancouver's roads to be by zero emission vehicles, aligns the action plan of the *EV Ecosystem Strategy*. The action plan included developing the private and public charging networks (City of Vancouver 2020). A schematic of the action plan is shown in Figure 52.

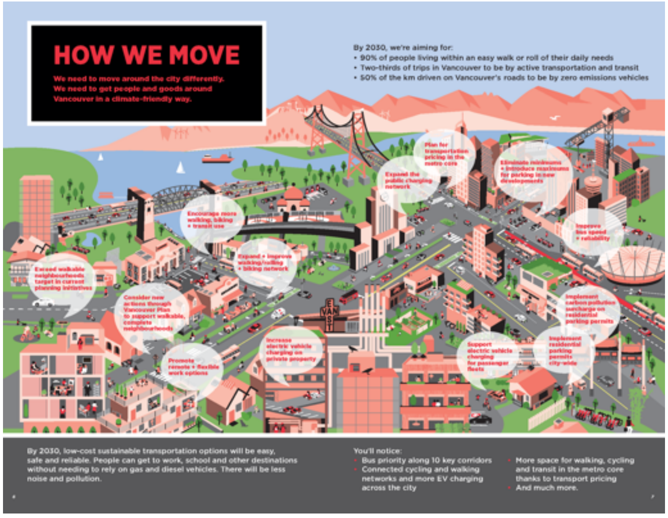



**Figure 52 How We Move from the City of Vancouver Climate Emergency Action Plan**

Source: City of Vancouver Climate Emergency Action Plan Summary

### 7.3.1 Fees

Vancouver chose to implement a fee structure intended to offer a user-friendly experience for payment and is cost competitive with the fuel costs of an ICE vehicle. Fees were introduced in November 2018 for nine charging stations that needed greater turnover (City of Vancouver 2018). Fees were based on a duration model and not per kW usage. Fees were in effect from 9am to 6pm and evening or overnight rates were free. Fees start at $2-per hour for Level 2 chargers, and $0.26 per minute for a DC fast charger (City of Vancouver n.d.), with highest rates in areas with stronger demand and more expensive general parking. The cost of charging an EV in these areas reflects the higher value space.

### 7.3.2 Private sector involvement

Vancouver envisions the private sector taking a greater role in investment and operating charging infrastructure in the medium term (2 – 5 years). As previously mentioned, Vancouver supports this market change through building regulation changes and mandating EV charging stations for every parking stall in new multi-family residential units (City of Vancouver 2016). The City will also partner with organisations that are ideal sites for fast charging stations but are not on City owned land. By providing financial support to ensure the uptake of charging infrastructure, the network and partnerships can increase. To encourage greater participation from residents to switch to EVs, owners or building managers who meet eligibility requirements can apply to have City-owned EV chargers installed in their buildings for use by tenants. This program is paid by council with part funding from BC Hydro, a government owned power provider. Vancouver council will pay up to $93,000 for the infrastructure, including the cost of the chargers, and applicants are required to contribute $2,000 (City of Vancouver n.d.).

## 7.4 Seattle, USA

The City of Seattle, under its *Drive Clean Seattle* implementation plan includes the goal of having 30% of cars being EV by 2030 (City of Seattle 2019). Under the Plan, charging infrastructure must also integrate any paid parking and fee collection into a single transaction. The charging station owner must also pay for any lost meter revenue in the event no EV is being charged. Private owner stations are responsible for construction and maintenance costs, whereas publicly owned infrastructure construction costs will be covered by the City, excluding maintenance and repair. Each infrastructure owner must also have general liability insurance.

The Seattle Department of Transportation concluded the *Electric Vehicle Charging in the Public Right-of-Way (EVCROW) Pilot Program*[24] in 2019. The purpose for the program was to establish guidelines for EV charging on non-residential streets within Urban Centres and Urban Villages and commercial streets outside of Urban Centres and Urban Villages. The Permit Pilot was the first step in a multi-step process to develop right-of-way charging policies city-wide. Seattle kerb space policies prioritise space for EVs for short-term and shared-use as opposed to long-term vehicle storage on right-of-way in commercial and mixed-use areas. The data acquired from this program was evaluated and presented in *the EVCROW Evaluation Report* (Seattle Department of Transportation 2019) with some notable points brought up in the discussion:

[24] http://www.seattle.gov/Documents/Departments/SDOT/NewMobilityProgram/EVCROW_Program.pdf

- Some EV drivers use EVCROW stations as their primary charging point, thus making EVCROW solutions an alternative to at-home charging.
- Off-street spaces should be utilised for EV charging and Right of Way space for public and active transport. Prioritising Right of Way charging where off-street charging isn't available should only be adopted where off-street EV charging is not able to provide adequate support.
- Sites for EVCROW should not conflict with existing Right of Way demands, and the priority should still be on walking, biking, and public transport.
- Expansion of EVCROW should identify the desired use-case and design with the end-user in mind. A Right of Way equity toolkit can help implement strategies in areas of high displacement risks.
- There is concern that installing Right of Way EV charging station will remove parking for residents and exacerbate gentrification and displacement in disadvantaged communities.
- Permit structure, requirements and application process needs to be simplified.

Seattle City Light will construct and maintain 20 DC fast chargers and have a fee structure that is set at US$0.33/kWh between 7am – 7pm from Monday to Saturday, with a cheaper rate applies for all other times; payment is possible through an app, an RFID card, by phone, or by credit card (Seattle City Light n.d.). A residential charging pilot project to assist in the installation of 200 EV chargers in homes also took place in 2017.

**Figure 53 Two DC Fast Chargers owned by Seattle City Light on the 2500 block of 16th Avenue S**

Source: EVCROW Evaluation Report

Seattle aims to begin public-private partnerships with EV industry partnerships for the purpose of improving charging infrastructure throughout the city as well as electric shared transport options (City of Seattle 2019).

#### 7.4.1.1 Planning codes

In 2019, Seattle City Council passed an EV readiness ordinance requiring all new developments that include off street parking to provide power outlets for EV charging (U.S. Department of Energy 2021). Seattle is far from the only US city with a requirement to install EV chargers. In San Francisco, for instance, 10% of parking spaces in new construction must have level 2 chargers.

**It is now a requirement in Seattle that 20% of the parking bays in multi-dwelling developments must be equipped with wire conduits to facilitate the installation of EV chargers**

#### 7.4.1.2 EV Fleet

Seattle has undergone a significant fleet transformation since 2010 when they were provided federal funding to begin investment in EVs.

Through the Green Fleet Program, the municipal fleet comprises more than 500 petrol/electric hybrid vehicles and 300 EVs. Approximately 80% of the light-duty fleet is fully electrified with plans to retrofit vehicles that cannot yet be electrified, i.e. Class 8 trucks are outfitted with auxiliary battery power to eliminate emissions from idling (U.S. Department of Energy 2021). The transition towards an EV fleet has resulted in a 40% reduction in operating costs compared to ICE vehicles as well as 98% reduction in greenhouse gas emissions due to the fleets' powering via green energy (Seattle Office of Sustainability & Environment 2017).

## 7.5 Adelaide: Case Study

### Focus area: Public charging infrastructure

The City of Adelaide is one of Australia's most advanced local governments in terms of the number of public charging facilities it has installed. The City of Adelaide is heavily involved in the off-street car parking market, operating a number of multi-deck car parks generating revenue for Council (UPARK). It is partly as a consequence of this historical fact, coupled with the Council's interest in lowering transport emissions that have motivated the City of Adelaide to provide EV charging facilities.

There are currently around 30 charging bays located in their off street car parks, provided by the City of Adelaide. These are AC chargers.

In addition, the City of Adelaide has four charging bays (plugs) from two Tritium 50kW DC units. There are also four Schneider 22kW AC 3 Phase chargers co-located with the fast chargers. The fee for the use of fast chargers is 35 cents per kWh, compared to 25 centres per kWh for the AC chargers.

The 22kW AC chargers require the vehicle owner to bring their own cable with a Type 2 (Mennekes) plug, whereas the fast chargers have their cable fixed to the charger.

Ease of payment was an important consideration for the City of Adelaide. When they developed their RFQ, suppliers were required to offer Paywave, in addition to App-based payment, to maximise the ease with which people were able to use the EV chargers. While limited data is currently available regarding usage rates, it was implied during a phone call the author had with the City manager that usage rates are currently low, though increasing over time. Figure 54 captures the Tesla Super Charger station in the centre of Adelaide (installed independent of the City of Adelaide).

The use of the 22kW AC chargers requires payment for on-street parking, in addition to the electricity consumption. Time limits apply, to ensure access is maximised. Initially, the City of Adelaide did not provide clear signage that the bays were only to be used by EVs. As a consequence, there were instances of ICE vehicles parking in EV only bays. They have since improved signage to minimise incursions.


**Figure 54 Tesla Super chargers, central Adelaide**

Figure 55 shows an example from Adelaide of the information provided to the public regarding the use of EV charging bays.


**Figure 55 Information on EV charging in the City of Adelaide**

The network tariff increases as the consumption spikes, though it is possible with the system Adelaide has deployed to throttle down in high demand times. The City of Adelaide is currently working with the Department of Energy and Mining to develop a trial using smart chargers that will capitalise on the excess renewable energy in the middle of the day. This program will use Schneider 7kW AC wall box chargers.

#### 7.5.1.1 Key lessons learnt

- BYO cable reduce the risk of trip hazards, copper theft and plug crash/vandalism rates (though Moreland City Council provide cables and have not experienced vandalism, as described in Section 7.6).
- Streamlining the connection types to only CCS 2 in the future will simplify the use and operation of the EV chargers
- 'Nose to Kerb' is best for on street bays. Angle parking can cause a problem for 5m cables.
- Parallel bays are not considered acceptable to risk managers as the user may need to stand on the traffic side of the car to plug/unplug cable. Additionally, cyclists may be placed at risk, with cables and charging port doors. Given that most of the EV market is designed for countries driving on the right-hand side of the road (i.e. Europe and North America), for countries that drive on the left-hand side, such as Australia, the charging port on the car faces the street rather than the kerb.

All electricity supplied to the chargers is sourced from renewable means. The City of Adelaide are set to strategically review their EV charger program in 2022, in light of changing EV ownership, the commercial sectors' activity in this space and the impact of wholesale electricity price changes.

## 7.6 Moreland City Council: Case Study

### Focus area: Public charging infrastructure

Moreland City Council are considered one of the most advanced municipalities in Melbourne with regards to the deployment of publicly available EV charging infrastructure.

Moreland's EV charging program began eight years ago, when Council participated in the Victorian Government's Electric Vehicle Trial. The trial included the launch of Victoria's first EV fast charge station as well as the first trial of a plug-in electric car share service. On-going expansion of the network means that Moreland currently manages one of the largest charging networks owned and operated by council in Australia. The overarching objective of Moreland's EV charging program is to decrease emissions of the organisation's fleet and increase the uptake of EVs among the community.

### 7.6.1 The charging network

Moreland Council runs a network of sixteen EV chargers. Eleven are for public use, capable of charging fourteen cars simultaneously. For of these chargers are 50kW DC 'fast' chargers. Five chargers are reserved for Council only use, and these are capable of charging nine cars simultaneously. Council owns 28 EVs, making up almost half of Council's car fleet. There are 2 – 3 EVs in Council's EV fleet per charger bay reserved for Council,

The Moreland Brunswick EV Hub, composed of two 50kW DC fast chargers and two slow charging bays was the busiest on the Chargefox network in early 2021. Figure 56 shows both the 7kW AC chargers (to the left), and the faster, DC chargers (on the right). The time limit varies at the EV Charging Hub depending on whether it is a DC (fast) or AC (slow) charger (see Figure 56).


Figure 56 EVs charging at the Brunswick EV Hub

Table 33 provides a summary of the slow and fast chargers at the Brunswick EV Hub in Moreland.

**Table 33 Brunswick EV Hub User Statistics**

| | Slow (AC) Charger | Fast (DC) Charger |
|---|---|---|
| **No. of charging sessions per day** | 5 | 9 |
| **Duration of stay** | 65 min | 40 min |
| **Cables provided?** | Yes | Yes |
| **Cost per kWh for the user** | Free | Free |
| **Time limit** | 3 hrs | 1 hr |
| **Average energy consumed per charge (kWh)** | 6 | 21 |

There are a number of possible reasons for the popularity of the Brunswick EV Hub. Electricity is provided for free, the site is on a key transport route (Sydney Road), near a busy shopping centre (Barkly Square), and is located in a built-up area where residents tend not to have off-street parking. As well as this, the hub is surrounded by a diverse set of destinations including numerous cafes, an activity centre and a wide variety of businesses (see Figure 57).

**One of the reasons for the popularity of the Brunswick EV Hub, apart from the fact it is free, is the location. It is very close to a large variety of shops, cafes and other services.**

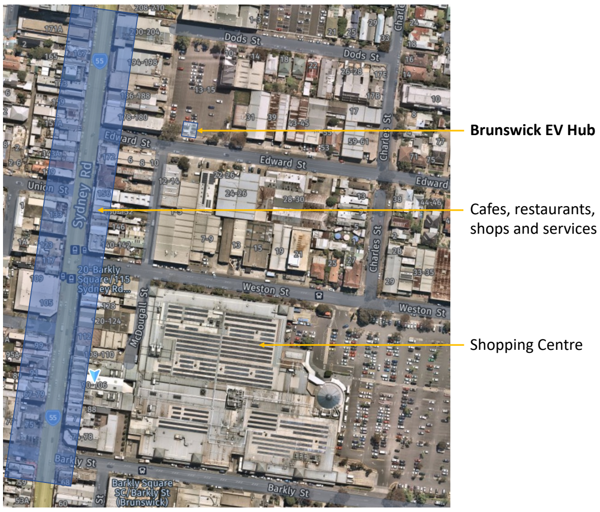



**Figure 57 Brunswick EV Hub is surrounded by popular destinations**

It is important to recognise that not all chargers in Moreland are busy. Two of the slower (AC) chargers were used less than once per day during the assessment period. These are located next to aquatic centres, which were closed during COVID-19 lockdowns. These chargers are seeing usage increase with the aquatic centres reopened. The busiest AC chargers are those located near fast chargers.

Moreland's charging network contains a range of chargers and all have performed well. Key charger models are the Schneider EV Link (AC charger), Keba AG (AC charger) and Tritium (DC charger).

Some 37% of all charging sessions at Moreland public chargers are by vehicles registered to a Moreland address. This may be due to commuters working in Moreland, or the chargers are attracting visitors to the area. Further research is needed to quantify the economic benefit to the local area of EV owners waiting for their vehicle to charge.

**Some 37% of vehicles using Moreland chargers are registered to a Moreland address.**

### 7.6.2 What makes a successful charging network?

The chargers provided by Moreland Council are all 'tethered' – a charging cable is locked to the charger, so that users do not need to bring their own cable. Council considers this provide a better user experience, and Council has not experienced theft or vandalism of these cables. Moreland has not received reports of 'ICEing', where an ICE (Internal Combustion Engine) parks in an EV-only charging bay. Overstays are an issue, however, where EVs stay parked longer than permitted. Moreland have installed remote sensing technology that alerts compliance staff to EVs that have remained in the bay longer than the time permitted.

All electricity provided at Moreland EV chargers is zero-carbon, sourced from the Crowlands Wind Farm under the Melbourne Renewable Energy Project (MREP). This fact is advertised on Moreland's chargers, and has been highlighted as something very important to the community.

### 7.6.3 What's next?

The charging network will continue to grow. Moreland's Sustainable Buildings Policy (link) requires that EV chargers be installed on suitable Council sites when Council carries out a significant construction or refurbishment project. Work is also on-going to incorporate a requirement for EV infrastructure within the Moreland Planning Scheme.

Moreland is keeping a keen eye on new business models in the EV charging space, where commercial organisations offer to install and maintain chargers in exchange for long-term leases. Moreland will continue to assess whether these offerings can successfully complement the existing charging network.

Moreland is also keen to explore whether car share providers could start to offer EVs. Barriers include insurance limits on car-share vehicles, and matching charging infrastructure to the needs of these vehicles. It is however an area that offers significant potential environmental benefits.

## 7.7 Existing Australian Road Rules for parking a non-EV in an EV bay

The City of Adelaide sought advice from the National Transport Commission (NTC) regarding the Australian Road Rules for parking a non-EV in a bay marked as EV only. The following provides a summary of the advice:

> *At present there is no defined offense for parking in an area reserved for electric vehicle parking. Additionally, there is no means to formally restrict an electric vehicle bay to those charging their vehicles at charging stations. Whilst we are currently trying to limit abuse of spaces by having time limits that can be expiated, there remains no means of expiation against vehicles that are not electric and/or are not using the charging bays to charge their vehicles. There is also a need to differentiate between electric vehicles that can be plugged in for charging versus hybrid vehicles that are unable to utilise electric vehicle charging infrastructure.*

In summary, EV charging bays are currently not enforceable. It has been recommended to the NTC that an *'Amendment to Part 12 Division 6 to include a section on Stopping in a parking area for electric vehicles and also include a requirement for a vehicle to be plugged when parked at a charging station'*. It is recommended SECCCA members investigate progress on this issue prior to implementing any publicly available EV charging bays. This presents an opportunity for Council officers to gain a greater understanding of current enforcement policy regarding the use of EV parking bays for non-EVs.

## 7.8 Summary

The case studies highlighted in this section have illustrated that many cities have maturing programs in place to overcome the barrier to EVs related to charging. Cities are beginning to extend their networks of on-street charging (both fast and slow chargers) and establish planning controls to ensure newly constructed buildings have charging infrastructure included in their design.

While cities like Oslo, London and Seattle are more advanced than all Australian cities in relation to the development of their EV charging network, some Australian regions have begun to develop a publicly available network of chargers. Adelaide City Council and Moreland City Council are among the most advanced. It is important to note that utilisation rates are still relatively low. The SECCCA should not expect publicly available charges to have a very high initial utilisation rate. As highlighted earlier, this demonstrates the multiple factors that influence EV adoption, whereby the provision of EV charging infrastructure is an example of a factor. The key implications from the Australian case studies presented in this section are:

- Charge a fair price
- Require users to bring their own cable to reduce vandalism
- Offer easy payment options (e.g. tap and go)
- Be conscious of safety factors when determining which bays to use
- Lead by example: Ensure EVs are used by the most prominent members of Council.

# 8. Appendix 2 Transport and Population Background Analysis

**This section provides an analysis of existing travel patterns, transport network and population features within the study area. This was used to inform the development of suitable charging locations and appropriate charging speeds for this project.**

## 8.1 Analysis of travel patterns and land use

### 8.1.1 Journey to work data, both from a trip origin and destination perspective.

The ABS Census is the most comprehensive dataset on trips in Australia. While all households participate in the census, only data related to journeys to work are collected. The mode share for journeys to work, by LGA of origin, is shown in Figure 58. The car is the dominant in all LGAs, however, there is variation. In Kingston, 80% of journeys to work are by car, while 91% of journeys to work in Mornington Peninsula are by car.

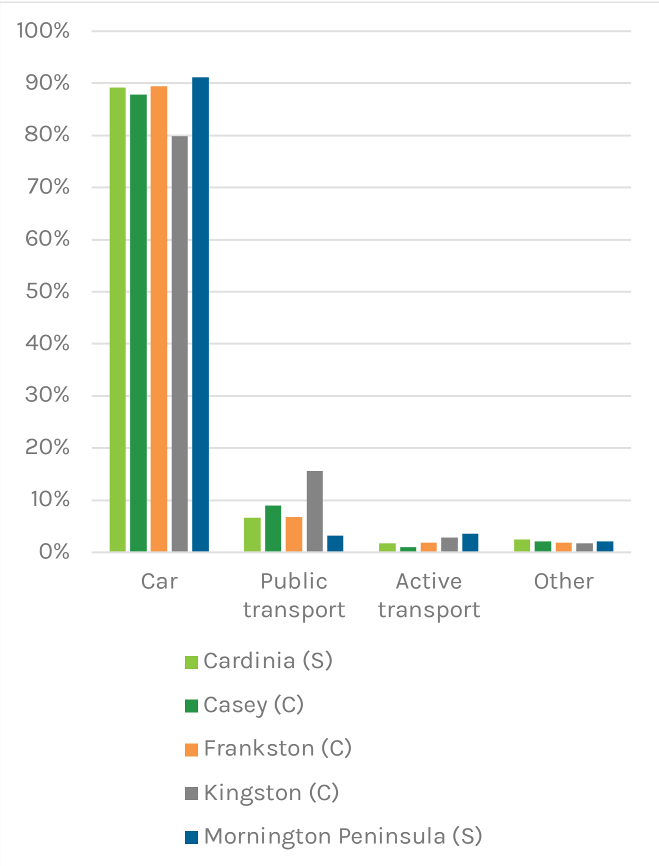



**Figure 58 Journey to Work mode share by origin LGA**

Source: ABS Census 2016

Census data can also be integrated to reveal journey to work mode share by destination. Figure 59 shows journey to work mode share by LGA as a destination. The car is the dominant mode of journey to work, for commutes ending in the five LGAs. Between 91% (Kingston) and 93% (Casey) of all journeys to work are by car.

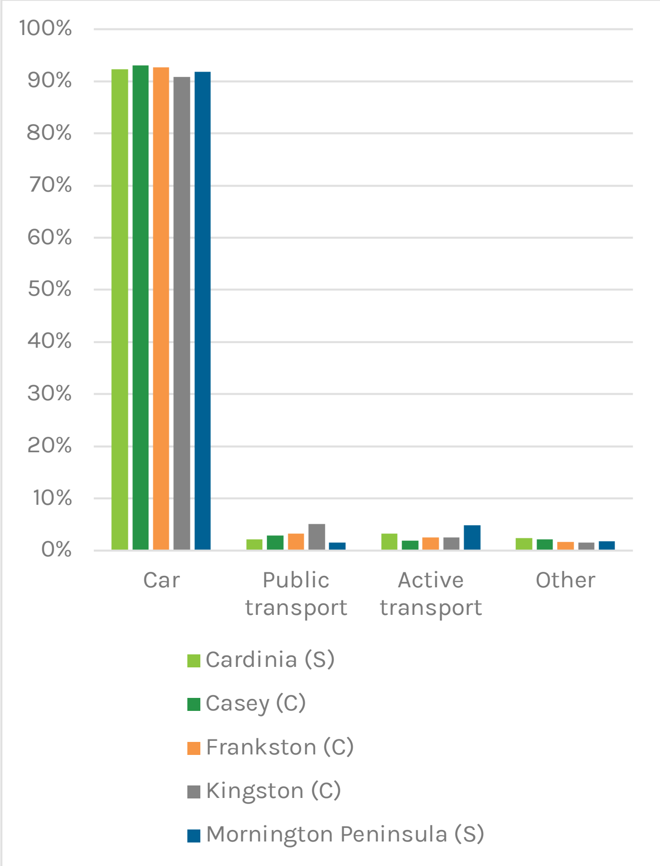



**Figure 59 Journey to Work mode share by destination LGA**

Source: ABS Census 2016

ABS Census data indicates that for most workers, they drive to work. This is true for residents of the five LGAs, and for those who work in the five LGAs. A consequence of this travel pattern is that most workers will have their cars with them at work, and may benefit from charging infrastructure at places of employment.

### 8.1.2 Victorian Integrated Survey of Travel and Activity (VISTA) data

The Victorian Integrated Survey of Travel Activity is a travel diary, covering all trips, by purpose and by mode. Analysis of these data show that for all trip purposes, across the five LGAs, 82% are by car, with 56% drivers and 26% passengers, as shown in Figure 60. A comparison of total mode share across the five LGAs is shown in Figure 61. There is some variation between all LGAs, albeit small, ranging from 79% of all trips being by car in Kingston to 85% of all trips being by car in Casey.

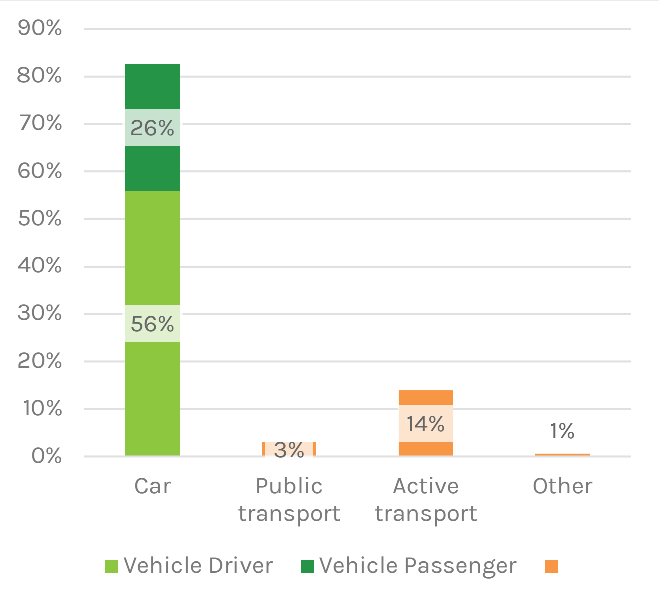



**Figure 60 Mode for all trip purposes**

Source: VISTA

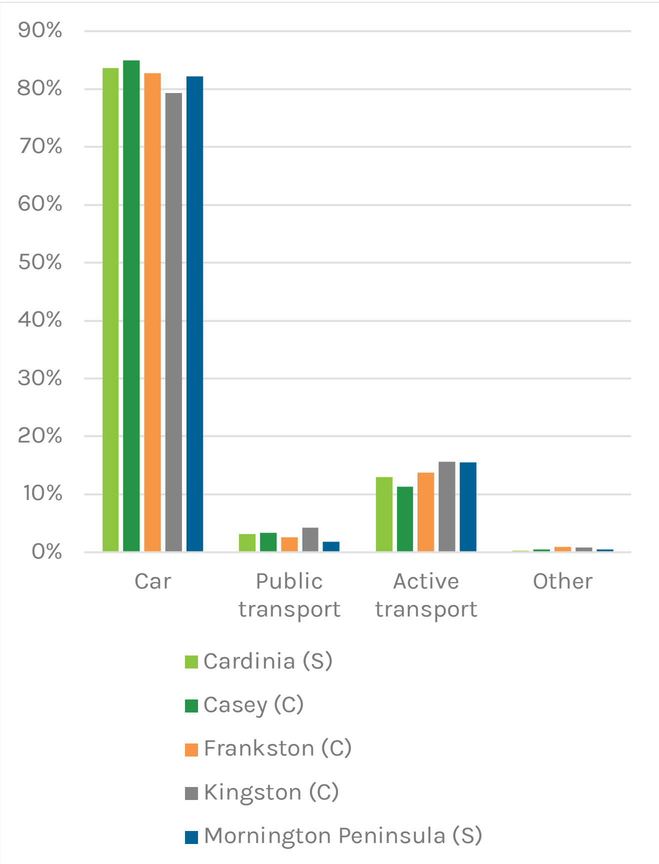



**Figure 61 Mode share for all trip purpose per LGA**

Source: VISTA

A comparison of trip purpose is shown in Figure 62. Approximately one in five journeys are work related, with Mornington Peninsula being lower (14% of all journeys), and Kingston being slightly higher (21% of all journeys). Approximately one in five trips are to buy something. Around one third of trips are for social, recreational, or personal business reasons. Education varies, from 5% in Mornington Peninsula to 9% in Casey. Lastly, around one in ten trips are to pick-up or drop-off another person.

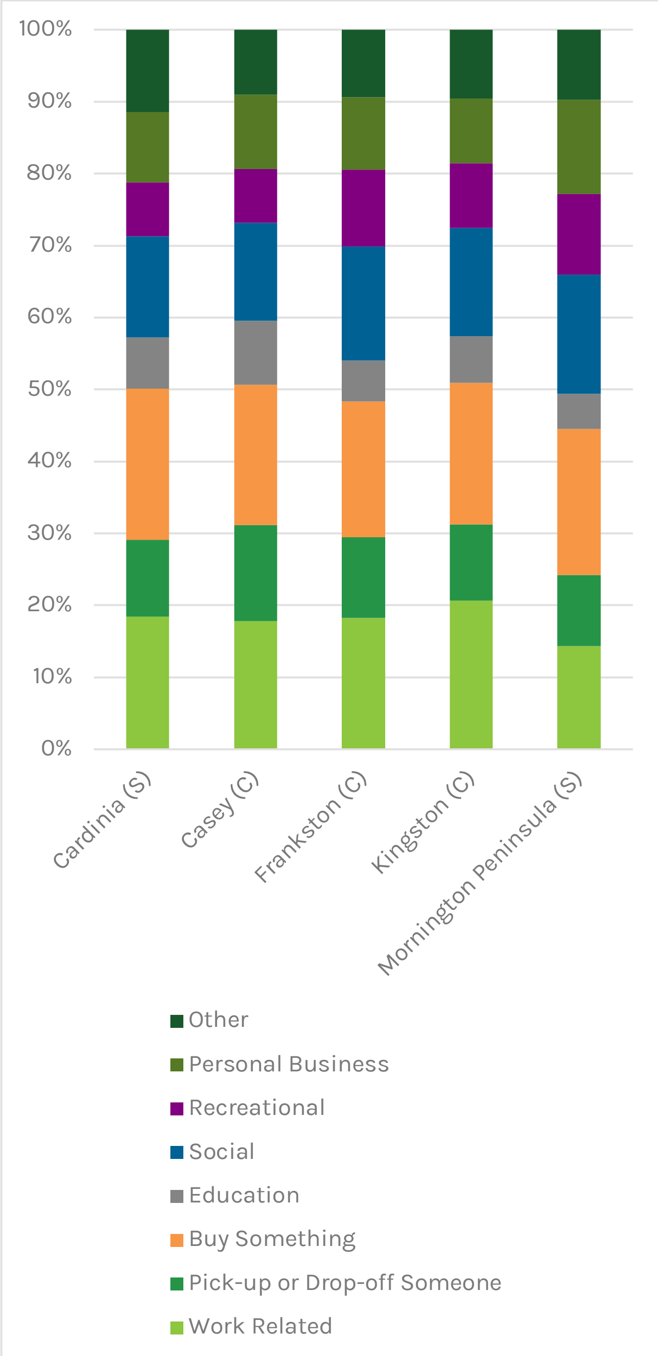



**Figure 62 Journeys by purpose, by LGA**

Source: VISTA

### 8.1.3 Vehicle ownership and vehicle type, based on ABS Motor Vehicle Census data.

The Census provides the number of motor vehicles per dwelling, which can be segmented by dwelling structure. Table 34 shows the average number of vehicles per dwelling, based on dwellings structure, for each of the five LGAs. For all dwellings, there are between 1.7 vehicles per dwelling in Kingston and 2.1 vehicles per dwelling in Cardinia and Casey.

However, these numbers vary depending on dwelling structure within each LGA. Separated housing have more vehicles per dwelling, typically over 2, in each LGA. Semi-detached dwellings, of one or two storeys, typically have around 1.5, coming close to 2 in Casey and Kingston. Flats typically have fewer vehicles, with several contexts having less than one per dwelling. All up, between 13% and 27% of flats (of any size) have zero vehicles, while between 53% and 62% of flats have only one car.

This has important implications for placing on-street charging infrastructure in residential neighbourhoods. Separated and semi-detached dwellings are, in almost all circumstances, able to install charging equipment themselves, however, those in multi-unit developments (i.e., flats) can face barriers. However, due to lower car ownership rates, the amount of chargers per dwelling may be lower than could be necessary for separated dwellings.

**Table 34 Average vehicles per dwelling, by dwelling structure, by LGA, 2016**

| | Cardinia | Casey | Frankston | Kingston | Mornington Peninsula |
|---|---|---|---|---|---|
| Average for all dwellings | **2.1** | **2.1** | **1.8** | **1.7** | **1.9** |
| Separate house | 2.2 | 2.1 | 2.0 | 2.0 | 2.0 |
| Semi-detached, row or terrace house, townhouse etc. with one storey | 1.3 | 1.5 | 1.2 | 1.3 | 1.2 |
| Semi-detached, row or terrace house, townhouse etc. with two or more storeys | 1.5 | 1.9 | 1.5 | 1.8 | 1.6 |
| Flat or apartment in a one or two storey block | 0.8 | 1.1 | 0.9 | 1.2 | 1.2 |
| Flat or apartment in a three storey block | N/A | 0.6 | 1.0 | 1.2 | 1.2 |
| Flat or apartment in a four or more storey block | N/A | 1.1 | 0.8 | 1.2 | 2.4 |
| Flat or apartment attached to a house | N/A | 1.0 | 1.0 | 1.3 | 2.0 |
| House or flat attached to a shop, office, etc. | 1.9 | 1.5 | 1.3 | 1.3 | 1.4 |

Source: ABS Census

### 8.1.4 Population density

Figure 63 provides an indication of the residential population density across the study area. The residential density is one factor to consider when developing the Roadmap, but is generally not a factor that would dictate where to position chargers, as almost all charging occurs at home and almost all homes within the study area have off street parking at their dwelling.

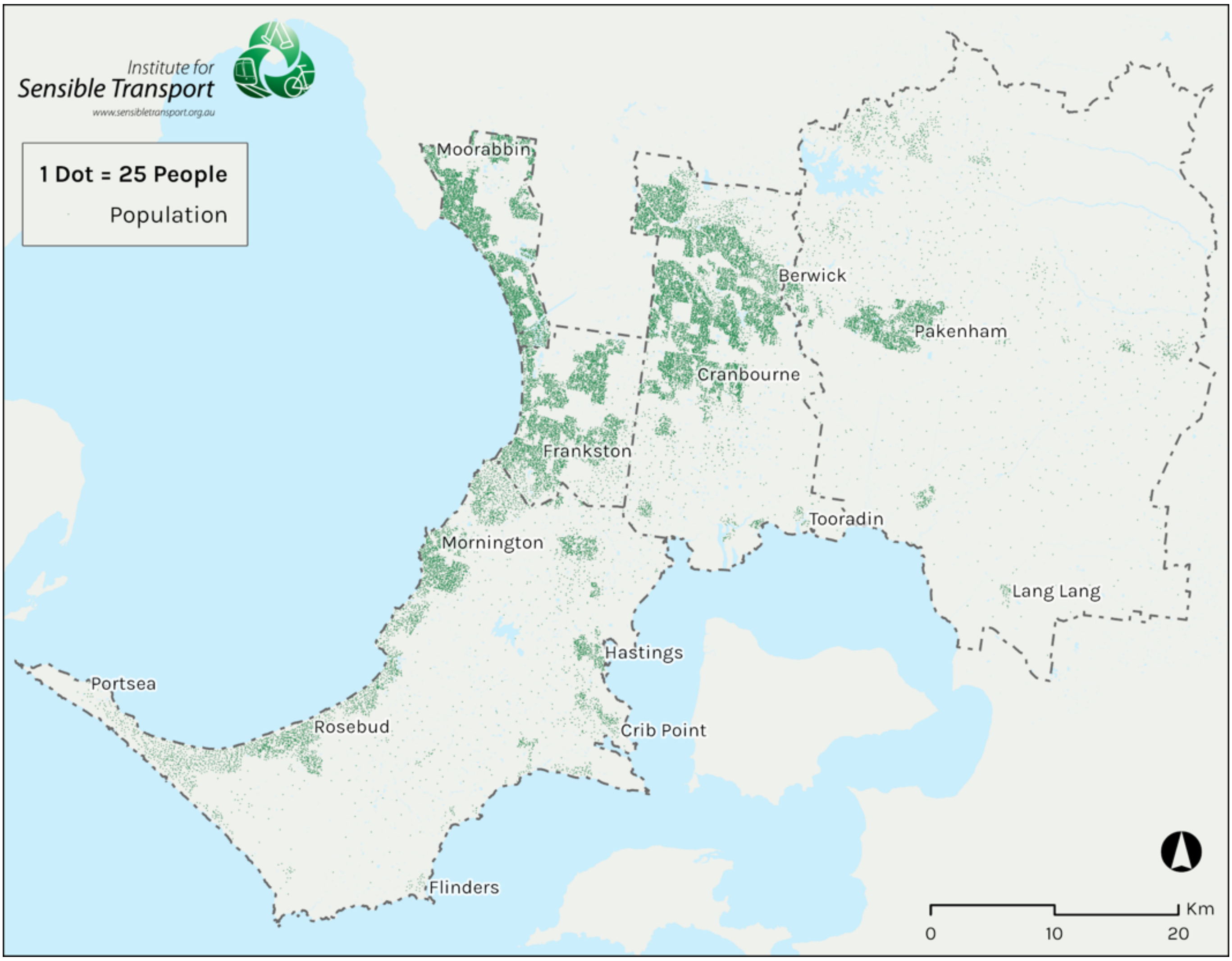



**Figure 63 Population density**

Source: ABS Census

## 8.1.5 Road traffic volumes.

The average daily road traffic volumes provided by VicRoads has been illustrated for the study area in Figure 64. As highlighted previously, this data is particularly useful, as sites with very high traffic volumes are likely to offer busier charging sites than those roads with lower volumes. The Monash Freeway, Eastlink, Mornington Peninsula Freeway, and Princes Freeway are all heavily trafficked roads that were closely investigated for their suitability for charger sites.

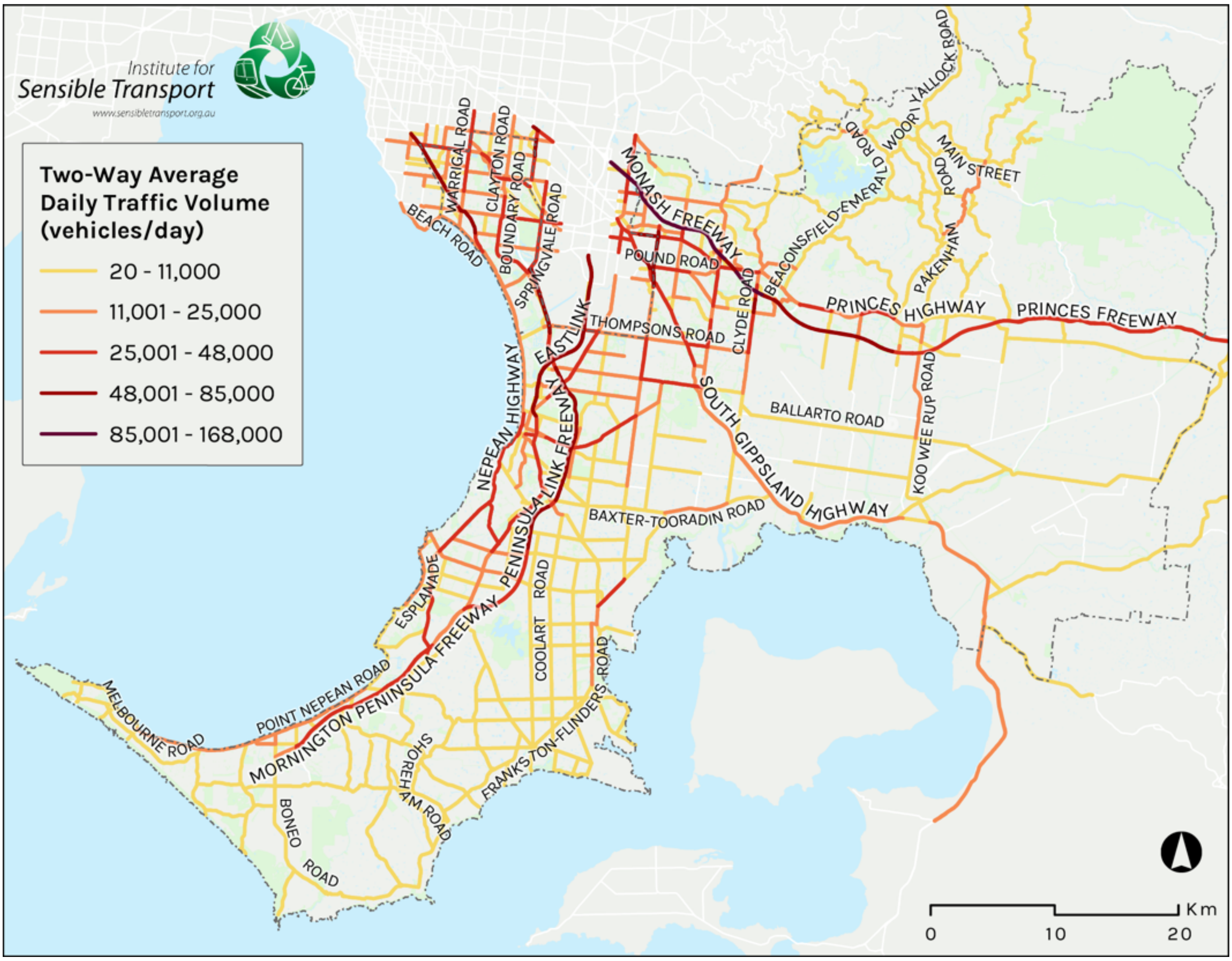



**Figure 64 Road traffic volumes**

Source: VicRoads

## 8.2 Demographic data

This section provides an analysis of demographic data of relevance to EV charging demand, based on known predictors for future EV purchase. This includes household income, education and industry profession. It is expected that each of these factors will become less important as EV ownership becomes normalised closer to 2030.

Figure 65 illustrates the variation in socio-economic advantage/disadvantage. Areas of highest advantage are scored 10, while those of least advantage are scored 1. This has been provided because currently, EVs are generally only within the price range of those that are towards the top end of socio economic advantage. This is however expected to diminish overtime, as EVs become more affordable. While the results of this analysis may not have a direct impact on the siting of future EV charging stations, it is nevertheless useful to be cognisant of variation in advantage and disadvantage.

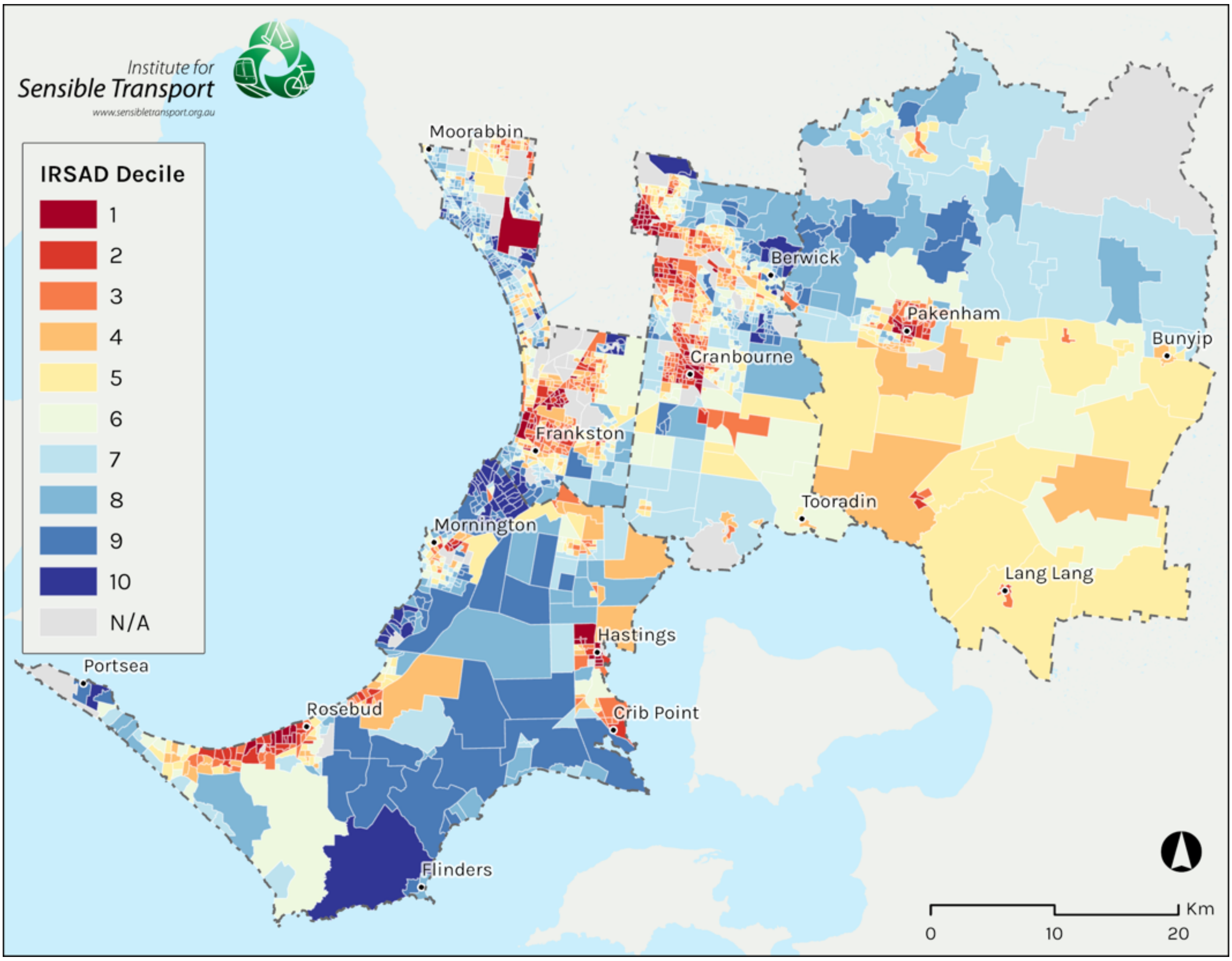
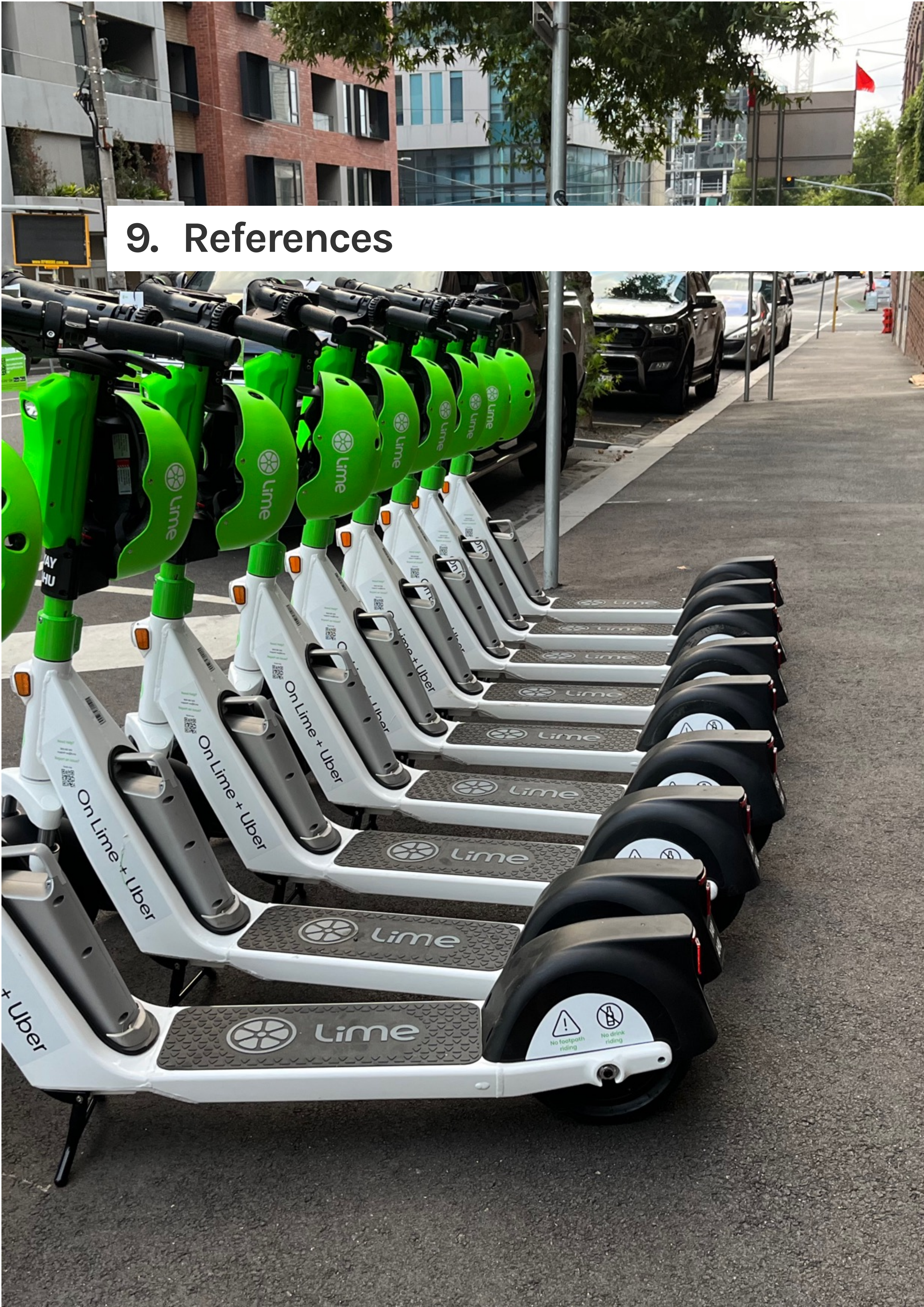



**Figure 65 SEIFA Index**

Source: ABS

# 9. References



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