Charging Gippsland for Future Transport

July 2019

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Acknowledgements

Prepared for South Gippsland Shire Council and their partners: Bass Coast Shire, Baw Baw Shire, East Gippsland Shire, Latrobe City and Wellington Shire Councils.

Major Project Sponsors

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1. Executive Summary

The report outlines the principles for supporting a network of electric vehicle (EV) charging infrastructure across Gippsland, understanding the right type of infrastructure in the right locations, as well as the best way for councils to facilitate the growth of such a network.

The report has considered the six local government areas across Gippsland including: Bass Coast Shire, South Gippsland Shire, Baw Baw Shire, Latrobe City, Wellington Shire and East Gippsland Shire, and provides a regional approach to guarantee that the delivery network is across the region.

The report is intended to assist all players in the charging infrastructure value chain who may be looking at installing EV infrastructure within the regions covered.

The work, commissioned by the councils and supported by the Victorian State Government, will help to ensure that the opportunities for a well-planned and integrated network of EV chargers will be maximised, providing for broad charging infrastructure in the region, allowing residents and tourists who own an electric vehicle to travel without anxiety within the region while allowing local business to capitalise on the electric vehicle tourism traffic that may not otherwise dwell in the region.

The document is structured into sections to cover the three project goals outlined below.

Project Goals

- Ensure that the planning process is optimised to allow for efficient private deployment of Electric Vehicle (EV) charging infrastructure;
- Ensure that the councils have a clear understanding of the optimum timing and placement of infrastructure; and
- Ensure that the councils clearly understand where it should best position itself in the value chain of delivering this infrastructure

Key findings from the report

The first section of the report, “Electric vehicle charging infrastructure” is simply an overview of existing charging infrastructure in Australia and globally. After describing the various types of infrastructure, we create typologies that group this infrastructure.

A review of current charging infrastructure available and network operators is provided along with an understanding of their relative positioning in the marketplace. Analysis of the potential uptake of electric vehicles given the current estimations used by the Australian Energy Market Operator (AEMO) is used to predict the uptake to the regions covered in the report. This data becomes critical in latter parts of the report, and it should be noted that variations in these uptake figures will strongly influence the data in the rest of the report such as potential number of chargers required and impacts on business models that could be considered. Nonetheless it provides a strong basis for an order of magnitude understanding of dynamics.

The report then looks at the considerations that go into specific site selection, followed by a comprehensive review of the entire region to look at potential locations for charging infrastructure. This follows a best practice methodology that identifies use cases for travel patterns, and then applies an understanding of battery state of charge at different distances from Melbourne Airport (along with significant amount of local knowledge contributed by each council) to determine the most logical locations for charging infrastructure.

The next section identifies the commercial drivers for electric vehicle charging networks and finds that while there is no clear business case if looking at charging infrastructure on a site by site basis, there are models that will work when looking at regional networks.

This report examines the six planning schemes of the Gippsland councils and their planning frameworks in relation to consideration of the development and use of EV charging stations. The following planning schemes were considered. In undertaking this review the planning schemes were considered in terms of:

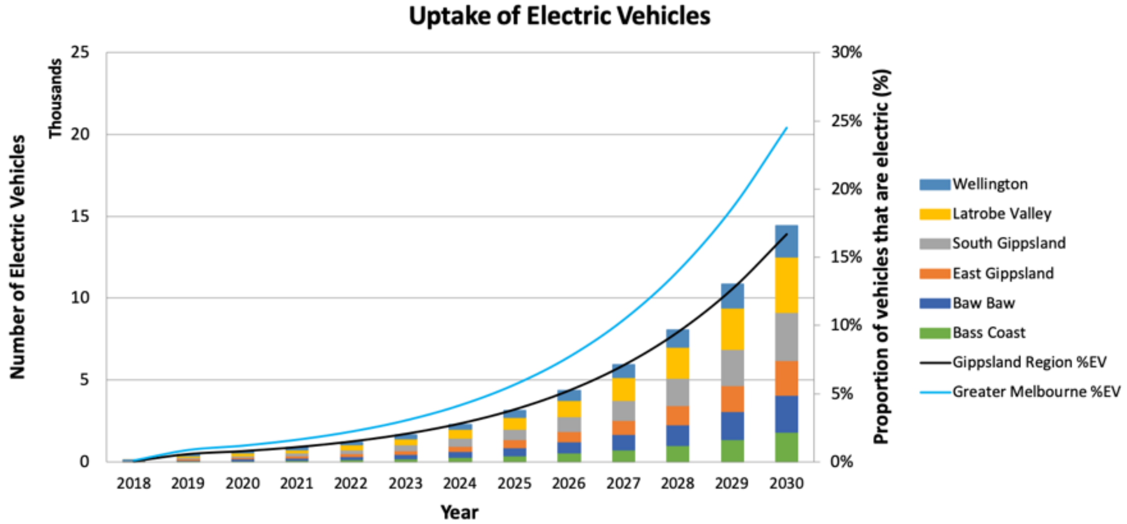
- The State and Gippsland (region) planning content and policies contained at clauses 11 – 19;
- The local planning content and policies contained within each planning scheme at clause 21 and clause 22 (as the schemes have not formally translated to the PPF format);
- Zones and Schedules as they relate to the Gippsland councils;
- All overlay schedules contained within the planning schemes;
- Clause 62 – Exemptions; and
- Clause 74 – Land Use Terms.

Project workshops were held with partner councils; Latrobe City and South Gippsland Shire to workshop considerations for approval as part of the research and analysis for this project.

We found that in many cases there will be planning exemptions for installation of chargers, but that there is no harmonised system across councils and installation could get held up at many points. A basic flowchart is then proposed to provide framework for harmonisation

Conclusions and recommendations from the report

- **Councils need to start to prepare for an electric vehicle future**
  Electric vehicles will start to impact the region by 2020 with exponential growth expected. While the uptake of EVs is only at 0.2% of new vehicles sold today, our analysis predicts that by 2025 this could grow to 20% of new vehicles sold. This projection would mean 3,400 Gippsland residents could own an electric vehicle by 2025 and approximately 3.9 million tourists per year of which 5.6% will drive EVs.

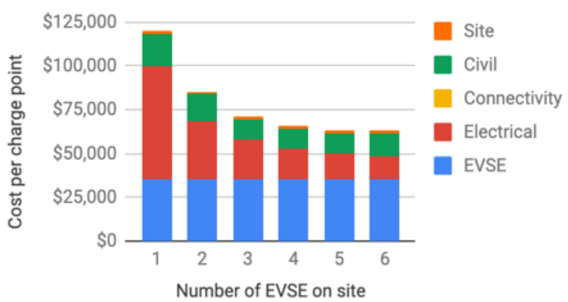


- **The charging infrastructure market is starting to mature and there is a sufficiently diverse array of hardware solutions available. The charging management system area has less diversity, however, there are a range of feature rich offerings on the market.**

  Management systems are an effective way of limiting the charging station's power draw to within the site power capacity, especially when shared with other users. These can be controlled on site or remotely. We expect that in the near future, these systems will be responsive to network constraints as a key part of the smart grid.

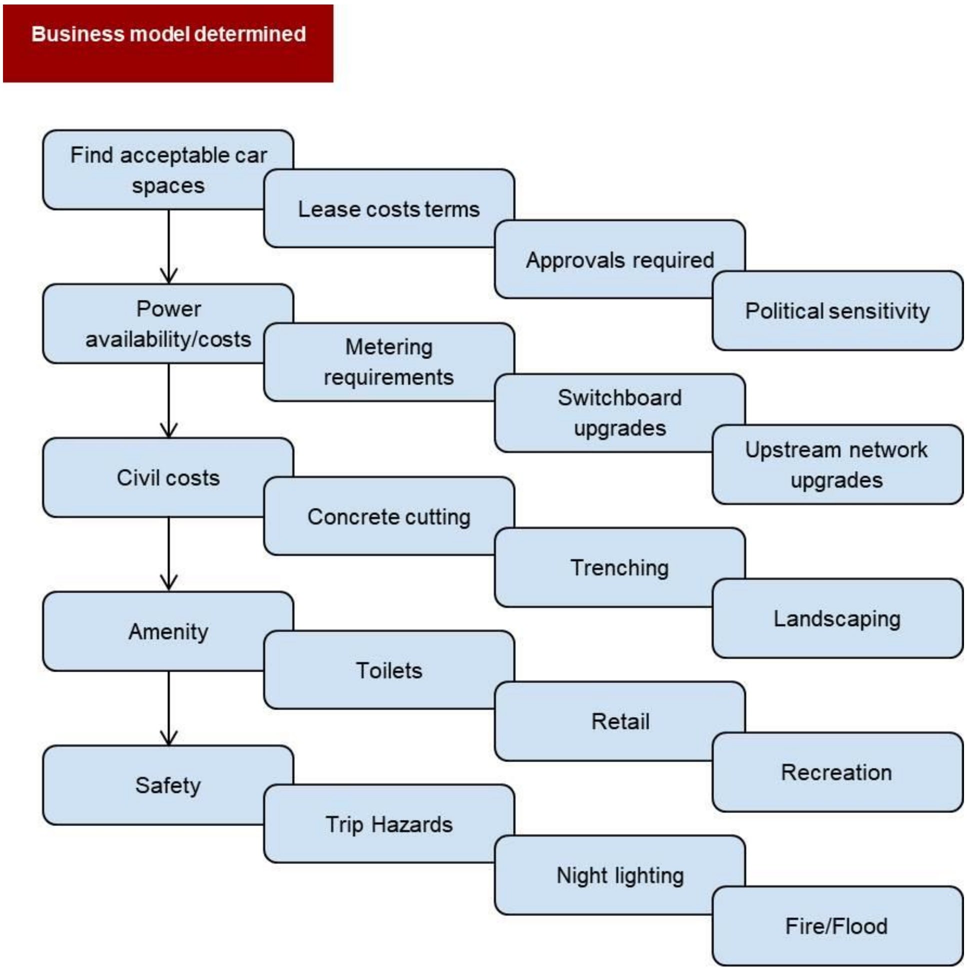
- **There are strong economies for multiple charging infrastructure on one site**

  Council should always encourage the installation of infrastructure to support multiple chargers on a site, regardless of the numbers of chargers being installed initially.



- **Site selection has become a well-documented process and a site selection criteria has been developed in this document**

  The following is an overview of the site selection process developed in this document



- **Dealing with the local electricity distribution business is a critical part of the electric vehicle charging ecosystem.**
  The largest potential planning and implementation delays can come from approvals from distributors. Much of the region suffers from significant network constraints and this will drive site selection. It is recommended that a strong partnership with AusNet is formed as the project progresses.

- **Charging sites are best located in townships that serve as regional nodes for tourism, commerce and regional populations.**

  The best sites cater to a number of different users (including council fleets), delivering the maximum benefit. Charging stations in these locations can be set up for journey enablement and destination/convenience charging, with co-location of level 2 and level 3 chargers that share site electrical systems.

- **Councils should seek to install chargers at sites with existing high-power grid connection.**

  New grid connections take time to commission and are costly. Costs can be reduced or avoided by either incorporating the charging infrastructure into a new large commercial build or by installing the charging station at a site with sufficient capacity. Operating the site as an embedded network also improves the feasibility of on-site solar and storage.

- **Given the current state of the market, the business case for individual charging stations will be marginal in many cases and may be beyond the risk profile of councils in cases where they may be more likely to have a return.**

  This report has demonstrated that in many cases there will not be a purely economic case for a stand-alone charging station. To make the business case work requires strong will and coordination/collaboration between councils and the private sector. Potential for a statewide charging network supported by councils and funded using a mix of grants, environmental upgrade finance could see a strong return.

- **Councils must establish clear valuation of the environmental and tourism/retail co-benefits of charging infrastructure along with innovative business models.**

  Most case studies reviewed featured councils with strong belief in the environmental benefits of charging infrastructure. We have found initial research which indicates that the impact on retail and tourism trade will be positive.

- **Councils will be most effective in stimulating private investment if they provide high quality and transparent information, streamline planning processes, and offer site leases at nominal or no cost where appropriate.**

  This report has developed a format for site classification and should provide helpful insight for future developers seeking to install infrastructure.

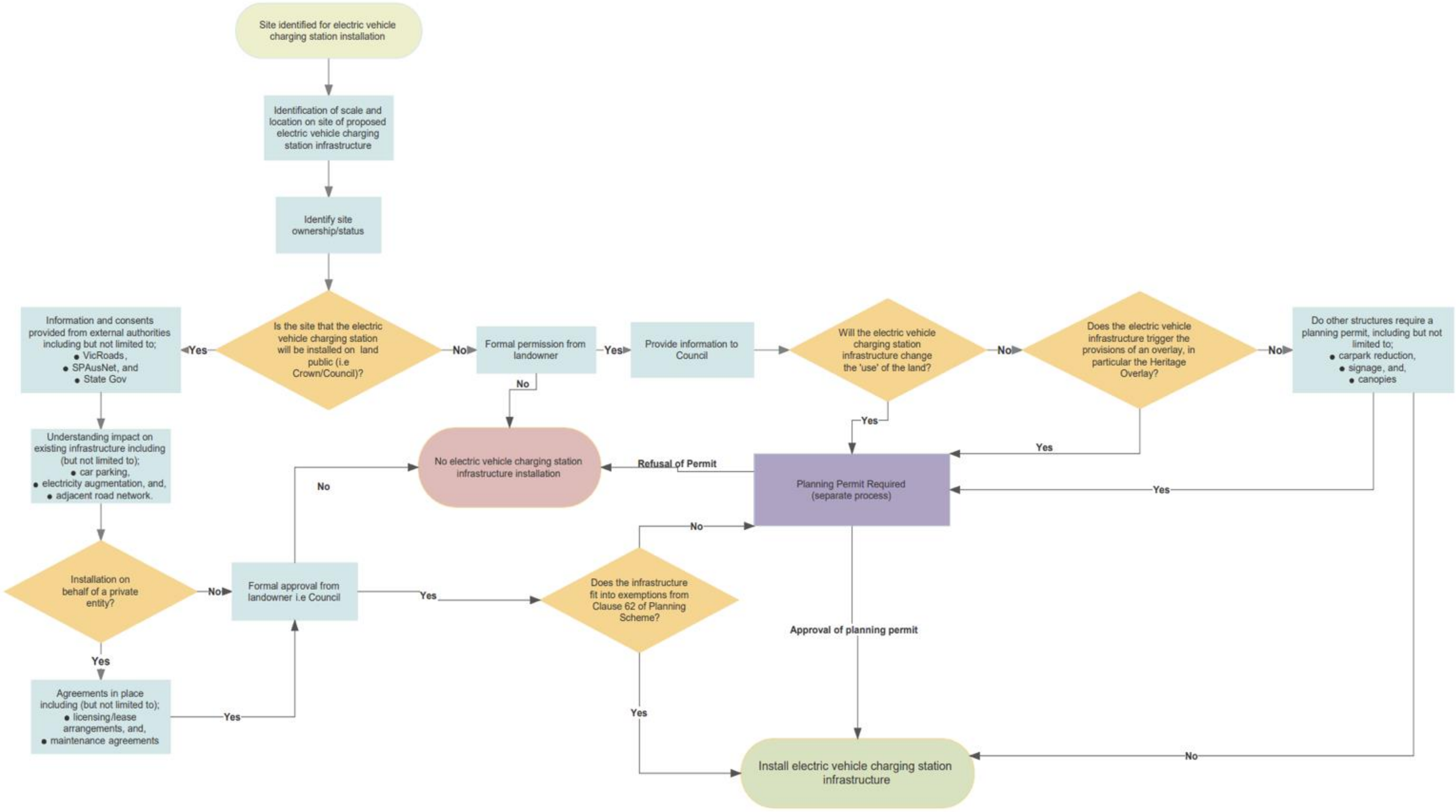
- **The planning requirements across the region are complex and need clear policy direction to assist with appropriate direction for decision-makers.**

  This report has taken a detailed review of the planning regulations and infrastructure approvals processes at each council. We have captured in a simple flow chart the different considerations that must be taken during decision making within Councils.

  In summary, we would recommend that councils develop a clear policy on their position in relation to electric vehicle charging stations. Once that policy is in place, it is most effective if there is delegated decision making put in place.

  Following the development of an Electric Vehicle Charging Station Policy, all other key Council documents and policies should be updated including:

  - Council Plan;
  - Municipal Health and Wellbeing Plan;
  - Council’s local planning provisions; and,
  - Sustainability Strategy.



Electric Vehicle Charging Station Infrastructure Approvals Process/Considerations

2. Quality Control

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3. Acronyms

Alternating Current - AC

Battery Electric Vehicle - BEV

Charging Management Software System - CMSS

Combined Charging System - CCS

Direct Current - DC

DC Fast Charging - DCFC

Electric Vehicle Charging Station - EVCS

Electric Vehicle Supply Equipment - EVSE

Electric Vehicle - EV

Hybrid Electric Vehicles - HEV

Internal Combustion Engine - ICE

Open Charge Point Protocol - OCPP

Plug-in Hybrid Electric Vehicle - PHEV

Smart Electrical Demand Management Module - SEDMM

4. Electric vehicle charging infrastructure

Public electric vehicle charging infrastructure is generally either used for long distance journey enablement, to provide “top-up” refueling to local electric vehicle drivers, or as a means of charging for those that do not have home or work charging. The presence of publicly accessible charging infrastructure also alleviates range anxiety among EV drivers and leads to higher rates of EV use.

For the Gippsland region, the presence of public charging infrastructure means the area becomes accessible to “EV tourism” from Melbourne or interstate, providing a boost to local tourism and the region’s economy. It will also facilitate local uptake of EVs, lowering greenhouse gas emissions from transport, improving air quality and reducing road noise on busy streets.

The following sections will detail the aspects of charging infrastructure that will deliver these outcomes for the Gippsland region:

- Technical overview
- Hardware available in Australia
- Management software
- Cost of infrastructure
- Application of infrastructure (typologies)
- Implementation considerations

4.1 Technical overview of charging infrastructure

Electric vehicle charging infrastructure can be a daunting subject for the uninitiated. In this section we will provide a technical overview from the following perspectives:

- Charging speed (levels)
- Charging hardware
- Equipment standards (modes)

4.1.1. Charging Speed (Levels)

The rate at which power is delivered to an EV is referred to as the charging speed. While faster, more powerful chargers might seem to be the practical ideal, they are accompanied with greater complexity and cost. And so, the needs of drivers must be balanced with the cost of the charger.

Chargers are commonly referred to by their classification into *levels*. Although the U.S.-based Society of Automotive Engineers (SAE) standardised the EV charging level terminology, the term “level” has entered common usage that is not strictly adhered to.

Furthermore, many charger operators have used trademarked names (such as Tesla’s Supercharger) to describe their high-powered chargers, and so there are a number of synonymous terms for charging speed floating around in common use.

The table below sets out the definition of levels and common names that we will use throughout this document.

Power Level	Common name	Charger Type	Power	Time to charge 100 km of range*	Application
Level 1	Slow charging	Wall socket	2.3 kW	8 hr 42 min	Home Charging, emergency charging
Level 2		AC Charger	3.5 kW	5 hr 43 min	Workplace charging, all day/night parking
	AC fast charging		7.4 kW	2 hr 42 min	Public destination charging
			22.1 kW	54 min	Public multi-purpose charging
Level 3	DC fast charging, Rapid charging	DC Wall Charger	25 kW	48 min	
		DC Charger	50 kW	24 min	Public journey-enablement
			100 kW	12 min	
	Tesla Supercharging		120 kW	10 min	
	Ultra-fast charging		up to 350 kW	less than 10 min	
*For EV with driving energy efficiency of 20 kWh/100 km					

4.1.2. Charging Hardware

4.1.2.1. Electric Vehicle Supply Equipment (EVSE)

The core of every charging station is the Electric Vehicle Supply Equipment (EVSE). Most EVSE connects to the 400/230V Alternating Current (AC) mains power but may differ in the way that they deliver power to the vehicle. Generally, the higher the charging rate required, the more power the EVSE must draw, and the more complex the equipment.

There is a fundamental difference between AC and DC chargers that enables DC chargers to deliver higher power and thus shorter charge times. Ultimately, the battery itself must be charged with a Direct Current (DC). This is shown by the red arrows in the diagram below. All EVs incorporate an onboard charger, called a rectifier, which converts AC to DC for both charging and regenerative braking. Due to size and weight limitations, the onboard charger has a limit to the amount of AC power that it can convert to DC. This limit varies between models, from 7 kW up to 43 kW.

High powered chargers bypass the rectifier and deliver DC power directly to the battery. DC chargers are capable of delivering upward of 50 kW. While next generation DC chargers can deliver over 350 kW, most cars will have a limit to the power that they accept.

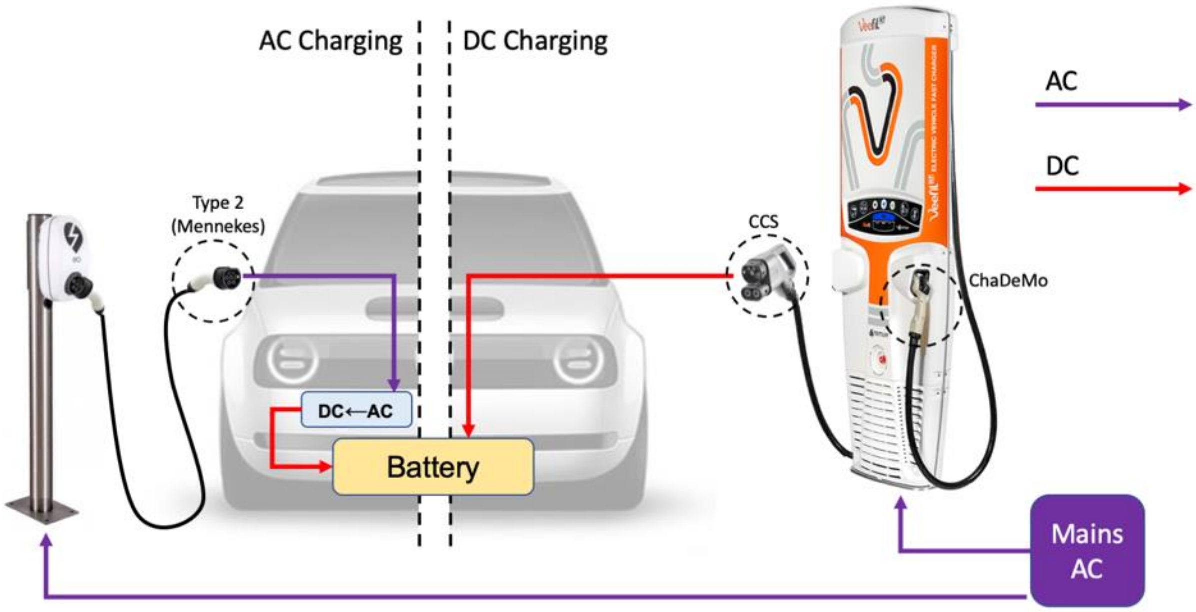
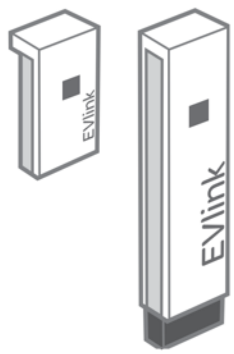


Image: AC charging scheme (left) is compared with DC charging scheme (right). The onboard charger (rectifier) is in blue, AC circuit is purple and DC circuit is red.

4.1.2.2. Wall vs Pedestal Mounting

Many Level 2 EVSE can be mounted on a wall or be integrated into a pedestal installed on the ground. Functionally, there is little difference between the two, however pedestal mounted EVSE can be around 25% more expensive to install than wall mounted EVSE. This is because pedestal mounted EVSE usually requires trenching to run the conduit between the EVSE and distribution board, with cost increasing with distance[1].



Example: The Schneider EVlink comes in both wall (left) and pedestal (right) forms.

[1] EPRI, 2013.

Connector Types

AC and DC charging require different connectors, and within each category there are alternative connector types. The Australian standard endorses each of the European and Japanese plug types, with each type found across Australia. However, the Federal Chamber of Automotive Industries (FCAI) has settled the Type 2 (Mennekes) plug as the standard AC connector. This means that all industry members will supply new EVs with the Type 2 sockets.

Plug	Power Delivery and Features	
Type 2 (Mennekes)	Level 1 and Level 2 AC ● Vehicle-charger communications ● Single-phase charging up to 14.5 kW ● Three-phase charging up to 43.5 kW ● Compatible with CCS vehicle socket ● Theft-proof locking pin	

DC charging is a little more complicated, with different communications protocols that have implications for Vehicle-to-Everything (V2X) and Vehicle-to-Grid (V2G) technologies. Both of the major types, Charge-de-Move (CHAdeMO) and Combined Charging System (CCS) are in use in Australia.

Plug	Power Delivery and Features	
Combined Charging System (CCS)	Level 3 DC ● Deliver high power, over 50 kW ● Uses Power Line Communication (PLC) – the standard grid communication system ● Theft-proof locking pin	
"Charge de Move" (CHAdeMO)	Level 3 DC ● Deliver high power, over 50 kW ● Uses CAN (Controller Area Network) – the 'standard' in-vehicle communication protocol	

4.1.2.3. Tethered or Untethered Chargers

A tethered charger is one where the charging cable is permanently connected to the EVSE. Untethered chargers feature a socket and require drivers to supply their own cable. The Type 2 Mennekes plug/socket system features a locking mechanism that can be configured for semi-permanent attachment to the charger.

The clear benefit of untethered is that it is theoretically future proof, as an adaptor cable can be used in many instances if the socket type is not supported. However, a tethered unit is sometimes thought of as more convenient due to the fact there is no chance of loss or theft of the cable, and lifting the cable in and out of the car can become onerous.

DC fast chargers require specialised heavy duty cables, capable of transmitting high currents. Some even incorporate cooling systems into the design of the cable. For these reasons, DC chargers are typically tethered with many EVSE featuring both CHAdeMO and CCS connectors.

We expect that nearly all EV drivers will carry an AC charging cable with them, meaning untethered chargers are suitable for public charging points. However, anecdotal evidence suggests that many users prefer the convenience of tethered chargers.

4.1.3. Modes

Charging infrastructure can also be categorized by “mode,” which specifies the type of power delivery, safety and communications connection between the vehicle and the charging infrastructure.

- Mode 1 consists of 230 V charging up to 16 amperes (A) on a shared circuit without safety protocols.
- Mode 2 consists of 230 V charging up to 32 A from a standard outlet, on a shared or dedicated circuit, with safety protocols including grounding detection, overcurrent protection, temperature limits, and a pilot data line.
- Mode 3 allows 230 V charging at any amperage on a wired-in charging station on a dedicated circuit, with the same safety protocols as Mode 2 and an active communication line with the vehicle. This enables smart charging—the coordination of charging according to utility needs, fleet schedules, or renewable energy availability.
- Mode 4 is defined as DC fast charging on a 400 V, wired-in connection, and requires more advanced safety and communications protocols.

The public charging infrastructure outlined in this report are categorised as Mode 3 and Mode 4.

4.2. Hardware available in Australia

There is a diverse range of EVSE on the market, with many features aimed at satisfying different market segments. We have narrowed the field and present here a range of suitable EVSE for public use. Each is robust for outdoor applications and features connectivity that complies with the Open Charge Point Protocol (OCPP), allowing monitoring and billing services. Each of these EVSE are available from a major distributor.

4.2.1. AC Level 2 Chargers

Manufacturer	Chargepoint	eo	Keba	Rolec	Schneider	Circontrol	ABB
Model	**CT4000**	**Genius**	**X-Series Fast EV**	**Autocharge: EV Superfast**	**EVlink Parking**	**eVolve Smart T**	**Lunic**
							
Distributors	ChargePoint	EVSE Australia	EVSE Australia	JetCharge	JetCharge, Chargers Direct	E-Station	Everty
Mount	Wall/ Pedestal	Wall	Wall	Pedestal	Wall/ Pedestal	Wall/ Pedestal	Wall/ Pedestal
Power (kW)*	7.2	22	22	22	22	22	22
Port(s)	2	1	1	2	2	2	1
Unit Price**	$10,900	$1,500	$3,500	$2,500	$9,800	$5,000	
Pedestal	$700	$770	$1,012	-	$400	-	
Control Unit***	$500	$800					
Power Supply	230 VAC	400 VAC, 3ø	400 VAC, 3ø	400 VAC, 3ø	400 VAC, 3ø	400 VAC, 3ø	400 VAC, 3ø
Connectivity	ChargePoint	eoCloud	Chargefox	Chargefox	Chargefox	Charge Star, Next Charge	Everty

*Power delivery may vary between vehicle **Some prices are from overseas vendors and are converted from foreign currencies and are correct as of April 2019. ***One control unit is required locally for each installation,

4.2.2. Tesla Destination Chargers

Tesla destination chargers are Level 2 AC chargers that can deliver up to 16.5 kW of power depending on the configuration. They have become popular among tourism operators and can be found across the Gippsland region. The underlying reason why they are so popular is that operators receive up to two chargers from Tesla at no cost. The upfront cost of installation and the electricity supply are the only costs borne by the operator. Tesla promotes the use of the charger to Tesla owners, who have exclusive use. So, while it might be a good deal for operators and Tesla owners, we do not recommend the installation of Tesla Destination charges as a publicly accessible charging solution due to their exclusivity.

4.2.3. DC Level 3 Chargers

Manufacturer	ABB	Delta	Delta	Circontrol	Tritium	Efacec
Model	**50 kW DC Fast Charger**	**DC Quick Charger**	**DC Wallbox**	**Raption 22**	**VEEFIL-RT 50kW Fast**	**HV160, HV175**
						
Distributors	JetCharge	JetCharge	NHP	E-Station	JetCharge	N/A
Mount	Floor-standing	Floor-standing	Wall	Floor-standing	Floor-standing	Floor-standing
Power (kW)	50	50	25	22	50	161
Port(s)	2	1	2	2	2	1
Unit*	$35,000		$20,000	$25,000	$35,000	$$$
Plug Type	CHAdeMO and CCS	CHAdeMO	CHAdeMO and CCS	CHAdeMO and CCS	CHAdeMO and CCS	CHAdeMO and CCS
Range (km) per hour**	280	280	140	125	280	800
Connectivity	Chargefox	Chargefox	Chargefox,	Nextcharge	Chargefox	OCPP
*Unit prices are only indicative, **Rate of charge varies between vehicle						

4.3. Management software and billing

All chargers considered here conform to the OCPP, which allows operators to use their choice of management software. However, most chargers work best with the software that is installed by the distributor. The following are management and billing software available in Australia.

4.3.1. Chargefox

Chargefox is the management software for the Australian installer/developer Jetcharge. Chargefox allows drivers to link their credit card to the Chargefox app via a Payment Card Industry (PCI) compliant platform. Any OPCC compliant charger can be connected to the chargefox network, facilitating revenue generation from any charger. Chargefox has the largest network of chargers in Australia.

4.3.2. eoCloud

The UK based eo Charging offer a suite of management software that is specific to its eoGenius chargers. The eoCloud system allows the management of any number of eoGenius chargers. To connect each charger to the system, an eoHub controller must be installed at each site.

The operator can set up their system with a number of functions that can be controlled remotely:

- Set or restrict access to chargers
- See driver profiles
- Set pricing policies (pay via eoApp, free to RFID card holder, free to all)
    - Pay per time ($/min), per energy consumed ($/kWh), and variable rates
- Demand side response
- Load scheduling (limit power during certain times)
- Active load management (requires installation of sensors to measure site load and controls EO)

The eoGenius + eoHub system can be set up to report charger data to hosts, installers and the distributor. This allows monitoring of the performance of the system and continued technical support. All charge session data can be viewed on the eoCloud and can be exported as a spreadsheet.

4.3.3. Chargepoint

USA based Chargepoint is another EVSE manufacturer and management software provider with a worldwide network of operators and users. Any OPCC compliant charger can be connected to the Chargepoint network, facilitating billing and management services through their Commercial Plan.

4.3.4. Charge Star

Charge Star is an electric vehicle charging station network operated as a managed serviced by the Australian company E-Station. Billing on the Charge Star network is performed via the NextCharge app.

4.3.5. Free service

Many public chargers are offered as free services. This is because the management software services (particularly Chargefox and Chargepoint) can cost more than the revenue that they generate. This may change as EVs increase in number and chargers become more viable. The big winners from a free service are the EV drivers, who might be attracted to an area otherwise overlooked, so local businesses could benefit too.

4.3.6. Summary of Connectivity Features

	Chargefox	eoCloud	Chargepoint	Charge Star	No Service
For driver					
Charger Availability Map	Yes	3rd Party	Yes	Yes	3rd Party
Billing via app (Credit card, apple pay)	Yes	Yes	Yes	Yes	Free
Support	Yes	via installer	24/7	Yes	via host
For operator					
Yearly fee per unit*	$360	$120	$350	$350	No
Set or restrict access to chargers	Yes	Yes	Yes	Yes	No
Monitor electricity consumption	Yes	Yes	Yes	Yes	No
View live charger status	Yes	Yes	Yes	Yes	No
View charge session reports	Yes	Yes	Yes	Yes	No
View operating cost	Yes	Yes	Yes	Yes	No
Calculate revenue	Yes	Yes	Yes	Yes	No
Export raw data	Yes	Yes	Yes	Yes	No
Uses any OCPP EVSE	Yes	No	No	Yes	Yes
*As of April 2019					

4.4. Upfront cost of infrastructure

This section will outline how each component of the charging station contributes to the overall cost of a charging station installation. The following are the key cost components related to installation of charging infrastructure.

Item	Component
EVSE	● The charger unit, connectors, pole mount
Electrical	● Cable, conduits, distribution board ● Transformer* ● Labour
Network*	● Site inspection ● Connection fee ● Cost of network upgrade
Civil	● Trenching, tunneling, boring ● Repairing ● Labour
Site works	● Signs, bollards ● Road markings ● Landscaping ● Labour
Connectivity	● Software installation
*For new grid connections and high-power installations such as DC fast chargers or multiple Level 2 AC chargers that require	

It is important to note that these cost estimates are indicative only and current only at the date of publication of this report. Each location will require a site inspection for an accurate installation cost estimate. Some equipment costs are converted from foreign currencies. Civil and electrical costs are derived from case studies and industry analysis. Electricity network connection fees can vary by an order of magnitude if network augmentation or upgrade is required.

4.4.1. Cost of electric vehicle Supply equipment

The EVSE considered in this paper is a shortlist of models suitable for public charging applications. They are robust, weatherproof designs with billing and monitoring features. As such they are more expensive than typical home or work chargers. The costs given here have been based on discussions with installers and are indicative only and may vary considerably with the typology of the charging station site.

Component	Description	Cost
Type: AC or DC	DC chargers are inherently more expensive than AC chargers due to the additional hardware, called a *rectifier,* required to convert the current from AC to DC. Additionally, the purpose of this design is to deliver a higher power to the vehicle, and so DC chargers are heavier duty, with thicker, heavier and stiffer connectors which all add to the cost.	AC cost range: $1,500 to $10,900 DC cost range: $20,000 to $35,000+
Power Output	EVSE with higher power delivery does so by utilising a higher amperage current. Most AC EVSE delivers power at either 16 A or 32 A, with a 3-phase supply facilitating higher power at the same amperage. Commercial grade chargers are equipped for both 16 A and 32 A.	3-phase power delivery incurs a 5% increase in charger unit cost
Number of ports	Some EVSE is available in single and double port versions. While the double port version is more expensive, on a per-port basis, it is much cheaper than installing two single-port versions.	Double port versions can cost 17% more than single port versions. However, on a per-port basis, a double port version costs 42% less than a single port version.
Mount type: Wall or Pedestal	Pedestal mounted EVSE is generally more expensive than wall mounted EVSE for a number of reasons: ● The pedestal mount itself has a material cost ● For pedestal mounted EVSE, the electrical circuit must pass underground. The civil work involves trenching/tunneling and repairing	Overall cost for pedestal designs are between 20% and 30% more expensive.

4.4.2. Cost of charging station electrical system

The electrical design work, installation and connection to the electricity network must be done by a Level 2 Accredited Service Provider (ASP[2]), with associated civil works best done by a local contractor. These costs will depend greatly on the site. A site inspection must be carried out in order to get an accurate cost estimate.

Component	Description	Cost
Design and labour	The design of the charging system by electrician.	AC: $1,000 DC: $10,000
Switchboard	The majority of Level 2 charge installations require an upgrade to the switchboard. 72% of installations require new/upgraded switchboard[3].	Up to $6,000
Meter	A National Meter Identifier (NMI) meter is required so that the energy retailer can measure the energy consumption of the site. Only required if charging station is only network connection on site.	$1,500
Distance to switchboard	The cost of installing the electrical circuit increases with distance between the EVSE and switchboard. For pedestal mounted EVSE, this means higher trenching costs.	Trenching, laying conduit, repairing: $360 per metre[4]
Transformers	Charging stations with multiple Level 3 DC fast chargers will require an on-site transformer to step down the mains supply voltage to the correct voltage for the chargers.	Equipment cost: $50,000+

4.4.3. Cost of network connection

Connecting the EV charging station to the electricity network involves working with the local utility. In the Gippsland region, this is AusNet Services.

Component	Description	Cost
Site inspection	For Level 3 chargers, a site inspection by a network technician is necessary.	$500
Connection fee	“Pole to pit” connection to local distribution network (AusNet cost calculator)	From $2500
Cost of network upgrade	The additional load from a level 3 charger may trigger an upgrade to the local distribution network.	Cost provided on application to the network

[2] See Appendix 8.3 for ASP accreditation levels
[3] EPRI
[4] US Department of Energy

4.4.4. Cost of civil works

Civil works are a major cost of outdoor charging stations. The costs given here have been based on discussions with installers and are indicative only. Each site may vary depending on whether the charging system is retrofitted or part of a new development, indoors or outdoors, rocky or soil ground and any other combination of circumstances.

Component	Description	Cost
Trenching and coring	The electrical cable must pass underground to supply pedestal mounted EVSE.	Trenching and electrical circuitry costs $250 to $380 per meter (depending on ground type)
Concrete	The foundation of the EVSE pedestal, footpaths and gutters.	$1,200 per EVSE
Install	The installation of the pedestal, bollards	$1000 per EVSE
Total cost	For pedestal mounted Level 2 EVSE	$1,500 to $4,000 per EVSE
Total cost	For pedestal mounted Level 3 EVSE	Up to $40,000 for new project.

4.4.5. Cost of site equipment installation

Site equipment installation is similar for most site layouts, both indoor and outdoor. Costs here have been derived from supplier quotes.

Component	Description	Cost
Road markings	Line and road stencil painting	$700 per car space
Vehicle Safety	Tyre stops	$200 each
Wayfinding	Signs	$60 each
Landscaping	Low maintenance garden bed.	Varies

4.4.6. Cost of connectivity

EVSE that has built in connectivity, such as the Schneider EVlink and most DC EVSE is often referred to as *smart chargers.* A more scalable solution is to have just one connected unit, for example the CT4000 *Gateway* or *eoHub*, which connects all of the others *smart ready* units via WIFI.

Component	Description	Cost
Hardware[5]	Control module for site	$400 to $800 per site
Connection	Management software subscription	$120 to $380 per EVSE

[5] Supplier quotes - local

4.5. Cost minimisation strategies

There are a number of ways to reduce the costs of charging infrastructure construction.

4.5.1. Use EVSE with dual connectors

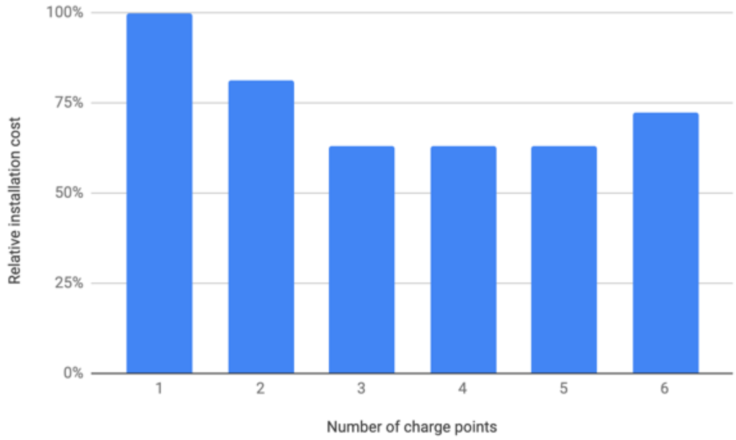
EVSE with dual connectors is often more expensive. In the EVSE that we have reviewed here, up to 17% more per unit. However, if we consider the overall cost on a per-port basis, the dual port EVSE is 42% less expensive than single ports. This is due to the savings made by avoiding installation costs of the second unit.
It must be noted that this figure is specific to the highly specified EVSE with connectivity such as the Schneider EVlink and Chargepoint CT4000. The cost benefit of pairing two single port EVSE such as the eoGenius on the same mount is much smaller because these units are much cheaper.

4.5.2. Minimise distance between EVSE and switchboard

This will reduce the length of the electrical circuit and in turn reduce the amount of civil works required. A rule of thumb is to keep EVSE within 30m of the switchboard.

4.5.3. Economy of scale

Installing multiple EVSE on one site that can share the cost of civil and electrical labour. The benefit is best observed increasing the number of charge points from 1 to 3. It is still more cost effective to install greater than 6 EVSE on one site, but the likelihood of electrical upgrades increases and the economy of scale diminishes.



4.5.4. Planning process

Consulting with utilities early on in the site selection and design process to ensure that charging station site has sufficient electrical capacity will substantially reduce installation costs, especially for DC fast charging stations or for multi-unit installations.

4.6. Application of infrastructure (charging typologies)

Electric vehicle charging infrastructure is applied in a variety of ways, referred to as charging typologies, in order to best meet the needs of the client given the site constraints. We have categorised the typologies as follows:

- Inter-regional service station
- Urban service station or “hub”
- Shopping centre rapid charger
- Multi-level car park system
- Outdoor car park destination charger
- Public kerbside destination charger

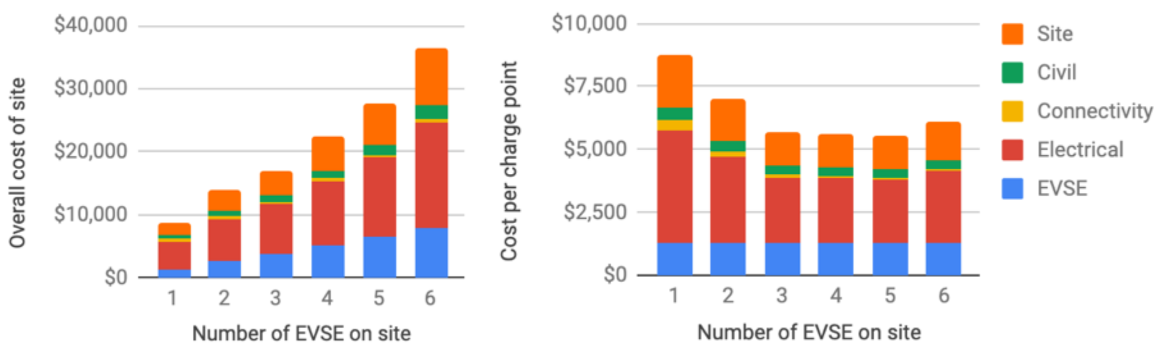
In addition, we have identified special typologies that would require a separate feasibility study in order to estimate their cost:

- Public kerbside destination charger - mounted on public asset
- Integrated solar charging station

In the previous section we described all of the associated costs of equipment and installation.

Unfortunately, without a site inspection, it is very difficult to determine the expected cost of a charging station. To help, we have generated a series of “cost stacks” that illustrate the main contributors to the overall cost. Many costs can be shared between multiple charge points on one site, and so it is cost effective to install multiple chargers.

Example cost stack (multi-level car park with Level 2 EVSE)

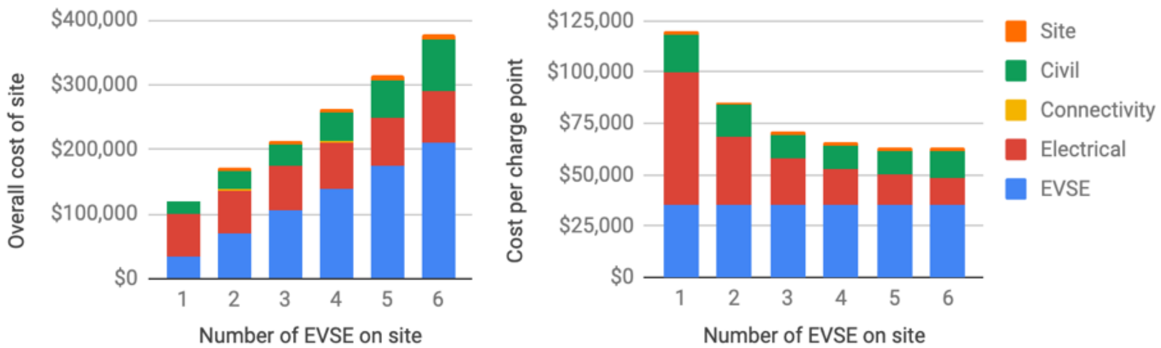


The example above is for a multilevel car park with Level 2 EVSE. By providing cost stacks for 1 to 6 EVSE on the site, we can see the rise in total cost is not quite linear (left). When we look at the cost from a “per-charge point”, we can see that it falls with each additional EVSE up to the 5th. The reason for this is that often the 6th and subsequent EVSE may require an upgrade to the distribution board. However, it is still more cost effective to install 6+ EVSE than it is just 1.

4.6.1 Inter-regional service station

Image: Tesla Superchargers at Goulburn Tourist Information Centre

Tritium Veefil



Market

- Domestic tourists
- EV drivers without access to home/work charger
- High mileage workers

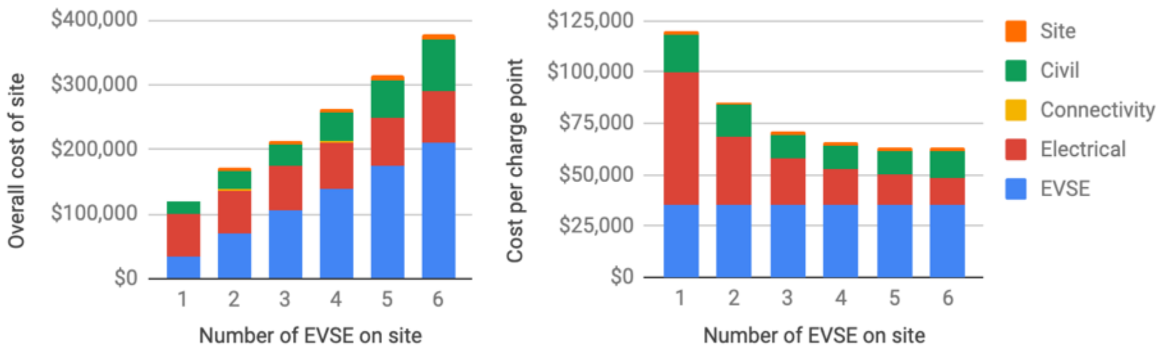
Features

- Level 3 DC fast chargers
- Multiple charge points
- Ancillary electrical equipment
- On-site amenities
- Landscaping

4.6.2 Urban service station or "hub"

Image: Adelaide City EV Hub

Tritium Veefil



Market

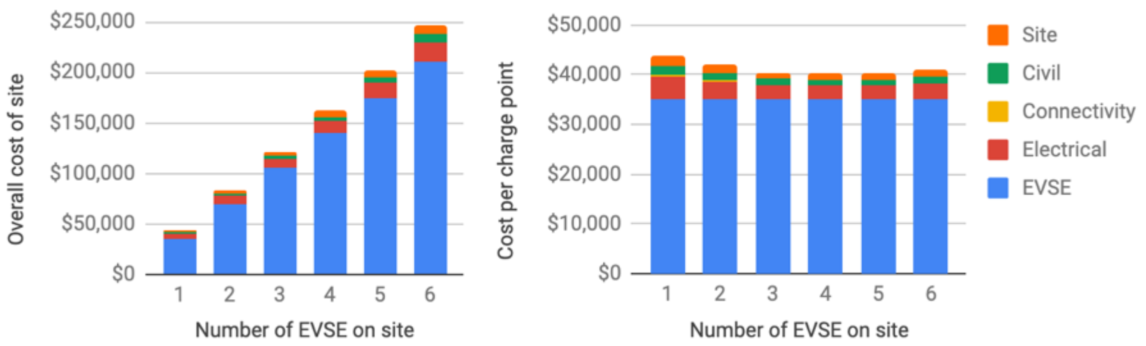
- Domestic tourists
- EV drivers without access to home/work charger
- High mileage commercial vehicles

Features

- Level 2 and 3 fast chargers
- Multiple charge points
- Ancillary electrical equipment
- Shared grid connection
- Landscaping

4.6.3 Shopping centre rapid charger

Tritium Veefil



Market

- Domestic tourists
- Shoppers
- EV drivers without access to home/work charger

Note: Low civil costs due to greenfield installation

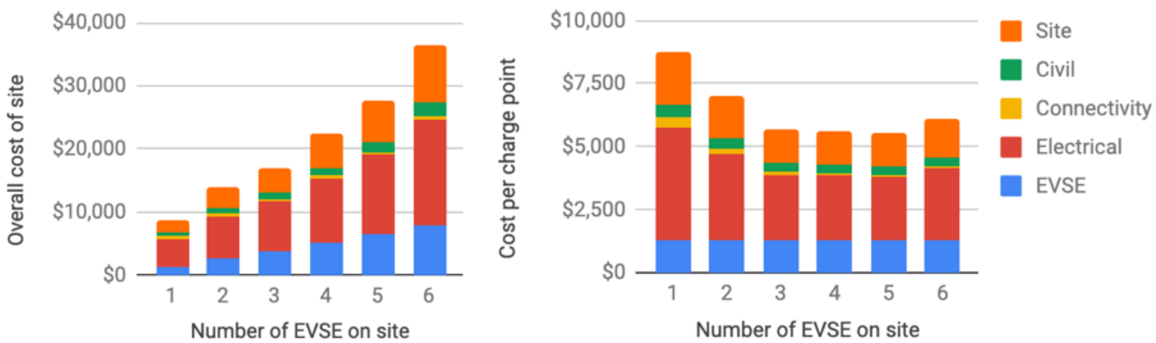
Features

- Level 3 DC chargers
- Ancillary electrical equipment
- Very low civil costs if incorporated into new build
- Utilises shopping centre embedded network

4.6.4 Multi-level car park system

Image: Adelaide City UPark

eoGenius System



Market

- Local residents without access to home/work charger
- Domestic tourists

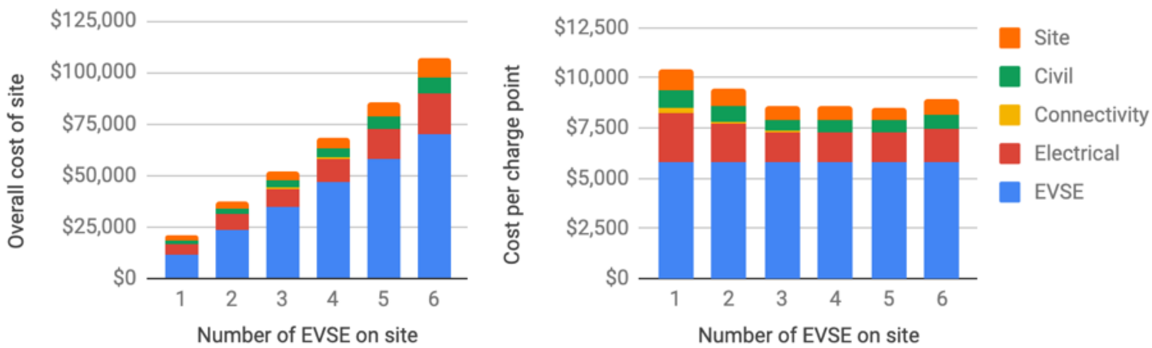
Features

- Level 2 AC chargers
- Multiple charge points
- Load management system
- Utilises car park electrical

4.6.5 Outdoor car park destination charger

Image: Chargepoint installation

Chargepoint CT4000



Market

- Domestic tourists
- EV drivers without access to home/work charger

Features

- Level 2 AC chargers
- Multiple charge points
- Ancillary electrical equipment
- Landscaping

4.6.6 Public kerbside destination charger - Pedestal

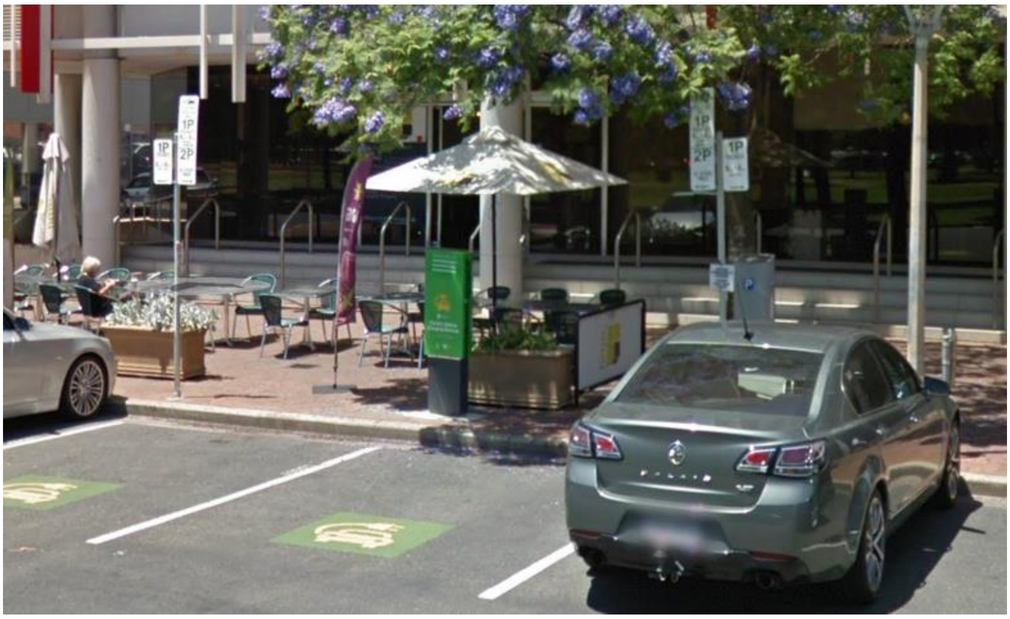
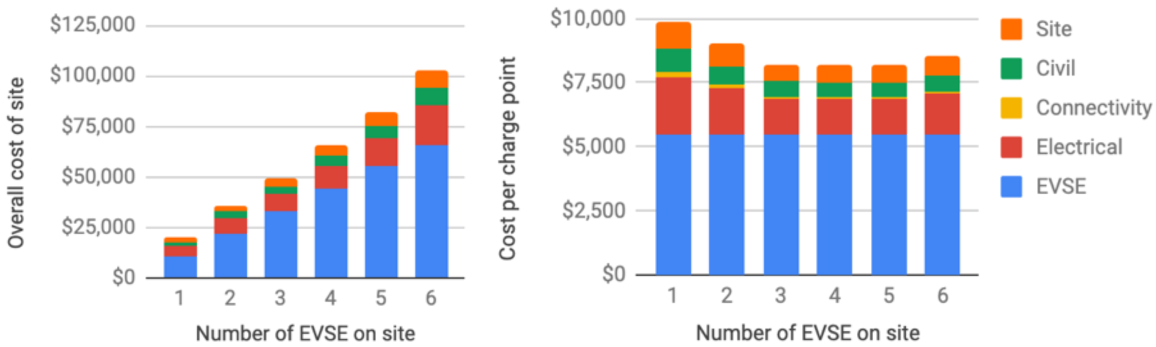


Image: Adelaide City (Google street view)

Schneider EVlink



Market	Features
• Domestic tourists • EV drivers without access to home/work charger	• Level 2 AC chargers • Feature rich all-in-one EVSE • Close to amenities

4.7. Special charging typologies

4.7.1. Public kerbside destination charger - Mounted on public asset

Urban Centre location ● Incorporated into streetlight or bollard Example: ● Hub-group ● Rolec	 Image: Smart streetlight plus EV charger by Eluminocity

4.7.2. Integrated solar charging station

Remote location ● Integrated solar-battery-EVSE system ● Designed to minimise site power capacity	

Urban location ● Integrated solar-evse ● Excess solar used on site or exported to grid	

4.8. Ongoing running costs

4.8.1. Property Lease costs

Land costs for EV charging stations depend on the ownership of the land and charger operator. They can be broken down into the following:

- Site acquisition
  - Loan repayments
  - Leasing
- Maintenance
  - Negotiated between the operator and the land owner

Land owners are at a competitive advantage here, but may not have the resources to operate the charging station.

4.8.2. Energy

Energy costs are composed of fixed and variable costs that are dependent on the energy supply and charger typology.

Energy supply

Operators typically pay retail rates for electricity, with the charges broken down into fixed and variable charges, as outlined in Table below. Councils may pay a reduced rate through a brokered multi-council power purchasing scheme.

Gippsland 120 kW commercial electricity charges

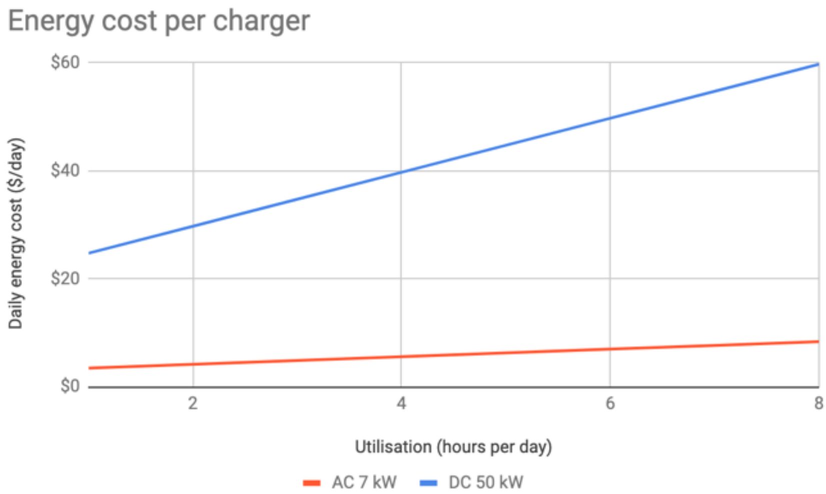
Charges	Variable			Demand & Capacity Charges
	Peak	Shoulder	Off Peak	
Energy	11 c/kWh	-	7.7 c/kWh	
Network	12.3 c/kWh	9.3 c/kWh	4.1 c/kWh	4.2 $/kVA/month
Environmental	2.7 c/kWh			
Regulated	0.15 c/kWh			

Alternatively, an operator may explore a partnership with the energy utility or a Power Purchase Agreement (PPA) with a renewable energy retailer (e.g. Flow Power), whereby a long-term renewable energy supply contract can be negotiated, hedged against the wholesale electricity price. These are becoming increasingly popular ways of sourcing low emission energy at low prices.

In some markets, Distribution System Operators (DSO) are entering the EV charging space as they have a vested interest in the cost and reliability of the grid. Partnerships with DSOs (such as AusNet) may present an opportunity to participate in smart grid projects that reduce the network costs for charge station operators.

Dynamic Load Management systems

High powered chargers incur higher *demand and capacity* ($/kVA/month) and *energy* ($/kWh) costs. If we compare a 7 kW AC charger to a 50 kW DC charger, we can see that the charger[6] costs increases proportionally with utilisation.



The number of chargers multiplies the relationship described above. However, with multiple chargers comes flexibility. A demand management system can cap the total power draw for the site, resulting in lower *demand and capacity* costs. Load management systems are designed to keep the power draw of a group of EV chargers within the limit of the overall site power capacity. Dynamic systems can respond to other loads, reducing charging rate in response.

Since load management systems may slow the rate of individual chargers, they are more suitable for destination (or work) charging systems. To ensure a fair distribution of power, systems can be set up to prioritise EVs with a lower battery state, or charge a premium for priority charging.

Solar-battery-charger

A feature of grid constrained sites is the potential expense of grid connections and the risk of loss of connection. Storage can dramatically reduce the *demand and capacity* cost of energy[7] while also having the potential to provide grid services. On-site solar can reduce fixed and variable costs while also generating revenue by exporting surplus power to the grid.

The addition of battery storage decouples the power delivery to the vehicles from the power drawn from the grid. By charging at lower power and discharging at higher power to the EV, the power draw of the site is flattened, reducing demand peaks that incur high network costs (highlighted yellow in table). This can be useful for both lowering costs and enabling connections in areas with constrained supply. Integrating on-site generation in the form of solar is another way of reducing fixed costs, while also generating revenue when the system is not in use. Of course, the battery can be an expensive addition to the installation at about $1000/kWh[8].

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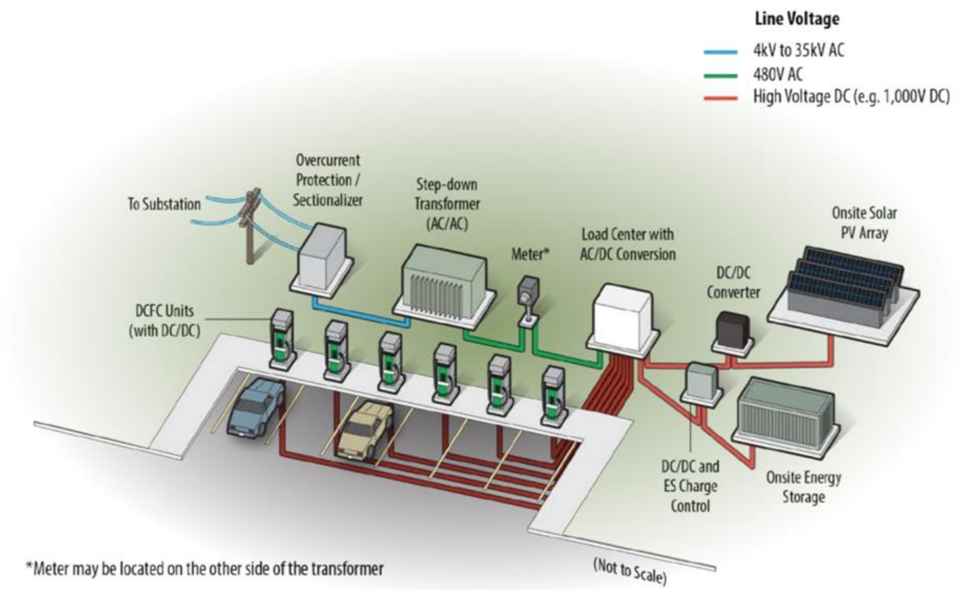
[6] Assumption for example is taken from NSW case with network charge of $12 per kVA per month, which equates to $2.80 per day for the 7 kW charger and $20 per day for the 50 kW charger. The energy charge is 10c per kWh for both.

[7] "How battery storage can help charge the electric-vehicle market", McKinsey, 2018.

[8] Source: Reneweconomy



Battery integrated DCFC. Credit: Idaho National Lab

Examples of battery integrated DC Fast Charging (DCFC)

An example of a battery integrated DCFC is Chargefox DCFC Euroa :

- 2x 350 kW ABB DC Chargers
- 150 kW Solar
- 273 kW/ 410 kWh battery.

4.8.3. Electric vehicle charger operator services

A charger operator is responsible for mediating the interaction between the driver and the charging station. This role can be performed by the site owner/manager (commonly referred to as the host) or it can be outsourced to a third-party service provider. The charging station host can perform the role of operator by using a stand-alone software package that meets their needs. These may perform any or all of the following functions:

- User authentication via RFID (access card)
- Local energy management
- Time of use controls

Hosts can access further functionality by outsourcing management to a 3rd party, usually a charging network operator. These systems require hardware that is networked. This allows the operator to remotely:

- Authenticate users and initiate charge sessions via the cloud
- See charger status (in use/available)
- Monitor performance
- Report and aggregate usage data
- Update firmware
- Option: Handle billing for paid services

Charging network operators usually offer support services, as they are often the EVSE distributor and system installer.

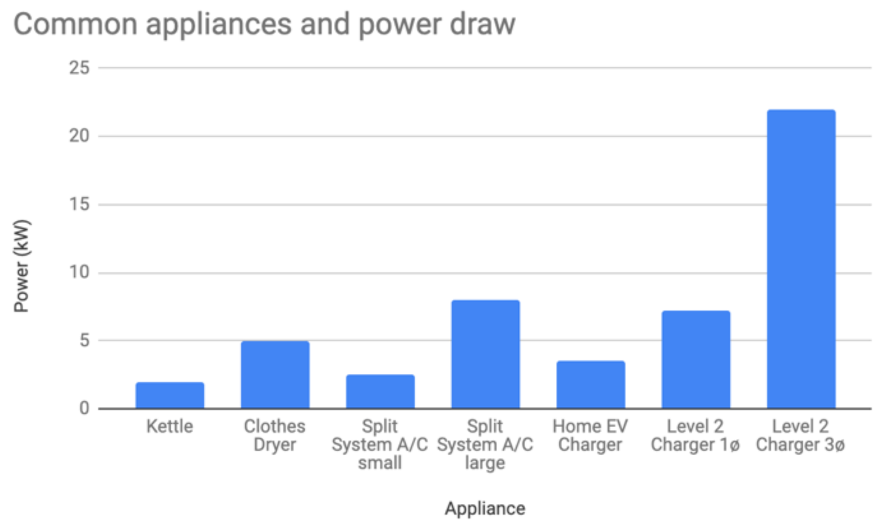
Networks available in Australia are listed below.

EVSE Distributor	Network	Exclusivity	Service fee (per year)	Example
Tesla	Tesla	Only Tesla	Free	• Goulburn, NSW
Jetcharge	ChargeFox	Members	$390 per port	• Adelaide City, SA • Barnawartha and Euroa (Ultra Rapid), Vic.
Chargepoint	Chargepoint	Members	$350 per port	• Moreland City Council
E-Station	Charge Star	Members	$319 per port	• City of Swan (DC Fast Charger), WA
EVSE Aus.	EO System	App	$120 per port	• North Sydney Council, NSW • Sterling Council, WA

4.8.4. Grid requirements

Electric vehicle charging places significant demand on the grid. If we compare EV chargers to common household appliances, we can see that a single phase AC charger is on par with a split system air conditioner, while a 3 phase AC charger has a larger power draw than a typical household with all its appliances on.

When multiple chargers are installed on a single site, or even more powerful DC Fast Chargers are installed, the site may require a special connection to the grid. Furthermore, the connection may trigger distribution network upgrades.



The electrical transmission and electrical distribution in the Gippsland region are operated by AusNet Services. Connections must be negotiated with AusNet, especially due to the high-power capacity, i.e. greater than 4.6 kVA (~4.6 kW).

4.8.4.1. Insights from AusNet

We spoke with AusNet about the implications of installing EV charging infrastructure.

The installation of EV charging equipment may require a new or upgraded connection to the grid. Even small (7 kW) connections may trigger an upstream upgrade, especially in remote areas. However, major towns have sufficient network infrastructure to handle Level 2 AC charger installations. Placement of DC fast chargers can be guided by location of high voltage transformers. AusNet require that the charger operator provide load profiles so that they can make assumptions about the capacity of the grid.

In remote areas the installation of charging infrastructure may require expensive network augmentation, paid for by the user.

Battery and solar integrated charger typologies can be employed in remote areas to reduce the need for network upgrade/augmentation (e.g. Euroa Chargefox Ultra Rapid DC charge station), however, these designs are more complicated than typical connections as they both download and upload energy to the grid in a similar way to embedded networks/generators. These systems may also provide a mutual benefit between the operator and the grid, and so a specialist team will manage these connections.

The current process for new or upgraded connections

1. The process is initiated via the Supply Proposal Request Form (on website).
2. There are three categories of connection, managed by different teams:
    - Connections up to 300 kW
    - Connections over 300 kW
    - Embedded network connections with on-site generation and/or storage
3. Site-by-site estimates
    - Preliminary site inspection is free
    - If upgrade necessary, $550 fee for estimate
4. Timeframes
    - 2 months for firm offer
    - 3 month lead time for construction
5. If no upgrade required
    - Pole-to-pit connection takes 4 weeks
    - Fee is negotiated

Implications for charger operators

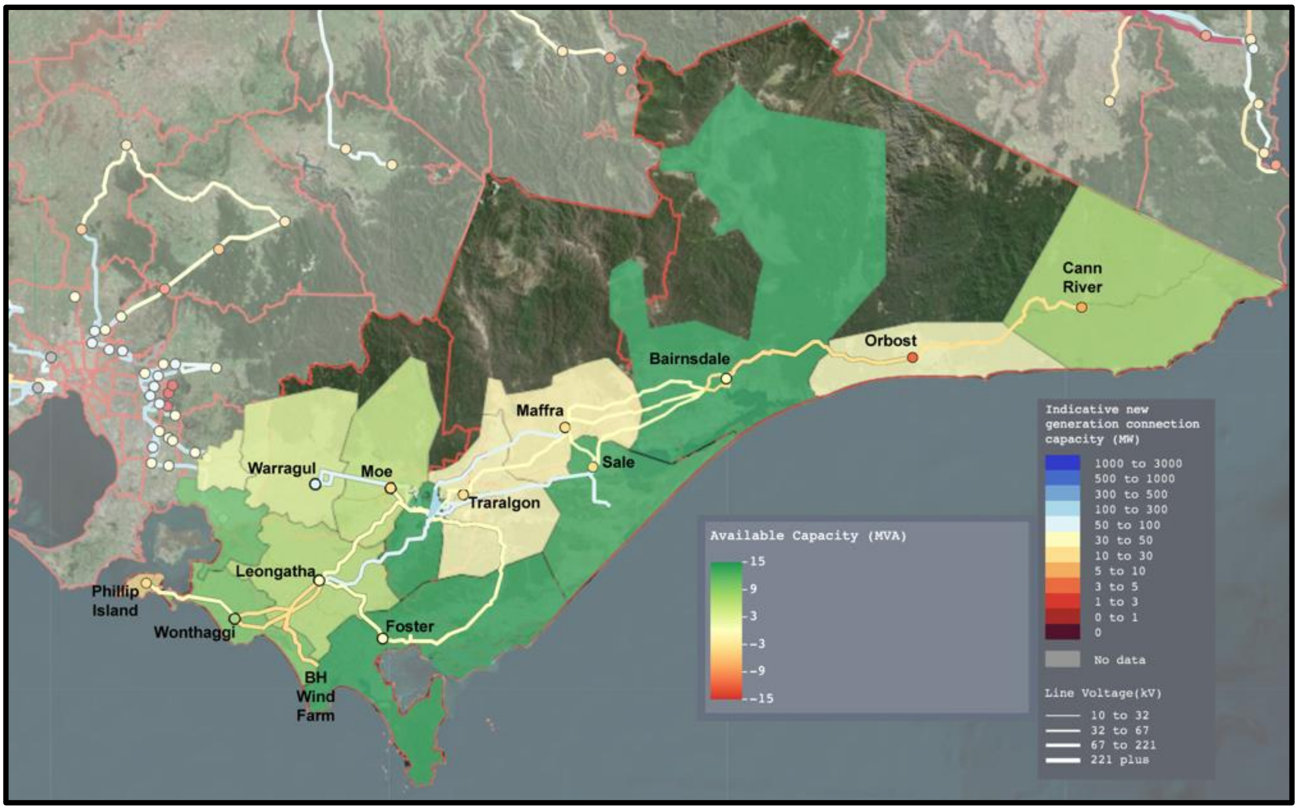
- The most important consideration when planning the installation of EV chargers is ensuring that there is sufficient time in the project plan dedicated to the above process. It is important to initiate the process as soon as possible and to establish a working relationship with AusNet. This is especially true if a continuing roll-out of infrastructure is anticipated.
- If expensive network upgrades are necessary, solar-battery integrated systems may become cost effective, however, this requires a site specific feasibility study.

4.8.4.2. Sub-Transmission and Distribution Network

AREMI Map

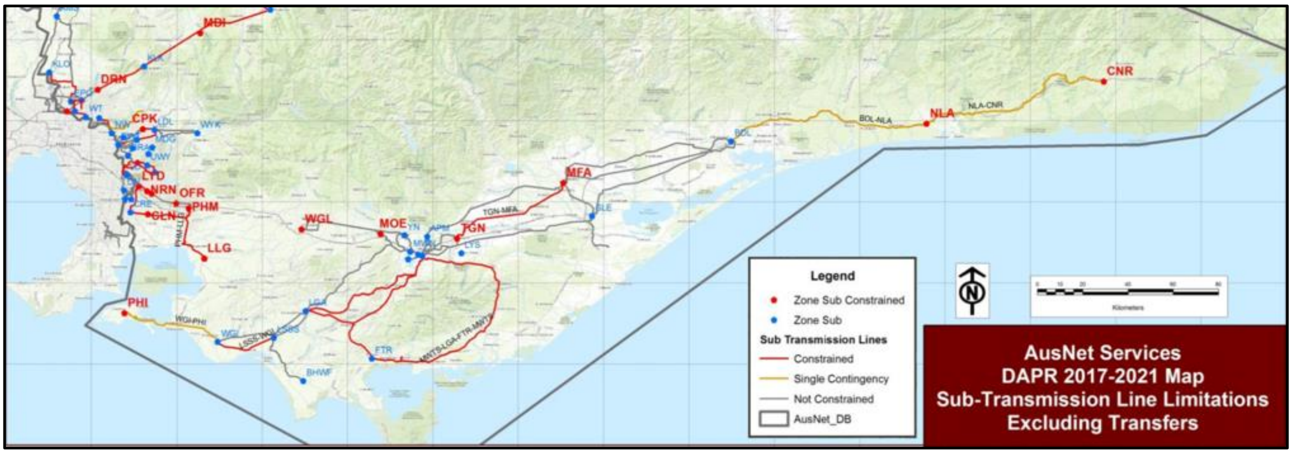
The Australian Renewable Energy Mapping Infrastructure tool does not give us definitive answers on the technical feasibility of charging infrastructure, however the map layers provide some insights into the capacity of the grid to service electric vehicle charging infrastructure:

- Available capacity is approximately 0 MVA at Traralgon, Maffra and Orbost.
- The 66kV network does not extend past Cann River
- Substations align neatly with journey enablement charger locations



AusNet Services Map

The AusNet Services map shows the constrained sections of the distribution network.



Code	Name	Capacity (MVA)
BDL	Bairnsdale	81
BHWF	Bald Hills Wind Farm	N/A
CNR	Cann River	10
FTR	Foster	66
LGA	Leongatha	73
LSSS	Leongatha South Switching Station	N/A
MFA	Maffra	40
MOE	Moe	40.5
NLA	Newmerella	10
PHI	Phillip Island	26
SLE	Sale	60
TGN	Traralgon	60
WGI	Wonthaggi	40.5
WGL	Warragul	84

Overview of Subtransmission circuits

Circuit	Customers	Energy Risk Period	Risk Mitigation
LGA-WGI-PHI 66 kV loop	30,270	Peak tourism seasons including all school holidays, long weekends and special events such as the motorcycle Grand Prix	Network upgrade, embedded generation, demand management.
MWTS-LGA-FTR-WGI-PHI 66 kV loop	50,672	Peak tourism season of Christmas and early January	Network upgrade, embedded generation, demand management. 106 MW Bald Hills Wind Farm eliminates risk of overload.
MWTS-TGN-SLE-MFA-BDSS-BDL-NLA-CNR 66 kV loop	66,608	Demand in this loop is currently supported by local embedded generation, including through a network support agreement with Bairnsdale Power Station (BPS).	Load transfers to Bairnsdale substation.

4.8.4.3. Impact of EV charging on network

The electrification of transport will increase demand for energy and increase loads on the grid. The seasonality of tourism already contributes to coincidental demand, increasing the risk of overload. If poorly integrated, EV charging may increase incidences of load transfer or shedding. Fortunately, there are a suite of solutions to this problem:

- AusNet *Demand Side Engagement Strategy* - non-network demand management and embedded generation options are sought as economically efficient alternatives to network augmentation.
- Grid Energy Storage System (GESS) - 1 MW / 1 MWH battery storage system for peak demand management, voltage support, power factor correction and islanded operation.
- EV charging placed on “controlled load” circuit, whereby EV charging is controlled in a similar fashion to hot water systems.
- Dynamic pricing incentivises customers to optimise their energy use.

In fact, EVs and smart EV charging systems can present a net positive impact on grid reliability[9]

[9] “Managing the impacts of renewably powered electric vehicles on electricity distribution networks”, Evenergi, 2019.

4.9. Implementation considerations

4.9.1. Signage

There are currently few Australian regulations specific to EV charging stations, and so we will present some examples of current practice. Signage can be grouped into *wayfinding signage* and *station signage.*

Type	Function	Examples
Wayfinding Signage	Help EV drivers navigate to and identify charging stations	 (1a)  (1b)  (2a)  (2b)
	Facilitate deployment of plug-in vehicles by providing visibility for charging infrastructure to prospective PEV drivers.	 (3)  (4)  (5)  (6) (1) Main Roads Western Australia, (2) USA, (3) France, (4) Sweden, (5) Denmark, (6) Belgium
Station Signage	Optimize use of EVSE by helping all drivers understand that parking spaces at charging stations are for PEVs only	 (1a)  (1b)  (1c)  (2)  (3) (1) USA, (2) Tesla, (3) Road Stencil

<table>
<tr>
<td></td>
<td>Provide instructions for the use of EVSE</td>
<td>(1) 

(1) Example from USA with billing instructions</td>
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<td>Provide information about regulations - such as access, time limits, and hours of use - and facilitate enforcement</td>
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(1) 

(2)


(3) 

(4)
(1) Reserved parking sign by EVSE Australia (2) Street sign (USA) (3) Tow warning sign (USA) (4) Tesla parking rule sign</td>
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<tr>
<td></td>
<td>Hazard identification and safety</td>
<td>

(1) 

(2)
(1) Hazard warning for power supply (2) Hazard warning for EVSE</td>
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4.9.2. Public Safety

The following measures can be undertaken to minimise the risk of serious injury to members of the public, both operators and bystanders.

Hazard	Risk	Strategy
EVSE Connector	Trip	The charge station should be designed to minimise the risk of tripping by: ● implementing car stoppers, bollards and elevated connectors ● Situating charger away from pedestrian traffic ● Signage to alert pedestrians
Water	Electric shock, damage to electrical equipment	The charge station and associated infrastructure should: ● not be placed in an area of flood risk and standing water ● be weather resistant to at least IP54 and be operable in usual prevailing weather conditions
Moving vehicles	Collision damage	The charging station bay and layout should ensure: ● physical protection and enclosures for electrical and electronic equipment ● provide anti-collision infrastructure such as tire stops and bollards
Equipment failure	Electric shock	The charging equipment should be periodically assessed for safety at a period not exceeding 12 months.
Bushfires	Fire damage	Consult bushfire risk map, attain fire risk assessment from https://www.vfrr.vic.gov.au/index.php Reduce risk of damage from bushfire by implementing Building Protection Zone around asset. Different building rules may apply if asset is located in a *designated bushfire prone area:* https://www.data.vic.gov.au/data/dataset/designated-bushfire-prone-area-bpa

5. Demand for electric vehicle charging infrastructure

In this section we have sought to provide an indication of the scale and distribution of EV uptake in the Gippsland region. In order to do this, we took into account the key drivers of EV uptake, then using the best available models of EV uptake in Australia (Energeia and BNEF), and using current passenger vehicle ownership rates as a basis, we projected the number of EVs in Gippsland to 2030.

5.1. Drivers of EV uptake

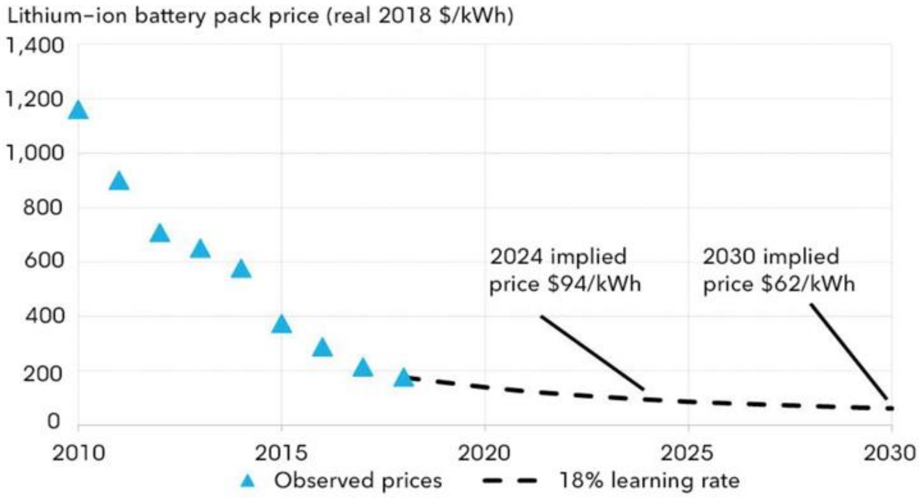
The following factors contribute to the uptake of EVs:

- The availability of affordable models
- A variety of vehicles to suit different personal requirements
- The accessibility of charging infrastructure and related range anxiety
- Supportive government policy in terms of either emissions standards or incentives
- Level of community understanding of this new category of vehicles
- The existence of a viable secondary market

At the moment few of these criteria are met and the number of EVs on Australian roads is very low. However, this is all about to change very rapidly.

5.1.1. Falling cost of electric vehicles

Currently, EVs are more expensive to buy than equivalent ICE vehicles. The battery constitutes nearly half of the overall cost of an EV and the technology itself is novel and the manufacturing of EVs is still early on in the learning curve and small scale. Fortunately, there are a number of global forces that are pushing the price of EVs down.



Source: Bloomberg NEF (USD)

The cost of batteries is falling as global demand for battery technology booms. In addition, as EV manufacturing also ramps up, the economies of scale are improving, and production costs are being reduced as the industry learns. It is believed that due to falling battery prices, EVs will reach price and performance parity for most use cases by 2024 and will represent the cheapest vehicles on the market by 2030. On top of this, many markets are banning the sale of Internal Combustion Engine (ICE) vehicles or imposing strict environmental standards on the sale of new cars. As a result of these inevitable global trends, most manufacturers are investing heavily in battery electric vehicle technology, while some manufacturers have already ceased investment in ICE research and development.

5.1.2. Availability of suitable vehicles

Vehicle suitability is another driver of uptake and one that we have incorporated into our Gippsland uptake projection. With most manufacturers hopping on the electric bandwagon, a flurry of new EVs are entering the market, however current choice is limited to small passenger vehicles or high-end luxury cars. The majority of the currently available mass-market[10] EVs including the Nissan LEAF, Hyundai Ioniq, Hyundai Kona and Renault Zoe are all in the small passenger vehicle category.

We have noted that the rate of vehicle ownership is high in the Gippsland region. The number of passenger vehicles per 1000 population in Gippsland is 1.1 times the national and Melbourne Greater Metropolitan Area (GMA) rates.

Additionally, the number of Light Commercial Vehicles (LCV) per 1000 population in the Gippsland region is 1.6 times the national rate and 2.6 times Melbourne GMA rate.

Although this is a very coarse segmentation of the market, we expect that there will be models of EV that will meet the suitability requirements of the passenger car segment from this year, even if LCV models are still years off. For example, Toyota has committed to releasing an electric version of the HiLux, Australia's best-selling vehicle, by 2025[11].

Table: Number of vehicles per 1000 population and number of vehicles per household

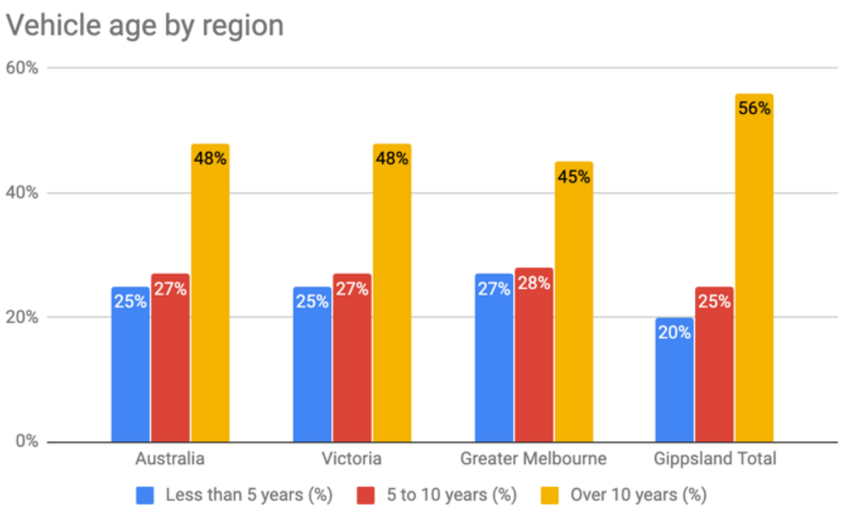
Description	Aus.	Vic.	Greater Melb.	Gippsland	Bass Coast	Baw Baw	East Gipps.	South Gipps.	Latrobe Valley	Wellington
Passenger vehicles per 1000 pop.	**572**	**593**	**584**	**638**	**687**	**634**	**645**	**651**	**640**	**610**
Light Commercial Vehicles per 1000 pop.	125	107	78	199	177	180	231	202	165	243
Vehicles per 1000 population	697	700	662	837	863	814	876	853	805	853
Passenger vehicles per household	**1.70**	**1.78**	**1.80**	**1.72**	**0.87**	**1.82**	**1.70**	**1.73**	**1.70**	**1.66**
Light Commercial vehicles per household	0.37	0.32	0.24	0.54	0.22	0.52	0.61	0.54	0.44	0.66
Vehicles per household	2.07	2.10	2.04	2.26	1.10	2.34	2.31	2.27	2.14	2.32

10 Vehicles that are under the Luxury Car Tax threshold: $75 526

11 Toyota Australia [Source]

5.1.3. Effect of regional fleet age

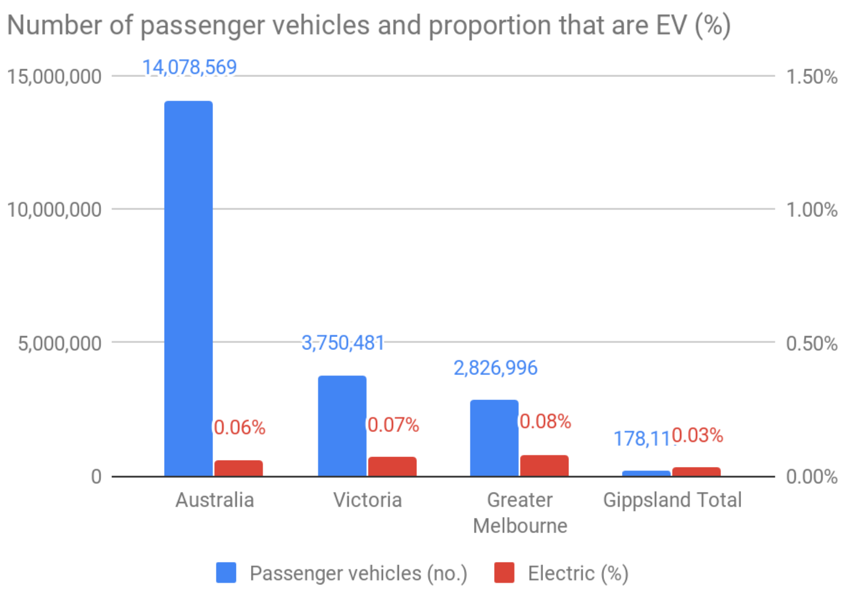
The age of the vehicle fleets on the road can be an indicator of the likely penetration of EVs. Vehicles in the Gippsland region are older than for Australia as a whole, Victoria and Greater Melbourne. This could mean that there is a slower vehicle turnover rate or that vehicles are more likely to enter Gippsland via the second hand market. Either way, this is likely to be reflected in a delayed uptake of EVs, already reflected in the current statistics.



5.2. Basis of EV uptake (current number of EVs)

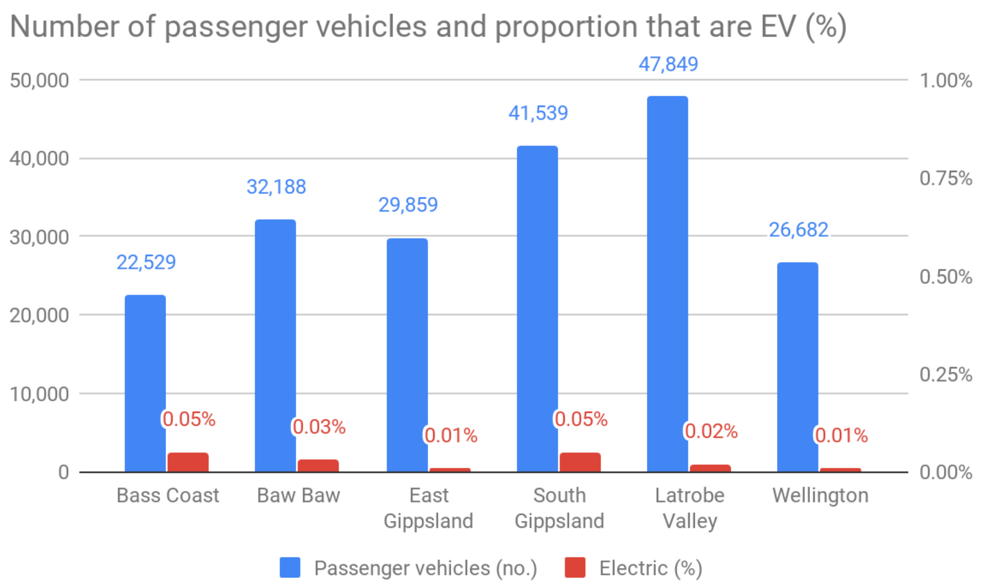
Looking at the current fleet of passenger vehicles and the proportion that are EVs will give us a starting point of our projections.

Right now, the number of EVs registered in Victoria overall and in Gippsland is very low. As of January 2017[12], there were 46 EVs registered in the Gippsland region, comprising 0.03% of the 178,117 passenger vehicles. As for Greater Melbourne, there were 2,294 EVs, comprising 0.07% of the 3.75 million passenger vehicles.



[12] Australian Bureau of Statistics, published October 2018

A look at the distribution of passenger vehicles also gives us an indication of the likely distribution of EVs within the Gippsland region.

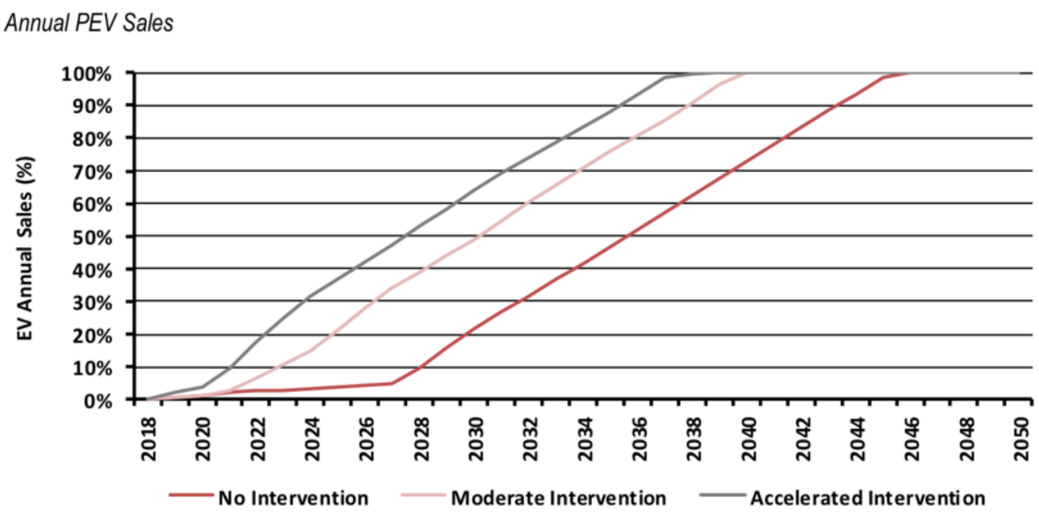


5.3. Australian EV uptake projections

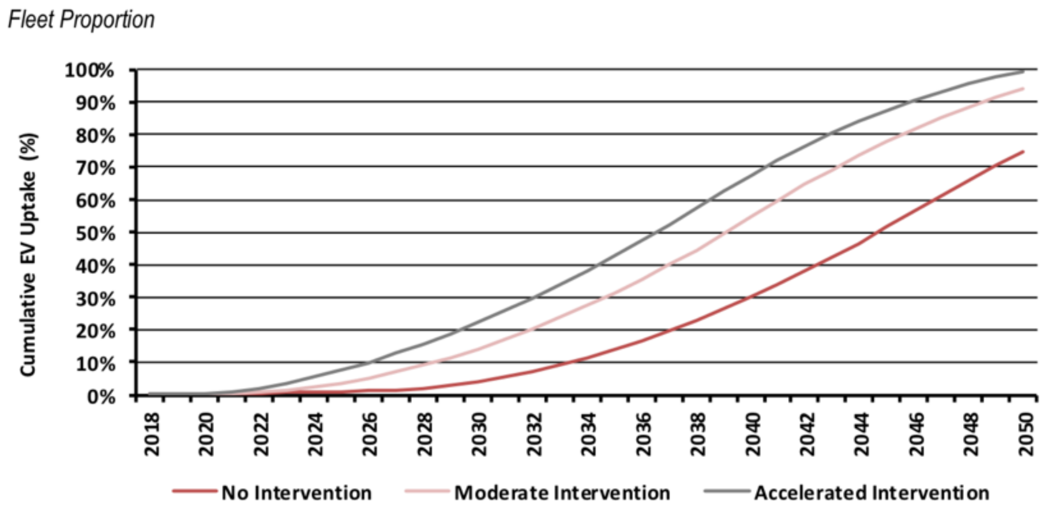
We are using the Energeia model of EV uptake, as it is consistent with our views on the Australian EV market. It follows a simple "diffusion of innovation" S-curve shape, that represents cumulative sales of EV and the phasing out of the current fleet of ICE vehicles.

5.3.1. Energeia forecast

The Energeia model is derived from a projection of new car sales. We are of the opinion that EVs are likely to comprise 50% of new car sales by 2030. This corresponds to the "Moderate Intervention" scenario in the graph below.

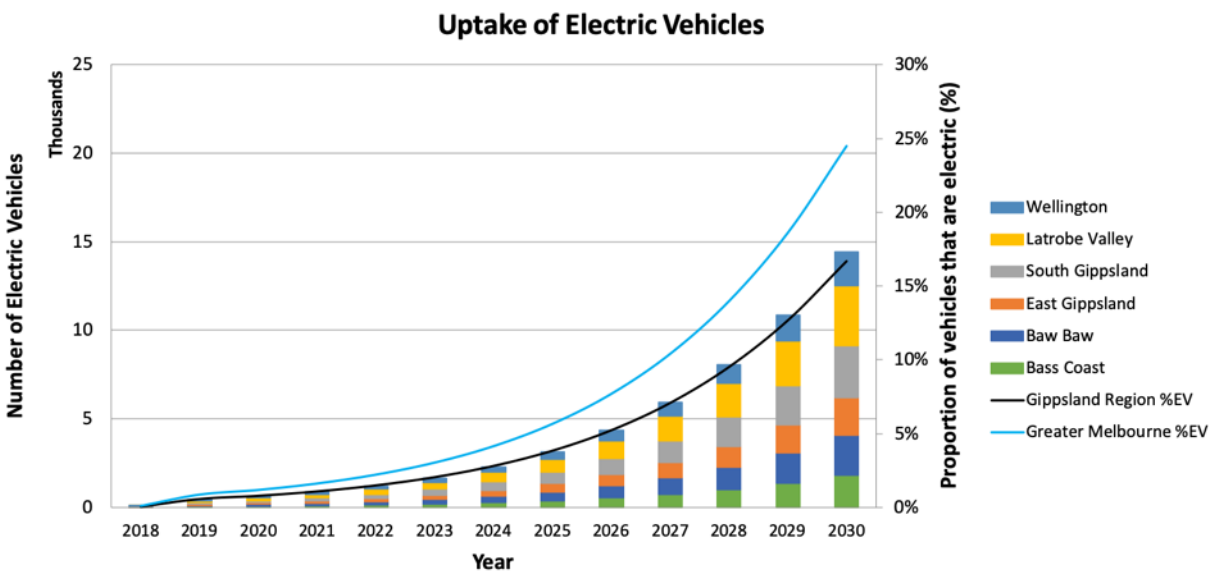


The Energeia moderate intervention forecast puts EVs at 4% of the national fleet in 2025 and 17% of the national fleet 2030.



5.3.2. Evenergi projection

We have adapted the Energeia projection to the regions of focus in this study. Based on the assumptions on uptake drivers described in the previous section, we expect the Greater Melbourne uptake to exceed the national rate and the Gippsland uptake to fall behind. This projection sees Gippsland reach 1.8% EV by 2025, and 7.8% by 2030.

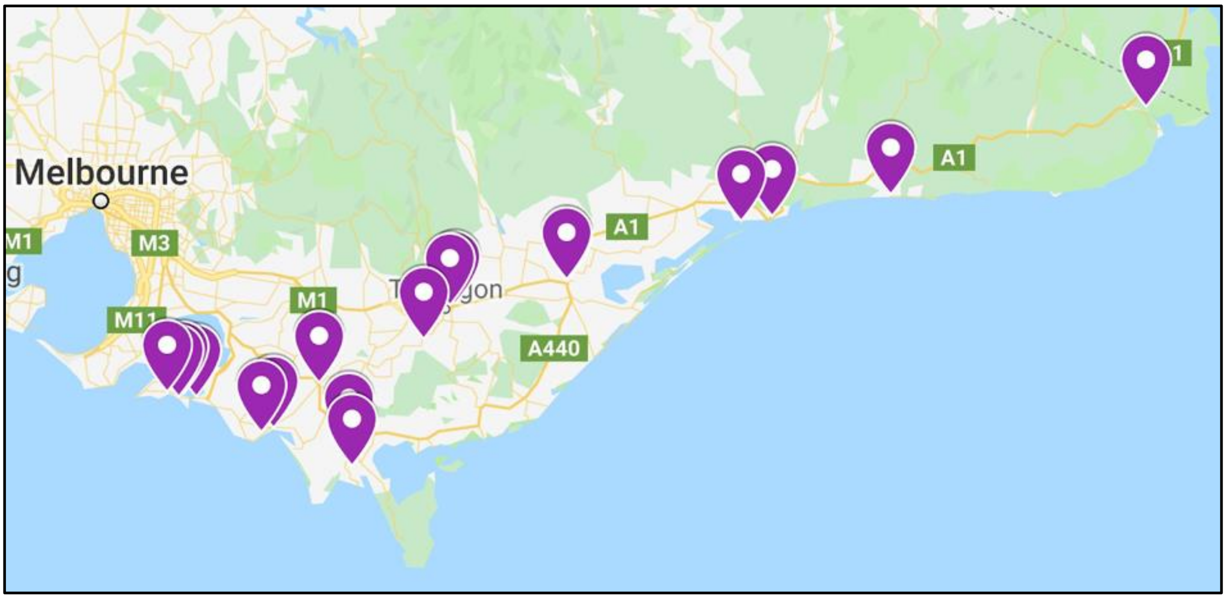


These uptake rates correspond to EV numbers listed in the table below.

Region	2025	2030
Australia	615,130	2,854,060
Victoria	199,067	931,800
Greater Melbourne	180,881	851,931
Gippsland	3,441	15,728
Bass Coast	397	1,814
Baw Baw	622	2,842
East Gippsland	577	2,637
South Gippsland	803	3,668
Latrobe Valley	925	4,225
Wellington	516	2,356

5.4. Existing charging infrastructure

The existing charging infrastructure is comprised of mostly Tesla Destination Chargers. Although it appears that there is a good coverage, most of these chargers are slow (3.5 kW) and are situated on private properties and are intended as an amenity to the patrons.



5.5. Alignment with Victorian Infrastructure Plan

The transition to electrified transport presents an unprecedented challenge to both local, State and Federal governments, straddling energy, transport and environment areas. In May 2018, the Government of Victoria published its "Inquiry into electric vehicles", which identified many benefits of EVs to Victorian consumers and opportunities that large-scale uptake of EV might have for Victorian industries.

In October 2018, the Victorian State Government released the Victorian Infrastructure Plan (VIP), a long term plan based on the recommendations of Infrastructure Victoria within their "30-year infrastructure strategy" published in Dec 2016. Infrastructure Victoria is an independent statutory authority, with three key roles:

- prepare a 30-year Infrastructure Strategy for Victoria
- provide advice to the Victorian Government on infrastructure matters
- publish research on infrastructure matters.

References to EV and charging-related energy infrastructure are notably absent in the VIP. This is likely due to the separate, dedicated work of the Victorian government such as the aforementioned Inquiry. This work preceded Infrastructure Victoria's, "Evidence Base Report Advice On Automated And Zero Emissions Vehicles Infrastructure" released in October 2018. This project included consultation with the Municipal Association of Victoria, whose submission to Infrastructure Victoria report is published.

It is likely then, that a formal policy framework around EV and charging infrastructure will be announced by the Government of Victoria within the next 2 years. In the meantime, the government is open to consultation with councils.

Infrastructure Victoria's Report included the following recommendations that align with electric vehicle charging investment, but notably only minor changes to planning processes were included. The core findings were to:

- Develop design standards to govern the design and placement of electric vehicle charging infrastructure in public areas. (Recommendation 10.a)
- Establish principles for smart charging and integrated payment systems in all charging infrastructure in Victoria to ensure interoperability between various charging infrastructure providers. (Recommendation 10.b)
- Review state-based regulatory settings to allow electricity providers to set demand-variable rates and demand management strategies. For example, consider amending metering and pricing arrangements to allow for separate 'vehicle only' electricity tariffs to be offered to zero emissions vehicle owners, to shift the electricity demand from these vehicles away from peak times. (Recommendation 12.a)
- Consider changes to minimum car parking requirements in the planning scheme within the broader context of policy objectives for the transport system with automated and zero emissions vehicles. This could build on recent amendments to the Victoria Planning Provisions that reduce car parking requirements for new uses of existing buildings in commercial areas and for land within walking distance of public transport. (Recommendation 13.a)

The other core context of this work is the need to understand the existing and potential infrastructure roll-out plans that will connect with and support anything done in the local council regions.

The Government of Victoria has shown a willingness to partner with the private sector in accelerating EV uptake by providing funding for high power DC charging infrastructure. In October 2018, Lily D'Ambrosio, Minister for Energy, Environment & Climate Change, announced $2 million of funding for Chargefox's Ultra-Rapid network.

6. Strategic placement of charging infrastructure: Regional Analysis

6.1. Aim of analysis

To determine where to put journey enablement charging infrastructure we will model the number of EVs travelling along major travel corridors and the corresponding energy demand. We will propose a placement strategy and charging typologies that will service this demand.

6.2. Data Availability

In order to create the methodology below, we had to deal with the constraints of available data. The following were the data sources utilised in the development of the placement recommendations.

Category	Datasets
Regional Geography	• Tourism destinations: Visit Victoria • Strategic Assets Map • Regional Growth Plan • Town Data (ABS)
Travel	• Road network map • Visit Victoria touring routes • Vic Roads traffic volume interactive map
Council-proposed sites	• Bass Coast • Baw Baw • East Gippsland • Latrobe • South Gippsland • Wellington
User Stories	• Regional tourism market • Journey to Work • Local EV model: Population, demographics, % of home ownership, vehicle type data
Electric Vehicles	• Performance data • EV uptake forecast
Electricity Distribution Network data	• Interactive network map

6.3. Assumptions and constraints to model

6.3.1. Model Assumptions

1. While we have been provided with a large set of data and insights, the placement of charging infrastructure will be determined on the basis of two qualitative factors: *Journey Enablement Charging* infrastructure and *Destination Charging* infrastructure. Our analysis is organised around these primary functions:

   a. Journey Enablement infrastructure is the backbone of fast chargers that make inter-regional travel possible for electric vehicles. These are typically located within major towns, providing convenient charging services to the local population.
   b. Destination Charging infrastructure is the network of chargers located at places of interest, where charging typically occurs while the driver is engaged in activities such as tourism or shopping. Destination chargers are slower by design, however, they may still provide journey enablement services in many applications.

2. Early adopters of EVs may be forgiving of charging challenges but, like a mobile phone network, there is a requirement for general “coverage” in the midterm. Regardless of the logic behind the placement of infrastructure, drivers will just expect a certain coverage and to be comfortable that an area caters adequately to EV drivers. While statistically drivers will frequent certain routes, psychologically they will not want to have a sense of being “trapped” into particular routes just because they have an EV. As such our recommendations are a combination of data-driven analysis, and a general precedent set in other markets around driver anxieties.

3. Charging infrastructure will be driven by economics as well as a green agenda. The final placement of chargers will be subject to the business models outlined in section 7.2, and may also be based on private and public commitment to the mission of electrification.

4. We have used Melbourne Airport as the origin for our journey modelling. This takes into consideration international and domestic tourists who are hiring cars. The airport is 25 km north of the CBD, a distance which also accounts for tourists who are coming from the North and West of the city.

5. While it is possible to outline the best sites for journey enablement, the number of chargers of particular types on each site will be determined over time by the operator/owner of the infrastructure. It is likely that core infrastructure would be in place for multiple chargers, with only one or two per site until volume demonstrates a requirement for additional chargers.

6. An ideal network of journey enablement chargers would provide adequate coverage for every user type. The user type with the greatest need for journey enablement charging is a day visitor who does not have access to charging at their accommodation. Journey enablement charging along the key routes should be located at intervals of 70 km[13] to allay range anxiety and give flexibility to drivers. Providing these services at locations with the highest volume of traffic will provide the largest benefit to society and present the best business case to charging station operators.

[13] European Commission’s guideline is one fast charging site every 60 km, Australian best practice is 70 km.

7. Destination chargers are used to give a more general sense of coverage for a network. They are often located at places of interest and are intended for use while the driver is engaged in an activity. The nature of the destination will often drive the type of charger. If it is at a hotel it can generally be a slower charger as people will stay overnight.

8. While there are unique user stories for each region, there are some fundamental user stories as outlined below. “User stories”, incl. value proposition, utility of services, driver behaviour, and case studies of typical tourism journeys in each municipality and associated charging requirement, etc.

   Charging infrastructure meet the needs of different users, segmented as follows:

Segment	Profile
Day Visitor	• A day visitor may have driven all the way from Melbourne and may have a low battery state of charge • These drivers may have a time constraint and prefer faster chargers • They must complete their round-trip using public chargers since they are not staying overnight • They will prefer tourist spots with charging facilities • They are most likely to experience range anxiety • They are most likely to be frustrated by poor service
Overnight Visitor	• An overnight visitor can rely on charging at their accommodation, therefore they may only require a top up charge • They are less dependent on public chargers • They may have more time to spend at rest stops or minor attractions
Locals	• They have similar use patterns to EV drivers in urban settings • They will incorporate charging into a weekly routine • They are least dependent on publicly accessible chargers
Commuters	• They have a daily routine • They are likely to charge at home or work

6.3.2. Electric vehicle energy efficiency and range assumptions

Electric vehicle range is improving all the time. The range of an electric vehicle is impacted by speed, loads, extreme temperatures (and related use of air conditioning). While charging is a relatively slow process, drivers leave 10-20% battery in reserve in case of an unforeseen-route change. This is incorporated into trip planning software.

Vehicle range is an important data consideration when determining the coverage of the charger network. When we forecast forward we have to make assumptions around the range of vehicles as it determines the spatial allocation of infrastructure (i.e. how far someone can drive before running out of charge).

Vehicle energy efficiency data is also important - by understanding the amount of energy consumed between charges, we can determine the energy demand at each charger. We can then use this data to predict top up or full charge duration, and even estimate queue times at chargers during periods of high demand.

When we consider the placement of journey enablement chargers, we must consider an entry-level EV taking the trip in extreme weather (under -6 ºC or over 35 ºC). This represents the shortest range of EVs travelling along the route. At the time of writing, an entry-level EV is capable of approximately 180 km in ideal conditions. In extreme heat, this falls to 140 km. More expensive EVs with larger battery capacities have a range greater than 320 km.

6.4. Methodology

The following methodology has been used to provide insights and recommendations around key areas and site candidates for charging infrastructure. We approached each of the six separate regions in detail (Bass Coast, Baw Baw, South Gippsland, Latrobe, Wellington and East Gippsland).

STEP 1: Establish the key routes

Firstly we developed user stories for each region. We then analysed traffic volume data, tourism data, local commuting data and council supplied local knowledge.

While the methodology below shows consideration of specific items, in general the following issues were considered:

- Regional tourism
  - Attractions
  - Market
  - Seasonality
- Travel corridors
  - Ex-Melbourne
  - Inter-regional
- Different types of road users
  - Tourists
  - Commuters
  - Local residents
- Energy demand model for each EV user
  - Number of users by type
  - Journey length
- Geography
  - Population
  - Home ownership
  - Number and type of vehicles
  - Retail and services
  - Places of interest
- Electricity network constraints

STEP 2: Analyse key “journey enablement” sites for fast charging

To establish Journey Enablement through a region we mapped distances from key departure points against the likely travel range of electric vehicles under various conditions, and then looked through the lens of traffic volume data.

We then simulated the journey of an entry-level EV along the key route, determining the vehicle’s state of charge and the likely charge required in order to complete the journey. We used this data to estimate the charge duration for different level chargers.

STEP 3: Create a map of convenience charging/destination charging to provide comfort to drivers

To determine convenience charging locations we developed a classification matrix that enabled a weighted factor based selection of sites which we grouped by level of attraction as a charging location. This step was focused on "zones" that required infrastructure rather than specific sites. We also considered the relative distances between zones to consider how important these sites would be.

The following Table is an outline of the charger classification matrix.

Utility Value	Data	"A" location	"B" location	Destination ("D")
Local	Town size	> 5000	> 500	Negligible
	Places of interest (e.g. shops, entertainment, community halls, services)	Many	Few	None
	Commuters	> 2000	> 500	< 500
Logistic	Road Type	Major highway	Main road	Minor road
	Traffic Volume (Vehicles per day)	> 4000	> 1000	< 1000
	en-route to X	Major tourism region	Other regions	Route terminus
Tourism	Tourism activity	Minor	Minor	Major
	Retail	Yes	Yes	No

STEP 4: Further site selection matrix to determine a shorter list of potential sites

We gathered more detailed data around each site with respect to the detail required for site selection. This information includes:

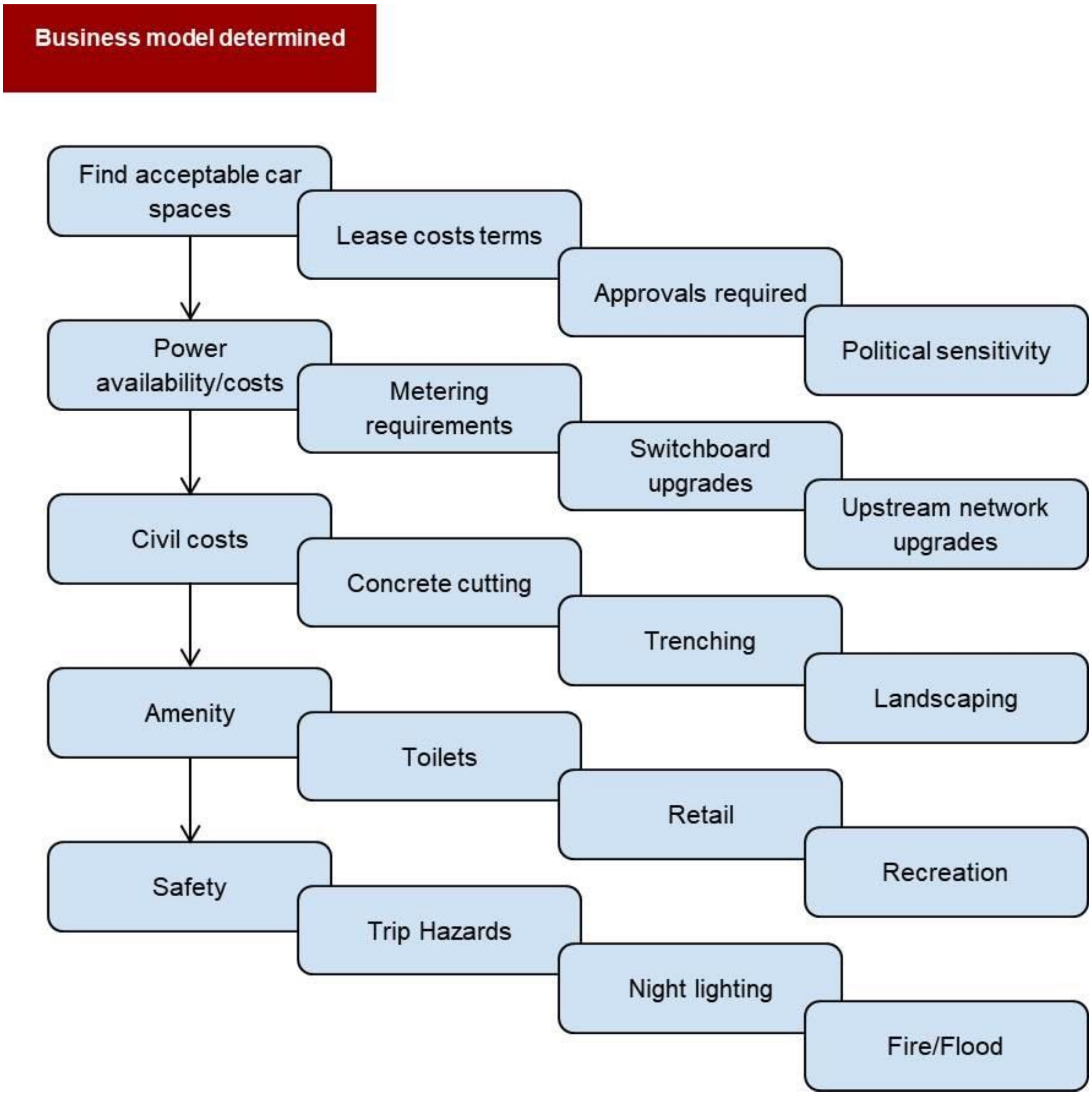
- Cost of any site leases
- The timeframes that may be encountered in negotiating with different sites - typically it is assumed that licensing agreements for council owned sites will take longer to negotiate
- Approvals required for any particular site choice
- The availability of power on the site - this also then impacts on time to deploy the site as utility negotiations can add months to a project
- Potential costs of civil works
- Whether there are car parks in appropriate areas, but also car parks that will not draw significant community back-lash
- Whether there is good local amenities for drivers while recharging
- Other site conditions that may be imposed

In reality this broad range of considerations, proponents may approach multiple sites and work through the various considerations iteratively until a specific site is identified. Even then, discussions around multiple sites may continue in case unexpected roadblocks are encountered in relation to a specific site.

As site lease costs are currently seen as a major item, proponents will typically approach councils seeking low or no cost leases on the basis that the council will see the project as meeting its sustainability or community objectives. Given this strategy, the first approach is often via the sustainability managers to discuss the public benefits of installing charging infrastructure in terms of meeting council sustainability objectives.

If the approach is about a council-owned site, then the process of council approvals will be required as it is designating a council asset to a private company and may cause issues if the car park is already highly utilised. This often takes the form of a preliminary proposal to get council approval via a meeting of counsellors. In this case several options may be provided and the council may approve one or all of these sites. Approvals are generally subject to detailed feasibility process and the council decision will then require final council approval or that approval may be delegated to a general manager.

The site selection process is shown as follows.



STEP 5: Consider peak travel flows to understand the potential density of charging infrastructure placement

Using daily and hourly traffic flow data we were able to create an understanding of medium and peak traffic flows and then relate those back to potential uptake of electric vehicles, as provided in the section above, to provide insight into the potential peak requirement for charging infrastructure by 2025.

The following sections involve going through this process for each region.

6.5. South Gippsland

6.5.1. Determining the "Key Route"

User Story: Day Visitor
The Melbourne to Wilsons Promontory route is a popular tourist drive and a vital travel corridor for the South Gippsland region. Here, tourism is an important industry where tourists undertake 540,000 day visits annually[14].

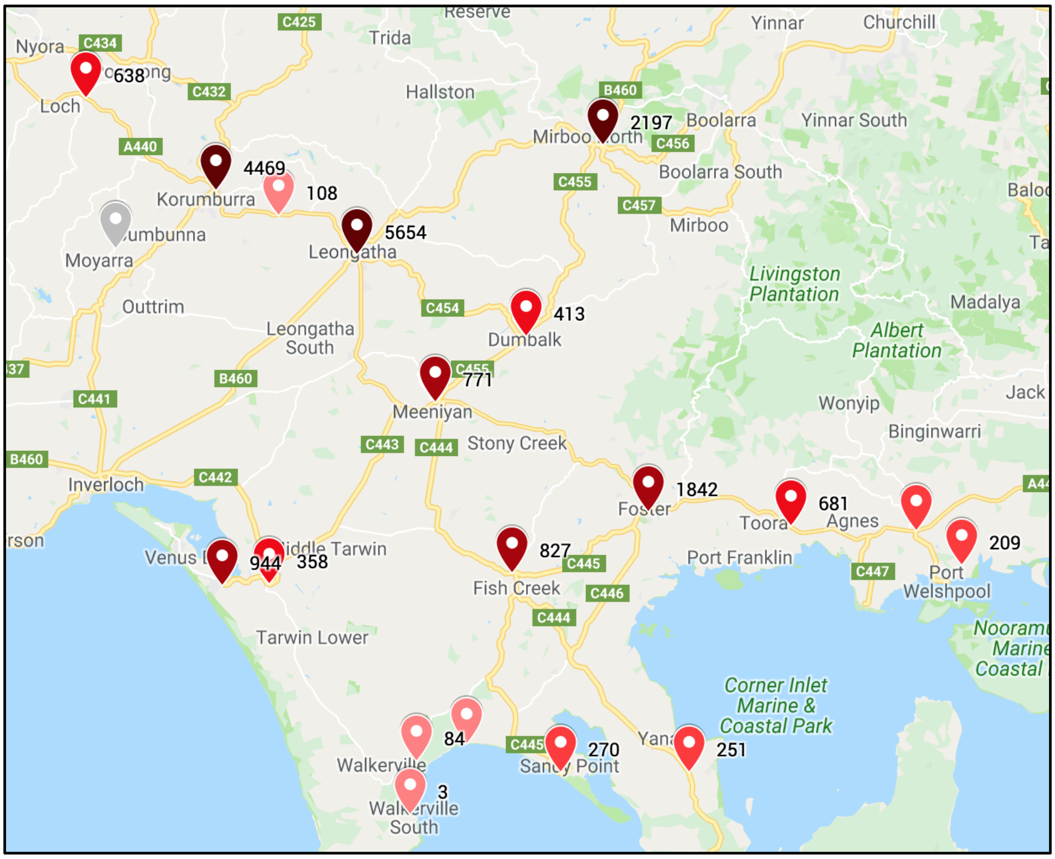
User Story: Overnight Visitor
There are 390,000 overnight visitors in South Gippsland, two thirds (64%) of visitors to the region will go to Wilsons Promontory for an average of 3 days[15].

User Story: Local
Korumburra, Mirboo North, Korumburra and Foster are the major towns in the South Gippsland region. These towns are all connected by the South Gippsland Highway.

Town	Population	Households	Dwellings with at least one vehicle (% of households)
Korumburra	4,469	2,055	1,527 (74%)
Mirboo North	2,197	941	740 (79%)
Leongatha	5,654	2,522	1,950 (77%)
Foster	1,842	1,030	693 (67%)

[14] Tourism Research Australia, 2017
[15] Prom Country Economic Impact and Visitor Profile, 2013

Map: Populations of towns in South Gippsland



User Story: Commuter

Korumburra, Leongatha and Foster are economic and strategic nodes from which many workers commute.

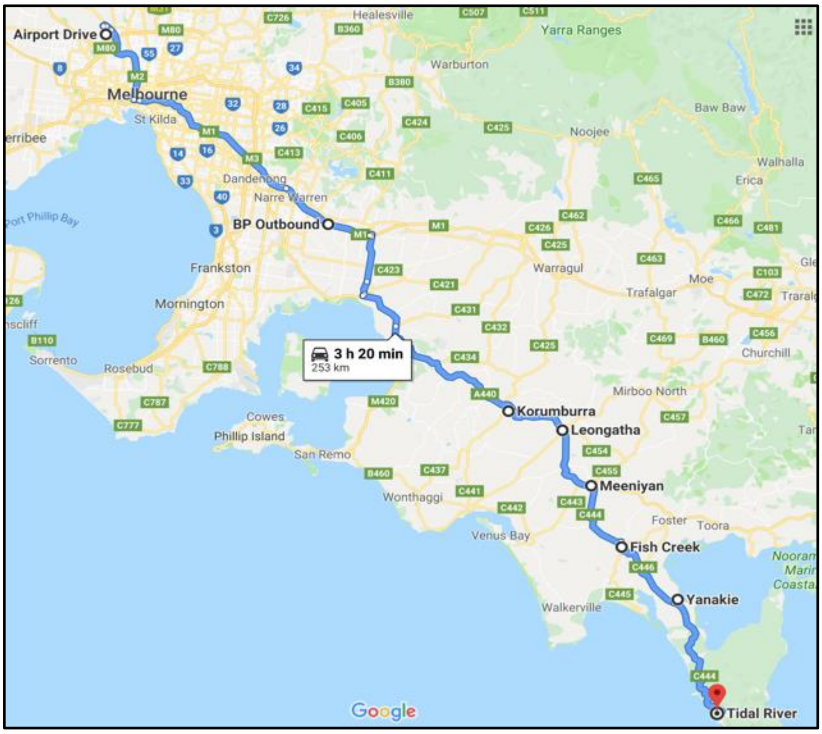
Statistical Area (SA2)	Commute by vehicle *to*	Commute by vehicle *from*
Korumburra	1,667	2,825
Leongatha	3,741	3,310
Foster	1,617	2,152

Key Route

Melbourne to Wilsons Promontory is the key route is in South Gippsland, comprising the South Gippsland Highway and Meeniyan-Promontory Road and linking the following towns:

- Korumburra
- Leongatha
- Meeniyan
- Fish Creek/Foster
- Yanakie
- Tidal River

In addition, we will consider that travelers may stop at the service centre (BP Outbound) on the M1 Princes Highway at Officer for a break. We expect this to be a likely location for a DC fast charger in the future (although it is outside of the Gippsland region).



6.5.2. Journey Enablement South Gippsland)

Route Node Analysis

The journey from Melbourne CBD to Wilsons promontory is 228 km (add 25 km if starting from Melbourne Airport). A one-way trip exceeds the range of entry-level EVs, while a return trip exceeds that of premium EVs.

Charging infrastructure at Korumburra, Leongatha and Meeniyan is likely to get significant use by tourists en-route to the Promontory, but also by drivers travelling across the region from Baw Baw and Latrobe to the Bass Coast.

Korumburra and Leongatha have significant populations and are important economic nodes, attracting commuters from across South Gippsland.

Node Summary: Melbourne to Wilsons Promontory								
	Melbourne CBD	M1 Service Station, Officer	Korumburra	Leongatha	Meeniyan	Fish Creek	Yanakie	Tidal River
Tourism Survey*			=	=	=	7%	=	37%
Distance between stops	Start	51	70	15	17	19	19	37
Distance from Melbourne CBD (Airport add 25 km)	0	51	121	136	153	172	191	228
Daily Traffic Volume		60,000	10,000	11,000	5000	1000	500	200
Population	5 mil	N/A	4,469	5,654	771	827	251	0
Commutes to Work			1667	3741	1617 (Foster)			20
*% of overnight visitors to South Gippsland stayed in these areas. Equally low distribution among other towns.								

Traffic Flow Analysis

The volume of traffic along the South Gippsland Highway tapers off towards Wilsons Promontory. From Fish Creek onwards, traffic volumes along the key routes are less than one-tenth that of the major towns.

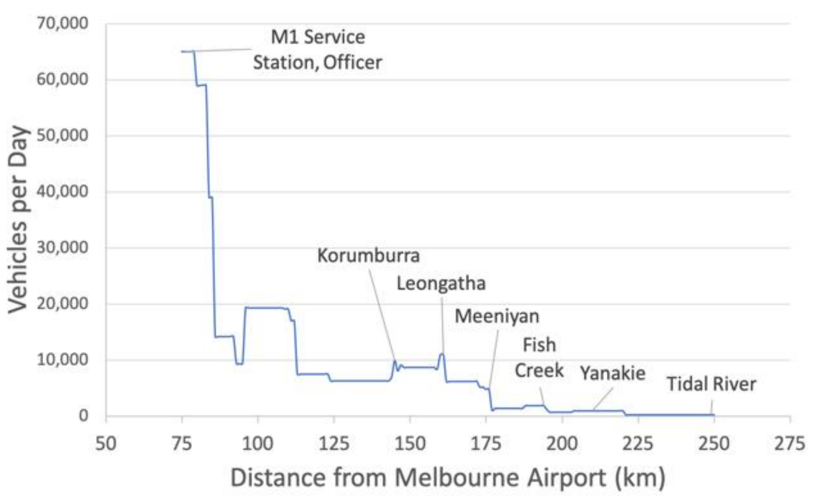


Figure: Traffic Volume along the key route between Melbourne and Wilsons Promontory

6.5.2.1. 2025 Electric Vehicle Projection and peak demand

By 2025, we expect EVs to account for 4% of the national vehicle fleet. We will assume this composition for traffic along the key route.

During weekends, particularly on school and public holidays, peak demand will be significantly higher than the daily average. We have used VicRoads data to compute a ratio of average to peak demand from which we can estimate the peak volume of traffic.

This is important as it indicates the potential number of chargers required to ensure a positive driver experience.

		Korumburra	Leongatha	Meeniyan	Fish Creek	Yanakie	Tidal River
Daily Traffic Volume	Vehicles /day	10,000	10,900	4,800	1,200	950	260
Peak ratio		1.76	1.28	2.13	1.68	2.28	1.36
Peak Daily Traffic Volume	Vehicles /day	17,600	14,000	10,200	2,000	2,170	355
Average daily EVs in 2025 (4% of Fleet)	EV/day	400	436	192	48	38	10
Peak EVs in 2025	EV/day	704	558	409	81	87	14
Peak Hourly Traffic	Vehicles /hr	744	461	228	240	95	88
Peak hourly EV (2025)	EV/hr	30	18	9	10	4	4

6.5.2.2. Example scenarios: "Entry level EV" charge strategy

In these scenarios, a tourist is driving an EV with advertised[16] range of 230 km and energy efficiency of 14 kWh/km, however various factors mean that energy efficiency is really 15.6 kWh/km meaning the *real* range is 180 km. We will also assume that the driver wishes to leave 20% battery in reserve.

Scenario A: Overnight visitor using destination charging available at Tidal River
In this scenario, we are assuming that there is a low powered (< 3.5 kW) destination charger at Tidal River while we explore the need for chargers at any of the towns en-route.

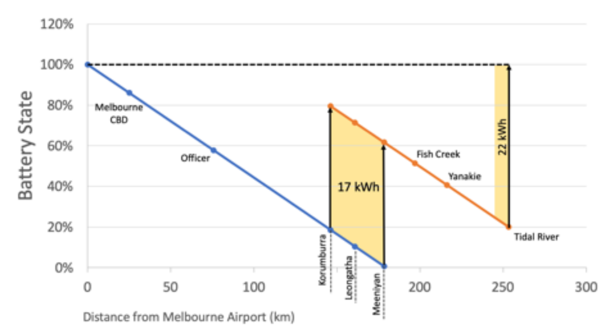
Drivers leaving Melbourne must charge at least once along the 253 km journey. By the time the driver gets to Korumburra, there is only 20% of battery left. At this point the driver can review his battery status and decide if it is possible to continue to Leongatha or Meeniyan.
Whether the driver stops at Korumburra, Leongatha or Meeniyan, they must *top up* with 17 kWh of charge in order to arrive at Tidal River with 20% battery in reserve. The table below shows how long this may take using different powered chargers.

After recharging fully at Tidal River, the driver heads back to Melbourne. On the return leg it is critical that the driver departs Korumburra with a full charge in order to arrive back at Melbourne with 20% battery in

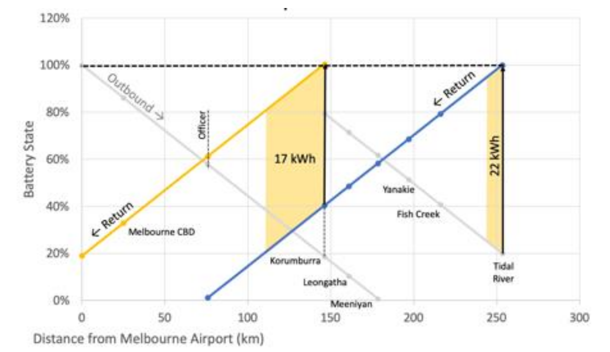
[16] Worldwide Harmonized Light Vehicle Test Procedure (WLTP)

reserve. If chargers are available, the driver may choose to top up charge at any of Yanakie, Fish Creek, Meeniyan, Leongatha or Korumburra, to break up the time spent charging.

Outbound



Return



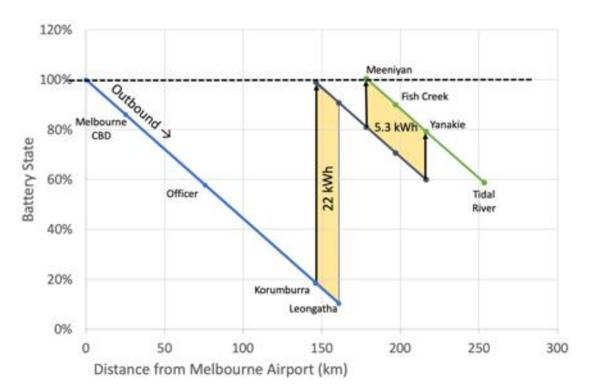
Scenario B: Day visitor with no destination charging available at Tidal River
In this scenario, we are assuming that there is no charger at Tidal River and that all charging must be done before or at Yanakie.

As in scenario A, the first charge must be made at Korumburra, but this time the driver must ensure that there is enough charge for a return trip (plus 20% in reserve). The range of the vehicle is insufficient to do this from Korumburra, therefore a top up charge of 5.3 kWh is necessary at either Meeniyan, Fish Creek or Yanakie. The state of charge is 59% when the driver arrives at Tidal River.

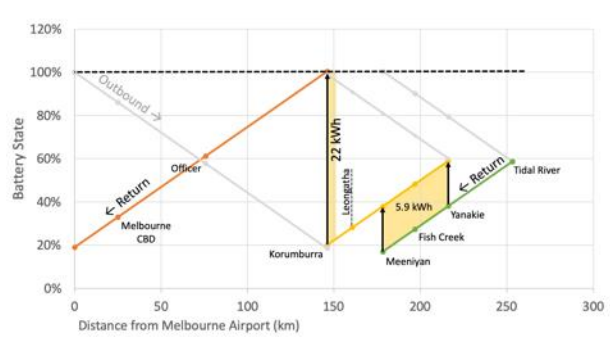
On their return trip, the driver must top up charge 5.9 kWh at either Yanakie, Fish Creek or Meeniyan (although Meeniyan slightly exceeds the 20% reserve).

In order to reach Melbourne airport, the driver must leave Korumburra with a full battery. In this scenario, that requires a 22kW charge.

Outbound



Return



The duration of each charge depends on the power of the charger. The table below shows the duration of each charge in the above scenarios. This allows us to make a decision on what power charger to install.

	Charge Amount		Charge Time for each charger power				
	Charge (% of battery)	Charge (kWh)	3.5 kW AC	7 kW AC	22 kW* AC	50 kW DC	100 kW DC
Top up	19%	5.3	1 h 31 min	46 min	15 min	6 min	3 min
	21%	5.9	1 h 41 min	50 min	16 min	7 min	4 min
	61%	17	4 h 53 min	2 h 26 min	47min	20 min	10 min
Full Charge (20% to 100%)	80%	22	6 h 24 min	3 h 12 min	1 h 1 min	27 min	13 min
***Hyundai Ioniq, Nissan LEAF limited to 7 kW while AC charging.**							

Insights

- For both the day and overnight visitor from Melbourne to Tidal River, it is necessary to charge at Korumburra or Leongatha.
- For day visitors (or if no charger is available at Tidal River), it is also necessary to charge at Yanakie or Fish Creek, on both the outbound and return journeys.
- For the return trip, it is necessary to charge at Korumburra in order to reach Melbourne Airport with 20% reserve.

6.5.3. Destination Chargers (South Gippsland)

South Gippsland Shire Council identified 86 potential charging locations across 21 locations. We first assessed the local, logistical and tourism value of each location and classified them as A, B or D locations.

A Location - Situated **on** Key Route, high logistical value, high local value, high tourism value.

B Location - Situated **off** Key Route, medium logistical value or medium tourism value

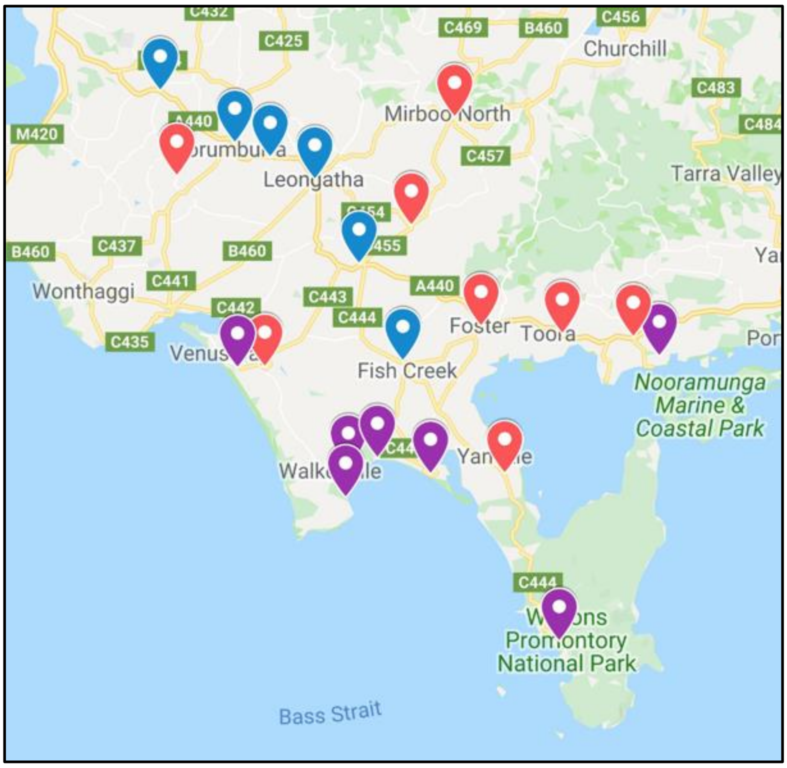
D Location - Purely destination, no logistical value, low local value, high tourism value.

Location	Utility Value			Location Class
	Local	Logistical	Tourism	
Dumbalk	Low	Medium	Low	B
Fish Creek	Low	High	Medium	A
Foster	Medium	Medium	Medium	B
Korumburra	High	High	High	A
Leongatha	High	High	Medium	A
Loch	Low	High	Medium	A
Meeniyan	Medium	High	Medium	A
Mirboo North	Medium	High	Medium	B
Moyarra	Low	Medium	Low	B
Port Welshpool	Low	Low	High	D
Sandy Point	Low	Low	Medium	D
Tarwin Lower	Low	Medium	Low	B
Tidal River	Low	Low	High	D
Toora	Low	Medium	Low	B
Venus Bay	Low	Medium	High	D
Walkerville	Low	Low	High	D
Walkerville South	Low	Low	Medium	D
Waratah Bay	Low	Low	Medium	D
Welshpool	Low	Medium	Low	B

Potential charging locations in the South Gippsland region.

A Locations - Blue
B Locations - Red
D Locations - Purple

The spatial distribution of each charger type also gives a clue to the power of the charger required. A and B Locations are suitable for the highest feasible power due to their high logistical value, shorter dwell time and high utilisation rates. D locations, due to their low logistic value and high dwell time are suited to slow, simple chargers. Due to their remoteness, groups of slow chargers at D locations may need demand management systems.



6.5.4. Site Summary - South Gippsland Region. Please see attached schedule - Site Summaries

6.6. Bass Coast

6.6.1. Establish Key Route

User Story: Day Visitor
The Melbourne to Inverloch route is a popular tourist drive and a vital travel corridor for the Bass Coast region. Here, tourism is an important industry where tourists undertake 1,280 thousand day visits per year[17].

Table: Popular attractions for day visitors:

Location	Attractions
Phillip Island	• Nobbies Centre • Phillip Island Nature Park • GP Circuit • Koala Reserve • National Vietnam Veterans Museum

User Story: Overnight Visitor
There are 881 thousand overnight visitors in Bass Coast who stay for an average of 3 nights[18].

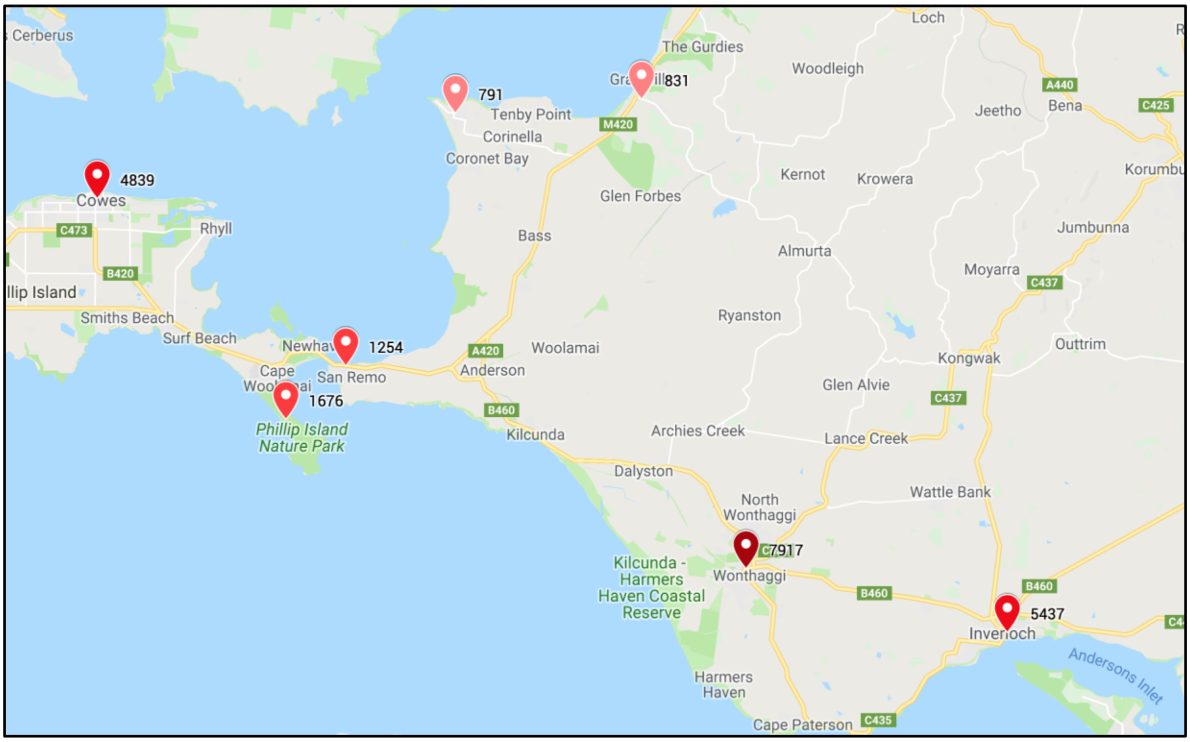
Popular attractions for overnight visitors:

Location	Attractions
Phillip Island	• Nobbies Centre • Phillip Island Nature Parks • Grand Prix Circuit • Koala Reserve • National Vietnam Veterans Museum
Cape Patterson	• Bunurong Marine National Park • Inverloch
Western Port	• Corinella • San Remo • Maru Koala Reserve (Grantville)
Wonthaggi	• State Coal Mine

User Story: Local
Grantville, Wonthaggi, Inverloch and Cowes are the major towns in the South Gippsland region. These towns are all connected by the South Gippsland Highway.

[17] Tourism Research Australia, 2017
[18] Prom Country Economic Impact and Visitor Profile, 2013

Town	Population	Households*	Dwellings with at least one vehicle (% of households)
Grantville	831	520	329 (63%)
Cowes	4,839	5,001	1,711 (34%)
Wonthaggi	7,917	3,942	2,761 (70%)
Inverloch	5,437	4,086	1,831 (44%)
*Includes holiday homes			



Map: Populations of towns in Bass Coast

User Story: Commuter
Wonthaggi-Inverloch and Phillip Island are the two major economic nodes in the Bass Coast region.

Statistical Area (SA2)	Commute by vehicle *to*	Commute by vehicle *from*
Wonthaggi-Inverloch	4,843	5,988
Phillip Island	2,233	2,872

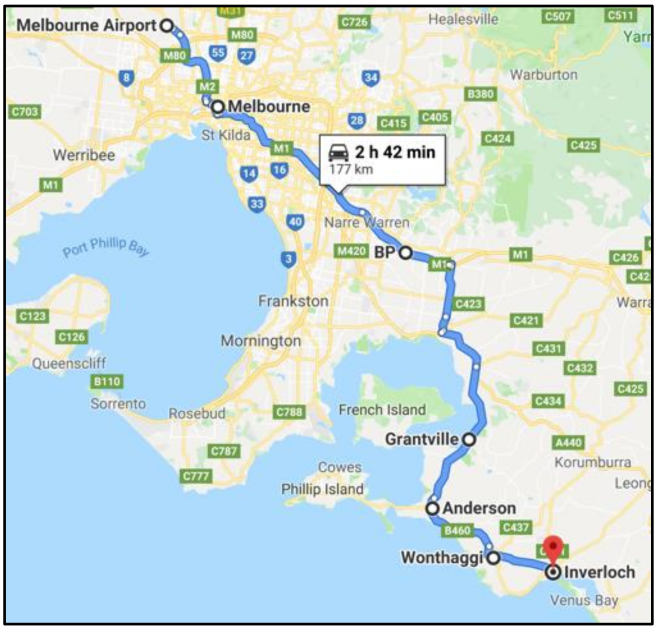
Key Route
Melbourne to Inverloch is the key route through the Bass Coast region, comprising South Gippsland Highway and Bass Highway and linking the following locations:

- Grantville
- Phillip Island

And/or

- Wonthaggi
- Inverloch

We will consider that travelers may stop at the service centre (BP Outbound) on the M1 Princes Highway at Officer for a break. We expect this to be a likely location for a DC fast charger in the future (although it is outside of the Gippsland region).



B Route
In addition to the Key Route, there is also a significant transport corridor between Inverloch and Phillip Island that includes traffic coming from Latrobe via Leongatha.

6.6.2. Journey Enablement (Bass Coast)

Route Nodes

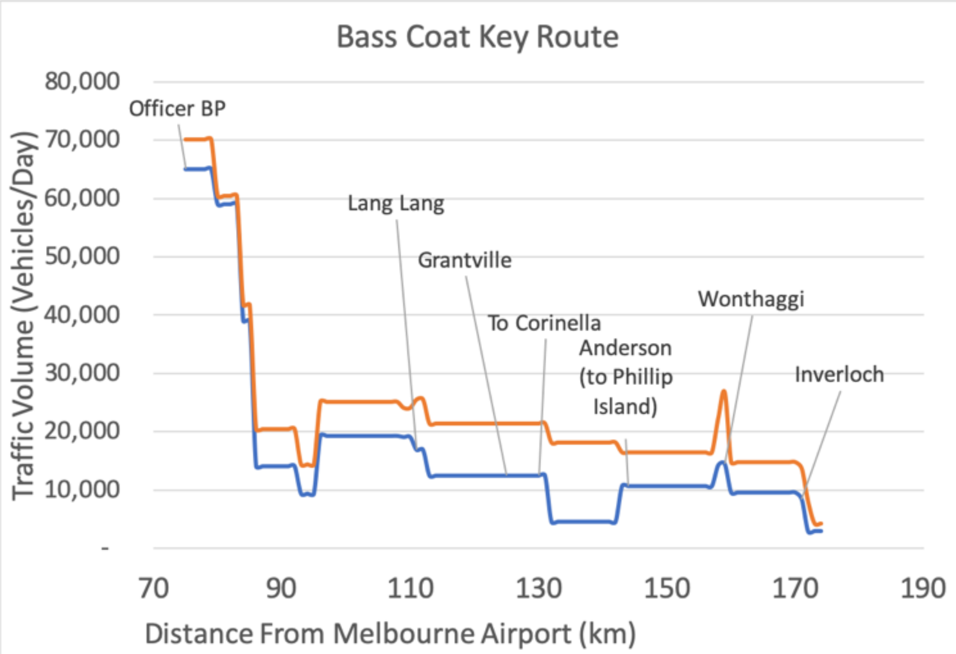
Wonthaggi, Inverloch and Phillip Island have significant populations and are important economic nodes, attracting commuters from across South Gippsland.

Route 1: Melbourne to Inverloch/Phillip Island								
	Key Route				Inverloch Route		Phillip Island Route	
	Melbourne CBD	M1 Service Station, Officer	Grantville	Anderson	Wonthaggi	Inverloch	San Remo	Cowes
Annual Day Visitors ('000s) (% of Bass Coast)	N/A						1 050 (89%)	
Annual Overnight Visitors ('000s) (% of Bass Coast)	N/A						788 (82%)	
Distance between stops	0	50	51	18	19	13	8 (from Anderson)	17
Distance from Melbourne CBD (Airport add 25 km)	0	51	101	119	138	151	127	144
Traffic Volume		65,000	12,000	10,000	15,000	10,000	14,000	8,200
Population		N/A	831	28	7,917	5,437	1,254	4,839
Commutes to Work					4843		2,233	

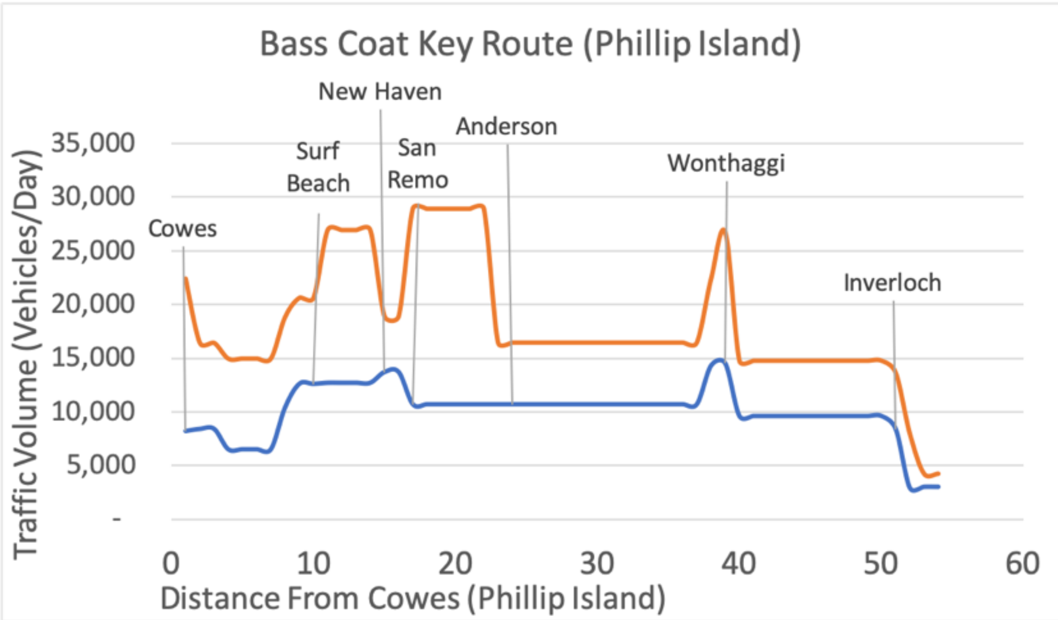
Traffic Flow Analysis

The journey from Melbourne CBD to Inverloch via Wonthaggi is 150 km (add 25 km if starting from Melbourne Airport). A one-way trip exceeds the range of entry-level EVs, although a small top up charge would be sufficient to complete the journey.

Phillip Island is a major tourist attraction *and* work destination, and we can see that much of the traffic to the Bass Coast region is flowing there from both the North route (ex-Melbourne) and the East route (Wonthaggi/South Gippsland/Latrobe).



We can see that ordinarily, traffic flows from the North to Corinella, of which half continues onwards to Phillip Island (via Anderson) or Wonthaggi. We can also infer that there is significant traffic flow between Phillip Island (via Anderson) and Wonthaggi. For this reason, we have looked into the Phillip Island to Inverloch route as well.



When we consider peak traffic, we can see that Phillip Island attracts much larger flows of traffic coming from the North (via Grantville). We can infer that an additional 12,000 vehicles are taking this route on peak days.

6.6.2.1. 2025 Electric Vehicle Projection and peak demand

By 2025, we expect EVs to account for 4% of the national vehicle fleet. We will assume this composition for traffic along the key route.

During weekends, particularly on school and public holidays, peak demand will be significantly higher than the daily average. We have used VicRoads data to compute a ratio of average to peak demand from which we can estimate the peak volume of traffic.

This is important as it indicates the potential number of chargers required to ensure a positive driver experience.

		M1 Service Station, Officer	Grantville	Anderson	Wonthaggi	Inverloch	San Remo	Cowes
Daily Traffic Volume	Vehicles/day	65,000	12,500	10,700	14,500	2,900	10,700	8,200
Peak ratio		1.08	1.71	1.54	1.84	2.75	2.7	2.73
Peak Daily Traffic Volume	Vehicles/day	70,100	21,400	16,500	26,700	8,000	28,900	22,400
Average daily EVs in 2025 (4% of Fleet)	EV/day	2600	500	428	580	116	428	328
Peak EVs in 2025	EV/day	2804	856	660	1068	320	1156	896
Peak Hourly Traffic	Vehicles/hr	6,300	2,520	1,940	3,260	852	2,530	1,880
Peak hourly EV (2025)	EV/hr	252	101	78	130	34	101	75

Example scenarios: "Entry level EV" charge strategy

In these scenarios, a tourist is driving an EV with advertised WLTP range of 200 km and energy efficiency of 14 kWh/km, however various factors mean that energy efficiency is really 15.6 kWh/km meaning the real range is 180 km. We will also assume that the driver wishes to leave 20% battery in reserve.

Scenario A: Overnight visitor using destination charging available at Inverloch

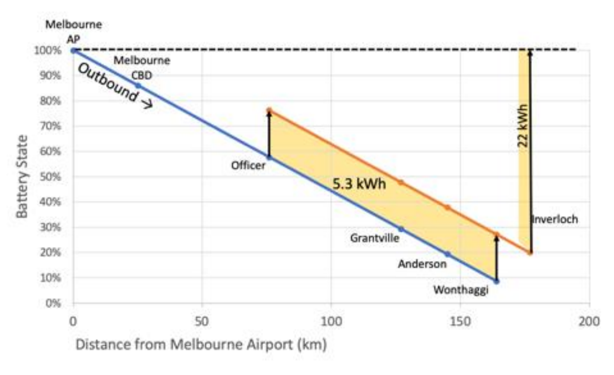
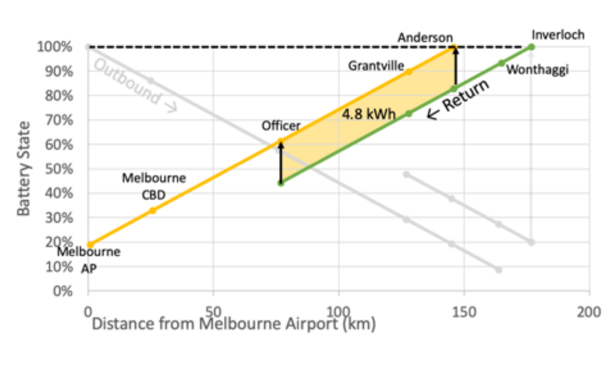
In this scenario, we are assuming that there is a low-power (< 3.5 kW) destination charger at Inverloch while we explore the need for chargers at any of the towns en-route.

Drivers leaving Melbourne Airport must charge at least once along the 176 km journey. By the time the driver gets to Anderson, there is only 20% of battery left. At this point the driver can review his battery status and decide if it is possible to continue to Wonthaggi.

Whether the driver stops at Officer, Grantville, Anderson or Wonthaggi, they must *top up* with 5.3 kWh of charge in order to arrive at Inverloch with 20% battery in reserve. The table at the end of this section shows how long this may take using different powered chargers.

The return trip requires a 4.8 kWh top up charge in order to arrive back at Melbourne Airport with 20% battery left in reserve.

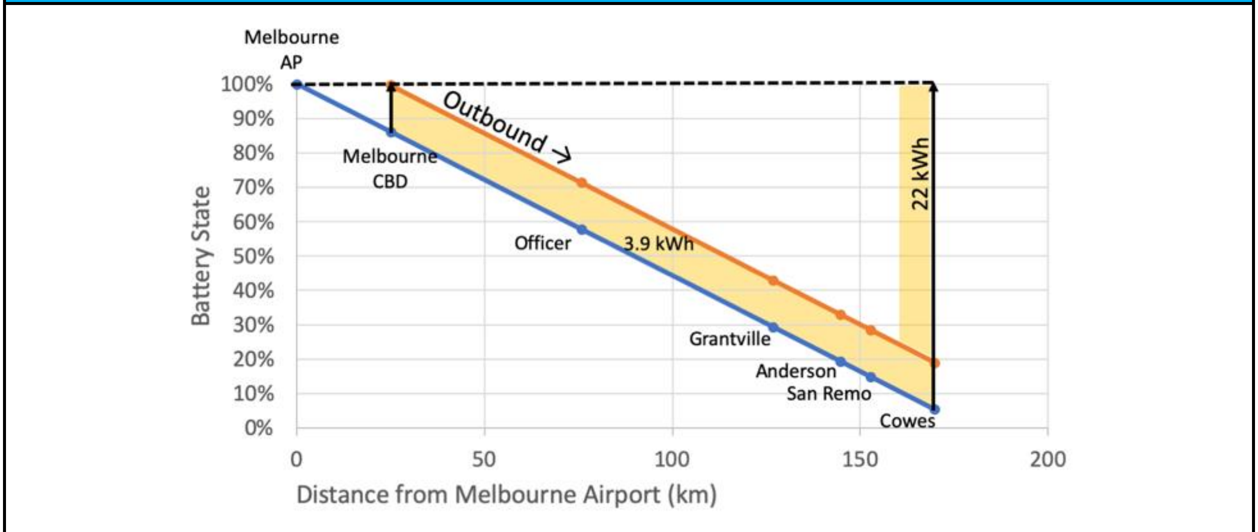
If we review both the outbound and return legs, the most suitable places for charging infrastructure are Anderson and Grantville (or Officer).

Outbound	Return
	

Scenario B: Overnight visitor to Phillip Island (Cowes) using charger at destination
In this scenario, we are assuming that there is a low-power (< 3.5 kW) destination charger at Cowes. We will explore the need for chargers at any of the towns en-route.

Drivers leaving Melbourne Airport can make the trip to Cowes on one charge, although it is cutting it fine. The driver will be able to use the vehicles trip computer to determine whether a top up of 3.9 kWh at any of the towns en-route is necessary.

An overnight charge of 22 kWh is required at the destination.

Overnight visitor to Phillip Island


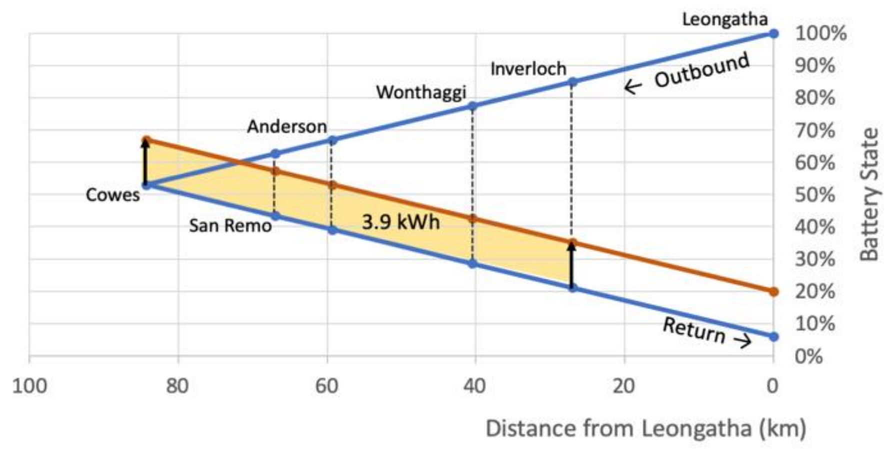
Scenario C: Day trip to Cowes from Leongatha via Inverloch

In this scenario, we are assuming that there is no available charger at Cowes and that the driver is departing Leongatha. This is a common route taken by tourists travelling from Latrobe or commuters travelling to Phillip Island from Wonthaggi/Inverloch.

Drivers taking this route can do so on one charge, however, to ensure a 20% reserve on returning to Leongatha, a 3.9 kWh top up is required at any of the towns.

The duration of each charge depends on the power of the charger. The table below shows the duration of each charge in the above scenarios. This allows us to make a decision on what power charger to install.

Day trip to Cowes from Leongatha via Inverloch



	Charge Amount		Charge Time for each charger power				
	Charge (% of battery)	Charge (kWh)	3.5 kW AC	7 kW AC	22 kW* AC	50 kW DC	100 kW DC
Top Up Charge	14%	3.9	1 h 7 min	33 min	11 min	5 min	2 min
	17%	4.8	1 h 22 min	41 min	13 min	6 min	3 min
	19%	5.3	1 h 31 min	45 min	14 min	6 min	3 min
Full Charge (20% to 100%)	80%	22	6 h 24 min	3 h 12 min	1 h 1 min	27 min	13 min

***Hyundai Ioniq, Nissan LEAF limited to 7 kW while AC charging.**

Insights - Bass Coast Journey Enablement
Due to the non-linear travel patterns, it is difficult to determine which towns best service the main routes. However, based on the information presented, we can offer the following insights:

- Anderson is a suitable location for journey enablement charging.
- The alternative is to put charging stations at Grantville *and* Wonthaggi
- Grantville and Wonthaggi are favourable locations due to higher traffic volumes and the local population

6.6.3. Destination Chargers (Bass Coast)

Bass Coast Shire Council identified 14 potential charging locations across 6 locations. We first assessed the local, logistical and tourism value of each location and classified them as A, B or D locations.

A Location - Situated **on** Key Route, high logistical value, high local value, high tourism value.

B Location - Situated **off** Key Route, medium logistical value or medium tourism value

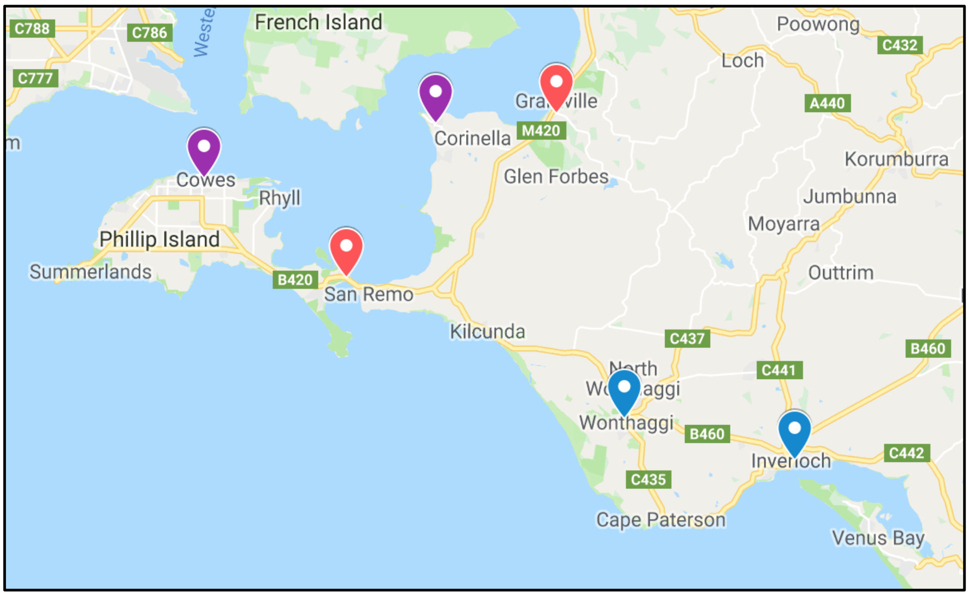
D Location - Purely destination, no logistical value, low local value, high tourism value.

Location	Value			Location Class
	Local	Logistic	Tourism	
Corinella	Low	Low	Medium	D
Cowes	High	Medium	High	D
Grantville	Low	High	Low	B
Inverloch	High	Medium	High	A
Newhaven	Medium	High	Medium	B
Wonthaggi	High	High	High	A

Potential charging locations in the Bass Coast region.

The spatial distribution of each charger type also gives a clue to the power of the charger required. A and B Locations are suitable for the highest feasible power due to their high logistical value, shorter dwell time and high utilisation rates. D locations, due to their low logistic value and high dwell time are suited to slow, simple chargers. Due to their remoteness, groups of slow chargers at D locations may need demand management systems.

A Locations - Blue
B Locations - Red
D Locations - Purple



6.6.4. Site Summary - Bass Coast
Please see attached schedule - Site Summaries

6.7. Baw Baw

6.7.1. Establish Key Route

The Baw Baw region encompasses popular tourist destinations and the Princes Highway, the major travel corridor for the Gippsland region.

Here, tourism is an important industry where tourists seek adventure in the natural environment, including skiing, bushwalking, fishing, canoeing, river rafting, bird watching or gold panning. The region is also well known for its produce and arts.

Additionally, agribusiness and manufacturing are key industries in the area.

Tourism Research Australia Data				
	International	**Domestic Overnight**	**Domestic Day**	**Total**
Visitors ('000)	5	171	710	886
Nights ('000)	125	372		497
Reason ('000 Visitors)				
Holiday	-	71	303	-
Visit Family	3	83	245	331
Work	-	-	84	-

User Story: Day Visitor
In close proximity to Melbourne, many of the tourist attractions within Baw Baw are within reach of day visitors. Many of these visitors will take the M1 Princes Highway to Yarragon and surrounds.

Table: Popular attractions for day visitors:

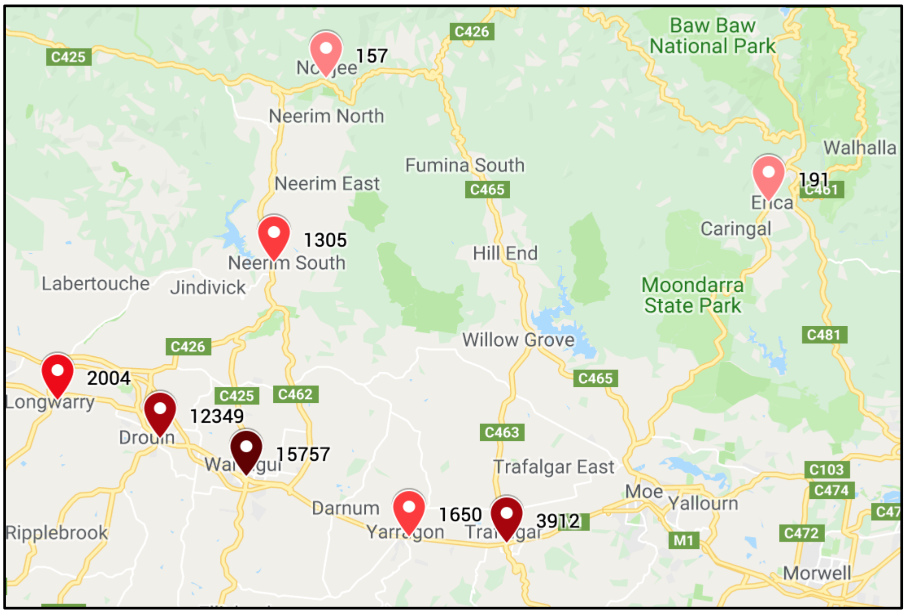
Location	Attractions
Yarragon & Surrounds	• Strzelecki Ranges • Local produce and arts • Drouin (food, retail, wineries, arts) • Warragul (West Gippsland Arts Centre, Lardner Park) • Mount Worth State Park • Trafalgar Holden Museum

User Story: Overnight Visitor
The natural environment of Walhalla and Noojee regions attracts many of the overnight visitors.

Location	Attractions
Walhalla & Surrounds	• Walhalla goldfields • Walhalla Goldfields Railway • Long Tunnel Mine • Cemetery Ghost Tour • Willow Grove (Blue Rock Lake) • Mountain Rivers Region (fishing) • Erica (ski accommodation, summer adventures) • Rawson (cross country skiing, summer adventures).
Noojee & Surrounds	• Noojee Trestle Bridge • Toorongo Falls Reserve • Mt Baw Baw Alpine Resort • Ada Tree • Rokeby Crossover Trail • Local produce and arts • Neerim South

User Story: Local
Warragul is the largest town in Baw Baw, followed by are the major towns in the South Gippsland region. These towns are all connected by the South Gippsland Highway.

Town	Population	Households	Dwellings with at least one vehicle (% of households)
Warragul	15,757	6,286	4,853 (77%)
Drouin	12,349	4,948	3,964 (80%)
Trafalgar	3,912	1,488	1,188 (80%)
Longwarry	2,004	608	495 (81%)
Yarragon	1,650	522	410 (79%)
Neerim South	1,305	350	280 (80%)



Map: Populations of towns in Baw Baw

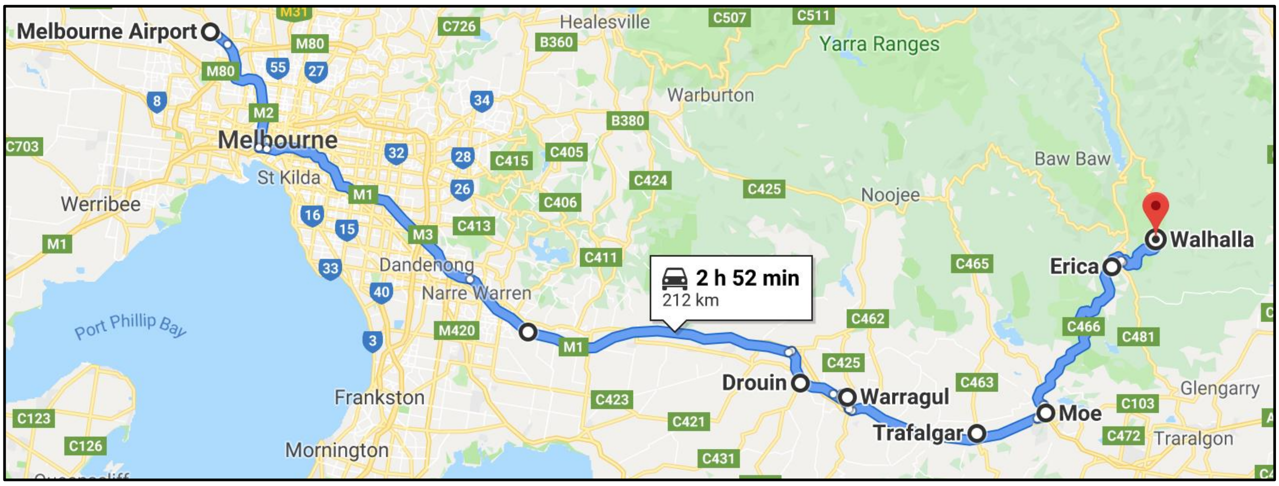
User Story: Commuter
Warragul and Drouin are the two main economic nodes in the Baw Baw region.

Statistical Area (SA2)	Commute by vehicle *to*	Commute by vehicle *from*
Warragul	6,803	6,335
Drouin	2,559	5,154
Trafalgar	1,230	2,453
Mount Baw Baw Region	864	1,830

Key Route

Melbourne to Walhalla linking the following stops:
- Officer M1 Service Centre[19]
- Longwarry*
- Drouin*
- Warragul*
- Yarragon
- Trafalgar
- Moe
- Erica
- Walhalla

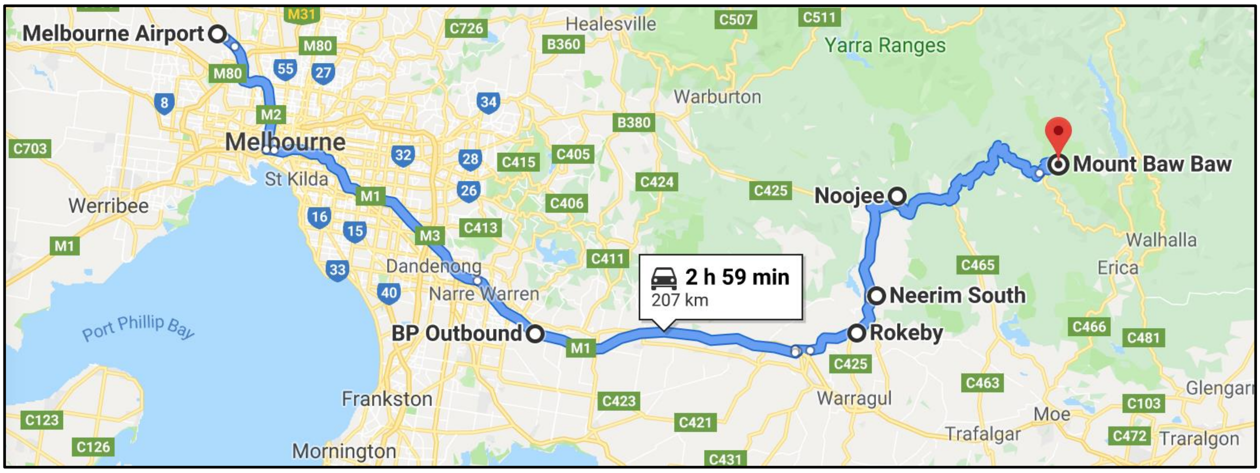
[19] We will consider that travelers may stop at the service centre (BP Outbound) on the M1 Princes Highway at Officer for a break. We expect this to be a likely location for a DC fast charger in the future (although it is outside of the Gippsland region).
* Locations that require leaving the dual carriageway M1



"B" Route

Melbourne to Mt Baw Baw linking the following locations:

- Officer M1 Service Centre[20]
- Drouin West
- Rokeby
- Neerim South
- Noojee
- Mount Baw Baw



[20] We will consider that travellers may stop at the service centre (BP Outbound) on the M1 Princes Highway at Officer for a break. We expect this to be a likely location for a DC fast charger in the future (although it is outside of the Gippsland region).

6.7.2. Journey Enablement (Baw Baw)

Key Route Nodes

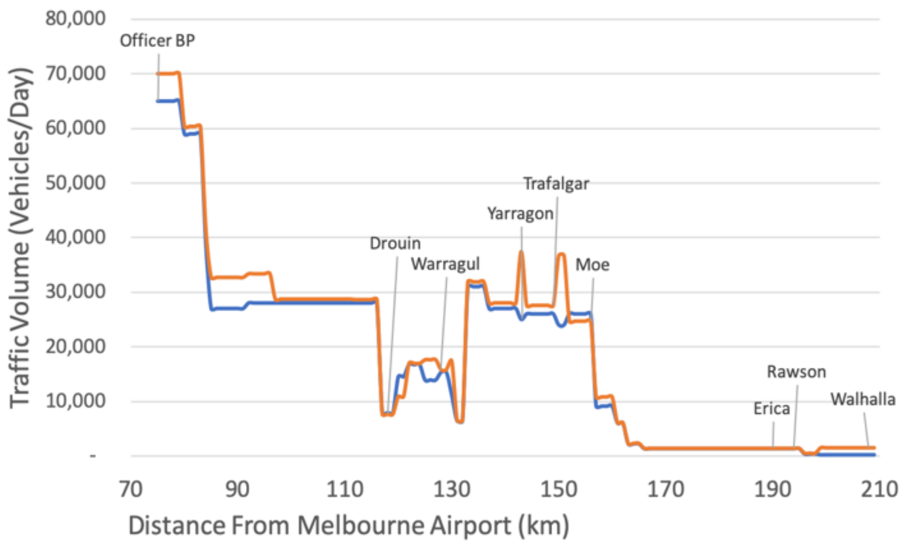
Warragul, Drouin and Moe[21] have significant populations and are important economic nodes, attracting commuters from across South Gippsland.

Route: Melbourne to Walhalla										
	Melb. CBD	M1 Service Station, Officer	Longwarry	Drouin	Warragul	Yarragon	Trafalgar	Moe	Erica	Walhalla
Distance between stops	-	51	37	11	7	14	7	12	30	17
Distance from Melbourne CBD (Airport add 25 km)	0	51	88	99	106	120	127	139	189	186
Traffic Volume		65,000	3,200	14,500	11,100	25,000	24,000	9,100	1,300	189
Population	N/A	N/A	2,004	12,349	15,757	1,650	3,912	8,778	191	20
Commutes to Work			2,559		6,800	1,230		3,653	860	
Annual Visitors ('000s) (% of Baw Baw)	N/A									120 (13.5%)

Key Route Traffic Analysis

The journey from Melbourne CBD to Walhalla via Warragul is 184 km (add 25 km if starting from Melbourne Airport). A one-way trip exceeds the range of entry-level EVs.

Yarragon and surrounds and Walhalla are major tourist attractions while the major towns on the M1 Princes Highway, including Warragul, Drouin and Longwarry are major work destinations. Much of the traffic to the Baw Baw region is flowing along the East-West corridor between Melbourne and Latrobe City.



[21] Moe is part of Latrobe City LGA

By 2025, we expect EVs to account for 4% of the national vehicle fleet. We will assume this composition for traffic along the key route.

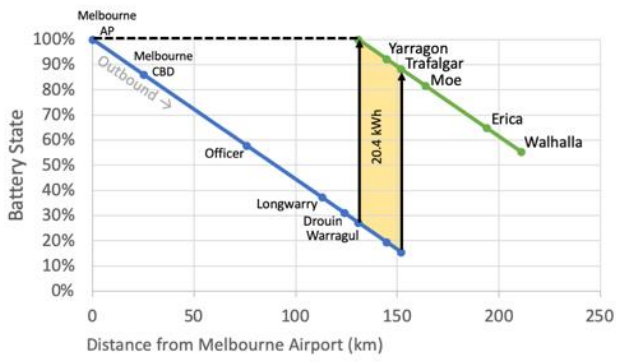
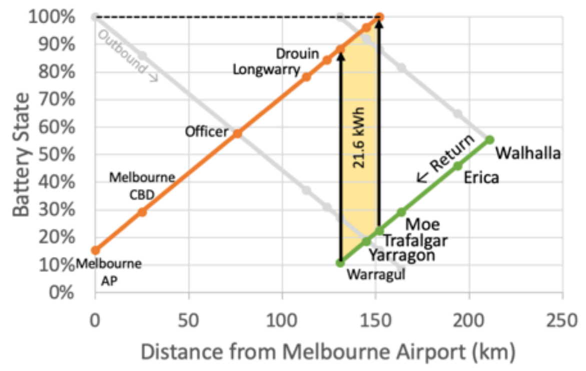
During weekends, particularly on school and public holidays, peak demand will be significantly higher than the daily average. We have used VicRoads data to compute a ratio of average to peak demand from which we can estimate the peak volume of traffic.

		M1 Service Station, Officer	Long-warry	Drouin	Warragul	Yarragon	Trafalgar	Moe	Erica	Walhalla
Daily Traffic Volume	Vehicles /day	65,000	3,200	14,500	11,100	25,000	24,000	9,100	1,300	189
Peak ratio		1.08	0.97	0.75	1.56	1.5	1.53	1.18	1.01	7.62
Peak Daily Traffic Volume	Vehicles /day	70,100	3,100	10,900	17,300	37,500	36,700	10,700	1,310	1,440
Average daily EVs in 2025 (4% of Fleet)	EV/day	2600	128	580	444	1000	960	364	52	8
Peak EVs in 2025	EV/day	2804	124	436	692	1500	1470	428	52	58
Peak Hourly Traffic	Vehicles /hr	6,300	286	985	1,503	3,040	3,230	2,070	186	223
Peak hourly EV (2025)	EV/hr	252	11	39	60	122	129	83	7	9

Example scenarios: “Entry level EV” charge strategy
In these scenarios, a tourist is driving an EV with advertised WLTP range of 200 km and energy efficiency of 14 kWh/km, however various factors mean that energy efficiency is really 15.6 kWh/km meaning the *real* range is 180 km. We will also assume that the driver wishes to leave 20% battery in reserve.

Scenario A: Day visitor to Walhalla
In this scenario, a driver from Melbourne is visiting Walhalla and surrounds where there is no charger available. We must take into account the battery state on arriving at Walhalla, and ensure there is enough remaining to return to a charger.

From Melbourne, the driver must charge 20.4 kWh between Warragul and Trafalgar in order to complete a round trip. Here, we are considering the optimal location for one charger, and so will assume that the driver will use this same charger on the return leg (we will explore Moe as a charger location in a subsequent section).

Melbourne to Walhalla	Return Trip
	

The duration of each charge depends on the power of the charger. The table below shows the duration of each charge in the above scenarios. This allows us to make a decision on what power charger to install.

	Charge Amount		Charge Time for each charger power				
	Charge (% of battery)	Charge (kWh)	3.5 kW AC	7 kW AC	22 kW* AC	50 kW DC	100 kW DC
Charge	73%	20.4	5 h 50 min	2 h 55 min	56 min	25 min	12 min
	77%	21.6	6 h 10 min	3 h 5 min	59 min	26 min	13 min

***Hyundai Ioniq, Nissan LEAF limited to 7 kW while AC charging.**

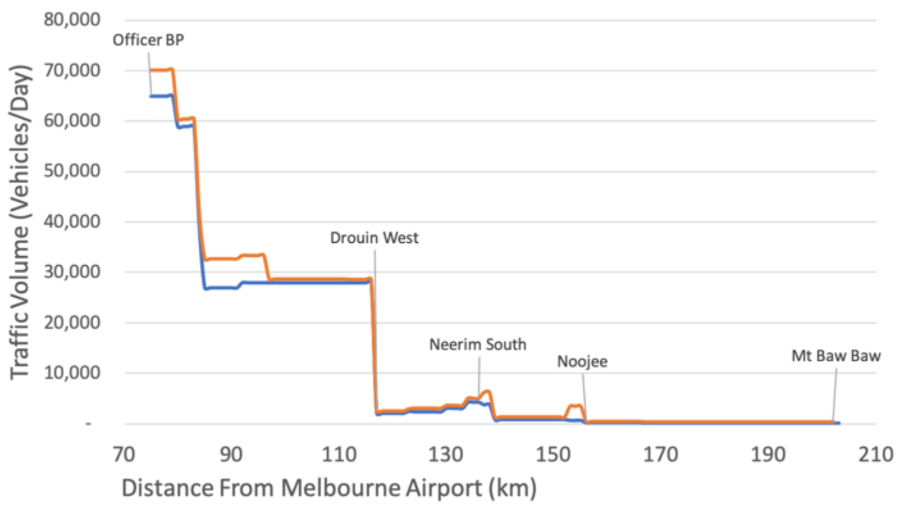
“B” Route Nodes

Drouin West and Neerim South are the two most populous towns on the route and are minor economic nodes, attracting commuters from across South Gippsland. Mt Baw Baw Alpine resort attracts 46 thousand visitors per year[22].

Route: Melbourne to Mt Baw Baw							
	Melbourne CBD	**M1 Service Station, Officer**	**Drouin West**	**Rokeby**	**Neerim South**	**Noojee**	**Mt Baw Baw**
Distance between stops	N/A	50	42	21	18	11	36
Distance from Melbourne CBD (Airport add 25 km)	0	50	92	113	131	142	178
Traffic Volume		65000	2100	3800	243	96	165
Relative Energy Demand*		1.000	0.027	0.025	0.001	0.000	0.002
Population		N/A	330	180	1,305	157	0
Commutes to Work	N/A	N/A	2,559	542	864		
Annual Visitors (‘000s) (% of Baw Baw)	N/A	N/A					46 (5%)

“B” Route Traffic Analysis

Traffic volume falls away steeply once off the M1 Princes Highway at Drouin West. Traffic volumes taper off after Neerim South and again at Noojee, indicating that there is little logistical value to the Mt Baw Baw route aside from access to Mt Baw Baw.



22 [Victorian Alpine Resorts Visitation Survey Report Summer 2017/18]()

“B” Route 2025 Electric Vehicle Projection and peak demand

By 2025, we expect EVs to account for 4% of the national vehicle fleet. We will assume this composition for traffic along the key route.

During weekends, particularly on school and public holidays, peak demand will be significantly higher than the daily average. We have used VicRoads data to compute a ratio of average to peak demand from which we can estimate the peak volume of traffic.

This is important as it indicates the potential number of chargers required to ensure a positive driver experience.

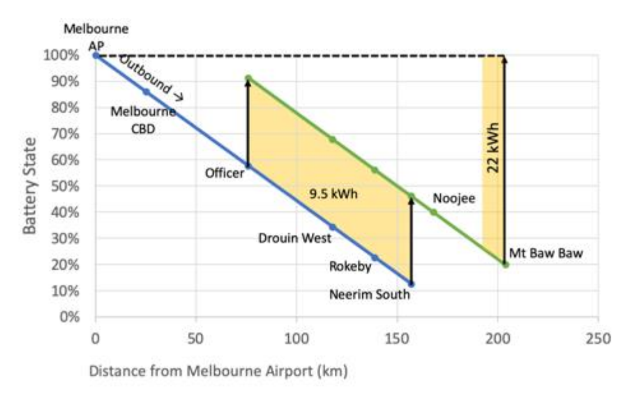
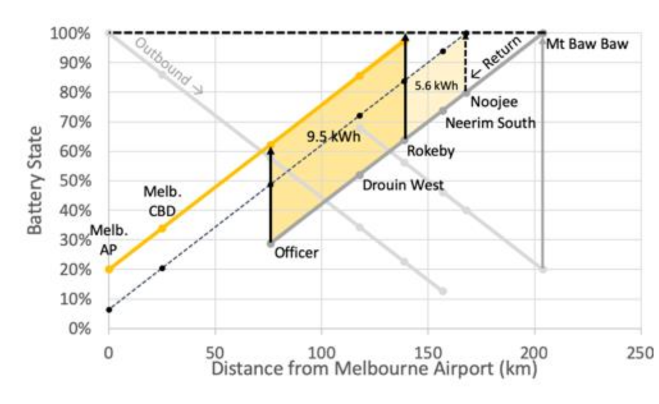
Route: Melbourne to Mt Baw Baw							
		M1 Service Station, Officer	Drouin West	Rokeby	Neerim South	Noojee	Mt Baw Baw
Daily Traffic Volume	Vehicles/day	65,000	2,100	3,800	243	96	165
Peak ratio		1.08	1.22	1.65	2.09	4.32	N/A
Peak Daily Traffic Volume	Vehicles/day	70,058	2,570	6,251	508	415	N/A
Average daily EVs in 2025 (4% of the fleet)	EV/day	2,600	84	152	10	4	7
Peak EVs in 2025	EV/day	2,802	103	250	20	17	N/A
Peak Hourly Traffic	Vehicles/hr	6,307	322	525	N/A	72	N/A
Peak hourly EVs in 2025 (4% of the fleet)	EV/hr	252	13	21	N/A	3	N/A

Example scenarios: “Entry level EV” charge strategy
In these scenarios, a tourist is driving an EV with advertised WLTP range of 200 km and energy efficiency of 14 kWh/km, however various factors mean that energy efficiency is really 15.6 kWh/km meaning the *real* range is 180 km. We will also assume that the driver wishes to leave 20% battery in reserve.

Scenario B: Overnight visitor to Mt Baw Baw
In this scenario, we are assuming that there is a low-power (< 3.5 kW) destination charger at Mt Baw Baw while we explore the need for chargers at any of the towns en-route.

Drivers leaving Melbourne Airport must charge at least once along the 203 km journey. By the time the driver gets to Rokeby, there is only ~20% of battery left. At this point the driver can review his battery status and decide if it is possible to continue to Neerim South (or maybe Noojee).

Whether the driver stops at Officer, Drouin West, Rokeby or Neerim South, they must charge with 9.5 kWh of charge in order to arrive at Mt Baw Baw with 20% battery in reserve. An overnight charge of 22 kW is required at Mt Baw Baw. The table at the end of this section shows how long this may take using different powered chargers.

Melbourne to Mt Baw Baw	Mt Baw Baw to Melbourne
	

The duration of each charge depends on the power of the charger. The table below shows the duration of each charge in the above scenarios. This allows us to make a decision on what power charger to install.

	Charge Amount		Charge Time for each charger power				
	Charge (% of battery)	Charge (kWh)	3.5 kW AC	7 kW AC	22 kW* AC	50 kW DC	100 kW DC
Top Up Charge	20%	5.6	1 h 36 min	48 min	15 min	7 min	3 min
	34%	9.5	2 h 43 min	1 h 22 min	26 min	11 min	6 min
Full Charge (20% to 100%)	80%	22	6 h 24 min	3 h 12 min	1 h 1 min	27 min	13 min
***Hyundai Ioniq, Nissan LEAF limited to 7 kW while AC charging.**							

Insights - Baw Baw Journey Enablement

- A charger is needed between Warragul and Trafalgar to enable day visitors to Walhalla
- A charger is needed between Drouin West and Neerim South to enable visitors to Mt Baw Baw.
- The Key Route and “B” Route diverge at Drouin West
- Warragul and Drouin are key populations and economic nodes
- Warragul (Korumburra) and Trafalgar (Mirboo North) link to South Gippsland
- A top up charge at Neerim South or Rokeby may be sufficient for the trip to Mt Baw Baw
- Warragul

6.7.3. Destination Chargers (Baw Baw)

Baw Baw Shire Council provided 152 sites from which 25 were identified as potential charging locations across 7 locations. We first assessed the local, logistical and tourism value of each location and classified them as A, B or D locations.

A Location - Situated **on** Key Route, high logistical value, high local value, high tourism value.

B Location - Situated **off** Key Route, medium logistical value or medium tourism value

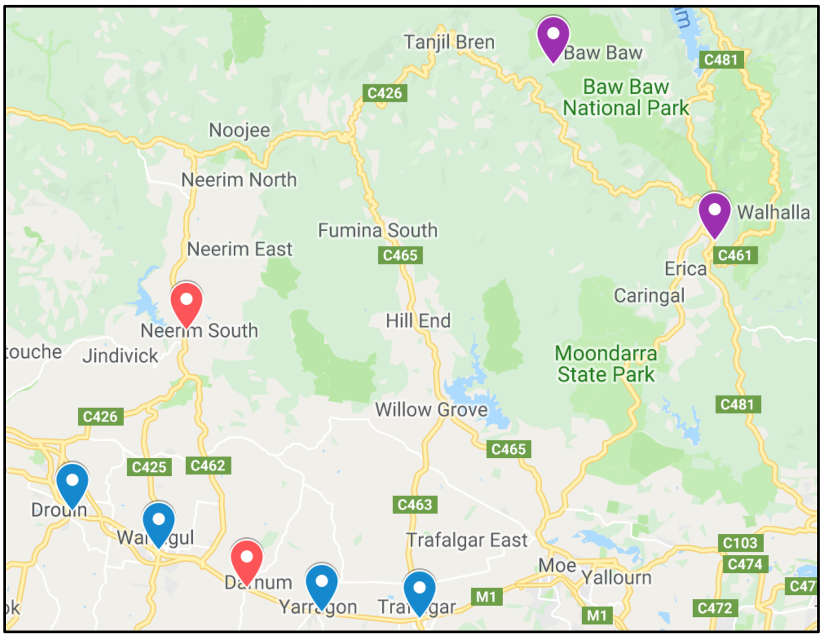
D Location - Purely destination, no logistical value, low local value, high tourism value.

Location	Value			Location Class
	Local	Logistic	Tourism	
Darnum	Low	High	Low	B
Drouin	High	High	High	A
Neerim South	Medium	Medium	Low	B
Mt Baw Baw Village	Medium	Low	High	D
Rawson	Low	Medium	High	D
Trafalgar	Medium	High	Low	A
Warragul	High	High	High	A
Yarragon	Medium	High	Medium	A

Potential charging locations in the Baw Baw region.

A Locations - Blue
B Locations - Red
D Locations - Purple

The charger location class also gives a clue to the power of the charger required. A and B Locations are suitable for the highest feasible power due to their high logistical value, shorter dwell time and high utilisation rates. D locations, due to their low logistic value and high dwell time are suited to slow, simple chargers. Due to their remoteness, groups of slow chargers at D locations may need demand management systems.



6.7.4. Site Summary - Baw Baw
Please see attached schedule - Site Summaries

6.8. Latrobe City

6.8.1. Establish Key Route

Latrobe City encompasses the three major towns - Churchill, Moe-Newborough, Morwell and Traralgon - situated on the Princes Highway, the major travel corridor for the Gippsland region.

Latrobe city is the economic centre of the Gippsland region, known for its coal mining and power industries. Agribusiness, especially forestry, and manufacturing are key industries in the area.

Providing journey enablement charging *through* Latrobe City is a key outcome, while the large population will represent a large demand for urban destination chargers.

The tourism data highlights a significant market of international visitors who stay an average of 19 days.

Tourism Research Australia Data				
	International	**Domestic Overnight**	**Domestic Day**	**Total**
Visitors ('000)	6	206	908	1,120
Nights ('000)	111	489		600
Reason ('000 Visitors)				
Holiday	No data	34	337	> 371
Visit Family	3	108	292	403
Work	No data	50	101	>151

User Story: Day Visitor
The local industries and the large population of Latrobe attract many workers and family visits from Melbourne. There are also a number of attractions and sights in the region that attract tourists from Melbourne or interstate.

Table: Popular attractions for day visitors:

Location	Attractions
Moe-Newborough	• Old Gippstown • Botanic Gardens • Lake Narracan
Morwell	• PowerWorks • Latrobe Regional Gallery • Waterhole Creek Cultural Trail
Traralgon	• Country Road Trail (Gippsland Plains) Scenic Drive

User Story: Overnight Visitor
Many of the natural environment attractions are best suited for overnight visits

Location	Attractions
Traralgon	• Strzelecki Drive
Latrobe Region	• Tarra Bulga National Park • Moondarra State Park • Gippsland Rail Trails

User Story: Local
Comprising Moe-Newborough, Morwell and Traralgon, Latrobe city has the largest population in Gippsland. These towns are all connected by the M1 Princes Highway.

To the North, Brown Coalmine road links Yallourn North and Glengarry, while Churchill and Hazelwood North are the most significant towns to the South.

Town	Population	Households	Dwellings with at least one vehicle (% of households)
Traralgon	26,659	11,553	8,666 (75%)
Moe-Newborough	15,541	7,667	5,259 (69%)
Morwell	13,771	6,864	4,560 (66%)
Churchill	4,783	2,043	1,500 (73%)
Yallourn North	1,545	537	394 (73%)
Hazelwood North	1,478	550	465 (84%)
Glengarry	1,084	248	220 (89%)

Map: Major populations in Latrobe City

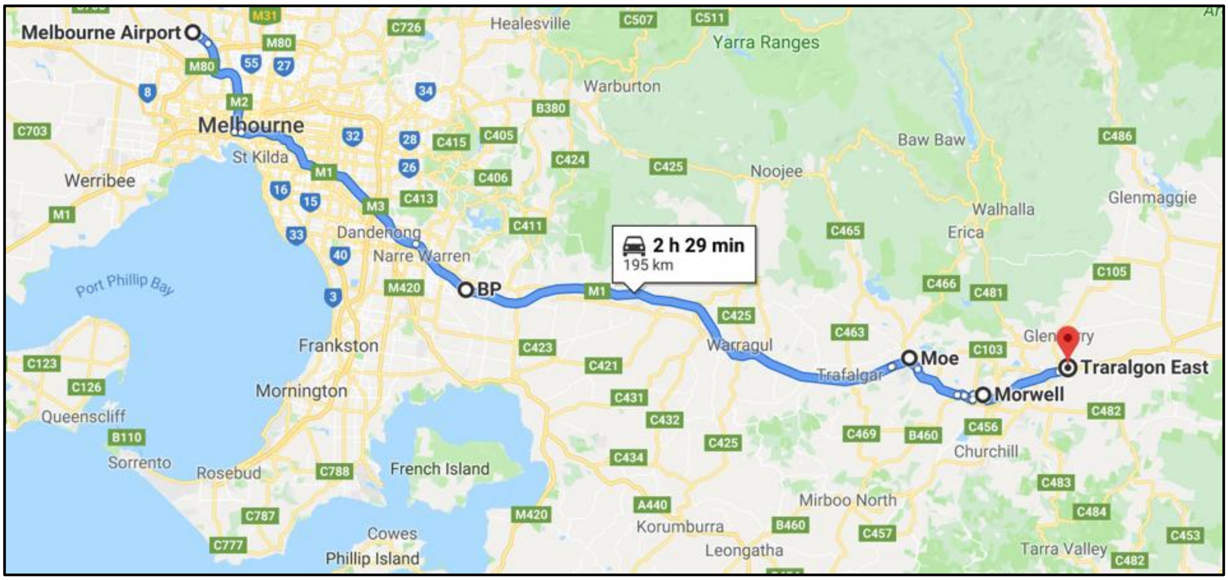
User Story: Commuter
Traralgon, Morwell and Moe-Newborough are the three main economic nodes in the Baw Baw region.

Statistical Area (SA2)	Commute by vehicle *to*	Commute by vehicle *from*
Traralgon	9,652	9,538
Morwell	7,739	3,486
Moe-Newborough	3,653	4,770
Churchill	3,045	3,774
Yallourn North - Glengarry	261	1,676

Key Route
Melbourne to Traralgon linking the following stops:

- Officer M1 Service Centre[23]
- Warragul*
- Moe
- Morwell
- Traralgon

[23] We will consider that travellers may stop at the service centre (BP Outbound) on the M1 Princes Highway at Officer for a break. We expect this to be a likely location for a DC fast charger in the future (although it is outside of the Gippsland region).
* Locations that require leaving the dual carriageway M1



6.8.2. Journey Enablement (Latrobe)

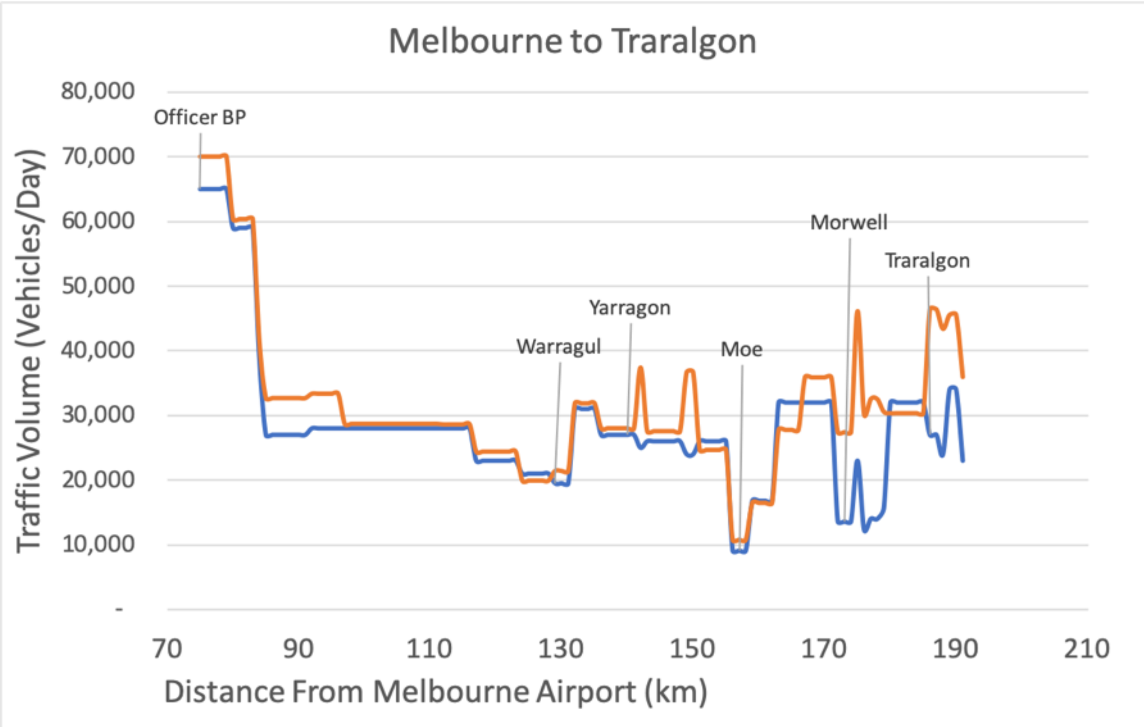
Key Route Nodes

Moe, Morwell and Traralgon have significant populations and are important economic nodes, attracting commuters from across the entire Gippsland region.

Route: Melbourne to Traralgon						
	Melbourne CBD	M1 Service Station, Officer	Warragul	Moe	Morwell	Traralgon
Distance between stops	-	51	54	32	17	13
Distance from Melbourne CBD (Airport add 25 km)	0	51	105	137	154	167
Traffic Volume		65,000	20,000	10,000	14,000	27,000
Population	N/A	N/A	15,757	15,541	13,771	26,659
Commutes to Work			6,800	3,653	7,739	9,652
Annual Visitors ('000s) (% of Latrobe)	N/A					

While the M1 passes through Moe and Morwell, the highway is segregated from the township, meaning local traffic must exit the highway. By looking at the local traffic, we can gain some insights into the visitation of the town during peak periods. The “dips” in traffic volume at each town simply mean that traffic volume in the town is lower than on the highway. The M1 passes straight through Traralgon, so there is no dip.

Interestingly, in Moe, there is no difference in traffic volume between the average and peak. Whereas in Morwell and Traralgon traffic volume doubles. This may indicate that Morwell and Traralgon attract many visitors during peak time.



Key Route 2025 Electric Vehicle Projection and peak demand

By 2025, we expect EVs to account for 4% of the national vehicle fleet. We will assume this composition for traffic along the key route.

During weekends, particularly on school and public holidays, peak demand will be significantly higher than the daily average. We have used VicRoads data to compute a ratio of average to peak demand from which we can estimate the peak volume of traffic.

Route: Melbourne to Traralgon						
		M1 Service Station, Officer	Warragul	Moe	Morwell	Traralgon
Daily Traffic Volume	Vehicles/day	65,000	19,500	9,100	14,000	27,000
Peak ratio		1.1	1.1	1.2	2.3	1.7
Peak Daily Traffic Volume	Vehicles/day	70,000	21,400	10,800	32,500	46,400
Average daily EVs in 2025 (4% of the fleet)	EV/day	2,600	780	364	560	1,280
Peak EVs in 2025	EV/day	2,800	857	431	1,300	1,080
Peak Hourly Traffic	Vehicles/hr	6,300	2,350	2,070	2,540	3,700
Peak hourly EVs in 2025 (4% of the fleet)	EV/hr	252	95	83	101	148

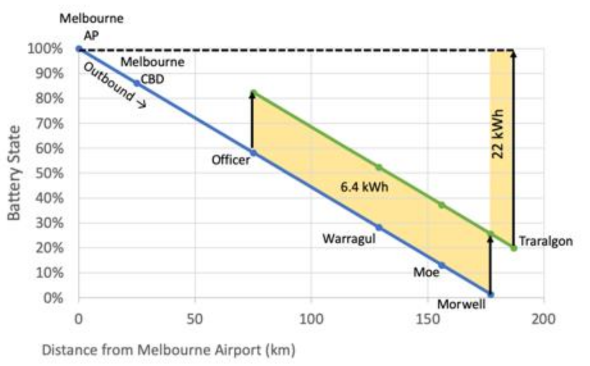
Example scenarios: "Entry level EV" charge strategy
In these scenarios, a tourist is driving an EV with advertised WLTP range of 200 km and energy efficiency of 14 kWh/km, however various factors mean that energy efficiency is really 15.6 kWh/km meaning the *real* range is 180 km. We will also assume that the driver wishes to leave 20% battery in reserve.

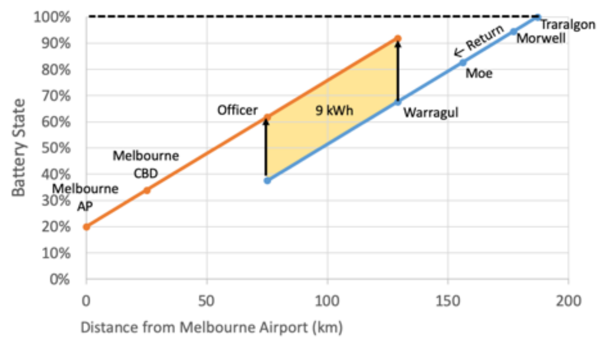
Scenario A: Overnight visitor to Traralgon
In this scenario, we are assuming that there is a low-power (< 3.5 kW) destination charger at Traralgon while we explore the need for chargers at any of the towns en-route.

Drivers leaving Melbourne Airport must charge at least once along the 187 km journey. By the time the driver gets to Warragul, there is only 28% of battery left. At this point the driver can review his battery status and decide if it is possible to continue to Morwell.

Whether the driver stops at Warragul, Moe or Morwell, they must *top up* with 6.4 kWh of charge in order to arrive at Traralgon with 20% battery in reserve. The table shows how long this may take using different powered chargers.

Outbound	Return

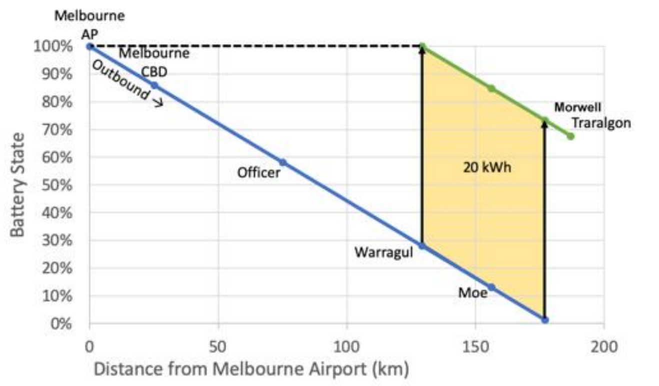


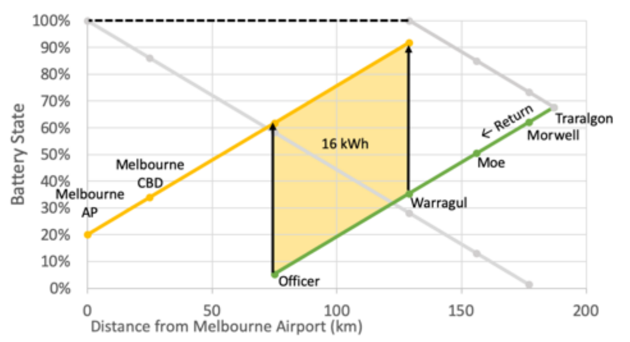


	Charge Amount		Charge Time for each charger power				
	Charge (% of battery)	Charge (kWh)	3.5 kW AC	7 kW AC	22 kW* AC	50 kW DC	100 kW DC
Top Up Charge	23%	6.4	1 h 50 min	55 min	17 min	8 min	4 min
	32%	9	2 h 34 min	1 h 17 min	15 min	11 min	5 min
Full Charge (20% to 100%)	80%	22	6 h 24 min	3 h 12 min	1 h 1 min	27 min	13 min
***Hyundai Ioniq, Nissan LEAF limited to 7 kW while AC charging.**							

Scenario B: Return trip to Traralgon with no charge facilities at the destination
In this scenario, we are assuming that there is no charging available in Traralgon and that an EV driver must charge at any of the towns along the route. As before, a fast charger a Warragul could provide sufficient charge to enable the trip to Traralgon, and another charge at Warragul on the return leg would enable the trip to Melbourne.

Outbound	Return





	Charge Amount		Charge Time for each charger power				
	Charge (% of battery)	Charge (kWh)	3.5 kW AC	7 kW AC	22 kW* AC	50 kW DC	100 kW DC
Journey Enablement Charge	57%	16	4 h 34 min	2 h 17 min	44 min	19 min	10 min
	71%	20	5 h 43 min	2 h 51 min	55 min	24 min	12 min
***Hyundai Ioniq, Nissan LEAF limited to 7 kW while AC charging.**							

6.8.3. Destination Chargers (Latrobe City)

We first assessed the local, logistical and tourism value of each location in Latrobe City and classified them as A, B or D locations.

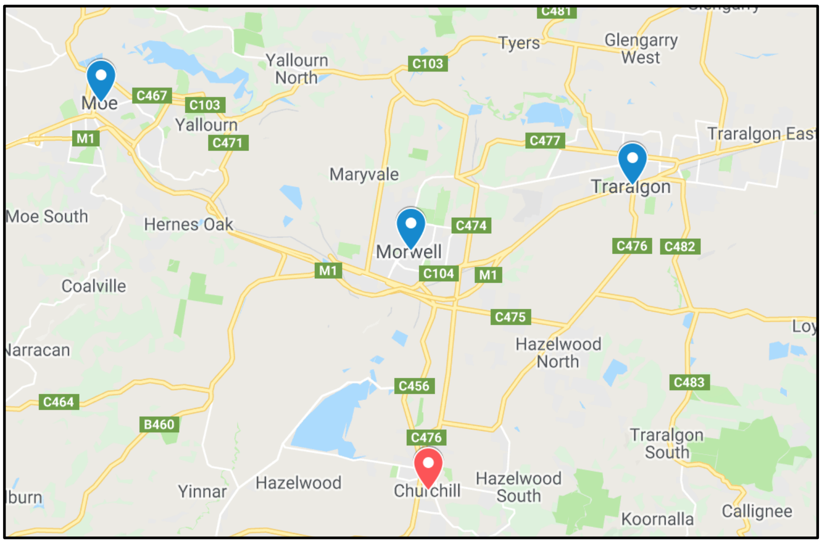
A Location - Situated **on** Key Route, high logistical value, high local value, high tourism value.
B Location - Situated **off** Key Route, medium logistical value or medium tourism value
D Location - Purely destination, no logistical value, low local value, high tourism value.

Location	Region	Values			
		Local	Logistic	Tourism	Location Class
Traralgon	Traralgon	High	High	Medium	A
Morwell	Morwell	High	High	Medium	A
Moe	Moe-Newborough	High	High	Medium	A
Churchill	Churchill	High	High	Medium	B

Potential charging locations in the Latrobe City region.

The spatial distribution of each charger type also gives a clue to the power of the charger required. A and B Locations are suitable for the highest feasible power due to their high logistical value, shorter dwell time and high utilisation rates.

A Locations - Blue
B Locations - Red



6.9. Wellington

6.9.1. Establish Key Route

The vast Wellington region spans the Victorian high country to 90-mile beach, including regional centres such as Sale, Maffra, Stratford and Yarram. The region is well known for its agriculture industry which is the largest employer in the region. There are also significant fossil fuel assets such as the ESSO natural gas plant and Bass Strait oil and gas industry.

The diverse natural environment attracts many tourists with popular activities, including alpine adventures, bushwalking, cycling, camping, golf and water sports. The region is also well known for its produce.

Tourism Research Australia Data				
	International	**Domestic Overnight**	**Domestic Day**	**Total**
Visitors ('000)	10	362	581	954
Nights ('000)	144	1,067	N/A	1,211
Reason ('000 Visitors)				
Holiday	6	192	241	439
Visit Family	3	108	188	299
Work	No data	46	No data	No data

User Story: Day Visitor
A 2-hour drive from Melbourne, tourist attractions in central Wellington such as Sale and Maffra are within reach of day visitors. Many of these visitors will take the M1 Princes Highway to Sale.

Table: Popular attractions for day visitors:

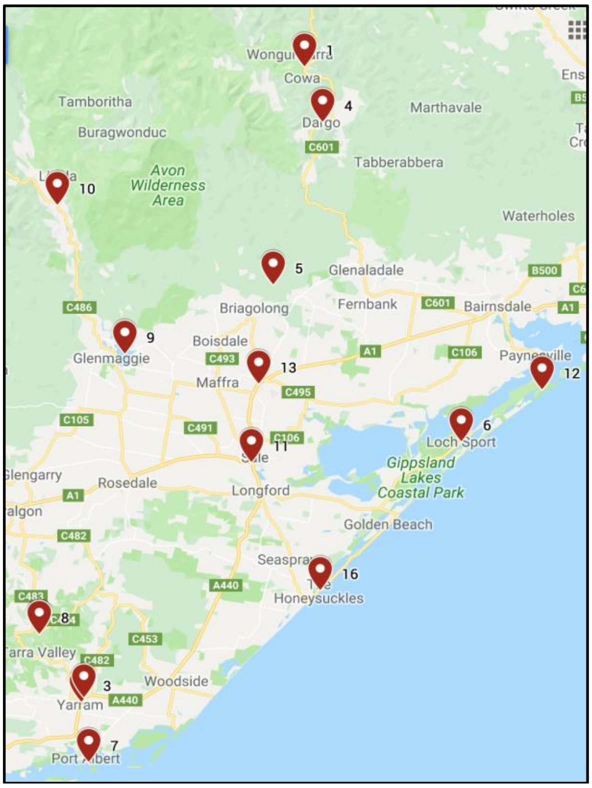
Location	Attractions
Sale	• Wellington Entertainment Centre • Gippsland Armed Forces Museum • Gippsland Vehicle Collection • Greenwattle Racecourse • Lake Guthridge Parklands and Botanic Gardens • Nambrok Antiques • Port of Sale • RAAF Base East Sale • River Heritage & Wetlands Trail • Sale Historic Museum • Sale Powder Magazine • Sale Railway Museum Signal Box • The Swing (Latrobe) Bridge • Victoria Park • West Sale Migrant Memorial

Maffra	● Macalister River Regional Park ● Macalister Wetland Reserve (bird watching) ● Maffra & District Car Club Hill Climb ● Maffra-Sale Motorcycle Club ● Maffra Sugar Beet Museum ● Pino Deriu Mineral Collection ● Robotic Dairy

User Story: Overnight Visitor

The natural environment and regional centres of Wellington attract many overnight visitors.

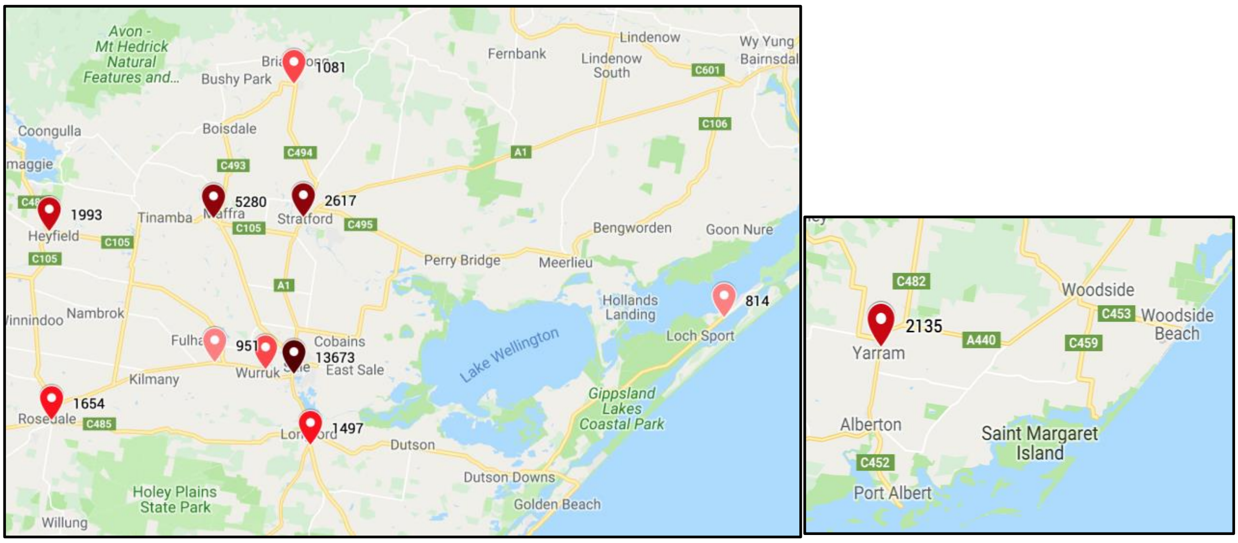
#	Attraction	#	Attraction
1	Alpine National Park	**10**	Licola Wilderness Village
2	Antique Marine Engine Museum	**11**	Port Sale, Victoria
3	Courthouse Gallery	**12**	Rotamah Island Bird Observatory
4	Gold Adventures	**13**	Stratford Courthouse Theatre
5	Freestone Creek/Blue Pool	**14**	Stratford Historical Society and Museum
6	Gippsland Lakes Coastal Park	**15**	Tarra Bulga National Park
7	Gippsland Regional Maritime Museum	**16**	The honeysuckles, Victoria
8	Grand Strzelecki Walking Track	**17**	Yarram & District Historical Society
9	Lake Glenmaggie		



User Story: Local

Sale is the largest town in Wellington. All of the major towns are relatively close to Sale, with the exception of Yarram in the South.

Town	Population	Households	Dwellings with at least one vehicle (% of households)
Sale	13,673	6,466	4,519 (71%)
Maffra	5,280	1,957	1,516 (77%)
Stratford	2,617	786	639 (81%)
Yarram	2,135	920	645 (70%)
Heyfield	1,993	712	558 (78%)
Rosedale	1,654	550	424 (77%)
Longford	1,497	565	430 (76%)
Wurruk	1,112	385	318 (83%)
Briagolong	1,081	267	212 (79%)



Map: Populations of towns in Wellington

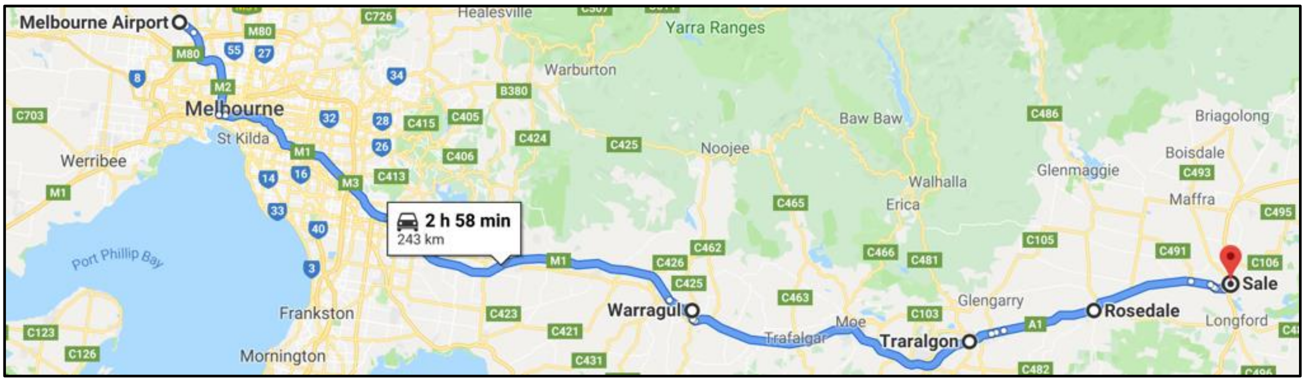
User Story: Commuter
Sale and Maffra are the two main economic nodes in the Wellington region.

Statistical Area (SA2)	Commute by vehicle *to*	Commute by vehicle *from*
Sale	5,595	4,707
Longford - Loch Sport	1,977	1,135
Yarram	1,426	1,381
Rosedale	831	1,279
Maffra	2,693	4,328

Key Route

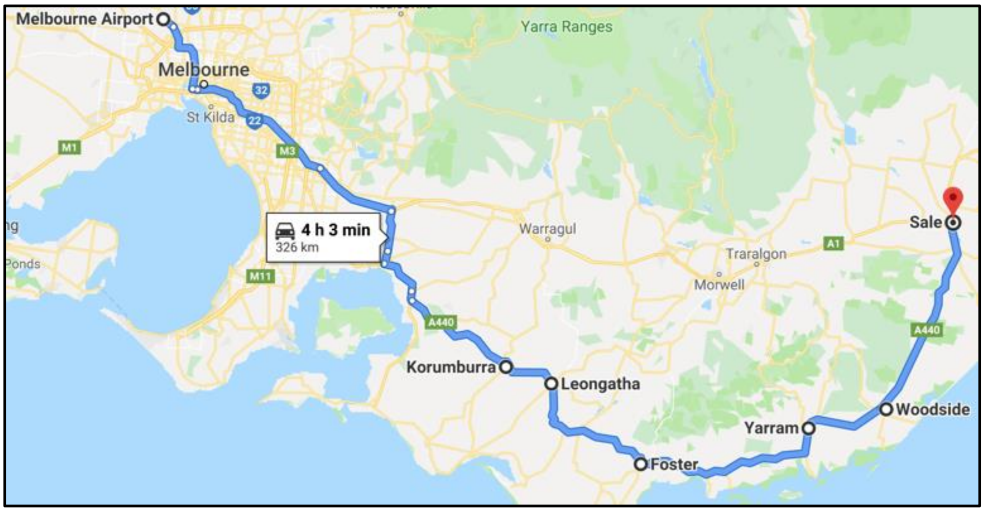
Melbourne to Sale linking the following stops:

- Warragul*
- Traralgon
- Sale



“B” Route
Melbourne to Sale linking the following locations:

- Korumburra
- Leongatha
- Foster
- Yarram
- Woodside
- Longford
- Sale



6.9.2. Journey Enablement (Wellington)

Key Route Nodes

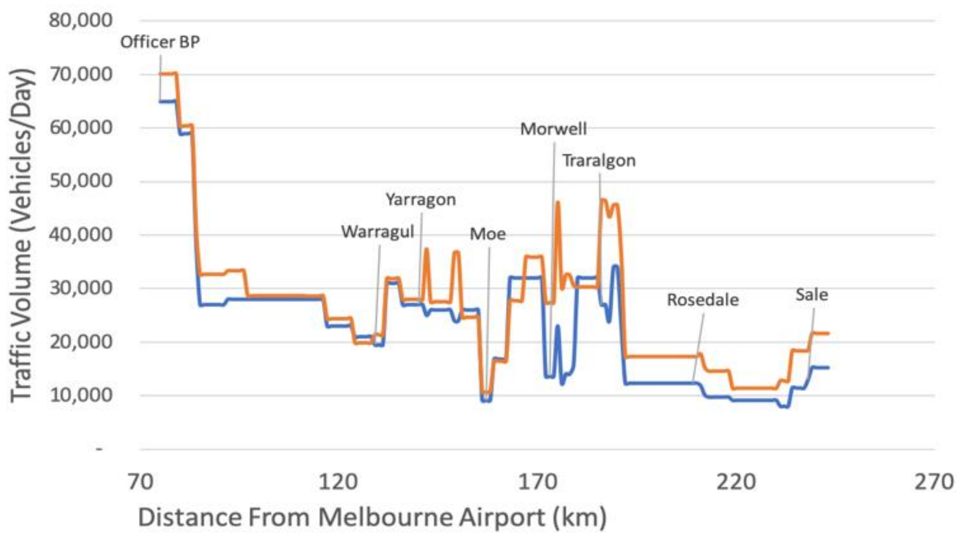
Sale is the most significant population and important economic node. Others such as Maffra are not on the key route, but may present a similarly attractive stop for inter-regional drivers.

Route: Melbourne to Sale via Traralgon							
	Melbourne CBD	**M1 Service Station, Officer**	**Warragul**	**Traralgon**	**Rosedale**	**Maffra****	**Sale**
Distance between stops	-	51	55	58	22	35	33
Distance from Melbourne CBD (Airport add 25 km)	0	51	106	164	186	222	216
Traffic Volume		65,000	11,100	27,000	12,300	6,600	15,200
Population	N/A	N/A	15,757	26,659	1,654	5,280	13,673
Commutes to Work			6,800	9,652	831	2,693	5,595
** Alternative route							

Key Route Traffic Analysis

The journey from Melbourne CBD to Sale is 216 km (add 25 km if starting from Melbourne Airport). A one-way trip exceeds the range of entry-level EVs.

Sale is central to many tourist attractions and a major work destination. Much of the traffic to through Sale is moving along the East-West corridor between Melbourne and East Gippsland via Latrobe City.



By 2025, we expect EVs to account for 4% of the national vehicle fleet. We will assume this composition for traffic along the key route.

During weekends, particularly on school and public holidays, peak demand will be significantly higher than the daily average. We have used VicRoads data to compute a ratio of average to peak demand from which we can estimate the peak volume of traffic.

Route: Melbourne to Sale via Traralgon							
		M1 Service Station, Officer	Warragul	Traralgon	Rosedale	Maffra**	Sale
Daily Traffic Volume	Vehicles/day	65,000	19,500	27,000	12,300	6,600	15,200
Peak ratio		1.1	1.1	1.7	1.41	1.14	1.41
Peak Daily Traffic Volume	Vehicles/day	70,000	21,400	46,400	17,300	7,500	21,700
Average daily EVs in 2025 (4% of the fleet)	EV/day	2,600	780	1,280	490	260	610
Peak EVs in 2025	EV/day	2,800	857	1,080	690	300	870
Peak Hourly Traffic	Vehicles/hr	6,300	2,350	3,700	1,500	908	1,900
Peak hourly EVs in 2025 (4% of the fleet)	EV/hr	252	95	148	60	36	76

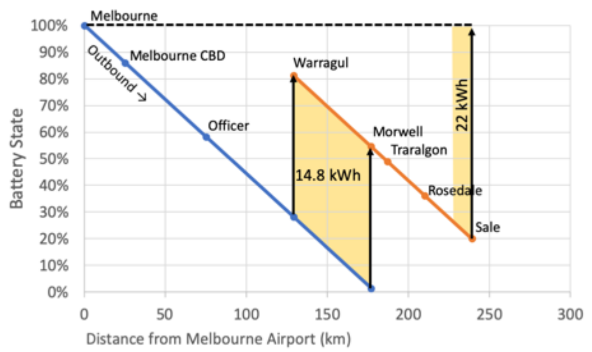
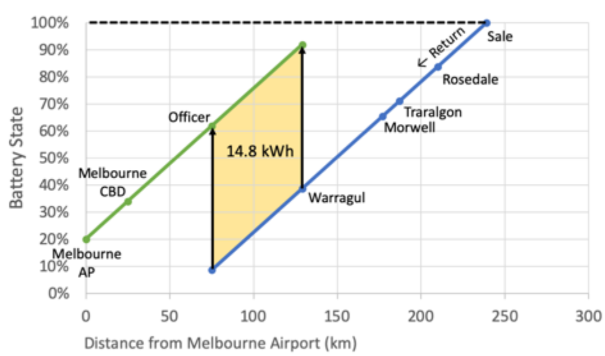
Example scenarios: "Entry level EV" charge strategy

In these scenarios, a tourist is driving an EV with advertised WLTP range of 200 km and energy efficiency of 14 kWh/km, however various factors mean that energy efficiency is really 15.6 kWh/km meaning the *real* range is 180 km. We will also assume that the driver wishes to leave 20% battery in reserve.

Scenario A: Overnight visitor to Sale

In this scenario, we are assuming that there is a low-power (< 3.5 kW) destination charger at Sale while we explore the need for chargers at any of the towns en-route.

Drivers leaving Melbourne Airport must charge at least once along the 322 km journey. This charge must be done between Warragul or Morwell. This is further confirmation of Warragul as a suitable charge location. No further top up is necessary in order to complete the journey to Sale.

Outbound	Return
	

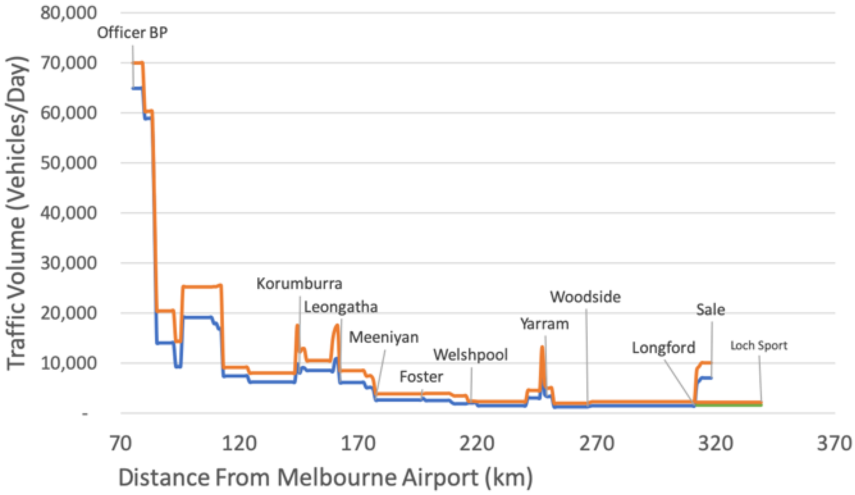
	Charge Amount		Charge Time for each charger power				
	Charge (% of battery)	Charge (kWh)	3.5 kW AC	7 kW AC	22 kW* AC	50 kW DC	100 kW DC
Journey Enablement Charge	53%	14.8	4 h 14 min	2 h 15 min	40 min	20 min	10 min

"B" Route Nodes

The "B" Route runs from Melbourne to Sale, via Yarram. This is a popular tourist drive that often incorporates attractions in Bass Coast and South Gippsland regions. We will explore charging opportunities along this route while assuming that there is a Level 3 DC fast charger at Korumburra and a Level 2 destination charger at Foster, as recommended in the report section for South Gippsland.

Route: Melbourne to Sale via Yarram							
	Melbourne CBD	**M1 Service Station, Officer**	**Korumburra**	**Foster**	**Yarram**	**Longford**	**Sale**
Distance between stops	N/A	50	72	52	49	65	9
Distance from Melbourne CBD (Airport add 25 km)	0	50	122	174	223	288	297
Traffic Volume (Vehicles per day)		65,000	9,100	10,900	2,600	3,900	1,542
Population		N/A	4,469	1,842	2,135	1,497	13,673
Commutes to Work	N/A	N/A				1,977	5,595
Annual Visitors ('000s) (% of Wellington)	N/A	N/A					

"B" Route Traffic Analysis
The traffic flows on this route are characterised by a peak at Yarram and a modest increase in traffic volume during peak times.



By 2025, we expect EVs to account for 4% of the national vehicle fleet. We will assume this composition for traffic along the key route.

During weekends, particularly on school and public holidays, peak demand will be significantly higher than the daily average. We have used VicRoads data to compute a ratio of average to peak demand from which we can estimate the peak volume of traffic.

Route: Melbourne to Sale via Traralgon								
		M1 Service Station, Officer	Korumburra	Foster	Yarram	Longford	Sale
Daily Traffic Volume	Vehicles/ day	65,000	9,100	10,900	2,600	3,900	1,540
Peak ratio		1.08	1.41	1.60	1.50	1.49	1.46
Peak Daily Traffic Volume	Vehicles/ day	70,100	12,800	17,500	3,900	5,800	2,250
Average daily EVs in 2025 (4% of the fleet)	EV/day	2,600	364	436	104	156	62
Peak EVs in 2025	EV/day	2,800	512	699	156	233	90
Peak Hourly Traffic	Vehicles/ hr	6,310	968	1,290	299	456	179
Peak hourly EVs in 2025 (4% of the fleet)	EV/hr	252	39	51	12	18	7

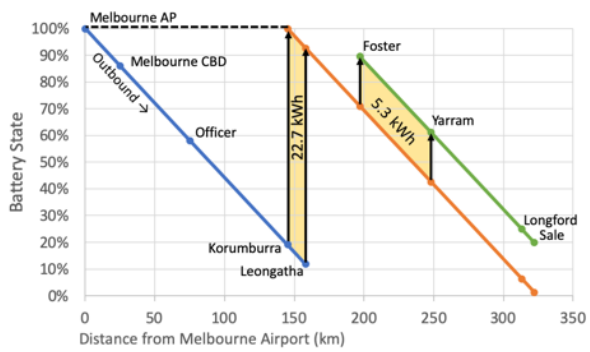
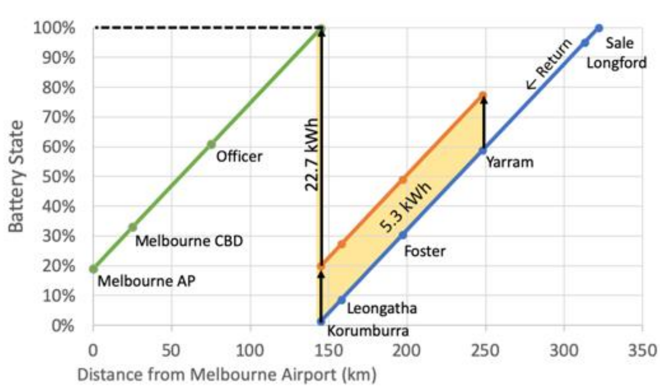
Example scenarios: “Entry level EV” charge strategy

In these scenarios, a tourist is driving an EV with advertised WLTP range of 200 km and energy efficiency of 14 kWh/km, however various factors mean that energy efficiency is really 15.6 kWh/km meaning the *real* range is 180 km. We will also assume that the driver wishes to leave 20% battery in reserve.

Scenario A: Overnight visitor to Sale via Yarram

In this scenario, we are assuming that there is a low-power (< 3.5 kW) destination charger at Sale while we explore the need for chargers at any of the towns en-route.

On the outbound journey, we can see that a full charge at Korumburra or Leongatha might be enough to complete the journey, however, in order to arrive at Sale with a reserve of 20%, it is necessary to do a top up charge at either Foster or Yarram.

Outbound	Return
	

	Charge Amount		Charge Time for each charger power				
	Charge (% of battery)	Charge (kWh)	3.5 kW AC	7 kW AC	22 kW* AC	50 kW DC	100 kW DC
Top Up Charge	19%	5.3	1 h 31 min	45 min	14 min	6 min	3 min
Full Charge (20% to 100%)	81%	22.7	6 h 29 min	3 h 26 min	1 h 2 min	30 min	16 min
***Many EVs such as Hyundai Ioniq, Nissan LEAF are limited to 7 kW while AC charging.**							

Insights - Wellington Journey Enablement

Melbourne to Sale via Warragul

- A 14.8 kWh charge at Warragul is required for a journey from Melbourne Airport to Sale along the M1 Princes Highway. This is an 18 minute charge session at a 50 kW DCFC.
- The return trip can be taken using the same strategy.

Melbourne to Sale via Korumburra

- A 22.7 kWh charge at a DCFC at Korumburra is required for a journey from Melbourne Airport to Sale along the "B" route. This is a 30 minute charge session at a 50 kW DCFC. A further 5.3 kWh top up charge is required at either Foster or Yarram. This is a 48 minute charge at a 7 kW AC destination charger.
- The return trip can be taken using the same strategy.

6.9.3. Destination Chargers (Wellington)

Wellington Shire Council provided 57 potential charging sites across 19 locations, from which 8 were identified as potential council owned charging locations across 7 locations. We first assessed the local, logistical and tourism value of each location and classified them as A, B or D locations.

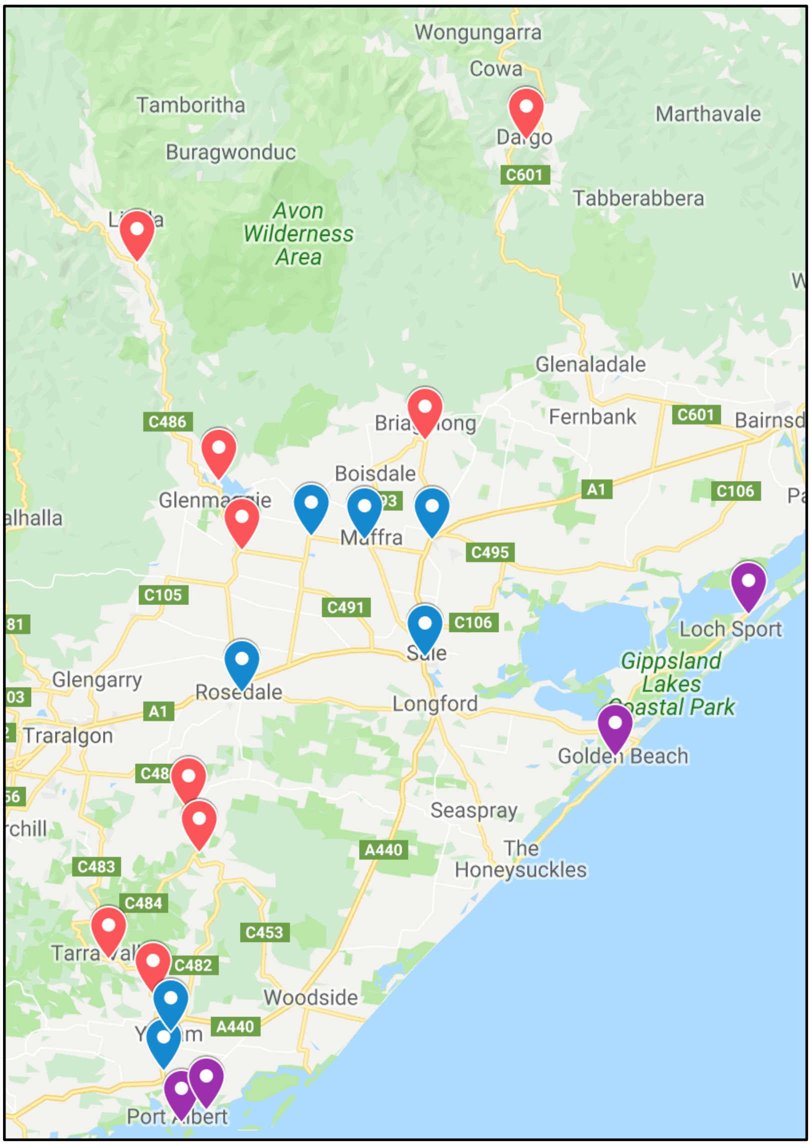
A Location - Situated **on** Key Route, high logistical value, high local value, high tourism value.
B Location - Situated **off** Key Route, medium logistical value or medium tourism value
D Location - Purely destination, no logistical value, low local value, high tourism value.

Location	Region	Summary			
		Local	Logistic	Tourism	Location Class
Licola	Alps - West	Low	Low	High	B
Dargo	Bruthen - Omeo	Low	Medium	High	B
Golden Beach	Longford - Loch Sport	Low	Low	High	D
Loch Sport	Longford - Loch Sport	Medium	Low	High	D
Briagolong	Maffra	Medium	Low	Medium	B
Glenmaggie	Maffra	Low	Medium	High	B
Heyfield	Maffra	Medium	Medium	Low	B
Maffra	Maffra	Medium	High	High	A
Stratford	Maffra	Medium	High	Medium	A
Tinamba	Maffra	Low	High	Medium	A
Gormandale	Rosedale	Low	Medium	Low	B
Rosedale	Rosedale	Low	High	Low	A
Sale	Sale	High	High	High	A
Alberton	Yarram	Low	High	Low	A
Devon North	Yarram	Low	Low	Medium	B
Port Albert	Yarram	Low	Low	High	D
Robertsons Beach	Yarram	Low	Low	High	D
Tarra Valley	Yarram	Low	Low	High	B
Willung South	Yarram	Low	Medium	Medium	B
Yarram	Yarram	High	High	High	A

Potential charging locations in the Wellington region.

The spatial distribution of each charger type also gives a clue to the power of the charger required. A and B Locations are suitable for the highest feasible power due to their high logistical value, shorter dwell time and high utilisation rates. D locations, due to their low logistic value and high dwell time are suited to slow, simple chargers. Due to their remoteness, groups of slow chargers at D locations may need demand management systems.

A Locations - Blue
B Locations - Red
D Locations - Purple



6.9.4. Site Summary Wellington

Please see attached schedule - Site Summaries

6.10. East Gippsland

6.10.1. Establish Key Route

The East Gippsland region encompasses high country, prime agricultural land, lakes and scenic coastlines. Service industries in the larger towns, namely Bairnsdale, are the largest employers in the region, while manufacturing and food production, especially fishing, are the biggest industries by output. The diverse natural environment attracts many tourists with popular activities such as alpine adventures, bushwalking, cycling, camping, golf and water sports. The largest tourist centre is Lakes Entrance.

Tourism Research Australia Data				
	International	Domestic Overnight	Domestic Day	Total
Visitors ('000)	34	652	462	1,148
Nights ('000)	161	1,970	-	2,131
Reason ('000 Visitors)				
Holiday	31	403	199	633
Visit Family	3	142	118	263
Work	-	60	-	-

User Story: Day Visitor
Over 3 hours' drive from Melbourne, day trips from Melbourne are likely to be limited to the Gippsland Lakes region of East Gippsland.

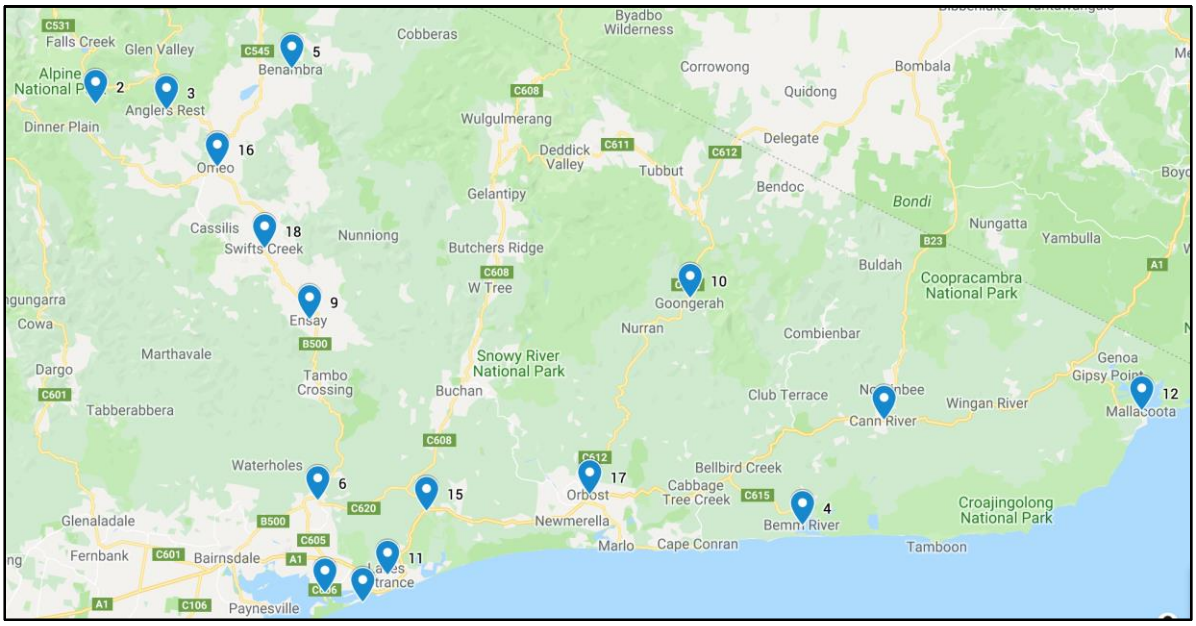
Table: Popular attractions for day visitors:

Location	Attractions
Bairnsdale	• Port of Bairnsdale • The Court House • Art gallery • Aboriginal Cultural Museum
Twin Rivers	• Wineries • Johnsonville Jetty • Fishing • Swan Reach hotel • Swimming in Tambo and Nicholson Rivers
Lakeside	• Lakes Entrance ○ 90-mile beach ○ Fish markets ○ The Esplanade ○ Lake Tyers Beach • Metung ○ Golf

	○ Boat hire ○ Farmers Market ○ Swim in Tambo River ● Paynesville ○ Raymond Island Ferry ○ Sunset Cove ○ Mitchell River Silt Jetties
Hinterland	● Lindenow ○ Scenic drives through fertile agricultural land ○ Local produce ● Nowa Nowa

User Story: Overnight Visitor

The natural environment and regional centres of East Gippsland attract many overnight visitors.



#	Attraction	#	Attraction
1	90 Mile Beach	10	Errinundra National Park
2	Alpine National Park	11	Lakes Entrance
3	Anglers Rest	12	Mallacoota
4	Bemm River	13	Marlo
5	Benambra	14	Metung
6	Bruthen	15	Nowa Nowa
7	Buchan	16	Omeo
8	Cann River	17	Orbost
9	Ensay	18	Swifts Creek

User Story: Local
Bairnsdale is the largest town in East Gippsland.

Town	Population	Households	Dwellings with at least one vehicle (% of households)
Bairnsdale	11,644	6,084	4,319 (71%)
Lakes Entrance	6,389	3,516	2,088 (59%)
Paynesville	3,480	3,376	1,289 (38%)
Orbost	2,227	1,100	703 (64%)
Wy Yung	1,657	735	573 (78%)
Metung	1,449	848	462 (54%)
Lucknow	1,254	561	422 (75%)

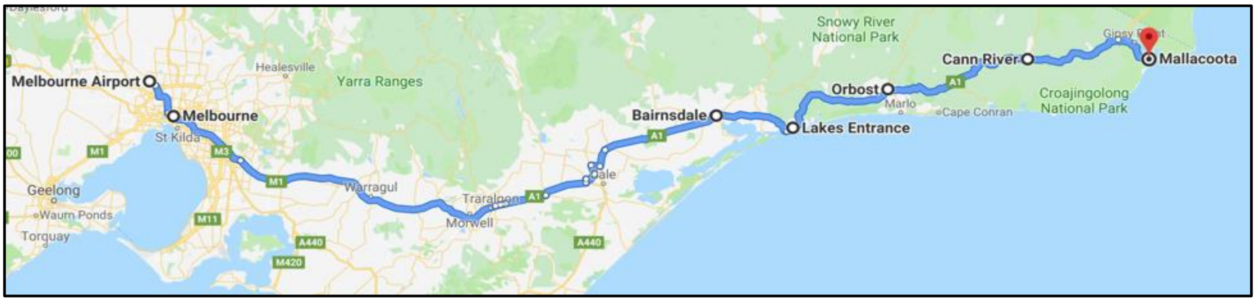
Map: Towns with population over 1000 in East Gippsland

User Story: Commuter
Bairnsdale and Orbost are the two main economic nodes in the East Gippsland region.

Statistical Area (SA2)	Commute by vehicle *to*	Commute by vehicle *from*
Bairnsdale	6,809	4,425
Lakes Entrance	1,798	2,514
Orbost	1,216	1,363
Bruthen - Omeo	1,051	2,434
Paynesville	471	1,524

Key Route
Melbourne to Mallacoota linking the following stops:

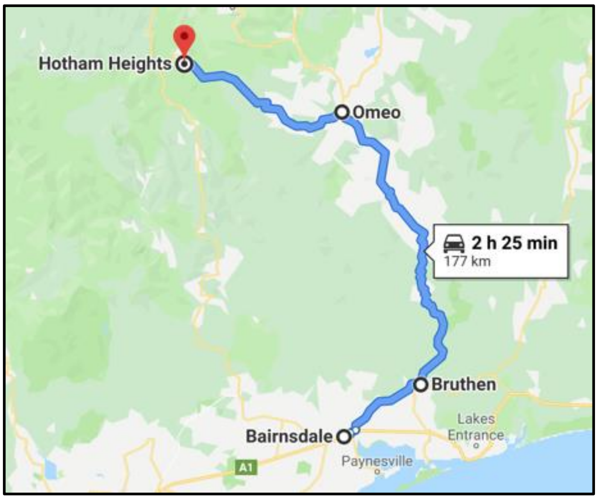
- Warragul*
- Traralgon
- Sale
- Bairnsdale
- Lakes Entrance
- Orbost
- Cann River
- Mallacoota



B Route
Bairnsdale to Hotham Heights

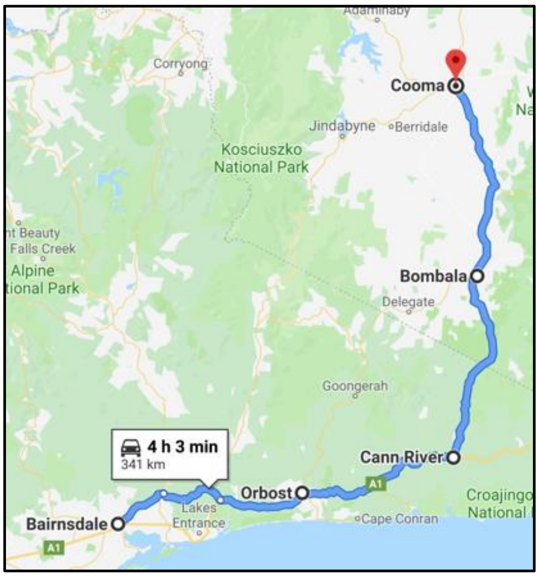
- Bairnsdale
- Bruthen
- Omeo
- Hotham Heights

Connecting to New South Wales



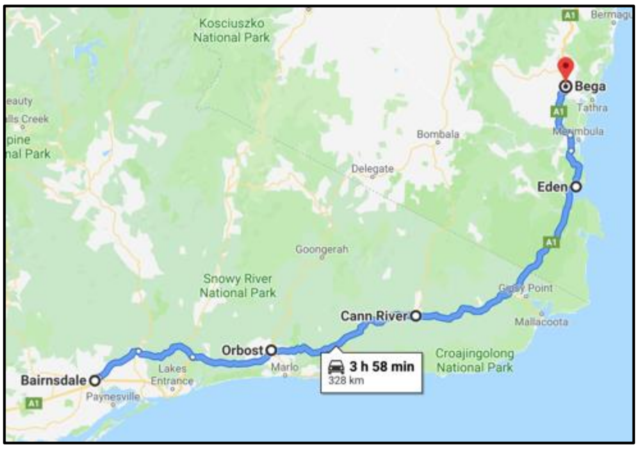
To Cooma (and on to Canberra) via Bombala

- Bairnsdale
- Orbost
- Cann River
- Bombala
- Cooma
- Canberra



To Bega via the coastal route

- Bairnsdale
- Orbost
- Cann River
- Eden
- Bega



6.10.2. Journey Enablement (East Gippsland)

Key Route Nodes

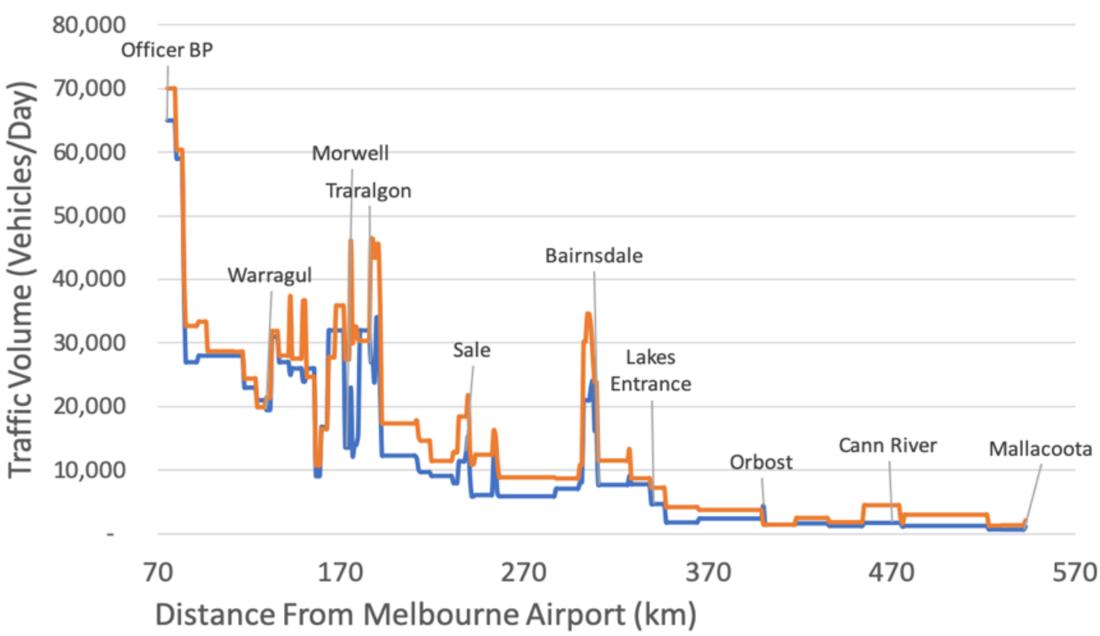
Bairnsdale and Lakes Entrance are the most significant populations and important economic nodes.

Route: Melbourne to Mallacoota										
	Melb. CBD	**M1 Service Station, Officer**	**Warragul**	**Traralgon**	**Sale**	**Bairnsdale**	**Lakes Entrance**	**Orbost**	**Cann River**	**Mallacoota**
Distance between stops		51	53	59	52	67	38	59	73	69
Distance from Melb.CBD (Airport add 25 km)	0	51	104	163	215	282	320	379	452	521
Traffic Volume			11,100	27,000	15,200	23,000	4,700	4,400	1,562	670
Population			15,757	26,659	13,673	11,644	6,389	2,227	194	1,063
Commutes to Work			6,800	9,652	5,595	6,809	1,798	1,216		

Key Route Traffic Analysis

The journey from Melbourne to Mallacoota is 518 km (add 25 km if starting from Melbourne Airport). A one-way trip exceeds the range of most EVs, with multiple charge stops required.

Bairnsdale is the regional centre, while Lakes Entrance is central to many tourist attractions and a major work destination. Much of the traffic through East Gippsland is moving along the East-West corridor between Melbourne and the New South Wales border.



By 2025, we expect EVs to account for 4% of the national vehicle fleet. We will assume this composition for traffic along the key route.

During weekends, particularly on school and public holidays, peak demand will be significantly higher than the daily average. We have used VicRoads data to compute a ratio of average to peak demand from which we can estimate the peak volume of traffic.

Route: Melbourne to Lakes Entrance						
		Bairnsdale	Lakes Entrance	Orbost	Cann River	Mallacoota
Daily Traffic Volume	Vehicles/ day	23,000	4,700	4,400	1,562	670
Peak ratio		1.42	1.54	0.33	1.43	1.98
Peak Daily Traffic Volume	Vehicles/ day	32,547	7,224	1,458	2,229	1,329
Average daily EVs in 2025 (4% of the fleet)	EV/day	920	188	176	62	27
Peak EVs in 2025	EV/day	1,302	289	58	89	53
Peak Hourly Traffic	Vehicles/ hr	3,000	626	163	193	228
Peak hourly EVs in 2025 (4% of the fleet)	EV/hr	120	25	7	8	9

Example scenarios: “Entry level EV” charge strategy
In these scenarios, a tourist is driving an EV with advertised WLTP range of 200 km and energy efficiency of 14 kWh/km, however various factors mean that energy efficiency is really 15.6 kWh/km meaning the *real* range is 180 km. We will also assume that the driver wishes to leave 20% battery in reserve.

Scenario: Overnight visitor to Mallacoota
In this scenario, we are assuming that there is a low-power (< 3.5 kW) destination charger at Mallacoota while we explore the need for chargers at any of the towns en-route.

On the outbound journey, we can see that multiple charge sessions are required. Due to the distance of this journey, the charge strategy can become complicated. We will demonstrate two approaches to charging.

1. Charging to 100% and maximising the distance travelled on each leg.
2. Charging the minimum amount in order to reach the next charge point with 20% reserve.

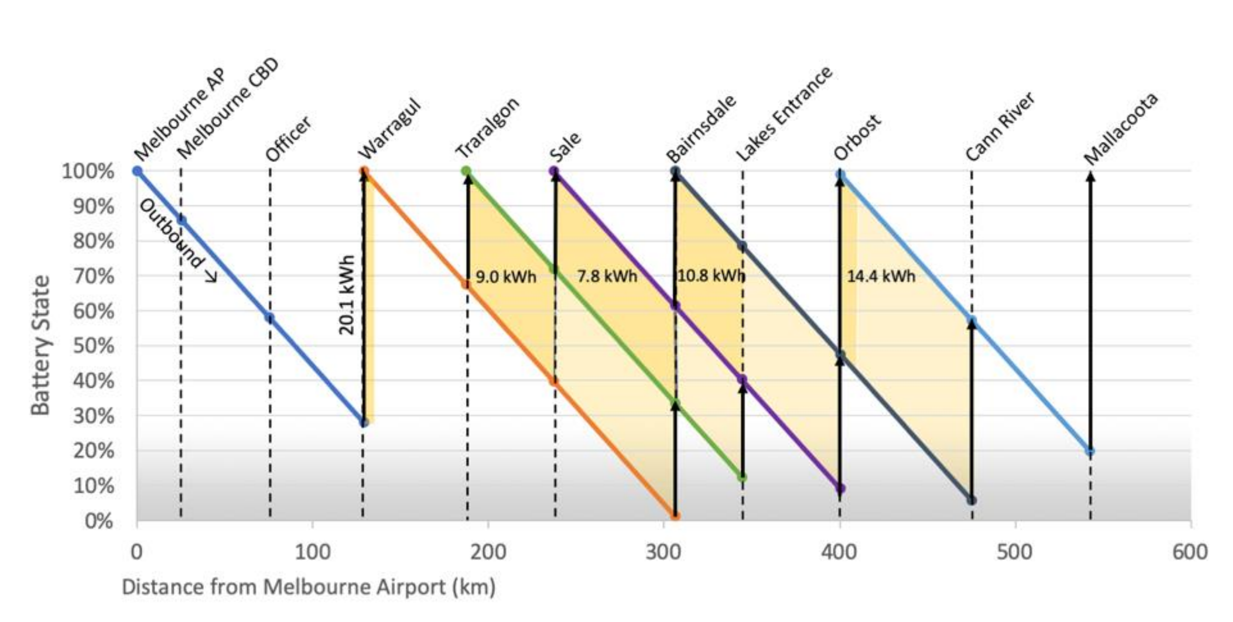
It’s important to note that exactly the same amount of energy is used.

Strategy A: Charging to 100%

This strategy is employed in order to maximise the distance covered in each leg in the journey. Having a full battery may present more choice of charging stations and may allow the driver to make fewer stops (e.g. Warragul, Bairnsdale, Orbost). The drawback is that most EVs will slow their charging rate as they approach 80% battery level. This means that this approach results in longer time spent charging (we haven't included this in our calculation because it varies between vehicles).

Applying this strategy, we can see that charging stations at Bairnsdale and Orbost could offer the minimum service in order to take this route. With chargers at Traralgon and Sale, there is freedom to choose whether to charge at Bairnsdale, Lakes Entrance or Orbost.

Charging Strategy A: Melbourne to Mallacoota charging strategy



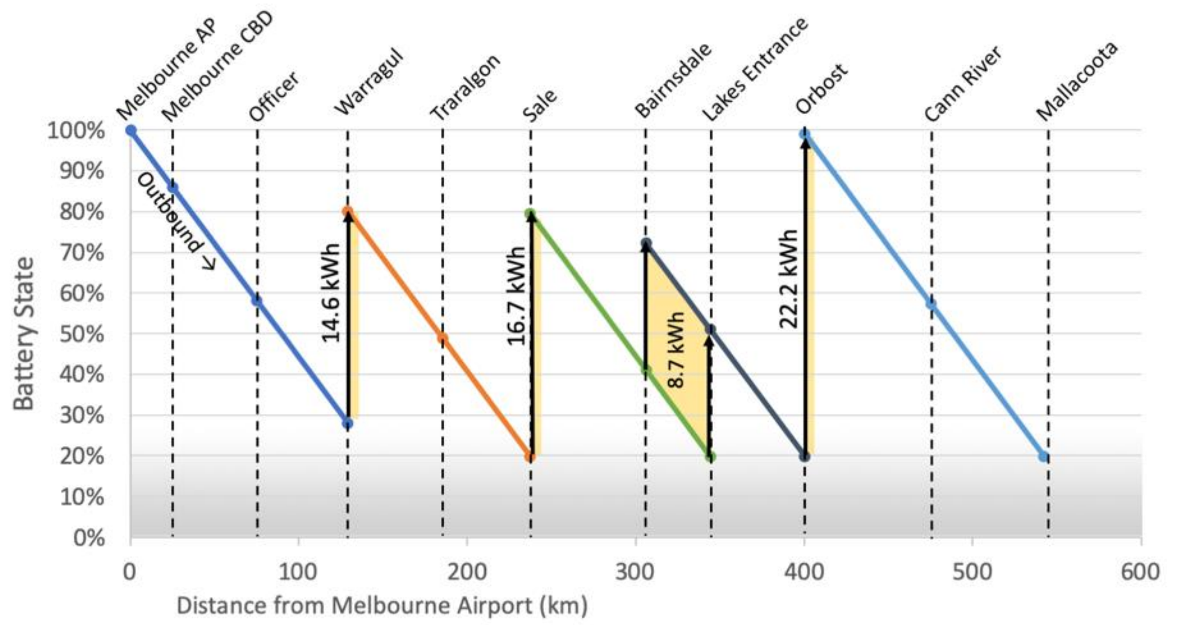
Charge Location	Energy	Charge time	
	(kWh)	7 kW AC	50 kW DC
Warragul	20.1	3 hr 3 min	27 min
Traralgon	9.0	1 hr 22 min	12 min
Sale	7.8	1 hr 11 min	10 min
Bairnsdale	10.8	1 hr 38 min	14 min
Orbost	14.4	2 hr 11 min	19 min
Total	**62.2**	**9 hr 25 min**	**1 hr 23 min**

Charging Strategy B: Charging to a minimum (leaving 20% in reserve)

This strategy is employed to minimise the amount of charge (and dwell time) at each stop. Since many of the charges do not exceed 80%, the charge rate is not curtailed. Battery life can also be improved by avoiding *full charge to deep discharge* cycles. This strategy may require the driver to take more stops, but in practice, the overall time spent charging will be less (we haven't included this in our calculation because it varies between vehicles)

Applying this strategy, we can see that charge stations at Warragul, Sale, Bairnsdale (or Lakes Entrance) and Orbost could offer the services necessary to cover this route. The return journey is possible utilising the same charge locations.

Charging Strategy B: Melbourne to Mallacoota charging strategy



Charge Location	Energy	Charge time	
	(kWh)	7 kW AC	50 kW DC
Warragul	14.6	2 hr 12 min	19 min
Sale	16.7	2 hr 32 min	22 min
Bairnsdale	8.7	1 hr 19 min	12 min
Orbost	22.2	3 hr 21 min	30 min
Total	**62.2**	**9 hr 25 min**	**1 hr 23 min**

Insights - East Gippsland Journey Enablement

To enable electric vehicles to travel from Melbourne to Mallacoota, DC fast chargers are required at Bairnsdale, Lakes Entrance and Orbost. They meet the following criteria:

- Significant local populations
- Regional economic and logistic nodes
- Provide sufficient coverage to avoid range anxiety.
- High traffic volume

6.10.3. Destination Chargers (East Gippsland)

A large list of council assets was assessed from which 18 sites in East Gippsland were identified as potential council owned charging stations across 9 locations. We first assessed the local, logistical and tourism value of each location and classified them as A, B or D locations.

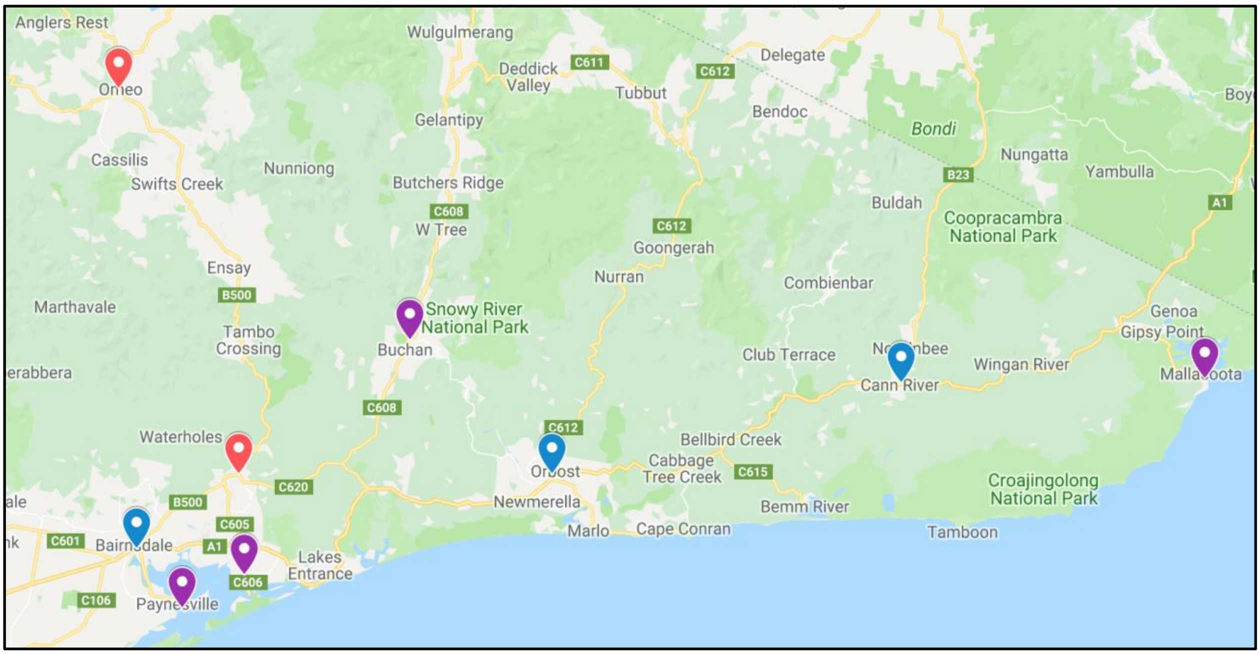
A Location - Situated **on** Key Route, high logistical value, high local value, high tourism value.
B Location - Situated **off** Key Route, medium logistical value or medium tourism value
D Location - Purely destination, no logistical value, low local value, high tourism value.

Location		Summary			
	Region	Local	Logistic	Tourism	Location Class
Bairnsdale	Gippsland Lakes	High	High	High	A
Bruthen	Alpine High Country	Low	Medium	Medium	B
Buchan	Snowy River Country	Low	Low	High	D
Cann River	Coastal Wilderness	Low	Medium	Medium	A
Mallacoota	Coastal Wilderness	Medium	Low	High	D
Metung	Gippsland Lakes	Medium	Medium	High	D
Omeo	Alpine High Country	Low	Medium	Medium	B
Orbost	Snowy River Country	High	High	Medium	A
Paynesville	Gippsland Lakes	High	Medium	High	B

Sites suitable for destination chargers in the East Gippsland region.

The spatial distribution of each charger type also gives a clue to the power of the charger required. A and B Locations are suitable for the highest feasible power due to their high logistical value, shorter dwell time and high utilisation rates. D locations, due to their low logistic value and high dwell time are suited to slow, simple chargers. Due to their remoteness, groups of slow chargers at D locations may need demand management systems.

A Locations - Blue
B Locations - Red
D Locations - Purple



6.10.4. Site Summary - East Gippsland
Please see attached schedule - Site Summaries

7. Private versus public investment in charging infrastructure

7.1. Charging infrastructure value chain

There are four core roles in the charging infrastructure value chain as outlined below.

Role	Description	Capabilities	Procurement approaches
Financier/ Owner	Provides project finance. Responsible for ensuring the end to end economics of the project, so is therefore the "client" of the project	• Developing and evaluating the business case • Providing and accessing the lowest cost capital • Procurement of 3rd parties	A financier is generally the procurer of the overall work packages
Installer	An installer will manage the entire process of ensuring that the charging hardware, electrical works and civil works are complete and tested	• Project management • Electrical engineering • Civil engineering • Charging station installation and testing • Communications installation and testing • Billing software implementation and testing (if required) • Signage and wayfinding • Liaison with electrical network company • Providing warranties around installation • If network augmentation is required a level 2 electrician is required Note that this role may involve several companies	Installers can be procured as a turnkey service or broken down into one or more services. For example the hardware supplier and electrical contractor can be separate entities
Operator	An operator of charging infrastructure will provide billing services and ensure that the equipment remains fit for purpose.	• Billing services • Provision of data where required • Equipment monitoring and maintenance - hardware and communications primarily (proactive and reactive)	The billing service and data provision can be a separate package to equipment maintenance and monitoring
Site owner	A site owner provides the physical land that a charging station is located on	• Provides property for the installation of the charger, the parking of an electric vehicle while charging, and for any wayfinding required	Site owners may also be the financier/owner (in the case of shopping centres for example), or may be independent entities who provide a lease over the land.

7.2. Value creation

While there are only four core functions to providing charging infrastructure, there are a number of other parties that may derive benefit from a charging infrastructure installation. These include:

1. Governments who believe that electric vehicles will assist in decarbonisation of our economy and that increased charging infrastructure will drive increased uptake of electric vehicles
2. The host of the electric vehicle charging station - who seeks to obtain leasing revenue for the provision of the parking space
3. The electric vehicle driver - who needs to charge their vehicle
4. The infrastructure owner - where there is a profit from an installation the infrastructure owner will receive a return on capital or will otherwise manage the losses that may be reflective of other benefits of the system - related to travel revenue, retail revenue or membership/subscription revenue
5. Local businesses - generally either tourism or retail related
6. Car manufacturer/OEM - receive benefit in terms of the attractiveness of their electric vehicle package/offer
7. Energy distribution companies who will derive income from charging infrastructure utilisation
8. Energy retail companies who will derive income from charging infrastructure utilisation

Driver Benefits

Depending on the type and location of infrastructure, a driver will accrue a number of key benefits from utilising charging infrastructure:

1. Delivering critical journey enablement re-fueling services to electric vehicle drivers as and when they require it
2. Delivering non critical convenience re-fueling services to electric vehicle drivers
3. Providing “peace of mind” that there is sufficient coverage in an area that they will be able to charge in the context of general journeys

Sources of revenue

Charging infrastructure providers seek to derive benefit from one or more of the following value-streams:

1. Receiving income from the provision of the charging service
2. Receiving income benefits from additional tourism revenue by attracting electric vehicle drivers to areas that they otherwise would not have traveled to
3. Receiving income benefits from additional retail revenue (including accommodation revenue in hotels) through attracting electric vehicles drivers to a site
4. Receiving income benefits from advertising revenue
5. Receiving income benefits from subsidies from other 3rd parties (vehicle manufacturers, energy companies)

Revenue models

There are several key revenue models that have been used in Australia and internationally. It should be noted that in some cases there will be no revenue derived from the service, and charging will be provided purely for the purpose of obtaining the co-benefits such as retail revenue, accommodation revenue or receiving social dividends.

Where revenue is involved the models may include:

1. A membership fee
2. A fixed “connection fee” for using a charger
3. Energy fee - directly related to a per kWh usage of the charger
4. An hourly usage fee
5. Advertising revenue

The following table outlines how the direct revenue models (i.e. excluding advertising) have been used in the United Kingdom by the multitude of operators.

Network	Network afflications	Locations	Geographic focus	App	Free Energy Chargers	Subscription fee	Connection fee	Energy fee	Rapid Chargers	Rapid Connection Fee	Rapid Energy Fee
POLAR Plus	Charge Your Car, Plugged-in Midlands	2104	London, Southern & Central England	No	**80% free to use**	£7.85 / month subsciption fee	Nil	Nil or 10.8p/kWh	Yes - mostly in greater London	Nil	10.8p/kWh
POLAR Instant	Plugged-in Midlands	924	London, Southern & Central England	Yes	**80% free to use**	Nil - PAYG	£1.20	Nil or £1.50 / hour	Yes	£1.20	£6 / hour
Charge Your Car	ChargePlace Scotland, GMEV, Source West, ChargerNet, Recharge,	1180	Scotland, Northern England, London, Southern England	Yes	**Majority (80%?)**	£20 / annum subscription fee then PAYG	£1	Mostly Nil	Yes - mostly in Scotland	£1	Mostly Nil
Source London - PayM	None	365	Greater London	No	No	£4 / month subscription fee	Nil	3.6p/min (min. 20 minutes)	No	N/A	N/A
Source London - PAYG	None	365	Greater London	No	No	Once off £10 - PAYG	Nil	5.9p/min (min. 20 minutes)	No	N/A	N/A
POD Point App	None	284	London, Southern & Central England	Yes	**100% free**	Nil - PAYG	Nil	Mostly Nil	Very limited	Nil	£6.50 / 30 min
POD Point Card - Legacy systems	None	109	London & Central England	No	**100% free**	Nil - PAYG	Nil	Nil	Very limited	Nil	£6.50 / 30 min
Charge Point Genie	None	85	London, Portsmith, SW England, Lakes District	Yes	No	Nil - PAYG	£0.50	30p/kWh	Yes	£1.80	£30p/KWh
Ecotricity	None	178	Highways in England	Yes	No	Nil - PAYG	£3	17p/kWh	Majority	£3	17p/kWh
e-car	E-carni	175	Northern Ireland	No	**100% free**	Nil - PAYG	Nil	Nil	Nil	Nil	Nil
Tesla	None	~60	England	No	**First 400kWh free**	Nil - PAYG	Nil	10p/kWh	Nil	Nil	20p/kWh

Business models

Business models for charging infrastructure take a number of these revenue sources and develop over-arching customer value propositions which deliver the "driver benefits" outlined above. All business models involve an investment in capital expenditure, some operating costs and then the revenue model required to underpin these costs. These models include:

1. Infrastructure investment based on reliable assets and operational profile
2. Large scale network established with an hourly, access or membership fee (often equity funded)
3. Funding partners for major travel enablement infrastructure. These partners may include Automotive OEMs or energy companies who may benefit from the availability of the infrastructure.
4. Funding pools financed by local businesses[24] who can derive income from uplift in sales (retail, restaurants and hotels)
5. Combinations of 2 and 3 and 4

Sources of capital for charging infrastructure projects

There are several potential sources of capital as outlined in the following table. Each has positives and negatives. For the council, obtaining grants will always be the most inexpensive form of capital. Leases will operationalise the costs and provide for asset replacement cycles.

Source of funding	When is it available?	Cost of capital	Available to councils?
Equity	Generally, only for larger networks	High > 20% IRR	Would be unusual and would be in the form of a recoupable grant
Infrastructure finance	For highly reliable tolling assets	Mid < 21% down to 10%	Would be if councils underwrote risks. Would require complex procurement.
General bank loan	For reliable assets backed by guarantee	< 5% to councils	Can be with significant process
Operating lease (equipment owned by 3rd party)	For assets with a reliable counter party	> 10%	Yes - with some process
Finance lease (equipment owned by council)	For assets with a reliable counter party	> 10%	Yes
Clean Energy Finance Corporation	For cleantech related assets, with infrastructure asset profile	< 5%	Yes
Australian Renewable Energy Agency	50% match funding for projects that have some innovation or knowledge sharing aspect	50% match grant	Yes
State government grants	50%-100% match funding	100% grant	Yes (where they exist)
Environmental upgrade agreement	Finance backed by council rate debt profile	<5%	Councils are part of the structure of provision

[24] http://leg.wa.gov/JTC/Documents/Studies/EV/FinalReport_EVChargingNetworksWEB.pdf

Which parties are best positioned to offer charging infrastructure?

Unfortunately there is not a one-size fits all answer to this question. From the above table of funding options it can be seen that different players will participate in programs of different risk profiles. In general local government has a low risk profile, and all expenditure is based on a perception of the best and most equitable outcomes for their community in general. The following table adapted from work by the centre for climate and energy solutions[25], outlines where the various values (in green below) and costs (in red) typically fall.

It can be seen from this that if government entities believe in the positive externalities associated with electric vehicles then they have the most to win and face some key uncertainties when backing charging infrastructure projects.

	Local Government	Network	Energy Retailer	Vehicle OEM	Local business	Tourism operator
Reduced environmental impact	✓				✓	✓
Local economic development from charger use	✓				✓	✓
Increased electricity use		✓	✓			
Increased EV sales	✓			✓		
Increased retail sales					✓	✓
Long term economic benefits from lower fuel costs	✓					
Cost of subsidies to general public (including free/peppercorn site leases)	✓					
Negative grid reliability impacts		✓				
Uncertain impact of EV adoption on increased charging infrastructure	✓	✓	✓	✓		
Uncertain impact of charging infrastructure on visitation and expenditure	✓				✓	✓

[25] http://leg.wa.gov/JTC/Documents/Studies/EV/FinalReport_EVChargingNetworksWEB.pdf

Can councils derive an economic benefit from charging infrastructure?

The holy-grail of participation in the infrastructure provision is that councils could derive both a social benefit from participation, along with an economic benefit. Councils could obtain economic benefit in a number of ways:

Revenue model	Relative return	Relative risk
Provide a lease over council car-parks and land. The council would be paid by the infrastructure owner for the long term benefit of using the car park and any associated land	Low	Low
Revenue from providing the charging service based on one of the revenue models outlined above	High	High

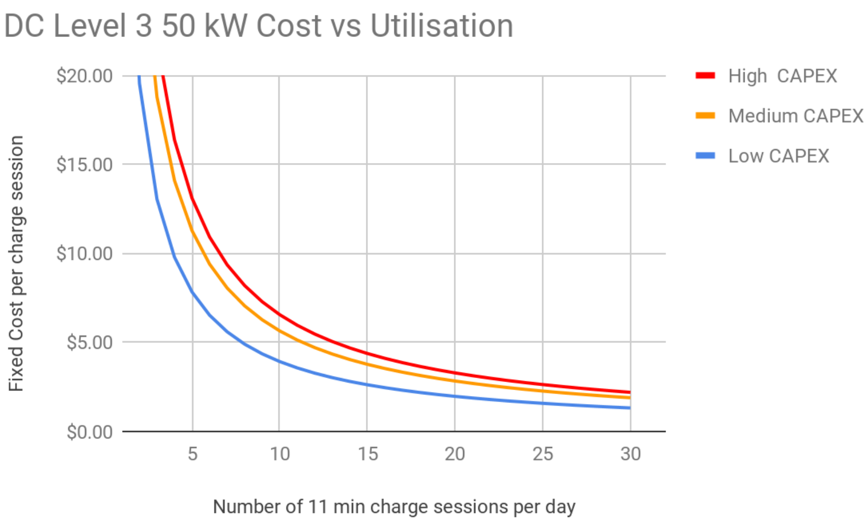
The table above provides a view on the revenue models and the relative risk return.
Within each of these models there will be specific cases where the economic model will over-perform or under-perform.

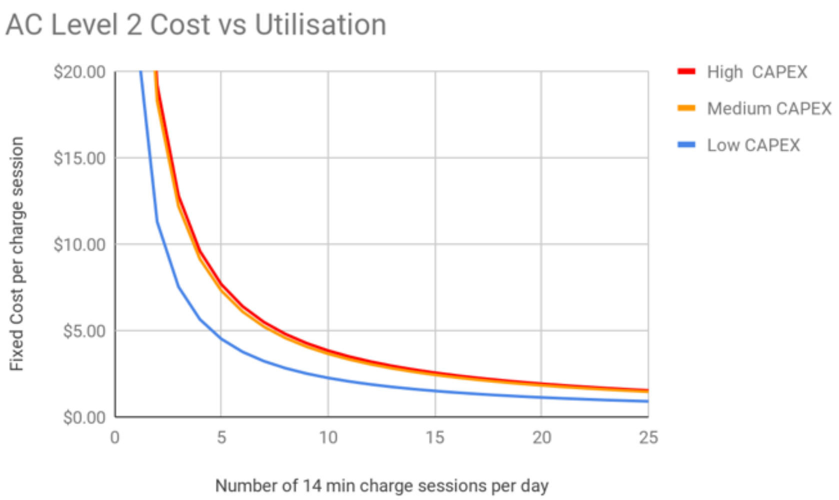
Where a site is on a highly desirable location it can ultimately demand higher leasing costs. Many of the locations we have identified in this report will have low or even zero benefit to a potential infrastructure investor as the return on installing infrastructure on that site will be high risk. In some cases, however, the land value may be significant due to its location on a key journey enablement route (these are documented above). Even sites that are more likely to have traffic will attract significant risk for any return on capital in the current Australian market.

Evenergi has created an “order of magnitude” economic model to demonstrate the potential risks and reward dynamic in providing a charging network. The model effectively looks at the fixed costs of running a charging site and then the required level of utilization (reflected as charging sessions per day) to break even on provision of the network.

The following figures represent the fixed costs of running a network and the revenue that would be required per day to cover these fixed costs. If we assume that electricity costs are a pass through, and that based on United Kingdom experience around $3-4 per session is the maximum that can be charged, we are looking for at least 20 charging sessions a day to break even on a DC fast charger. There are very few of the locations identified in this report that would deliver that many charging sessions in a day.

The graphs below show the curves and cost per charging session over a 12 year life of the equipment. As the number of sessions increase the cost per session decreases. Based on experiences in the United Kingdom we are assuming that a $3 per charge fixed rate (i.e. above the cost of power) is feasible.





The following tables combine the data on charging station installation costs and electric vehicle traffic at particular locations. It shows that the number of sessions required to break even on charging infrastructure based on different installation costs for both DC and Level 2 chargers. It shows that even in the low CAPEX scenario the return takes many years, so if each charging station was self-funded the business cases would not provide a return.

	Break even number of sessions - DC level 3		
	Low CAPEX	Medium CAPEX	High CAPEX
Number of charging sessions per day	**14**	**19**	**22**
Year when sessions reached (Traralgon)	2023	2023	2023
Year when sessions reached (Sale)	2025	2025	2025
Year when sessions reached (Orbost)	2029	2029	2030

	Break even number of sessions - Level 2		
	Low CAPEX	Medium CAPEX	High CAPEX
Number of charging sessions per day	**8**	**13**	**13**
Year when sessions reached (Cowes)	2020	2021	2021
Year when sessions reached (Yarram)	2022	2022	2022
Year when sessions reached (Tidal River)	2028	2030	2030

How much can local governments make for site leasing?

As outlined above, in many cases the potential for return on charging infrastructure is marginal unless the site is located in a prime location. In fact, one of the key criteria for charging station "owner/financiers" are sites where there is no lease and a high perception of value from co-benefits. The synergy then becomes a free charger in return for traffic and exposure.

When it is located in a prime location the alternate uses for the site (and therefore the opportunity cost) would be more competitive and owner/financiers understand that they will need to provide a commercial return in exchange for usage of the space.

What is the potential economic uplift to local business from charging infrastructure?

To understand the value to local businesses from installing infrastructure, and for the potential appetite for local business to install charging infrastructure, requires an understanding of the potential uplift in revenue to local business.

Unfortunately, given the nascent nature of the market, there have been limited studies into the benefit of charging infrastructure with respect to economic impact on tourism and retail trade.

From a Canadian Study[26], with 85 EV drivers and public EVSEs:

- 22% of people charged EV due to access to shops and services, and 23% because it was free, the 3rd reason was weather protected (10%)
- 64% of respondents said having an EVSE at retail location increases shopping behaviour (page 21 and 28)
- 80% charged with SOC 40-80%, so not really needing to.
- 80% of respondents that charged at retail and leisure locations, also have EVSE at home

Another study found that installing charge points at shopping locations provides a sales uplift of £5,000 - £7,000 per charge point per year (achieved in the UK [27]). There is also a wealth of research

[26] UBC Sustainability Scholars, 2018 "Impact of public electric vehicle charging infrastructure on EV adoption"
[27] BBP Managing Agents Partnership, 2018, Savills Case Study; ChargePoint, 2015, "RetailCo" case study

into retail dwell times for similar services. For example one study showed that providing mobile phone charging in a retailer could increase spending by 29%[28].

What can be stated with confidence from previous Evenergi research and research more generally available is that electric vehicle drivers are typically more affluent and so will have more disposable income for tourism. They are generally also more environmentally focused so will be more likely to tour areas of natural beauty. Years of experience in service stations demonstrates that retail trade associated with refueling is a lucrative business and it stands to reason that a charger located near retail will attract more electric vehicle drivers than those without. It is important that in moving forward pilots can track the associated benefits to retail trade.

It can also be said that an electric vehicle driver will need to charge on arterial roads as well as highways and the sites identified will all receive traffic that can be capitalised on by local retail and tourism operators.

[28] https://www.forbes.com/sites/marciaturner/2017/02/28/mobile-charging-stations-keep-retail-consumers-spending-money-in-store/#78902b891685

How should local government participate in the value chain?

Local governments generally explore local charging infrastructure due to the perceived social benefits derived from electrification of transport, and because they have become a major target of others who are looking to install infrastructure on council land, or who are seeking council approvals for installations.

If we assume that local government will not have an appetite for risky investments, then the main ways that councils can participate are:

1. Councils should establish a clear valuation for the co-benefits of installing charging stations so as to confidently promote to stakeholders (from local retailers and tourism operators, to the general public who need to buy-in) any plans for council investment (whether financial or provision of parking spaces).
2. Providing clear information to the private sector with respect to:
    a. The sites that are most likely candidates, and why they are good candidates (as per the information in this document)
    b. Raw data so that proponents can validate the business cases for investment.
3. Improving planning processes to streamline and minimise friction for approvals.
4. Providing land at no or nominal cost where the business case for a proponent will be marginal.
5. Facilitating introductions required to drive business model 4 below (i.e. finance from a pool of local businesses).
6. Coordinating players required for business models to build a broader network. For example, bringing together Energy Companies, OEM's, local retailers and financiers to help develop a wider regional business case.
7. Funding some assets which are lower risk but still may not have a return that is adequate for the private sector, but may have a return at the local governments expected rate of return.
8. Providing low cost debt funding - low interest rates and long dated debt - possibly leveraging existing Environmental Upgrade Agreement (EUA) structure.
9. Helping to quantify and capture the returns for regional tourism and retail sales so as to enable value-capture from that revenue stream.
10. Electrifying your own fleets to provide certainty to charging operators that a base level of demand will exist.
11. Putting in place building codes that enforce some level of charging infrastructure implementation.

Example of potential models that may work in the Gippsland region

Given the different profiles of various sites, a range of models may work in the Gippsland region, and it's likely that a mix of models will be appropriate. The following models have been provided under the following assumptions:

1. There will be limited funding from government sources - these additional funding streams will simply enhance the business model
2. There will be a need to provide funding for a number of uneconomic sites in order to create a network with sufficient coverage

Business model 1 - large business underwrites infrastructure costs	The councils approach electricity distribution business, electricity retailers and OEM's for some level of underwriting in exchange for advertising and other financial benefits.
Business model 2 - local business contribution investment pool created via a levy	Council creates a fund where local business can or must contribute in return for infrastructure installed in proximity to their land, thereby increasing their revenue.
Business model 3 - local business co-invest in infrastructure based on their own perceived benefit from installing infrastructure, and who can access low cost and long dated debt	Suggested that this pool of funding is accessible to business who can borrow low cost and long dated capital to invest in their own charging infrastructure. This could potentially leverage the Environmental Upgrade Agreement (EUA) structure[29].
Business model 4 - large scale council infrastructure implementation based on a "network effect" across the entire region underwritten by access or membership fee	A sufficient number of local councils band together to create a network that can operate at lower risk levels due to ability to charge a "network access fee". The additional benefit of this model is that the network would become an asset with an infrastructure asset profile that could potentially be sold at a future date - which would provide an upside with potential for high returns.
Business model 5 - demand response aggregator with charging station as ancillary service	A provider of grid scale services for solar and/or battery support of networks and wholesale market hedging with the charging stations simply as a co-benefit to a core business model

The key recommendation from this table is that if it is deemed to be of sufficient social benefit, the council should pursue a number of the above models, and ideally models in combination.

To give one example based on the Model 4 above and using the economic model created by Evenergi, if we assumed there were 15 Level 3 fast chargers and 45 Level 2 charging stations across the region and by the year 2025 there were 181,000 vehicles within Greater Melbourne and 3,400 in the Gippsland region, 20% of whom would pay a membership fee of just $25 per year to access all the chargers in the region, the annual revenue would be $1.25 M per year which would cover the cost of all 60 charging stations.

[29] https://www.energy.vic.gov.au/energy-efficiency/environmental-upgrade-agreements

Examples from other jurisdictions

Council	Description	User Pays	Business Model	Funding	Arguments used by council for investment
Adelaide City, S.A.	• 40 22kW AC Schneider EVLink • 2 DC Tritium 50kW Chargefox Network	AC: 20c/kWh DC: 30c/kWh	Host/ Operator	State Gov.	"Adelaide has a goal to become the world's first carbon neutral city by 2025" - Adelaide Lord Mayor Martin Haese, 2016
	4 Tesla Superchargers	Free to Tesla owners	Host	Tesla	
City of Swan, W.A.	1 Delta DC Fast Charger ChargeStar Network	40c/kWh	Host/ Operator	Council	Support council EV fleet
City of Stirling, W.A.	EO Universal 22kW	Free	Host/ Operator	Council	"Sustainable development is a priority for the City" - Stirling Mayor Mark Irwin
City of Cockburn, W.A.	Tritium Veefil	Free	Host/ Operator	EVSE funded by donation. Install funded by council.	"facility for local residents and visitors and helped further advance sustainability practices in the City" - City of Cockburn Manager Infrastructure Services
Goulburn Council, NSW	8 Tesla Superchargers	Free to Tesla Owners	Host	Tesla	"... strengthens the image of this city as a leader in innovative use of alternative technologies" - Goulburn Council General Manager

United Kingdom Experience

Electric vehicle charging infrastructure has been a key priority of the central government in the UK, particularly shown through its Road to Zero [30] plan that dedicated £400 million in a Charging Infrastructure Investment Fund, as well as its Go Ultra Low[31] initiative that provided £40m to deliver around 1600 new EVSEs including up to 1000 on-street EVSEs. This push for EV charging facilities aims to provide the necessary infrastructure for nationwide EV adoption and overcome some of the well documented technical and social aspects of driving EVs, such as range anxiety.

Considering the inter-city aspect of mobility, charging infrastructure has mostly been developed with a regional focus to enable commuter driving in between urban hubs and residential areas. While there are some notable examples across the country, two of the most prominent case-studies are found in

[30] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf
[31] https://publications.parliament.uk/pa/cm201719/cmselect/cmbeis/1881/188102.htm

the Nottingham City Council and the Milton Keynes Council charging networks. These two councils were successfully awarded funding under the Go Ultra Low initiative.

Nottingham City Council, in combination with Derby City Council, are developing the D2N2 charging network that will include 230 rapid and fast charging stations across both city regions. This is a result of investing over £2 million from the awarded grant, to deliver a publicly accessible charging facility. The charging infrastructure company, ChargeMaster BP, was commissioned to install and manage the network, while for interoperability the network uses a specific RFID card for local residents and the POLAR system card for non-residents to access charging services. Notably local residents have access to preferential reduced tariffs. For supplying the electricity requirements, the utility OVO Energy provides only renewable energy in all charging points operated by POLAR[32]. By 2018 the Councils had completed 53 rapid stations, with 13 under construction and 53 planned.

Milton Keynes Council, using £2.3m of its £9m grant [33], has also developed an extensive network by installing 170 fast and 56 rapid electric vehicle charging points, all of which are publicly available and located throughout the borough with a significant concentration in the central Milton Keynes. The network is managed by Chargemaster, and also makes use of the POLAR system for network interoperability. The aim of the Council is to have rapid charging facilities available that are no more than 1-2km apart to also support fleet operations, such as the local taxi companies.

32 http://www.chargeyourcar.org.uk/d2n2/faqs/

33 https://www.goultralow.com/news/consumer/milton-keynes-makes-15000-parking-spaces-free-electric-cars/

8. Pathways to approvals

Local governments can have complex decision making structures and approval processes. There are often differences between local government planning and other approval processes. The consideration of approvals related to EV charging stations is an issue that crosses a number of disciplines within councils including:

- Land use planning;
- Asset management;
- Infrastructure delivery;
- Environment sustainability; and,
- Local laws regulation.

These different and complex approval processes can be difficult for businesses and community to navigate. Processes can create uncertainty for users and regulators and impose compliance burdens, especially for businesses or infrastructure installers who are likely to operate across municipality boundaries.

The constant concern from charging infrastructure proponents is that the level of understanding of the issues is different at every council as are the systems and processes. They are all keen to see simplification and harmonisation.

Section 5.3 of this report highlights a significant future demand for a range of charging facilities. This will place pressure on the planning processes across the six councils as the current planning systems and processes within councils have generally not considered in detail the associated impacts of ancillary infrastructure and planning assessments have not been broadly documented.

To assist the Gippsland councils this project has considered the existing local planning schemes and gained an understanding of other internal processes to assist future decision making and application processing.

8.1. Land Use Planning

This section examines the treatment of constraints under the current Planning Scheme and assesses the strengths and weaknesses of the current regulatory framework with respect to the issue of electric vehicle charging infrastructure.

The Planning and Environment Act 1987 (the Act) is the foundation of the planning system in Victoria. The Act sets out the obligations and processes for councils and is enabling legislation that requires that each council maintain their planning scheme. The Act requires that a planning scheme:

- must seek to further the objectives of planning in Victoria within the area covered by the scheme;
- must contain a Municipal Strategic Statement (MSS), if the scheme applies to the whole or part of a municipality; and
- may make any provision which relates to the use, development, protection or conservation of any land in the area (section 3 of the Act defines the meaning of these terms).

As a result, a planning scheme is a statutory document which sets out objectives, policies and provisions relating to the use, development, protection and conservation of land in the area to which it applies. It contains State and local planning policies, zones and overlays and other provisions that affect how land can be used and developed. The planning scheme will indicate if a planning permit is required to change the use of land, or to construct a building or make other changes to the land. A planning scheme regulates the use and development of land through planning provisions to achieve those objectives and policies. Generally, planning schemes apply to all private and public land in Victoria.

There are two distinct different occurrences for the ‘triggering’ of need for a planning permit - these are categorised as either ‘Use’ or ‘Development’.

- Use of land refers to using land for a particular purpose (such as a dwelling or a shop) and may not involve building anything.
- Development includes the construction, alteration or demolition of a building or works and the subdivision or consolidation of land.

In some instances, the development of land and the proposed new use both require a permit. In terms of EV charging stations this is further discussed at Section 8.

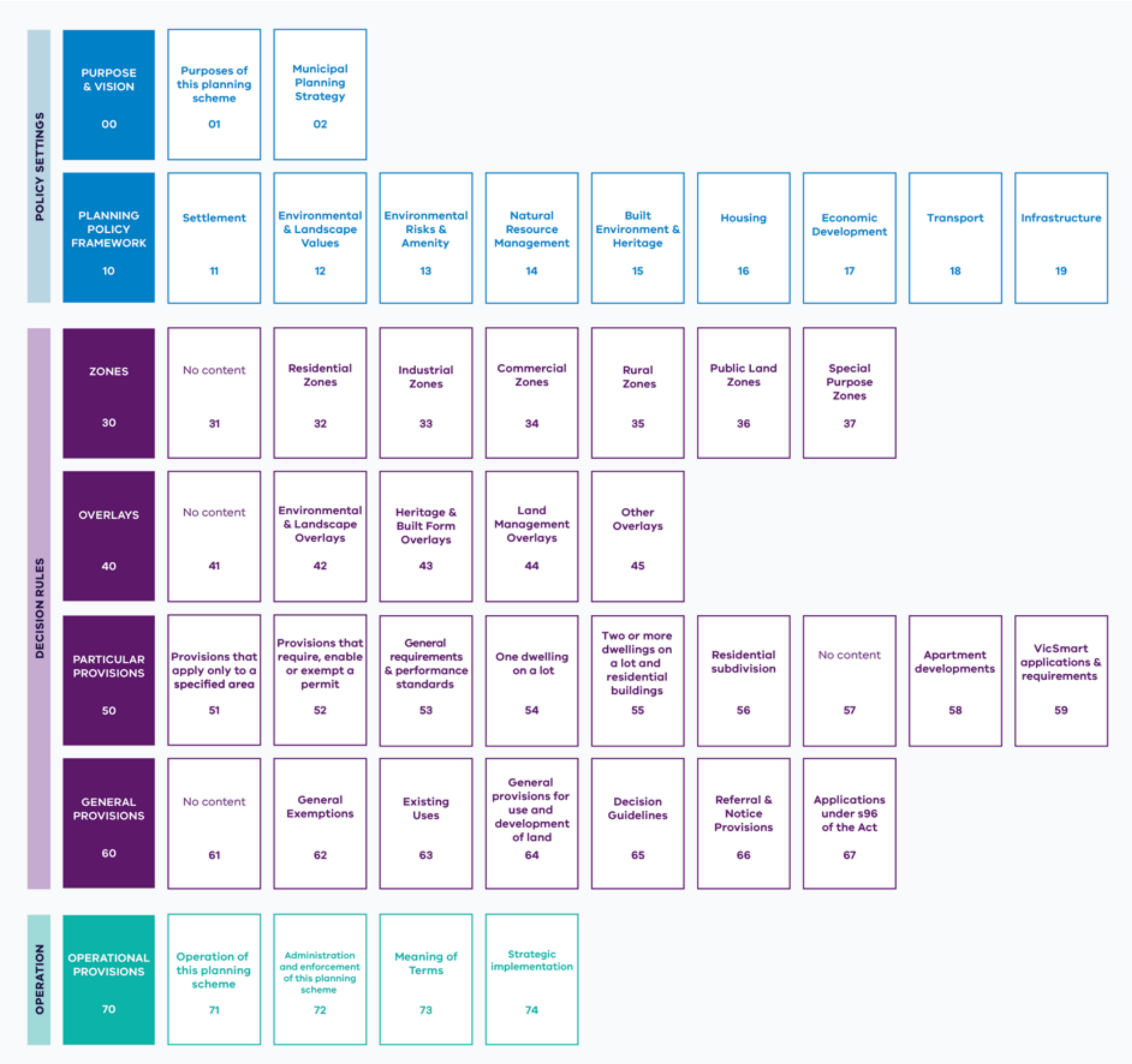


Figure 1 shows the structure and components of Victoria’s current planning system. (Source: A Practitioner’s Guide to Victorian Planning Schemes [Version 1.1])

8.1.1 Analysis of existing Gippsland Councils Policy Framework

This section examines the six planning schemes of the Gippsland councils and their planning frameworks in relation to consideration of the development and use of EV charging stations. The following planning schemes were considered;

- South Gippsland Planning Scheme;
- Bass Coast Planning Scheme;
- Baw Baw Planning Scheme;
- Latrobe Planning Scheme;
- Wellington Planning Scheme; and,
- East Gippsland Planning Scheme.

In undertaking this review the planning schemes were considered in terms of:

- The State and Gippsland (region) planning content and policies contained at clauses 11 – 19;
- The local planning content and policies contained within each planning scheme at clause 21 and clause 22 (as the schemes have not formally translated to the PPF format);
- Zones and Schedules as they relate to the Gippsland councils;
- All overlay schedules contained within the planning schemes;
- Clause 62 – Exemptions; and
- Clause 74 – Land Use Terms.

8.1.1.1. State and Regional Planning Policies

Within the Victorian planning context, the system is standardised and so the planning schemes follow the structure that has been established by the State Government. All planning schemes at clauses 11 – 19 contain the State and Gippsland region section of the Planning Policy Framework (PPF). This section comprises general principles for land use and development with specific State and Gippsland region based policies dealing with settlement, environment, housing, economic development, infrastructure, and particular uses and development.

Planning authorities (when considering planning scheme amendments) and responsible authorities (when deciding on planning permit applications) must take account of and give effect to the PPF's general principles and specific policies.

A review of the State and Gippsland provisions of the PPF demonstrates there are currently no policies that directly reference or refer to electric vehicle charging stations or the facilitation of electric vehicles in terms of land use. However, there are a number of clauses that could loosely be utilised to justify the delivery of different charging station infrastructure (depending on the specific case or instance). These are outlined in the table below.

Table: Relevant clauses in the PPF

PPF Clause	Planning objectives
Clause 15.02-1S 'Energy and resource efficiency'	Objective: - • To encourage land use and development that is energy and resource efficient, supports a cooler environment and minimises greenhouse gas emissions. Relevant Strategy: - • Improve efficiency in energy use through greater use of renewable energy technologies and other energy efficiency upgrades
Clause 17.01-2R	Strategy: • Facilitate opportunities for innovation and industry development arising from climate change and initiatives to reduce greenhouse gas emissions.
Clause 18 'Transport'	• Planning should ensure an integrated and sustainable transport system that provides access to social and economic opportunities, facilitates economic prosperity, contributes to environmental sustainability, coordinates reliable movements of people and goods, and is safe.
Clause 18.01-1S 'Land use and transport planning'	Objective: - • To create a safe and sustainable transport system by integrating land use and transport.
Clause 18.01-2S 'Transport system'	Objective: - • To coordinate development of all transport modes to provide a comprehensive transport system. Relevant Strategies: - • Reserve land for strategic transport infrastructure • Require transport system management plans for key transport corridors and for major investment proposals. • Ensure the design, construction and management of all transport modes reduces environmental impacts. • Consider all modes of travel, including walking, cycling, public transport, taxis and private vehicles (passenger and freight) in providing for access to new developments.
Clause 18.02-3S 'Road systems'	Objective: – • To manage the road system to achieve integration, choice and balance by developing an efficient and safe network and making the most of existing infrastructure. Relevant Strategy: - • Ensure that road space complements land use and is managed to meet community and business needs.
Clause 18.02-4S 'Car parking'	Objective: - • To ensure an adequate supply of car parking that is appropriately designed and located. Relevant Strategy: - • Allocate or require land to be set aside for car parking subject to the existing and potential modes of access including public transport, the demand for off-street car parking, road capacity and the potential for demand management of car parking. • Encourage the efficient provision of car parking by consolidating car parking facilities
Clause 19 'Infrastructure'	• Planning for development of social and physical infrastructure should enable it to be provided in a way that is efficient, equitable, accessible and timely. • Providers of infrastructure, whether public or private bodies, are to be guided by planning policies and should assist strategic land use planning.
19.01-2S 'Renewable energy'	Objective:- • To promote the provision of renewable energy in a manner that ensures appropriate siting and design considerations are met. Strategies:-

	● Facilitate renewable energy development in appropriate locations. ● Develop appropriate infrastructure to meet community demand for energy services. ● Set aside suitable land for future energy infrastructure.
Clause 19.02-2S 'Infrastructure design and provision'	Objective: - ● To provide timely, efficient and cost-effective development infrastructure that meets the needs of the community.

Given that EVs are an emerging technology it is unsurprising that there are limited notations or policy direction made with respect to this type of use or development.

8.1.1.2. Local Planning Provisions

A review of each of the Council's local planning provisions, municipal strategic statements and local planning policies also identified that there is no commentary regarding the provision or providing guidance of locations for an EV network.

It is noted that in Bass Coast Shire Council's 2018 Planning Scheme Review the issue of EV was identified as a key theme that may emerge over the immediate term but at this time no further advice has been provided within the local content of the planning scheme.

8.1.1.3. Clause 73 and the Nesting of Terms

Land use terms are defined in Clause 73.03 of the Planning Scheme.
Land use terms are 'nested'; that is, a term can be included in another term or include terms within itself. The nesting of land use terms reduces the number of land use terms that need to be listed in a table of uses.

The definitions are set out in a table with four columns:

- the defined term
- the definition, if there is one – some terms are listed without definition
- other listed terms that are included in the definition
- the land use term in which it is included, if any.

Clause 74 anticipates that not all land use terms will be listed:

> *'The following table lists terms which may be used in this planning scheme in relation to the use of land. This list is not exhaustive. However, a term describing a use or activity in relation to land which is not listed in the table must not be characterised as a separate use of land if the term is obviously or commonly included within one or more of the terms listed in the table.'*

Deciding under which land use term a proposal fits can be critical to determining whether a permit is required or whether the use is prohibited. Legal cases have drawn a distinction between:

- the 'purpose of use'; and,
- 'use' in the sense of activities, processes or transactions. It is accepted than the activities on a site may have more than one purpose, and it is the purpose that determines how the definitions should be applied.

The question of how to characterise a proposed use (and secondary issue of whether other related activity conducted on land might be regarded as either trivial or ancillary) was considered by Justice Ashley of the Supreme Court of Victoria in Cascone and Another v City of Whittlesea (Cascone).
In Cascone, Justice Ashley sets out relevant principles for considering if a use permit is required. These are:

1. It is always necessary to ascertain the purpose of the proposed use.
2. It is wrong to determine the relevant purpose simply by identifying activities, processes or transactions and then fitting them to some one or more uses as defined in a scheme.
3. It is wrong to approach the ascertainment of the purpose of the proposed use on the footing that it must fit within one (or more) of the uses defined in a scheme.
4. If the purpose of a proposed use very largely falls within a defined use and the extent to which it does not is so trifling that it can be ignored, then the purpose as revealed should be taken to fall within the defined use.
5. More than one separate and distinct purpose can be revealed. If one is dominant, and the lesser purpose or purposes are ancillary to the dominant purpose, then, in planning terms, there is one purpose. But if one use is not dominant, each revealed purpose must be considered. The mere fact that one purpose is authorised will not prevent other revealed purposes from being prohibited. VCAT has also noted: it is necessary to have regard to the structure, context and purpose of the planning scheme provisions at the time of interpreting the land use terms.

In Radford v Hume CC [2006] VCAT has also noted:

> *… it is necessary to have regard to the structure, context and purpose of the planning scheme provisions at the time of interpreting the land use terms.*

Notably, electric vehicle charging is not characterised within the ‘land use terms’ in the Planning Scheme at this time. This would suggest that when a planning permit is specifically triggered for use of land then it its land use characterisation would be ‘innominate’ and therefore a permit required (section 2 use); however, this assessment would be subject to the investigation and characterisation against the principles of Cascone.

8.1.1.4. Clause 62 – Exemptions

Clause 62 of the Planning Scheme provides for the exemption from the need for a planning permit unless it is specifically stated within another control.

Clause 62.01 – Uses not requiring a permit

Clause 62.01 sets out a range of land uses that do not require a planning permit for the ‘use’. Electric vehicle charging stations are not specifically stated in this clause. This results in the instance where land is to be used for the purposes of a charging station and not considered to be ancillary to another ongoing use of the land then it may trigger the need for a planning permit.

Clause 62.02 – Buildings and works not requiring a permit

Clauses 62.02-1 and 62.02-2 set out exemptions from the need for a permit in the Planning Scheme relating to the construction of a building or the construction or carrying out of works.
Within this clause there are a number of exemptions that may relate to works or associated works being undertaken with respect to EV charging stations.

In particular the clause provides an exemption for;

- An electric vehicle charging station (62.02-2).

Other exemptions that may apply (depending on the proposed or extent of works) include;

- Buildings or works with an estimated cost of $1,000,000 or less carried out by or on behalf of a municipality.
- Buildings and works associated with a use on adjoining land or street trading if authorised under a local law.
- Buildings and works associated with a minor utility installation
- Street furniture including post boxes, telephone booths, fire hydrants, bus shelters, shade sails, traffic control devices and public toilets.
- Park furniture including seating, tables, shelters, rubbish bins, playground equipment, barbeques, shade sails, drinking fountains and public toilets.

The context of these exemptions is further discussed in the following sections.

8.1.1.5. Zones Review

The planning scheme zones land for particular uses, for example, residential, industrial, business or other. The zones are listed in the planning scheme and each zone has a purpose and set of requirements. This information will describe if a planning permit is required, and the matters that the council must consider before deciding to grant a permit.

When determining whether a permit it is required to consider the provisions and statements within each zone. The zones contain a table of uses which follow the structure:

- A use in Section 1 does not require a permit, but any condition opposite the use must be met.
- A use in Section 2 requires a permit. Any condition opposite the use must be met. If the condition is not met, the use is prohibited.
- A use in Section 3 is prohibited.

As part of this review we considered all zones within the Planning Schemes. The following is a summary of the schemes and the zones and schedules.

In undertaking this work across the Gippsland councils, we have considered, every zone and schedule, including;

- Residential suite of zones, including General Residential Zone, Low Density Residential Zone, Mixed Use Zone, Township Zone, Neighbourhood Residential Zone, and Residential Growth Zone.
- Industrial suite of zones, including Industrial 1 Zone, Industrial 2 Zone and Industrial 3 Zone.
- Commercial suite of zones, including Commercial 1 Zone, Commercial 2 Zone and Commercial 3 Zone.
- Rural suite of zones, including Rural Living Zone, Rural Conservation Zone, Rural Activity Zone and Farming Zone.
- Public Land suite of zones, including Public Use Zone, Public Park and Recreation Zone Public Conservation and Resource Zone and Road Zone
- Special Purpose suite of zones, including Special Use Zone, Urban Floodway Zone, Comprehensive Development Zone, Urban Growth Zone and the Activity Centre Zone.

The review considered whether a permit was required specifically due to the zone. In undertaking the work, it is noted that buildings and works associated with charging stations are mostly exempt from the requirement of a planning permit (in accordance with the exemptions in 62.02).

The public land zones also had a number of special conditions requiring that buildings and works should be undertaken on behalf of, or by, the public land manager. As a result, where a private operator has not sought a licence agreement or have formal sign off the works may trigger the need for a planning permit as well as use.

However, when more generally the works are characterised as being a separate use this resulted in the need for a planning permit in all zones. The characterisation of the use and therefore how the zoning of the land may generate a permit requirement is considered a 'grey area', as there is not an established approach to characterisation of such a use.

We are aware that existing councils who have dealt with EV charging stations in the past few years have undertaken the work without planning permits being required for the use, having considered such proposals to be amongst other definitions a 'minor utility installation' use within the planning scheme definitions and ancillary in use to another parent use (i.e. associated with a caravan park or service station); or that they have been undertaken on Council land, providing infrastructure for community use, under the Local Government Act.

At this point in time, we have considered how these facilities are likely to be located and used. Given that this is an emerging need/facility/industry, we consider that in the vast majority of cases that EV charging stations will be developed and used in association with (ancillary to) other uses such as:

- Public car parking and roadways;
- Dwellings;
- Apartments and hotels/motels;
- Shopping Centres;
- Freeway and Service Stations; and,
- Other community facilities.

If this was the case, we consider that they would not require a planning permit for their 'use' as they would provide an ancillary component to another 'use'.

Based on the research we have undertaken for this project, we are unaware of any standalone EV charging stations that have required approval for their 'use' under planning scheme provisions. In the future, as the industry establishes, and is more heavily supported by various levels of government, it may be that EV charging stations are established as a standalone 'use' in their own right. If this is the case, councils will need to review the extent and intensity of the EV charging station 'use' and consider how it is defined under the planning scheme and if a permit is required for the defined 'use'.

8.1.1.6. Overlay Review

Overlays are another form of control within the planning scheme, if an overlay applies, the land will have some additional control/s for a special feature/reason such as a heritage building, significant vegetation or flood risk. The Heritage Overlay, for example, applies to heritage places of natural or cultural significance and describes the requirements that apply. The overlay information should specifically indicate if a planning permit is required for the construction of a building or other change to the land.

A review has been undertaken of all overlays and applicable schedules to these overlays for each of the six Gippsland Planning Schemes, having regard to potential overlay controls/requirements for the use and construction of EV charging stations. It is noted that planning scheme overlays in the majority of circumstances relate to requirements having regard to construction of buildings, or construction of or carrying out of works, vegetation removal and the like, as opposed to use or subdivision.

The review identified that:

- Clause 43.01 of the Heritage Overlay in each of the schemes was the only overlay that specifically requires a planning permit to construct a building or construct or carry out works for an electric vehicle charging station. A planning permit is only required if the charging station is visible from the street (other than a lane) or public park.
- Clause 45.01 provides the Public Acquisition Overlay. This is also worthy of note as it requires a planning permit to use land for any Section 1 or Section 2 use in the zone.

·However, this requirement does not apply:

- *'To the acquiring authority for the land if the land has been acquired and any of the above matters for which a permit is required is consistent with the purpose for which the land was acquired.*
- *To an authority or a municipal council if the responsible authority, after consulting with the acquiring authority for the land, is satisfied that any of the above matters for which a permit is required is consistent with the purpose for which the land is to be acquired.'*

All other overlays that required a planning permit to construct a building or construct or carry out works did not apply to an EV charging station as it was not specifically required by any of these overlays, and as such remained exempt under the provisions of Clause 62.02-2, Buildings and works not requiring a permit unless specifically required by the planning scheme.

8.1.1.7. Other works/structures associated with EV charging stations

It is also important to note that depending on the nature of the EV charging station, other associated works (beyond the specific EV charging station) may be required to facilitate or deliver the infrastructure.

Despite the exemptions discussed above, it is considered that in some instances that there may be other works that are undertaken in association with EV charging stations. This may include a range of other structures including (but not limited to);

- Transformer installation;
- Solar canopies;
- Signage; and
- Earth works.

In such instances, and depending on the proposal, councils may consider such works part of the EV charging station or separate to the EV charging station. If the construction of buildings or construction or carrying out of works are deemed to be separate, these may require a planning permit generated by specific planning scheme overlay controls.

Such triggers may be through -

- zones including (but not limited to):
  - commercial zones (and schedules);
  - residential zones; as well as,
  - other buildings and works provisions such as ‘setbacks from Road Zone Category 1’.
- overlays including a range of building and works triggers contained within:
  - Design and Development Overlays;
  - Environmental Significance Overlays;
  - Significant Landscape Overlays;
  - Restructure Overlays;
  - Flooding Overlays; and,
  - Erosion Management Overlays

In these circumstances, the Planning Scheme will need to be reviewed for each particular proposal and discussed with the relevant council at the time to determine appropriate requirements.

Signage is another specific requirement set out at Clause 52.05 of the relevant municipal planning scheme. The zoning of the land specifies the category of signage control applicable.

In some circumstances directional or (business) identification signage may trigger the need for a planning permit, however this will need to be considered at the time of a proposal. Signage controls are more restrictive in areas of high amenity areas (e.g. residential) compared with commercial and industrial areas.
Signage is not anticipated to be a headline issue in relation to the establishment and operation of EV charging stations.

8.2. Overall discussion of Planning Provisions and barriers and opportunities.

8.2.1.1. Gippsland Planning Scheme Barriers

The investigations and analysis undertaken suggests that there are a number of barriers which may hamper the establishment of a range of EV charging stations within Gippsland. The most significant are considered to be:

1. The potential requirement for planning approval to be obtained by private operators seeking to establish a stand-alone facility (i.e. establishing EV charging infrastructure which is not associated with another use, is of a notable scale and is on private land). This raises issues such as:
   a. How is the use characterised?
   b. Is a planning permit required?
   c. What are the key considerations which determine such uses requiring planning permits?
   d. What type of locations do Council consider appropriate for such uses?
   e. What impacts would such a use likely to have on its locality and surrounds?

2. The potential requirement for planning approval given the lack of clarity around how different councils may characterise such uses and the uncertainty this provides for private investors seeking to establish EV charging infrastructure.

Partially related to the barriers identified above, the review undertaken has not identified any specific policy direction by any of the Gippsland councils which supports the establishment of EV charging infrastructure or provides guidance on appropriate locations, outcomes sought, design detail and safety considerations having regard to proposed locations etc. It is noted that the planning policy framework and local planning policy framework of all six Gippsland council planning schemes are ‘silent’ when it comes to policy regarding facilitating, encouraging or providing any direction regarding consideration of planning permits for EV charging stations and infrastructure.

8.2.1.2. Gippsland Planning Scheme Opportunities

Notwithstanding the barriers previously outlined, there are opportunities available within the present suite of planning scheme controls to encourage and facilitate EV charging stations.

At this point in time, we have considered how these facilities are likely to be located and used at present and in the near future. Initially, it is considered that in the vast majority of cases that EV charging stations will (and should) be developed and used in association with (ancillary to) other uses. For example, they may be located within or adjacent to public car parking areas or community facilities, or included in shopping centres, service stations and within accommodation facilities (motels/caravan parks etc.).

Assuming this is the case, EV charging stations co-located with another use are not considered likely to require a planning permit. In most cases for their ‘use’ would provide an ancillary component to a parent ‘use’. This is the approach that has been occurring to date across Victoria with other councils leading the industry i.e. Moreland City Council. Further the ‘construction of buildings or construction or carrying out of works’ would also be unlikely to require a planning permit, exempt under the provisions of Clause 62.02-2 of the planning scheme.

In the future, as the industry establishes, it is anticipated that EV charging stations will seek to establish as a standalone ‘use’ in their own right.

There is an identified opportunity to address the barrier of policy silence and lack of planning scheme direction for EV charging stations. This may stimulate private investment in such infrastructure.

We consider that the most prudent way for Gippsland councils to stimulate investment (through the planning scheme) and encourage growth, whilst providing direction having regard to EV charging stations, is to introduce local planning policy statements into their respective planning schemes.

These objectives and local policy should seek to provide direction, support and locational/ design/functional layout guidance for such infrastructure. It may also include signage guidance.

Depending on the approach taken there are a number of opportunities for modification to the planning scheme which is outlined below (Figure 2). The areas with shading are clauses that could be targeted by Councils to improve policy direction and provide guidance to guide EV charging station installations.

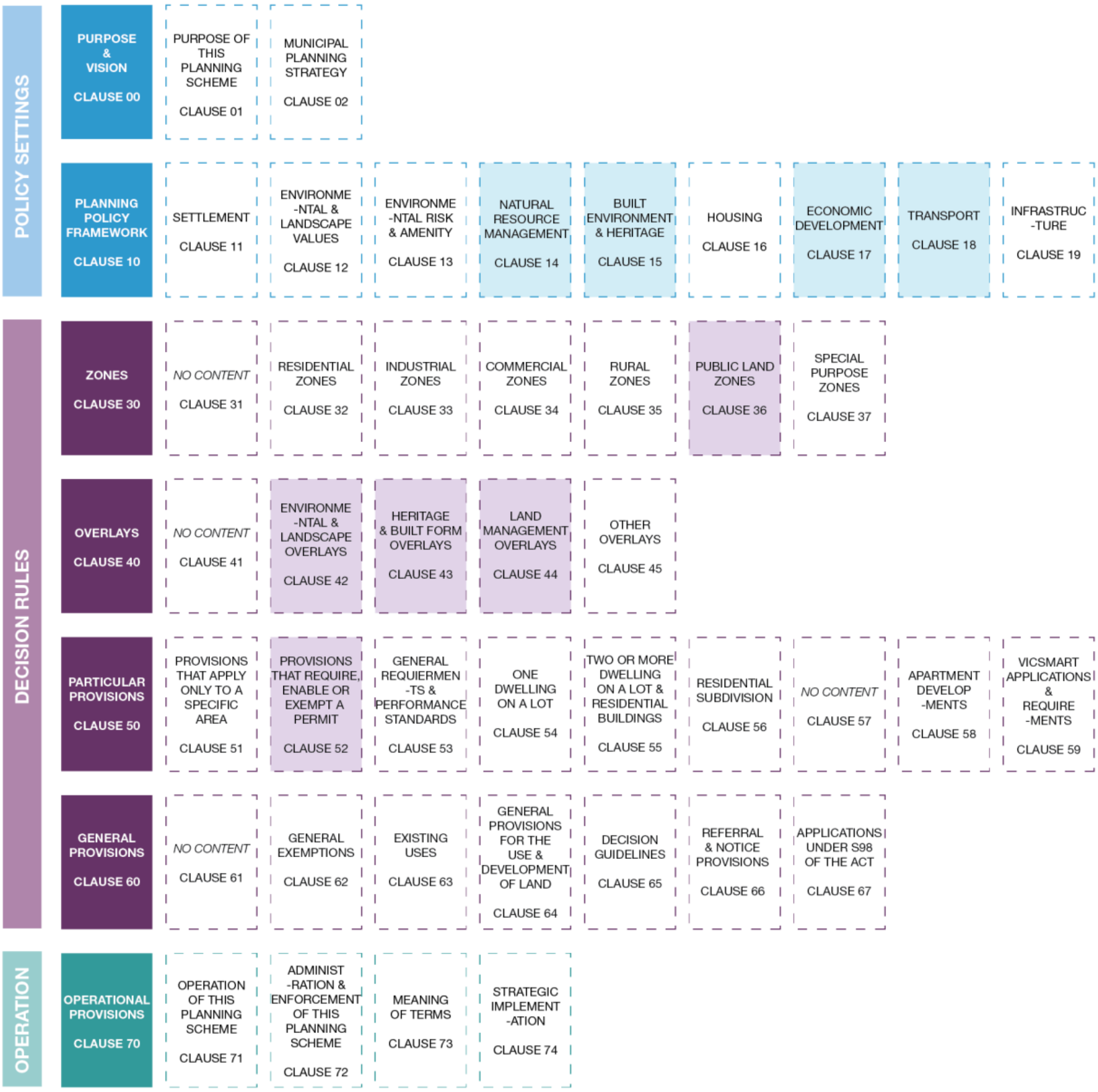


Figure 2: Modified version of Planning Scheme structure to highlight possible areas for improved planning policy input

Regardless of the agreed approach it is considered that there should be a consistent approach taken by each Council, tailoring particular guidance to their specific values/requirements.

Tied to this, it may also be prudent for councils to review other corporate policy/vision documents to identify other areas where support/guidance could be identified. For example, it may be that a council may wish to take a coordinated approach to such infrastructure with a joint partner, establishing such facilities on council owned land (i.e. community facilities, council-owned car parks, etc.).

We are aware that the City of Moreland, leaders in this field, have worked to establish their EV charging infrastructure on council-owned land and associated with other community facilities, negating the need for planning approval.

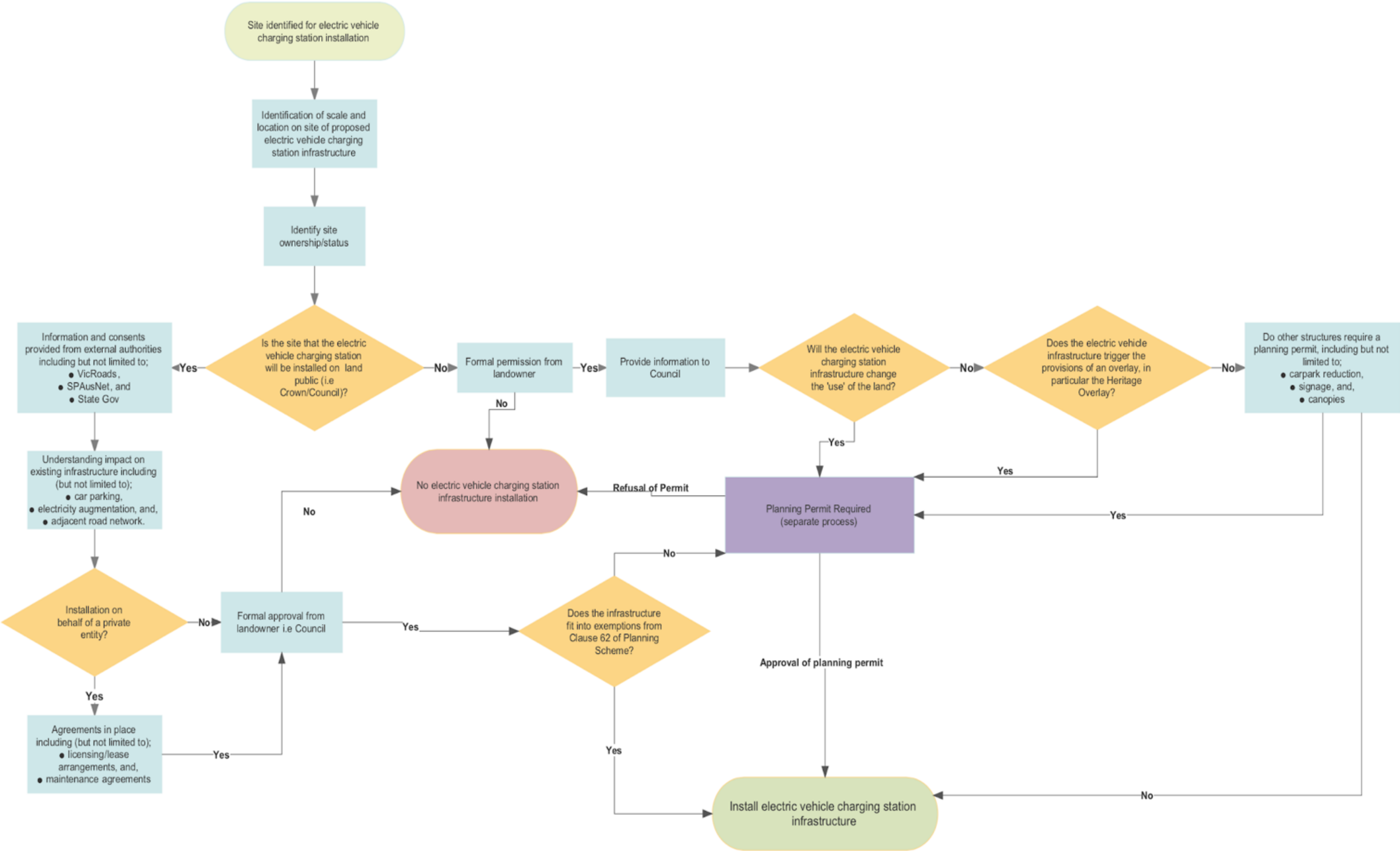
Alternatively, if councils sought to instigate the implementation of this type of infrastructure on council-owned land, there may be less need for a local planning policy to direct and support private investment of this nature. Instead, there may be a greater need/opportunity to produce an infrastructure delivery paper. Such a document may clearly set out each council's intent to deliver the EV infrastructure needs in a coordinated approach, on identified council-owned sites.

8.3. Other Infrastructure Related Approvals

Project workshops were held with partner councils; Latrobe City and South Gippsland Shire to workshop considerations for approval as part of the research and analysis for this project. These approval processes were generally considered separate to planning permit approval processes. As has previously been stated, processes and procedures within councils can vary however, the approvals process for electric vehicle charge station (EVCS) infrastructure installation can cross a range of disciplines and departments of council, including:

- Land use planning;
- Asset management;
- Infrastructure delivery;
- Environment sustainability; and,
- Local laws regulation.

As a result of these workshops and further investigation of various approval processes, the following 'flow-chart' has been produced to articulate the various considerations and process for approval.



Electric vehicle charging station infrastructure approvals process/considerations (guide only)

In undertaking consideration of various approvals processes, it has been identified that the most straight forward approval would result in charging station delivery on private property. However, this does not factor in the possible need for planning approval which is discussed in detail at Section 6 of this report.

It was acknowledged that through the process review that locating infrastructure on Council-owned land is likely to provide Council with a greater level of control regarding the location and associated impacts on the surrounds (i.e. traffic/car parking issues etc.). Councils are also likely to have greater input into the type and requirement for maintenance and upgrades of this type of infrastructure.

In terms of assessing installation proposals on Council/Public land there are a range of considerations that assist officers in undertaking assessments internally, including (but not limited to);

- Location of installation;

- Scale/Size and type of EVCS infrastructure;

- Land Status/Ownership;

- Permissions that have been granted, including,
    - Licensing agreements/ lease arrangements for land,
    - Insurance arrangements,
    - Ongoing maintenance and management of infrastructure
    - Permits for works within roadways or on Council infrastructure;

- Consent by other authorities that have through their own approvals processes, including:
    - VicRoads (road authority),
    - SP AusNet or other electricity/grid providers,
    - State government agencies where the public land is managed/owned i.e. VicTrack or Department of Environment, Land, Water and Planning (DELWP) or land for which has a Committee of Management in place.

- Other considerations including:
    - Configuration of EVCS and associated cords to avoid tripping hazards;
    - Bollards to protect infrastructure from being damaged; and,
    - Vandalism concerns.

As part of the workshops several examples were used and worked through to understand the approvals process. The examples, although theoretical, highlighted the complexity of the decision-making process and the need for proposals to be well developed. At the time of enquiry a range of information should be provided which includes, location, typology and installation methods.

In terms of processing and providing approvals for infrastructure it was evident that clear policy direction is needed to be provided by each organisation. The policies or strategic plans should consider:

- Whether or not EV charging station infrastructure should be encouraged on Council or Crown land;

- Policies for location, and ‘local laws’ for the management of car-parking; and

- Requirements in terms of leasing arrangements and access by private entities (if deemed required) for Council/Public Land

Clear direction for officers of Council in terms of installation of EVCS infrastructure will provide clarity twofold:

- For internal officers that provide input into decisions or inform key decision makers; and

- Clarity for private entities about expectations for location, siting and operation of EVCS infrastructure on public land.

Without clear council policy direction, the barriers to approval increase dramatically. This is likely to directly impact on the take-up and installation of EVCS infrastructure.

8.4. NRMA Case Study

NRMA has dealt with many councils as part of their statewide rollout of fast chargers in NSW. In interviews discussing their experience in relation to obtaining local government approvals, they provided the following insights relevant to this project:

- There is no knowledge or understanding in most councils - no one knows where to start.
- There is a wide divergence of levels of enthusiasm and participation.
- Level 2 chargers are not nearly as problematic as level 3.
- Most councils got stuck on issues around Development Approval (DA) requirements. Some required DA if the infrastructure was more than 2 meters in height.
- Many Councils did not know if they had to consult the community or not.
- In NSW there was a planning instrument called a SEPP which had a provision to exclude EV charging - that helped a lot.
- A key hope is that there would be some harmonisation of processes.
- When they evaluated sites they would usually apply to 3-4 locations.
- The biggest delays were often network related.
- Night security was a significant consideration for their drivers.
- They would ultimately look for local installers.
- There is community interest in how much the council is contributing to the project.
- Activation was a big driver for councils - need to make it part of economic development plans, community development plans and as a way to drive tourism.
- The best outcome is where there is delegated decision making authority to council officers, such as planning, traffic or engineering.
- It's better building on council owned land, not community land or crown land (which could need ministerial approval for change of use).
- Power sharing on sites is always a big issue - particularly on private sites.
- Councils are often interested in data - how much it is being used, dwell times etc. - to sell back into the community.
- Other issues - vandalism - what happens if they get tagged or damaged? Assurance is needed that someone will come out quickly, and that an agreed timeline is in place.
- Shoalhaven is trying to create an EV policy around how they deal with unsolicited proposals. They are looking at doing rounds of EOIs. They are trying to identify locations and then do EOIs when they feel it is appropriate to do it.
- Very high commuter towns or towns with high tourist traffic will have to come up with policy for a potential influx of providers.
- 3-4 configurations of charging installations that work for most people in the market. NRMA use charger cable 100mm longer than standard to improve ergonomics.
- Do not underestimate aesthetics - people like things that look attractive.
- Most of the agreements are captured in a site license agreement - which covers everything from leasing terms to decommissioning of the site. These contracts do provision for “Make-good”.