ARUP

South West Group

SWG Electric Vehicle Infrastructure Charging Network Plan

Final Plan

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Arup Australia Pty Ltd ABN 76 625 912 665

Arup Australia Pty Ltd
Level 14 Exchange Tower
2 The Esplanade
Perth
WA 6000
Australia
arup.com

ARUP

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		Name	Jason Hoad Franziska Korte	Daniel Beresford	Ben Haddock
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		Name	Jason Hoad Daniel Beresford	Darryl Patterson	Ben Haddock
		Signature			
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		Name	Jason Hoad	Ben Haddock	Darryl Patterson
		Signature			

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Contents

Executive Summary

Purpose

Arup has been appointed by the South West Group (SWG) to develop the SWG Electric Vehicle Infrastructure Charging Network Plan (the plan). The plan has been developed through an extensive review of available literature and interviews with industry leaders, alongside stakeholder engagement with representatives from each member council and the SWG.

The purpose of this plan is to provide a robust set of guidelines and policy advice, which will enable the rollout of context appropriate and well-planned EV charging infrastructure across the member councils, through the provision of:

- An overview of the existing context of EV technology, charging behaviour and rollout
- An articulation the role of member councils in the deployment, control and management of EV infrastructure and ability to influence uptake
- The direction of current and planned spatial spread of EV charging across the SWG
- An assessment framework that could be used to test the feasibility of proposed EV charging infrastructure within council areas, including a worked example on its use.

By providing the planned spread of EV charging in a spatial format, the plan can be used by member councils to match locations within their jurisdiction with charging infrastructure, alongside an assessment framework to assist in assessing its appropriateness.

Spatial plan

The plan takes the SWG's existing and identified centres and land uses to define a series of service layers for the provision of public EV charging infrastructure on a hierarchy of activity from Activity Centres (Service Layer 1) through to Industrial areas (Service Layer 5).

The charging requirements for each service layer aligns with six charging typologies that have been adopted for the plan – home charging, workplace charging, on-street charging, destination charging, on-route charging and hub charging.

Each charging typology assists in providing a high-level overview of the anticipated charging requirements, grid impacts, future intervention/ opportunities to pursue and potential of resultant local economic growth.

Home charging

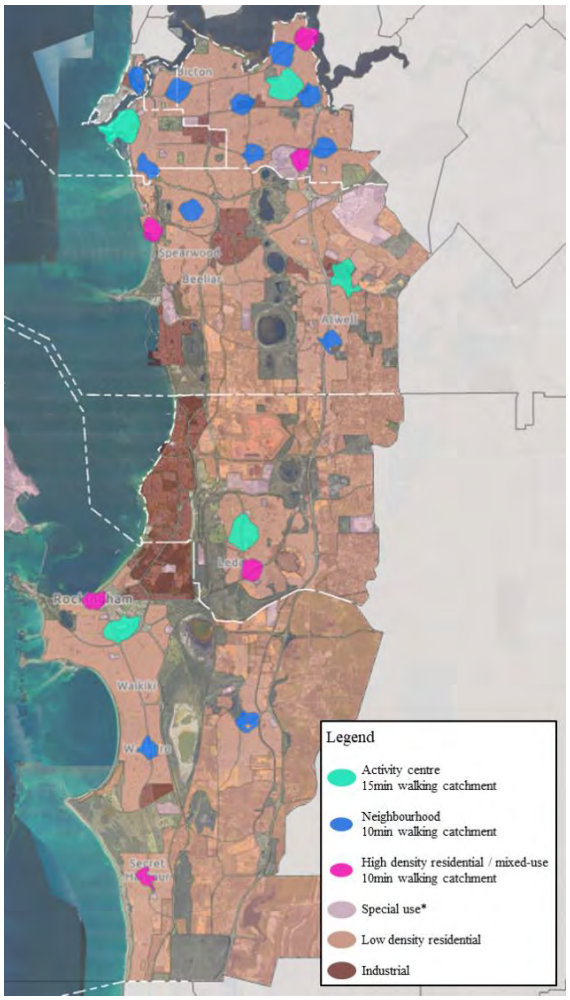
Workplace charging

On-street charging

Destination charging

On-route charging

Charging hub



Assessment framework

The SWG Charging Infrastructure Assessment Framework will help member councils in scoring potential interventions, while also outlining the needs that the network should address to deliver the vision. The performance indicators of the framework, to which interventions are scored, align with the network principles and project objectives developed through close engagement with the SWG. In application, interventions that are shown to lead to positive impacts against each desired objective and satisfy the assessment criteria should be progressed for further investigation.

Objectives	***Sustainable***	***Convenient and consistent***	***Future-ready technology***	***Fair and equitable***	***Leverages partnerships***
Network principles	The network embraces renewables and circular economies to mitigate impacts on the grid, community and environment.	The network is reliable, legible and simple for a diverse user-base, while maximising interoperability and consistency.	The network is futureproofed, encourages innovation, and trials emerging technologies.	Ownership and responsibility of infrastructure is clear and for the public, spreading benefits across the local community and economy.	Collaboration and partnerships are encouraged, through delivery, education and incentives.

Introduction

Purpose

Arup has been appointed by the South West Group (SWG) to develop the SWG Electric Vehicle Infrastructure Charging Network Plan (the plan). The purpose of this plan is to provide a robust set of guidelines and policy advice which will enable the rollout of context appropriate and well-planned EV charging infrastructure across the member councils. The plan will:

- Research, survey and audit the current and planned spread of EV charging across the SWG area in an integrated manner
- Articulate a vision and objective for EV charging across the SWG area
- Identify service layers linked to land use and demand for EV charging across the SWG area
- Outline partnership opportunities and commercial models for EV charging
- Develop an assessment framework to work through future EV charging opportunities for local governments
- Outline the potential role of local government in increasing EV uptake across the SWG area.

The plan has been developed through an extensive literature review alongside stakeholder engagement with representatives from each member council and the SWG.

How to use the plan

The plan is broken down into six sections as outlined below

#	Section name	Description
1	***Existing context***	An overview of the existing policy, infrastructure networks, stakeholder perspectives and an assessment of future demand.
2	***Vision and objectives***	Detail of the articulated vision for the plan, and the agreed objectives.
3	***The role of local government***	Summary of local government's role in the deployment, control and management of EV infrastructure, and ability to influence EV uptake.
4	***Spatial plans***	Spatial planning of the proposed EV charging deployment across the SWG.
5	***Partnerships and models of governance***	An overview of partnership opportunities and models of governance for public EV charging infrastructure.
6	***Assessment framework***	Detail of the assessment framework to be utilised for the assessment of proposed EV charging infrastructure, including a worked example on the use of the assessment framework.

1. Existing context

A review of existing national policy, current technology and international leading practice has been undertaken in order to build a technological baseline and get an idea of the policy and planning directions other jurisdictions are taking to support EVs. To assess where the SWG sits in comparison to other jurisdictions, a review of the existing energy supply, EV charging network, stakeholder perspectives and potential demand has been undertaken. These themes and key outcomes have been explored below.

1.1 Policy

1.1.1 Australian context

There are highly variable approaches across Australia, with State jurisdictions at different points of EV-Readiness and maturity. There is a lack of alignment nationally, with strategies generally lead by State Governments dependent on their relevant contexts

1.1.2 State policy

The *Western Australian (WA) Government's State Electric Vehicle Strategy for Western Australia*[1], released in 2020, seeks to facilitate the electrification of transport to deliver positive sustainability outcomes and support economic growth.

This strategy outlines the WA Government's committed to including a requirement for the provision of EV charging infrastructure in new public building capital works projects to ensure EV readiness. These include government office accommodation, hospitals, schools, TAFE colleges, sports facilities, and a range of other building types.

The WA Government has also committed to supporting amendments to the National Construction Code (envisaged to be updated and released in September 2022) to include a requirement that new buildings are EV-Ready. This amendment would contemplate electrical infrastructure to support the installation of EV charging equipment. It would also consider updating planning guidelines to encourage new residential buildings, precincts and parking structures which are designed to incorporate infrastructure that supports emerging technology including EV charging.

Renewable energy

The State Government's *Whole of System Plan*[2], under all forecast scenarios, renewable energy will provide at least 70% of the state's power by 2040. The WA government's Climate Change Policy dictates that the state will achieve net-zero carbon emissions by 2050[3].

[1] https://www.wa.gov.au/system/files/2020-11/State_Electric_Vehicle_Strategy_for_Western_Australia_0.pdf

[2] https://www.brighterenergyfuture.wa.gov.au/whole-of-system-plan/

[3] https://www.wa.gov.au/service/environment/environment-information-services/low-carbon-transition

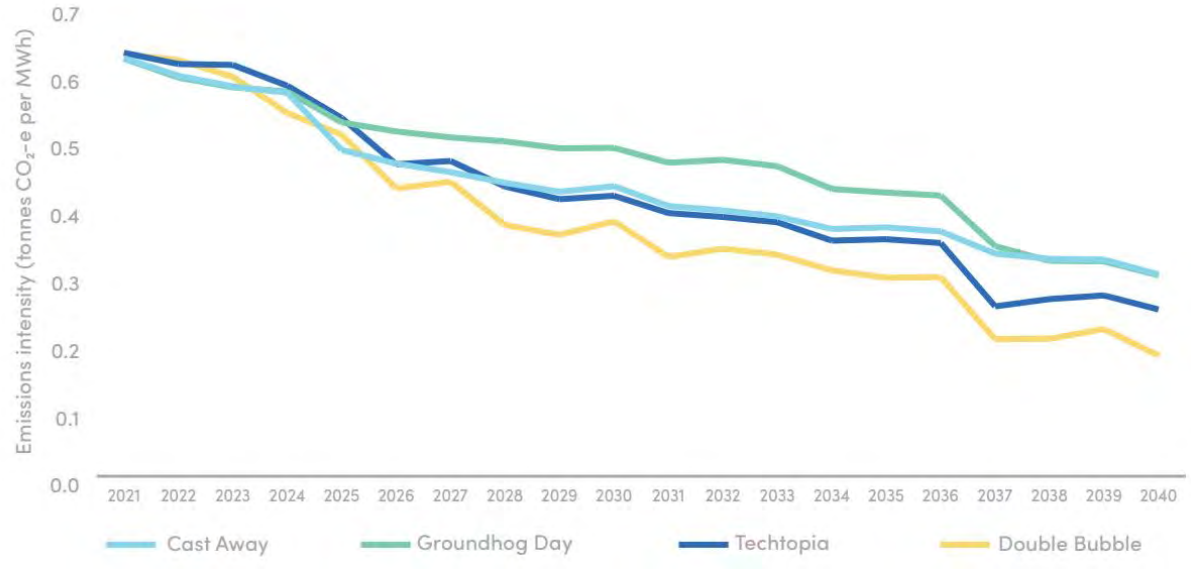


Figure 1 – Forecast annual emissions intensity to meet end-user demand across four assessed scenarios, tonnes CO2 -e per MWh (source: *WA Whole of System Plan*)

1.1.3 SWG Council Policy review

To help understand the existing context from a local government policy perspective, a review of existing policies, guidelines, plans and strategies from the SWG member councils was conducted. This review identified common key themes across these documents, as summarised in Table 1 below.

Table 1 – SWG council policy document review summary

Council	WALGA renewable PPA	Document name	Themes covered						
			GHG emission targets	Renewables targets	EV fleet target	EV procurement	EV infrastructure targets	Specific EV use cases	Car park design for EVs
City of Cockburn	✓	Climate Change Strategy 2020–2030	✓	✓			✓	✓	
		Integrated Transport Strategy							
City of Fremantle	✓	Corporate Energy Plan 2017		✓		✓	✓		✓
		Integrated Transport Strategy							✓
		One Planet Framework	✓	✓					
		Draft Electric Vehicle Parking and Charging Policy							✓
City of Kwinana	✓	Climate Change Plan 2021-2026	✓			✓	✓		
City of Melville	✓	Corporate Environmental Strategic Plan 2016 - 2025						✓	
		Additional information from Council	✓			✓			
City of Rockingham	✓	Community Plan Strategy - Rockingham Strategic Metropolitan Centre Public Parking							
		Sustainability Strategy February 2020	✓				✓		
Town of East Fremantle	✓	Climate Emergency Strategy Strategic Objectives			✓				
		Climate Action Strategy 2022-2032	✓	✓		✓		✓	
		Integrated Transport Strategy							

The key findings from the policy review were:

- All councils mention EVs in varying extents and most of them include high-level EV infrastructure considerations in their strategic documents

- Only one council includes a specific target to achieve 100% emission reduction of their fleet
- The majority don't have specific targets for EV uptake in their fleets or rollout of corresponding infrastructure
- Councils have started thinking about EV procurement and some have identified specific use cases for EVs (e.g., waste trucks).

1.2 Charging technology

EV charging infrastructure can be categorised by levels, modes and types. The following section explores the existing components of EV charging infrastructure. Due to the number of different types of charging infrastructure and plugs, the rollout of infrastructure should be technology-agnostic, to refrain from precluding some EV users from using infrastructure due to the make of their vehicle.

1.2.1 Charging levels

'Level' refers to the voltage and the power of the charging system. The higher the voltage, the higher the power output and the quicker an EV will charge. There are three different levels offered by today's technology:

- **Level 1 Chargers** are typically used in standalone domestic homes to 'top up' daily use of EVs. They are existing power points (10-15A, single phase), used in combination with a special cable which connects from the vehicles to the wall. This method will add between 10-20km of range per hour when charging. Level 1 chargers are not commonly used with the goal of fully recharging an EV overnight.
- **Level 2 Chargers** are dedicated AC EV chargers up to 7kW (32A single phase) or 21kW (three-phase). These are typically installed in homes, apartment complexes, shopping centres and other locations where vehicles will be parked for a long period of time. This method will add up to 40km of range per hour and will deliver a full recharge overnight.
- **Level 3 Chargers** are fast and ultra-fast DC chargers, which have power levels from 25kW to 350kW (40-500 Amp, three phase). These are typically commercial chargers, which provide fast charging services, and are commonly found along major highways, shopping complexes and charging hubs. At the lower end, this method will add up to 150km/h to fully charged vehicles in 10-15mins.

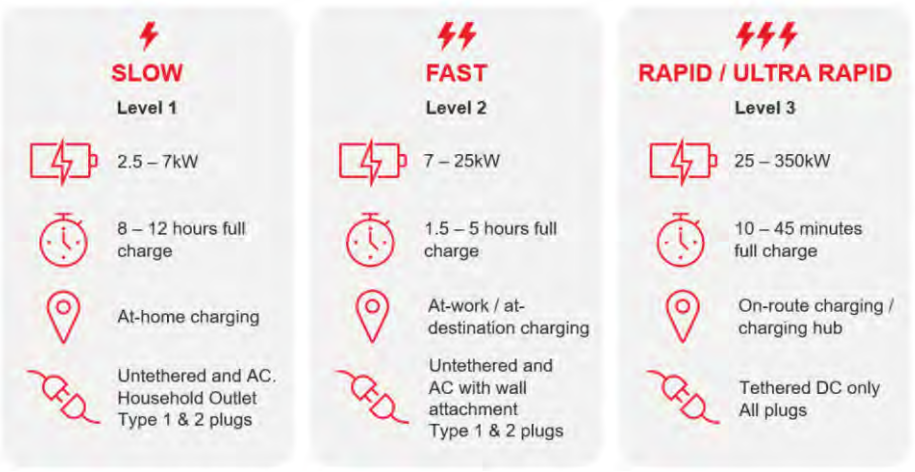


Figure 2 – EV charging levels

1.2.2 Charging modes

'Mode' refers to the electronic communication between the vehicle and the power source. Therefore, the mode determines the extent to which the charger can determine the percentage of charge, governed by four different modes. The purpose of this is to avoid overcharging and ensure batteries are charged in a safe and sustainable manner.

- **Mode 1 Chargers** are standard wall outlet to vehicle connections. These are found most commonly in residential homes and associated with Level 1 chargers. These cables have no communication capabilities between the power source and EV. Mode 1 chargers are no longer used in Europe due to advancements in technology and potential safety risks.
- **Mode 2 Chargers** are also standard wall outlet to vehicle connections found in residential homes, however attached to the cable is AC EV supply equipment. These are commonly used in domestic Level 1 chargers and support capabilities with simple and smart chargers (discussed further in Section 4.2.2)
- **Mode 3 Chargers** are power supplies which are permanently connected to the electricity network. This includes wall boxes, commercial charging points and all automatic charging systems in AC and utilise the onboard charger to convert from AC to DC. Mode 3 chargers are typically associated with Level 2 charging.
- **Mode 4 Chargers** supply direct DC power to the EV battery. This charging mode requires a current converter external to the vehicle. The delivery of DC current directly to the batter is much faster and therefore are often called rapid or super chargers. Mode 4 chargers are typically associated with Level 3 charging.

1.2.3 Charging types

'Type' refers to the model of plug associated with the charging cable and the vehicle inlet. There are two main plug types which are commonly used across different EV models and manufacturers. As well as specialty plugs which are either special to manufacturers (e.g. Tesla) or have special uses (e.g. CHAdeMO), as summarised below and shown in Figure 3.

- ***Type 1 plugs*** are single-phase plugs that allow for a charging power level of up to 7.4kW. These are typically used in residential charging settings and are also known as J1772 plugs. Type 1 plugs are typically associated with Level 1 charging.
- ***Type 2 plugs*** are single-phase plugs with three-phase capabilities. When used in private bays, they have charging power levels of up to 22kW. In public charging stations, Type 2 plugs can have power levels of up to 43kW. Most public charging stations are equipped with Type 2 sockets, however EVs can typically be charged by a Type 1 and 2 plugs. Type 2 plugs are typically associated with both Level 1 and 2 charging.
- ***Tesla superchargers*** are bespoke modified Type 2 plugs which can only be used by Tesla vehicles. By using two of the plug's pins for DC charging, Tesla plugs are able to deliver significantly more power than standard Type 2 plugs of up to 120kW.
- ***CHAdeMO*** are plugs used at DC charging stations which can be installed as a second socket by vehicle manufactures next to the AC charging socket on the EV. These plugs are typically associated with Level 3 charging, delivering high power of over 50kW.
- ***Combined Charging system (CCS) Combo 1 and 2*** are based on Type 1 and 2 plugs by adding two additional pins at the base. CCS's are made for DC fast charging. However, the connectors can be used for both AC and DC charging up to 350kW. Similar to CHAdeMO plugs, CCS plugs are typically associated with Level 3 charging.

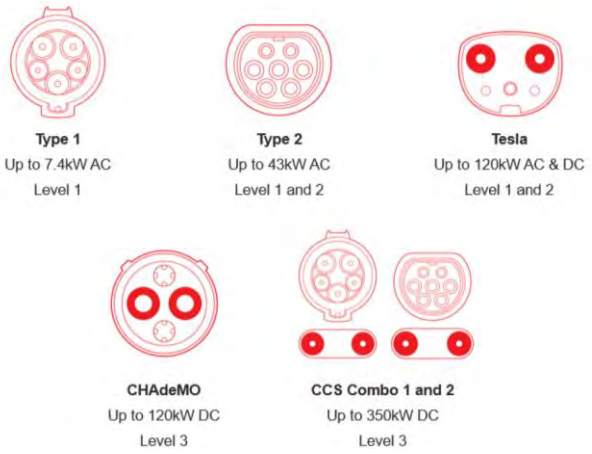


Figure 3 – EC charging plug types

1.3 Statutory planning – leading practice

Leading jurisdictions have been considering the impacts and trends of EV uptake over the last few decades. By tailoring policies, incentives and regulations, global leaders have streamlined their uptake in EVs, while minimising downstream costs and increasing charging convenience. Consistent across geographies is the need to set clear targets for EV uptake over the coming years. Leaders have responded to EV targets by introducing incentives for EV purchasing in parallel with strict and ambitious regulation for charging infrastructure within buildings and in the public domain. Particularly for buildings, setting clear requirements for EV-Readiness provisions, sets the minimum compliance for developers to make their buildings accessible for EVs. Minimum compliance is an influential tool, as it sets a baseline and ensures provision, catching developers who are less inclined to provide infrastructure for EVs. Regulating provisions during the design phase and before construction, allows for a more affordable approach from the outset, while avoiding retrofit costs, reducing market failures and further costs down the line.

1.3.1 International Leading Practice Examples

Global leaders in EV-Readiness are complemented by clear guidelines and standards on national or wider, regional levels. Norway is largely regarded as the global leader in EV uptake since the emergence of the technology, however its new building regulations are not as strict as some measures coming out of the United States (US) and the United Kingdom (UK). The international standard for EV-Readiness, in reference to an individual car parking bay, follows the three definitions of EV-Readiness: ‘EV-Capable’, ‘EV-Ready’ and ‘EV-Installed’ as outlined below.

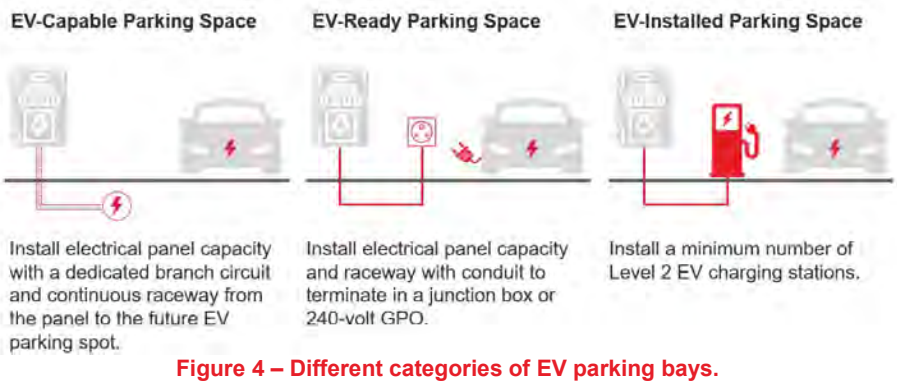


Figure 4 – Different categories of EV parking bays.

Norway

Norway has been one of the most successful countries in achieving market penetration and market share for EVs globally, with incentives for EV uptake dating back to the mid-1990s. Norway have mandated that all new buildings must ensure the availability of EV charging infrastructure, while releasing first of its kind

standards for grid capacity, ensuring the grid to be designed to charge 100% of carparking bays at 3.6kW without the need for smart charging.

New Zealand

Since 2017, Waka Kotahi NZ Transport Agency has been enabling a nationwide network of public charging infrastructure, with the vision of providing public charging facilities available every 75kms along the state highway network. The requirements of these charges must be a minimum mode 3 or 4 charger that are designed and intended for use by the general public. As of 2021, 97% of the network had been rolled out.

Additionally, Waka Kotahi have undertaken comprehensive planning as part of the 2016 Electric Vehicle Uptake Package, releasing the following cross-government work program and set of incentives:

- National guidance for public EV charging infrastructure – a guidance package coordinated with local and central government agencies, power distributors, technology providers and vehicle manufacturers.

United Kingdom

On a national level, the UK have announced new legislation to mandate the installation and readiness for EV charging stations in supermarkets and workplaces, including those undergoing major renovation, where over 10 parking bays are provided. Up to 145,000 charging stations have been projected to be installed in the UK each year due to the legislation, ensuring that while the majority of charging will happen at home, EV users will still have the option and piece of mind that they can charge their EV at new shops and workplaces across the country.

The Department of Transport have also investigated changes to building regulations regarding EV charge points in residential and commercial buildings. Regulations have recommended the following changes:

- New residential developments should have a charge point for each dwelling with a dedicated parking bay.
- Residential buildings with 10 or more parking bays undergoing major renovation works should have cable routes for an EV charge point in every bay.
- For commercial buildings and those undergoing major renovation with more than 10 parking bays, a charge point and cable route shall be provided for at least five bays.
- Existing commercial buildings with more than 20 parking bays should be required to have a minimum of one EV charger.

The 2016 London Plan required new residential developments to provide 20% of bays with active charging facilities (EV-Ready) and 20% of remaining bays to be provided with passive charging facilities (EV-Capable), new retail developments to provide 10% of bays EV-Ready and 10% of remaining bays EV-Capable, and new office parking to provide 20% of bays EV-Ready and 10% of remaining bays EV-Capable. In the 2021 update of *The London Plan,* EV-Readiness of residential developments have been updated to ensure 20% of bays are EV-Ready and all remaining bays are to be EV-Capable[6].

United States

Until recently, the US approach to EV uptake and charging has been on a state-by-state basis, similar to Australia.

California has led the way on the state level, setting viable policies that have been used as a model for national implementation across the country. Since the 1990s, the Californian EV policy context has expanded, with jurisdictions now focussing on amendments to relevant building codes to mandate the inclusion of charging infrastructure within buildings. In 2015, the Californian Building Code required all new developments to provide EV-Capable charging infrastructure.

On a city level, in 2018 San Francisco has required all new developments and major renovations to provide 100% of bays with Level 2 EV-Ready charging infrastructure. The requirement also allowed for developers to substitute five Level 2 EV-Ready chargers for one DC rapid charging station. These requirements are informed by a position that EV infrastructure provided during construction is the most cost-effective delivery model. This requirement has been enforced through the San Francisco Board of Supervisors' Green Building

and Environment Codes (2018). These codes recognise that San Francisco is particularly vulnerable to climate change and that EV uptake could benefit the health, welfare, and resilience for San Francisco's residents. provided and distinction between building types.

1.3.2 International provision of EV charging infrastructure

The provision of EV infrastructure relates to the proportion of total parking bays required within a building to allow the easy future installation of charging infrastructure. This includes the proportion of parking bays, the category of EV-Readiness provided and distinction between building types. A summary of the relevant requirements for EV-Ready Buildings across multiple international jurisdictions' building codes is supplied in Table 2.

Table 2 – Provision of EV infrastructure global minimum standards

Jurisdiction	Source	Detached dwelling	Apartment	Office	Destination
International	International Green Construction Code, 2021	N/A	20% EV-Ready (>10 bays)	4% EV-Ready (>20 bays) 8% EV-Ready staff parking (>20 bays)	4% EV-Ready (>20 bays) 8% EV-Ready staff parking (>20 bays)
European Union	Energy Performance of Buildings Directive, 2020	N/A	100% EV-Capable (>10 bays)	20% EV-Capable, 1 EV-Installed (>10 bays)	20% EV-Capable, 1 EV-Installed (>10 bays)
United States					
California	CALGreen, 2020	N/A	10-20% EV-Capable	6-10% EV-Capable	6-10% EV-Capable
San Francisco, CA	Green Building Code, 2018	N/A	100% EV-Ready*		
San Jose, CA	CALGreen, 2020	1 EV-Ready bay	10% EV-Installed, 20% EV-Ready, 70% EV-Capable	10% EV-Installed, 40% EV-Capable	N/A
Denver, CO	IECC and IRC (amendment), 2018	1 EV-Ready bay	5% EV-Installed, 15% EV-Ready, 80% EV-Capable*	5% EV-Installed, 10% EV-Ready, 10% EV-Capable*	N/A
Winter Park, FL	Land Development Code and Building Code, 2021	N/A	N/A	10% EV-Ready, 1 EV-Installed per 20 bays	
Washington D.C.	Green Building Ordinance, 2021	N/A	20% EV-Ready (>3 bays)		N/A
New York City, NY	New York City Building Code, 2013	N/A	20% EV-Capable		
Atlanta, GA	National Electrical Code (ordinance 17-0-1654), 2017	1 EV-Ready bay	20% EV-Capable		N/A
Canada					
Vancouver, BC	Building Code Bylaw 10908, 2019	1 EV-Ready bay	100% EV-Ready	10% EV-Ready	N/A
United Kingdom					

London	The London Plan, 2021	N/A	20% EV-Ready, remaining EV-Capable	10% EV-Ready, 10% EV-Capable**	
China					
Beijing	Beijing Municipal Government, 2017	N/A	100% EV-Capable	25% EV-Ready	25% EV-Ready (public buildings)
Guangzhou	People's Government of Guangdong Province, 2018	N/A	100% EV-Capable	30% EV-Capable	50% EV-Capable (service stations)
Europe					
Oslo, NO	EVSE Building Regulation, 2017	N/A	50% EV-Ready		
Other					
India	EVSE Building Code, 2019	N/A	20% EV-Ready		
*Developers can substitute 5 Level 2 EV-Installed/ Ready/ Capable bays with 1 DC rapid charging station (voluntary) **DC rapid charging stations to be provided on a case-by-case basis (voluntary)					

It should be noted that the provision of EV charging infrastructure laid out below is a reflection of mandated minimum standards for new buildings only, on both a national and city scale. Examples of voluntary guidance has also been provided, stepping out instances where developers can voluntarily go above and beyond the minimum standard presented by the building code (San Francisco, Denver and London).

1.3.3 National Leading Practice Examples

There are highly variable approaches across Australia, with each state generally at different points of EV-Readiness and maturity. There is a lack of alignment nationally, with strategies generally led by State Governments depending on their own relevant contexts.

Western Australia (WA) is committed to including a requirement for the provision of EV charging infrastructure in new public buildings to ensure EV readiness. These include government offices, hospitals, schools, TAFE colleges, sports facilities, and a range of other building types.

Given that over 80% of EV users charge their vehicle at home and that local governments are responsible for approving building developments, there is an opportunity for local governments to promote EV-Ready buildings by updating Development Control Plans to allow for simple and affordable installation of EV charging infrastructure in the future[4].

- The **Hornsby Council (NSW)** Electric Vehicle Charging Stations on Public Land Policy (2020)[5] is one of the first of its kind in Australia. It covers areas such as fair and equitable selection of providers, site selection criteria, charging station design considerations, parking configurations, charging technology and leasing arrangements. The policy is aimed at providing EV charging infrastructure for residents who don't have access to off-street parking for home charging; increasing visitation to town centres and retail hubs to improve economic development and tourism; and alleviating range anxiety.
- **Yarra City Council's (VIC)** EV readiness standards for new developments is a publicly available EV fact sheet. Rather than a planning scheme policy, the EV fact sheet covers the benefits for making new developments EV-Ready and the essential underlying electrical infrastructure required for EV readiness. It highlights evolving technology and opportunities in relation to EVs for new developments so that developers consider how buildings will need to adapt over their lifespan, including new technology such

[4] https://electricvehiclecouncil.com.au/wp-content/uploads/2020/12/EVC-Local-Government-Resource-Pack.pdf

[5] https://hscenquiry.hornsby.nsw.gov.au/temp/001_00DX_0K5X0QD02LAZ_CYZIGWJO.PDF

as V2G and V2B/H (vehicle-to-building/home), or new usage models such as public charging within commercial buildings after hours. The standards cover multi-residential and non-residential buildings, including:

- Non-residential: at least 20% of car parking bays within the development should be set up to be EV-Ready.
- Multi-residential: all car parking areas within a development should be set up to be EV-Ready.

1.4 Existing networks

1.4.1 EV Charging

Arup has conducted an audit of existing EV charging infrastructure within the SWG council areas. This audit was reliant on data sourced from publicly available mapping (i.e., PlugShare), supplemented by information provided by the SWG councils.

The audit found that there was a total of 33 chargers across 19 locations. Of these 33 chargers, 13 were classified as private usage – in that they were for use of customers, residents or students only. The remaining 20 were classified as public chargers available to be used by anyone. This split is shown in Figure 5 below, with the locations shown spatially in Figure 6 on the next page.

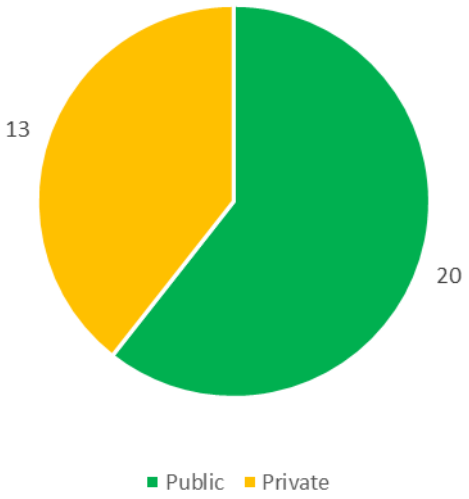


Figure 5 – Number of existing public and private chargers within the SWG area

Looking at the existing network in reference to the activity centres within the SWG (as defined by *State Planning Policy 4.2 – Activity centres for Perth and Peel*), we can see that there are a significant number of existing activity centres without any charging infrastructure close by. Figure 7 shows each charging location in reference to activity centres and respective 400m and 800m radial catchments alongside. This indicates that there may be significant opportunities for improved EV charging availability, especially for incidental charging during recreational and shopping activities.

Figure 6 – Existing EV charging – public & private

Figure 7 – Public EV charging proximity to activity centres

The audit also provided insight into the characteristics of chargers across the SWG, including charger type, chargers per location, maximum power draw and whether the charger was free or 'pay to use'. These characteristics are summarised in Figure 8 to Figure 11 below. It should be noted that of the pay to use chargers, five charge a cost for parking only (time basis), with the use of the charger being included in that cost, while the other two charge a cost per kW.

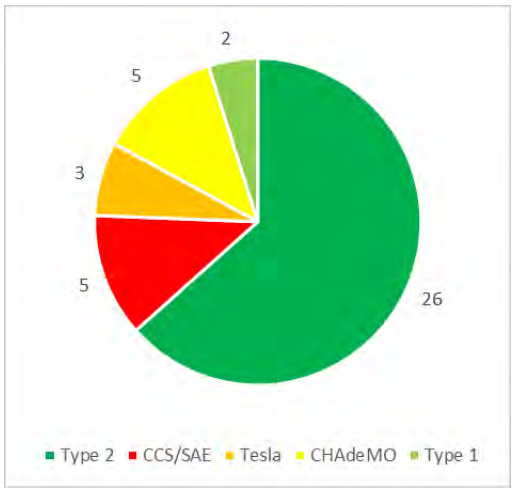


Figure 8 – Charger type breakdown

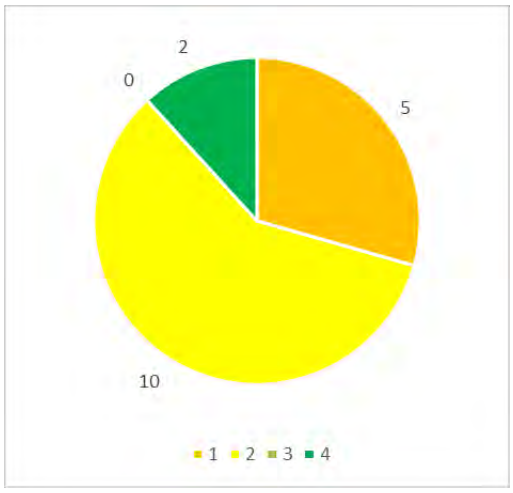


Figure 9 – Chargers per location breakdown

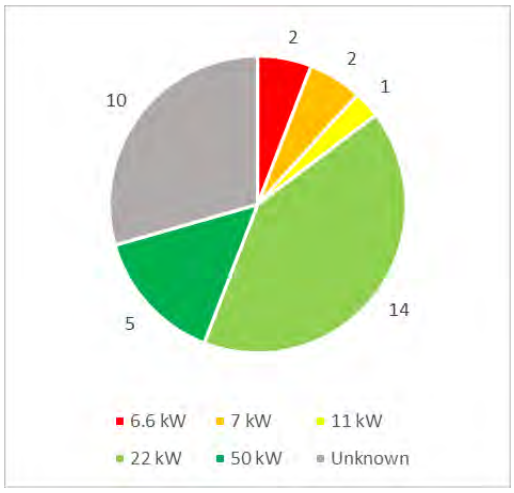


Figure 10 – Charger available power breakdown

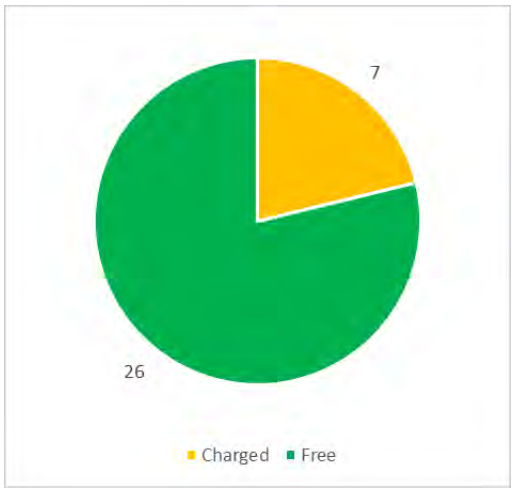


Figure 11 – Charger cost breakdown[6]

1.4.2 Power supply networks

Infrastructure

As part of the considerations for the planning of future EV charging infrastructure, a review of existing and planned power infrastructure and capacity was undertaken within the SWG member council areas. This review relied on information available through Western Power's Network Capacity Mapping Tool (NCMT). An overview is provided in Figure 12 below, with areas in green showing parts of the network with spare capacity on the network and areas in red indicating parts with limited capacity. A discussion of findings is included on the following pages.

[6] Note: all private chargers across the SWG are free to use – the breakdown for public chargers is 13 free, 7 pay per use.

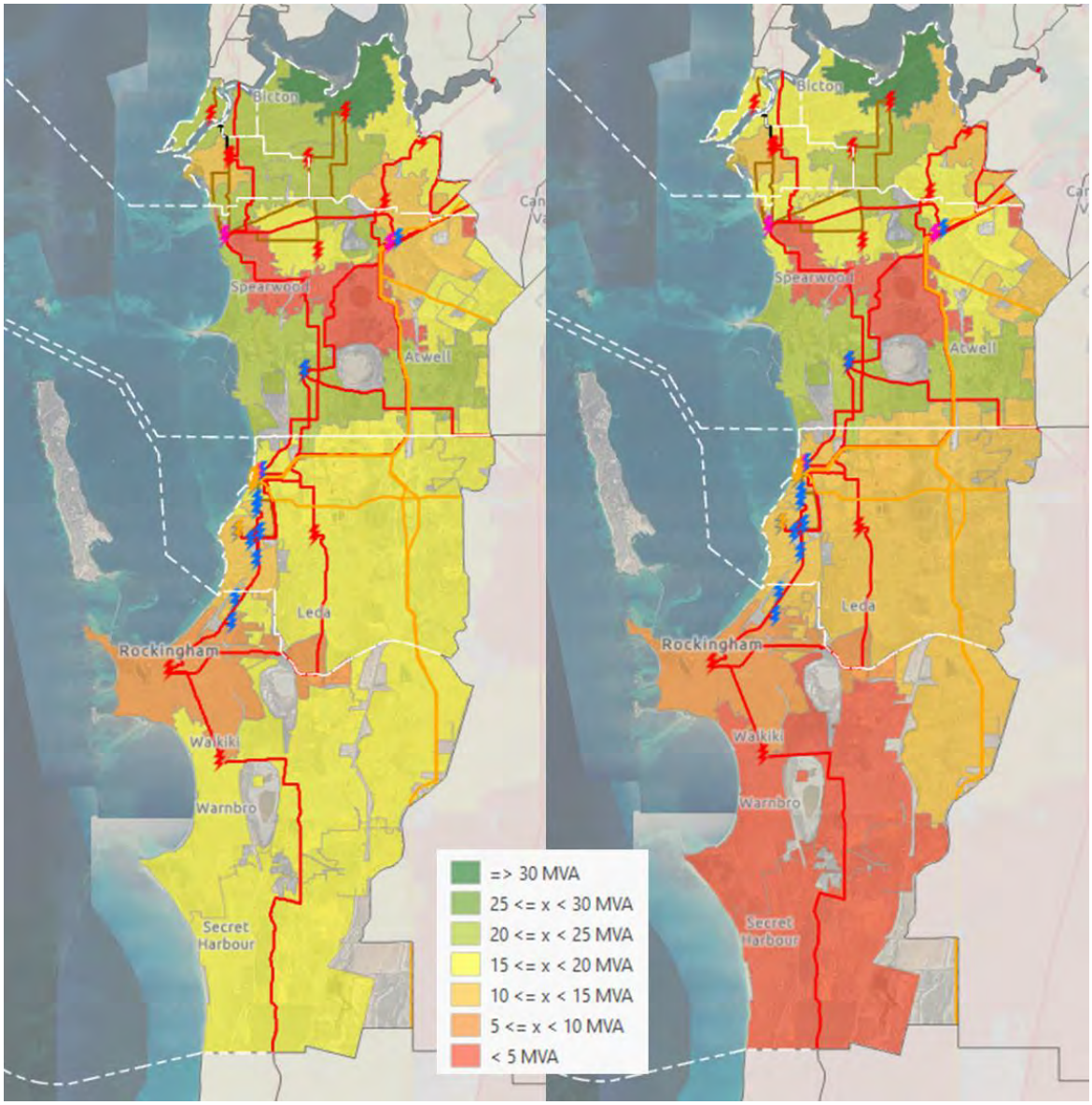


Figure 12 – Forecast network residual capacity for 2026 (left) and 2031 (right) – Western Power's NCMT

The key findings from the review of network capacity and infrastructure were:

- Substation locations generally correlate with activity/ neighbourhood centres, indicating that existing infrastructure would likely be able to support connections for EV charging
- There is expected to be a significant amount of residual capacity in 2026 and 2031, with the exception of the largely residential and industrial areas of the City of Cockburn from Spearwood to Atwell, through Beeliar and Cockburn Central. Areas south of Rockingham are also expected to experience limited capacity, including Warnbro and Secret Harbour. However, network capacity constraints are only expected to be a limiting factor in the roll out of mass rapid charging stations of significantly high power draw – as discussed below.
- Power distribution network coverage is not expected to be a limitation, as the distribution and transmission networks provide robust coverage across the SWG councils.

Although the network capacity mapping suggests there are potential issues in terms of available power across certain portions of the SWG, advice from Western Power is that most implementations of EV charging would fall under the *Distribution Low Voltage Connection Scheme (DLVCS)*[7]. Under this scheme, proponents are charged for new connections on the basis of the required supply power (kVA). This scheme

[7] https://www.westernpower.com.au/industry/distribution-low-voltage-connection-scheme-dlvcs/

applies for implementations up to 630 kVA – which is likely to capture most EV charging installations, with the exception of those proposing multiple ultra-rapid charging points (which may require 300kVA each). This is expected to only impact locations such as specifically built charging hubs – which may be more likely to be developed by private proponents.

Installations beyond the 630kVA threshold may be liable for increased infrastructure contribution costs in areas with forecast low power availability – which may be a consideration for the planning of installations of multiple ultra-rapid charging stations. Western Power are also in the process of developing a policy for potentially lower supply installation and/or ongoing costs for locations which will only be utilised during times of high power availability (see below) – however this policy is still in the early stages of development.

Renewable energy

Another key consideration for the deployment of EV charging is the source of power generation. The source of power is a key determinant on the sustainability outcomes for EV charging. As seen in Figure 13 – on a 12-month rolling average basis, renewable energy has grown significantly over the past 10 years as a power source in WA – from 6.0% in 2011 to 32.1% in 2021.

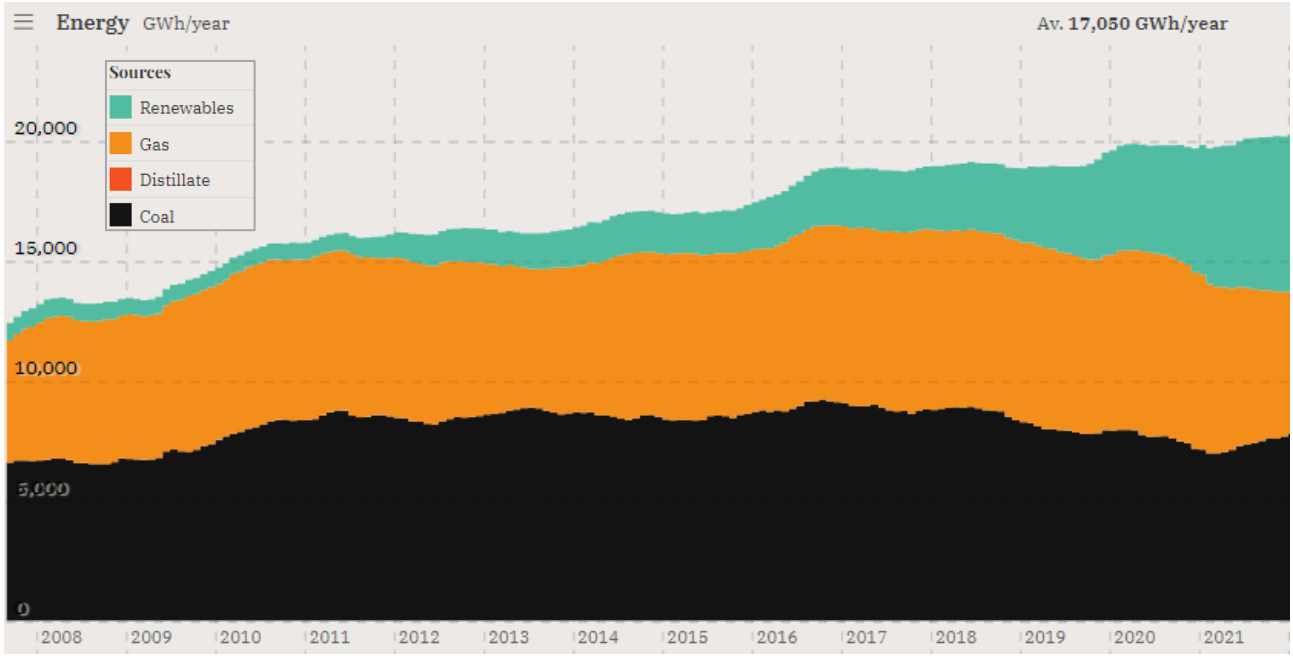


Figure 13 – 12 month rolling average power generation source for WA 2008-present (source: opennem.org.au)

Despite the increase in renewable energy power generation for an average day – there is high variability of available renewable energy. This is demonstrated in Figure 14 below. This figure clearly demonstrates that the availability of renewable energy is unsurprisingly at it's highest during the middle of the day – reaching as high as ~75%. Conversely, overnight renewable energy availability is at it's lowest, sometimes being less than 10%. This is largely due to a significant portion of renewable energy on the grid being from solar sources – the state's committed investment in base-load renewable energy such as wind will help the state transition to a higher proportion of renewable availability at all times of day.

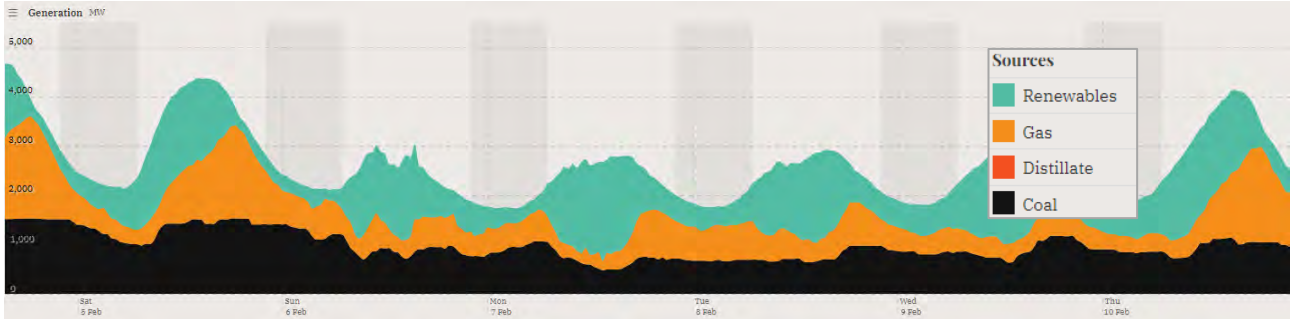


Figure 14 – Time of day variability for power generation sources in WA (source: opennem.org.au)

1.5 Social considerations

As part of the existing context review for the project, an analysis of socio-economic diversity across the SWG councils was undertaken. This was considered as an important contextual factor to ensure that social equity, and equal access to infrastructure, would be a critical consideration in the planning of EV charging infrastructure.

To assess socio-economic diversity, an analysis of the Socio-Economic Indexes for Areas (SEIFA) from the Australian Bureau of Statistics was undertaken. For clarity, SEIFA is a product developed by the ABS that ranks areas in Australia according to relative socio-economic advantage and disadvantage, including factors such as income, education levels, employment industries, dwelling characteristics, presence of an of internet connection and the number of motor vehicles at the dwelling.

The latest available SEIFA dataset is from the 2016 ABS census and is shown spatially, broken down into SA1 regions (generally blocks representing 200-800 people). Spatial representation of this data is shown in Figure 15 (right). As shown, there is high diversity of socio-economic profiles across the SWG, with more areas of advantage clustered to the north, and areas of low socio-economic advantage largely adjacent to industrial areas.

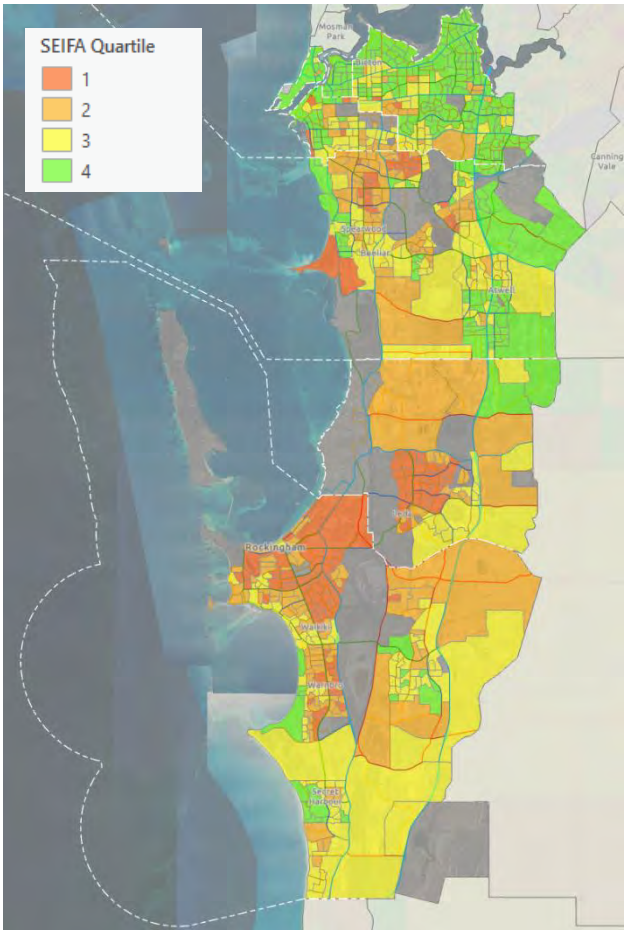


Figure 15 – SEIFA quartiles for SWG council areas (by SA1) – ABS 2016

1.6 Stakeholder perspectives

The SWG stakeholders provided key input into the plan throughout its development. Through feedback sessions, a strong understanding of the desired outcomes for EV infrastructure – and ultimately the plan – was developed. This is summarised in Figure 16 below.

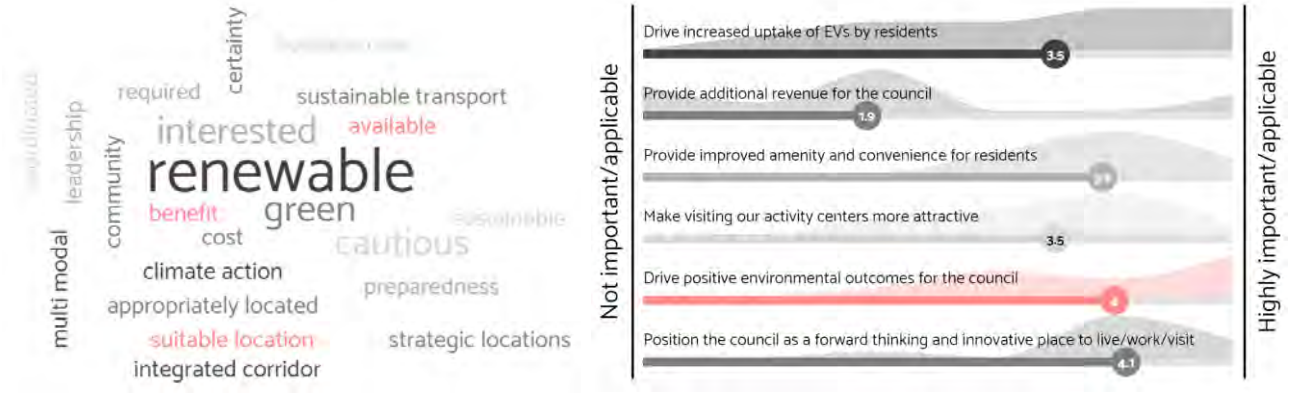


Figure 16 – SWG stakeholder perspectives on EV infrastructure plan

1.7 Potential demand

To estimate future demand for EV charging, an investigation into projected sales and EV fleet representation was conducted. This analysis relied on data from the Electric Vehicle Council (EVC) and the Australian Renewable Energy Agency (ARENA) to project future EV sales. Figure 17 below shows the actual EV sales across Australia from 2011 to 2021.

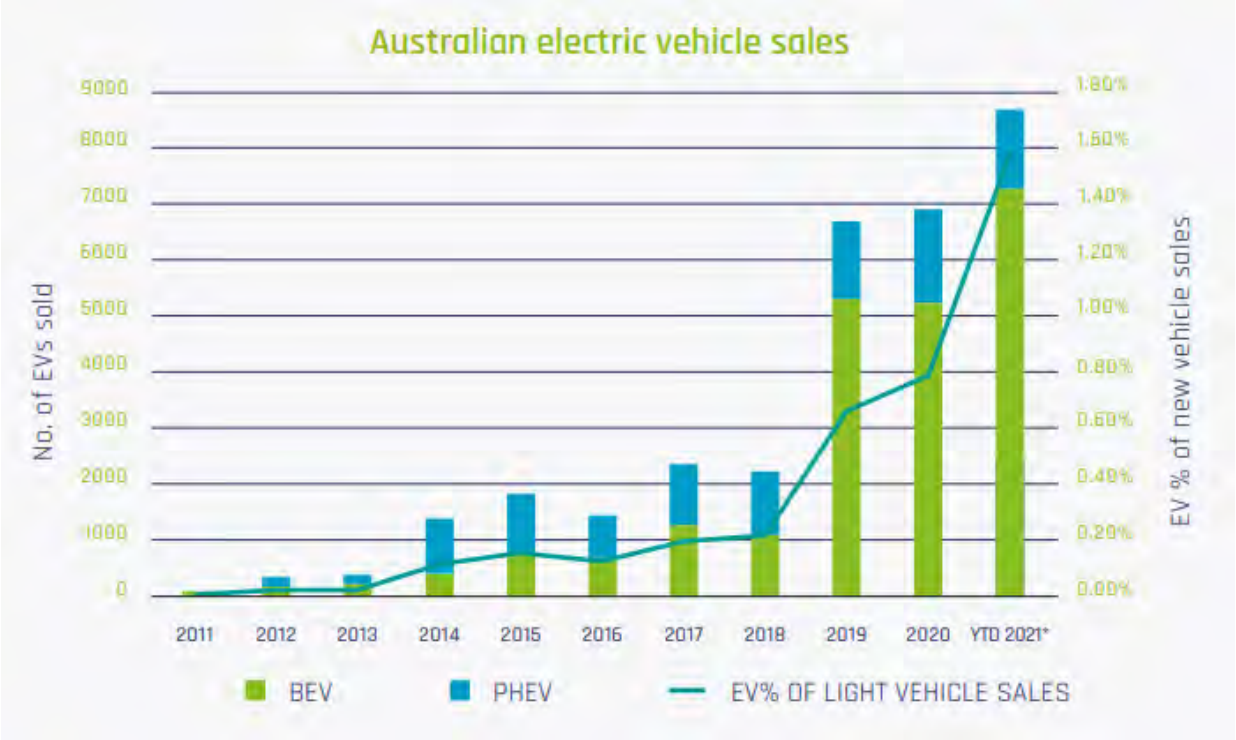


Figure 17 – Actual battery electric vehicle (BEV) and plug-in hybrid electric vehicle (PHEV) sales (source: EV Council State of EVs 2021[8])

Utilising the current EV sales data, existing EV fleet and overall fleet age and renewal time on a state-by-state basis, an exponential projection of EV sales (as a proportion of new car sales) has been produced forecasting future EV sales across Australia up to 2030. A high, low and medium forecast has been produced, which has been compared against actual sales (Australia and UK). The UK sales have been provided to demonstrate an actual example of exponential growth of EV sales.

[8] https://electricvehiclecouncil.com.au/wp-content/uploads/2021/08/EVC-State-of-EVs-2021-sm.pdf

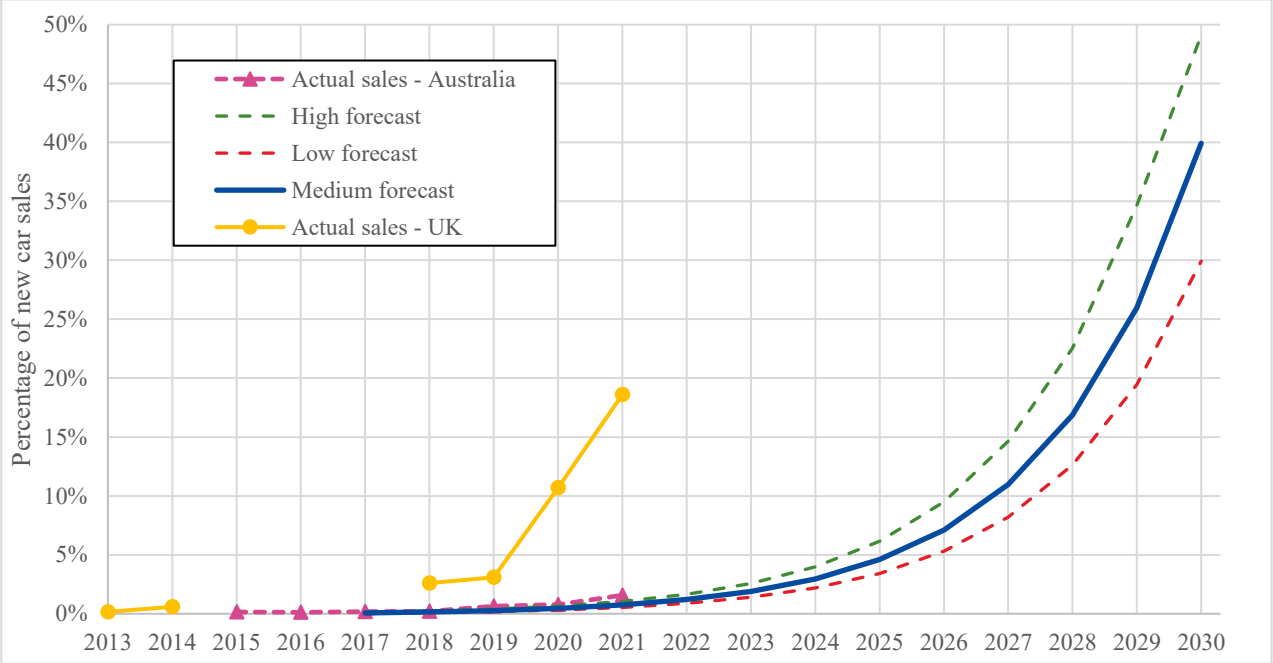


Figure 18 – Projected EV sales vs actual (Australia and UK)

From these projections, an estimate of the proportion of the total vehicle fleet for both WA and Australia has been made (based off the medium forecast), which is shown in Figure 19 below. This projection approximates that EVs will grow from 0.06% of the WA fleet in 2021, to 3.64% in 2031. Despite the fact that EVs will still only represent a small percentage of the total WA fleet, it represents a significant increase in EV numbers from today's values, with growth expected to continue strongly post-2030.

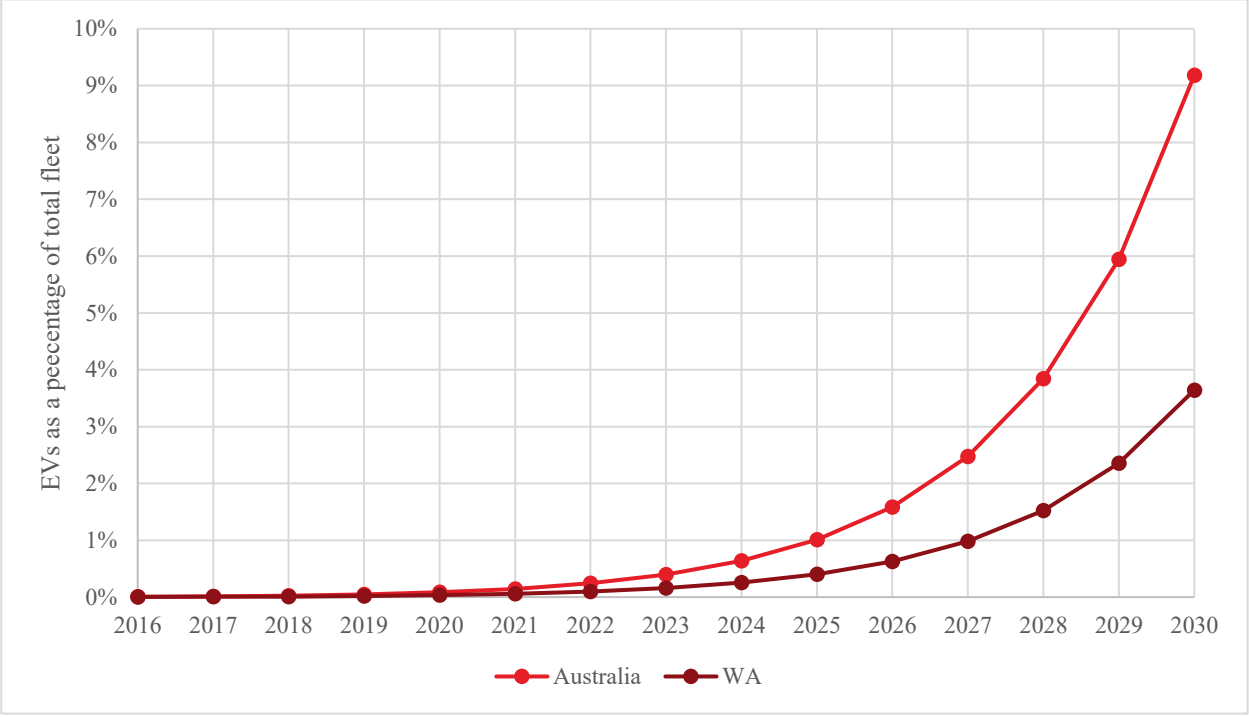


Figure 19 – Projected EVs as a proportion of total fleet – Australia and WA

2. Vision and objectives

Through engagement with the SWG member councils, the following vision statement has been developed as to guide the development of the plan:

Public charging infrastructure in South West Metropolitan Perth will catalyse the uptake of electric vehicles through convenient and consistent provision. Users will have equitable access to charging that accelerates decarbonisation through the use of renewable electricity and encourages technological innovation.

This vision statement is further reflected in the five key objectives agreed for the plan, which are outlined in Table 3 below. These objectives were utilised to develop the spatial planning (see section 4) and assessment framework (see section 6) for the plan.

Table 3 – Key objectives for the plan

Objectives	Key themes	
1 Sustainable	➢ Renewables ➢ Sustainability action plans ➢ Grid impacts	➢ Active transport ➢ Circular economy
2 Convenient and consistent	➢ Interoperability ➢ Reliability	➢ Location of infrastructure ➢ Aligned to design guidelines
3 Future-ready technology	➢ Future technology ➢ Plots and trials ➢ Retrofit costs ➢ Legal protections	➢ Innovation ➢ Data collection ➢ Security (data/assets)
4 Fair and equitable	➢ Ownership ➢ Local economy ➢ Privatised space	➢ Responsibility ➢ Wait times ➢ Access for all
5 Leverages partnerships	➢ Education ➢ Financial incentives	➢ Local government involvement ➢ Manufacturers and developers

3. The role of local government

There are a wide range of formal and informal roles of stakeholders involved in the planning and implementation of EV charging infrastructure. Local government is in a unique position to influence, guide and enable the future form of EV charging infrastructure. Figure 20 maps actors within the planning ecosystem according to their level of interest and influence on the outcome. This is by no means a definitive statement of interest / influence, rather a synthesis of broad themes and insights taken from a multi-disciplinary team sorting exercise and stakeholder interviews from various Australia-wide studies.

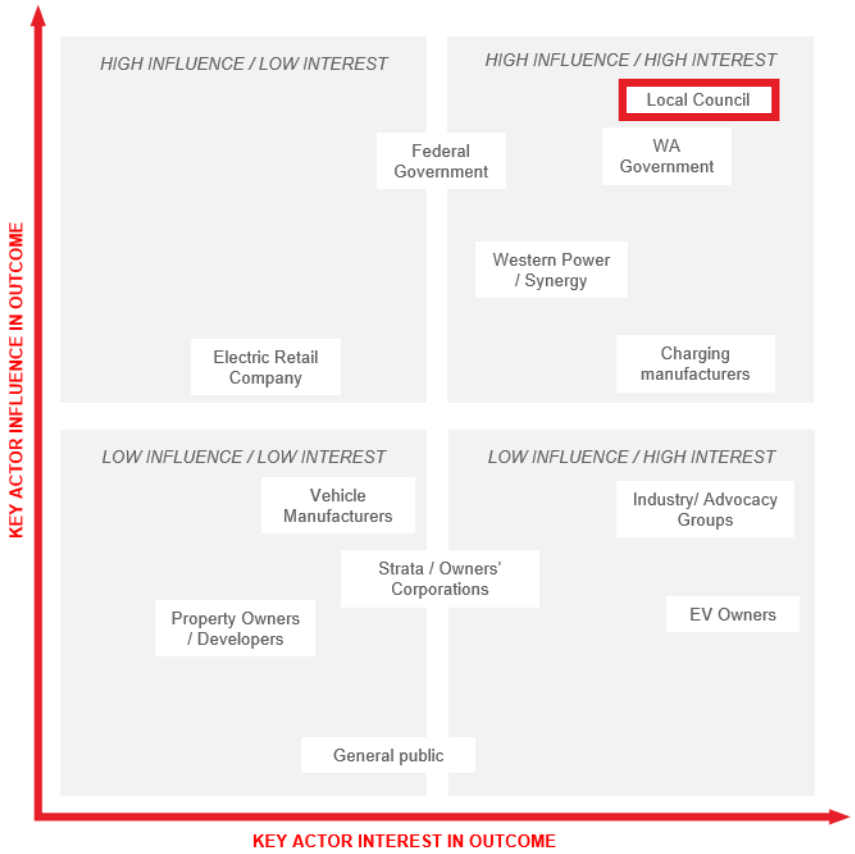


Figure 20 – Key stakeholder influence and interest

As shown, Local Council and State Government have been identified as the most influential and interested stakeholder groups concerned with outcomes of public EV charging infrastructure, including changes to planning regulations, policy, infrastructure, funding and fleet composition. State Government develop EV policy, and while a strong State Government position in the rollout of EVs will deliver a more effective outcome, it will ultimately be Local Council who roll out and enforce new planning requirements.

Local Councils are responsible for upholding State Government EV policies, approving planning and building applications, enforcing charging infrastructure requirements for new and existing public spaces and buildings, and partnering with industry groups, manufacturers and electricity providers. Local Councils are also responsible for integrating EV outcomes into their own strategies, including vision statements, transport plans and parking strategies. Across five themes, the role of local government is expanded on below.

3.1 Policy

Local Councils are responsible for upholding State Government policies by translating these into relevant planning schemes, strategies and plans. By integrating EV outcomes into strategies including vision statements, transport plans and parking strategies, Local Councils can have high influence on the form the infrastructure takes on a local scale. Local Councils do not necessarily need to align with State Government requirements and can position themselves with EV policies that enforce charging infrastructure requirements for new and existing public spaces and buildings above and beyond that of the state jurisdiction.

Policy levers can be used by Local Councils as a tool to target the provision of charging infrastructure within an area, guide the design of installation and encourage private investment. This can trigger the implementation of a number of charging infrastructure typologies, particularly home, workplace, on-street and destination charging.

3.2 Infrastructure approvals

The approval of planning and building applications are the responsibility of Local Council, with the majority of these applications having a big impact on the function and availability of infrastructure, amenity and built form within the local area. While planning and building applications will need to align with the statutory planning and policy of the local area, Local Council's discretion over the proposed provision and design of charging infrastructure can have an everlasting impact on the network.

Local Council can therefore work with the developer/ proponent delivering an application to suit the Council's vision of the network to best suit the local area and community. This is particularly relevant to home charging in high density residential developments, workplace charging and destination charging.

3.3 Fleet

Across Australia and similar jurisdictions across the globe, particularly in California, Local Councils have begun transitioning their owned and operated fleet to EVs. This includes vehicles used by Council Officers, service and maintenance vehicles, waste vehicles and even e-scooters and e-bikes. The transitioning of the Council fleet helps to increase awareness of low emission mobility, show the commitment of the local government in addressing identified challenges and creates a need for charging infrastructure which can be provided on Council-owned land with limited barriers.

3.4 Partnerships

While the provision of charging infrastructure will contribute to the overall charging network on a metropolitan scale, the provision of a single charger or charging hub will occur in a local area and will require input from the local authority. There is opportunity here for partnerships between Local Council and proponents delivering, managing and operating the infrastructure. The installation of charger/s will produce opportunities for partnerships with manufacturers and suppliers of charging infrastructure, electrical providers for commercial and residential developments, the metropolitan wide grid operator and vehicle manufacturers.

Partnerships on this scale will assist in better management across a wide range of Local Council initiatives and increased collaboration between private and public industry, while also encouraging innovation and competitiveness. Anticipated to be driven primarily by the private sector, the implementation of fast and ultra-fast chargers in charging hubs and on-route charging facilities can be assisted through partnerships with Local Council. Different approaches including encouragement for partnerships within the council area and complementary policy enablers can unlock potential for private investment.

3.5 Funding

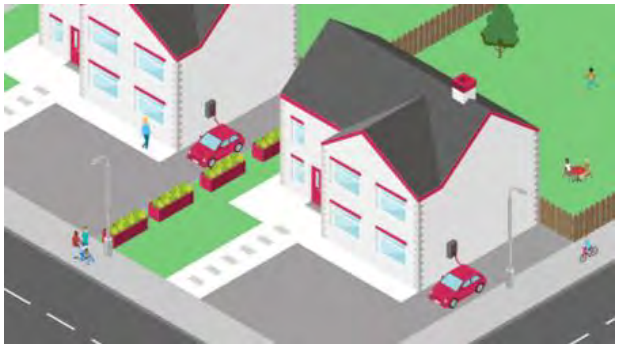
Particularly for public infrastructure, Local Council will have a key bearing on available funding for the provision, availability and overall quality of charging infrastructure and wider network. The availability of funding towards EV infrastructure will also influence the appetite of Local Councils to either support or undertake pilots and trials within their jurisdiction. This can impact the availability of resources including staff and equipment, availability of space/ roads within the area and synthesis of outcomes.

While it is recognised that funding to support the additional infrastructure costs is limited by many Local Councils, advocacy to State and Federal Government for the availability of funding is required to increase EV infrastructure.

4. Spatial plans

4.1 Charging infrastructure typologies

For the spatial planning of EV infrastructure, six charging typologies have been adopted for the plan – home charging, workplace charging, on-street charging, destination charging, on-route charging and hub charging. These typologies were cross referenced with the land-use within the SWG through a stakeholder workshop process to determine the most appropriate mix within each service layer. Detail for each typology is provided below.



Home charging

Description: Home charging is the cheapest and most convenient form of charging, usually slow charging overnight.

Likely target users: Users with off-street parking.

Challenges: On existing properties, the onus is on the user to arrange installation. Grants can be made available by State and Federal schemes, however, are limited in the Australian context. Clear and consistent information is needed to better support users.

Support from Council: Lobbying for grants, concise and up to date instructions for installation, education and encouragement for installation of chargers and benefits of renewable energy, minimum requirements for the provision of EV charging in new developments and major restorations/ repurposing of existing developments.

Workplace charging

Description: Workplace charging is typically provided in private car parks. Charging can be slow or fast and offers a convenient way to recharge an EV for employees and business fleets.

Likely target users: Employees, business fleet users.

Challenges: Parking space availability. On-street charging can incentivise behaviours to use private vehicles rather than promoting more sustainable transport modes such as e-bikes/ scooters. Grants can be made available by State and Federal schemes, however, are limited in the Australian context.

Support from Council: Lobbying for grants, concise and up to date instructions for installation, education and encouragement for installation of chargers and benefits of renewable energy, minimum requirements for the provision of EV charging in new developments and major restorations/ repurposing of existing developments.

On-street charging

Description: Standalone pillars, typically 'fast' chargers provide on-street charging options. Dedicated kerbside charging points have been developed that avoid cables trailing across footpaths.

Destination charging

Description: Fast charging is provided at destinations where the user may park for a number of hours, e.g. gyms, cinemas or shopping centres. Hotel chains may

Likely target users: Users with off-street parking.

Challenges: Managing parking to ensure that users have access when they need it, and others don't block spaces when not charging. Funding and arranging installation can be time consuming, especially where the grid is constrained. Can create localised rises in the value of land immediately adjacent to chargers.

Support from Council: Design and installation guidelines, formation of management and maintenance strategies.

take advantage of the overnight charging and use slow charging as it is more cost-effective.

Likely target users: Destination visitors.

Challenges: Not strategically planned or managed – based on individual investment decisions at destination.

Support from Council: Concise and up to date instructions for installation, education and encouragement for installation of chargers and benefits of collating chargers with complementary land uses, minimum requirements for the provision of EV charging at new shopping complexes.

On-route charging

Description: On-route charging is used to top-up midway through a long journey, for example at highway service stations.

Likely target users: Business travel users, private leisure users, freight and logistics.

Challenges: Market segmentation, resulting in incompatibility across charging equipment and supporting payment and data infrastructure. Lack of strategic planning. Sufficient grid capacity must be available to accommodate high powered charging.

Support from Council: Partnerships with State Government and private sector.

Charging hub

Description: Charging hubs can be at centralised or out-of-town locations. Hubs can include different types of users, as part of a multi-modal transport strategy. A mix of charging types would be required to service different user needs. There is the potential for synergies to offer greater value.

Likely target users: Taxis, buses, business fleet, park and ride/ multi-modal transport users, car rental/ share companies, freight and logistics.

Challenges: Land availability. Grid capacity and cross-sector integration. New delivery models are required to deliver multi-modal transport services.

Support from Council: Partnerships with private sector, land availability and zoning.

4.2 Overview

The Plan takes the SWG's existing and identified centres and land uses to define a series of service layers for the provision of public EV charging infrastructure. The desired provision of infrastructure has been determined through a comprehensive review of international best practice and charging behaviour, alongside outcomes from the visioning workshop.

Step 1: Identify centres and land uses

A spatial map has been prepared that shows the SWG's key nodes of activity and land uses, shown on the right. On a hierarchy, activity centres, neighbourhood centres, high density residential/ mixed-use, low density residential and industrial areas have been mapped to correspond with a level of public charging infrastructure provision.

Step 2: Define service layers

Each centre or land use type attract a different kind of EV user, and therefore require different availability of charging types. For the purpose of the plan, service layers assist in providing a high-level overview of the charging requirements, grid impacts and future interventions/opportunities to pursue. Each service layer also

summarises the potential of land uses within that area to capitalise on co-locating businesses and services near chargers for people who charge their car and explore the area while they wait.

4.3 Spatial plan outline

The spatial plan is split across five (5) service layers as follows:

Activity and land use: Activity Centre

Service Layer: 1

Charging typologies: Destination, Charging Hub, At-work, On-street

Charging requirements: High volume mix of Fast to Ultra-fast chargers

Opportunity area: 15min walking catchment

Activity and land use: Neighbourhood Centre

Service Layer: 2

Charging typologies: Destination, Charging Hubs, At-work, On-street

Charging requirements: Low volume mix of Fast to Ultra-fast chargers

Opportunity area: 10min walking catchment

Activity and land use: High Density Residential/ Mixed-Use/Special Use* Centre

Service Layer: 3

Charging typologies: Destination, Charging Hubs, At-work, On-street

Charging requirements: Mix of Slow to Ultra-fast chargers

Opportunity area: 10min walking catchment

*No opportunity area wider than Special Use locations

Activity and land use: Low Density Residential

Service Layer: 4

Charging typologies: At-home, On-street

Charging requirements: Slow chargers

Opportunity area: No opportunity area wider than land use locations

Activity and land use: Industrial

Service Layer: 5

Charging typologies: At-work, Charging Hubs

Charging requirements: Mix of Slow to Fast chargers

Opportunity area: No opportunity area wider than land use locations

An indicative list of these locations has been included in Appendix A for discussion purposes.

4.4 Service layers

4.4.1 Service layer 1 – Activity Centres

Description

Activity centres in the SWG are significant mixed-use centres outside of the Perth CBD with strategic significance. They facilitate high concentrations of commercial and retail land uses, while servicing the surrounding area as a key destination for employment, shopping and recreation.

With an influx of visitors arriving by all forms of transport and a diverse base of land uses, activity centres have high potential to capitalise on the co-location of EV charging infrastructure to stimulate local economic growth.

The plan sets out that EV users requiring charging within an activity centre will benefit from, and will have the opportunity to, visit land uses within a 15-minute walk surrounding the charging facility.

Charging types

Activity centres will require a mix of destination, at-work and on-street chargers to service the likely needs of users.

Charging hubs are also a viable option for activity centres in the SWG as they offer new facilities for the co-location of complementary land uses to capitalise and 15-30 minute dwell times for users.

Charging requirements, including infrastructure

These charging types will require faster levels of charging to service the needs of likely users.

It is recommended that chargers at charging hubs and destinations are capable of providing power between 22-350 kW to charge vehicles within a 10-45 minute dwell time.

Depending on parking restrictions, available kerbside space and adjacent land uses, it is recommended that on-street chargers are capable of providing power between 7-22kW to 'top-up' vehicles at a slower charging time.

Electricity network impacts

It is likely that these higher service standards within activity centres will have a significant impact on available grid capacity at a localised scale. However, existing activity centres are shown to generally correlate with substation locations and areas with residual capacity in 2031.

Policies / interventions

Short-term	Medium-term	Long-term
• DA requirements/planning scheme amendments for provision of EV chargers in buildings (see leading practice examples, section 1.3) • Partnerships with charging manufacturers • Encourage competitiveness of manufacturer contracts and private investment • Partnerships with Western Power to monitor grid impacts • Charging rebates for purchases at co-located businesses – or initial free charging • Showcase demonstration projects/trials to the public • Incentivise installation of EV charging points for businesses.	• Free parking for EVs and encourage micromobility and prioritise active transport • Provide secure charging for e-bikes and e-ridables • Examine spatial distribution of the fast charging network • Introduce appropriate charging tariffs, e.g. charging for fast-charging, TOU tariffs • Examine feasibility of measures for light duty trucks • Link charging infrastructure roll-out to public education campaigns relating to electro-mobility.	• Establish close cooperation with electricity network providers to plan the roll-out of fast charging infrastructure network cooperatively, and identify measures to address grid bottlenecks, such as charging demand management/peak charge management/smart charging, prior to grid augmentation • Aim for integration of tariffs and payment mechanisms across the entire region.

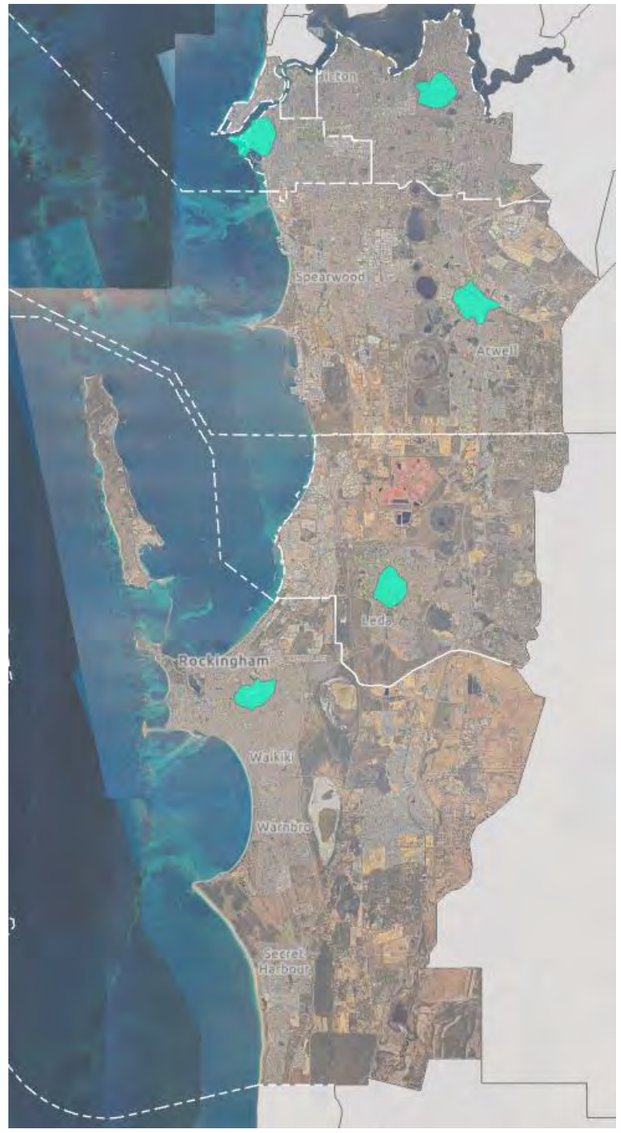


Figure 21 – Activity Centres

4.4.2 Service layer 2 – Neighbourhood Centres

Description

Neighbourhood centres in the SWG provide a mix of services within a small, concentrated area, typically an activated main street, for a suburb-wide residential area. Generally, these centres contain a supermarket and a mix of small-scale retail shopfronts and cafes.

Neighbourhood centres attract a steady volume of visitors each day yet peak at lunchtimes and on the weekends. Due to their smaller scale, EV users requiring charging in a neighbourhood centre are less likely to walk large distances from their car, yet surrounding land uses within a 10-minute walk could benefit from charging dwell times.

Charging types

The focus of neighbourhood centres should be around the provision of destination charging facilities, providing opportunities for EV users to charge their vehicle while visiting supermarkets and other short-term land uses such as cafes and restaurants.

On-street charging provision should also be a focus, especially for more constrained neighbourhood centres that do not offer off-street parking facilities.

There is also an opportunity for the provision of a single charging hub within these centres. Much like the existing operation of a service station, charging hubs on a neighbourhood centre scale can be co-located with a wealth of land uses to which a service station can't. This includes cafes, restaurants, small-scale retail and parks.

It should be noted that neighbourhood centres are focal gathering points for surrounding residential areas, and will be supported by the provision of at-home chargers in private dwellings and apartment buildings.

Charging requirements, including infrastructure

Much like in activity centres, neighbourhood centres will have a similar requirement for charging, yet on a smaller scale due to a smaller number of visitors.

It is still recommended that destination and charging hubs are capable of providing power between 22-350 kW, with on-street chargers capable of providing between 7-22 kW of power.

Electricity network impacts

It is likely that these higher service standards within neighbourhood centres will have a significant impact on available grid capacity at a localised scale. However, neighbourhood centres are on a smaller scale, attracting less visitors than activity centres with a similarly less demand for charging due to the surrounding support of at-home charging. Therefore the impact on the grid is only likely to be generated by a handful of chargers within one localised area or facility, increasing the possibility for smart planning and futureproofing of infrastructure.

Figure 22 – Neighbourhood Centres

Policies / interventions

Short-term	Medium-term	Long-term
• DA requirements/planning scheme amendments for provision of EV chargers in buildings (see leading practice examples, section 1.3) • Partnerships with charging manufacturers • Encourage competitiveness of manufacturer contracts and private investment • Partnerships with Western Power to monitor grid impacts • Charging rebates for purchases at co-located businesses – or initial free charging.	• Link neighbourhood centre development to planning concepts such as 15-minute neighbourhood, where accessibility of services through walking is the key component • Reduce car parking rates for EVs, encourage micromobility and prioritise active transport • Provide secure charging for e-bikes and e-rideables • Introduce appropriate charging tariffs, e.g. charging for fast-charging, TOU tariffs • Examine feasibility of measures for light duty trucks for local business owners • Link charging infrastructure roll-out to public education campaigns relating to electro-mobility.	• Establish close cooperation with electricity network providers to plan the roll-out of fast charging infrastructure network cooperatively, and identify measures to address grid bottlenecks, such as charging demand management/peak charge management/smart charging, prior to grid augmentation • Aim for integration of tariffs and payment mechanisms across the entire region • Give thought to all-electric neighbourhoods.

4.4.3 Service layer 3 – High density residential/ Mixed-use/ Special use

Description

Mixed-use areas in the SWG, while limited in number outside of activity centres, offer various land uses including high density residential, commercial and retail.

Alike neighbourhood centres, these centres will attract visitors throughout all times of the day, while keeping a relatively high night time resident population. Due to their smaller scale than activity centres however, mixed-use areas have smaller potential of local economic opportunities in the co-location of chargers with land use, with users likely to travel up to 10-minutes from their charging vehicle.

Special use areas such as universities, airport and other education facilities are likely to attract EV users for limited reasons other than the one they drove there for. For instance, an EV user charging at a university is most likely to only use the university offerings while charging, rather than venturing to other areas.

Charging types

Mixed-use and special use areas will require a mix of charging types covering the entire range. This is due to the mix of users, visitor reasons and dwell times.

Investment in charging hubs and destination charging is expected to be of high importance. Consideration for the removal of barriers for private investment in slow-fast chargers in residential apartment buildings and office buildings should also be given.

Charging requirements, including infrastructure

A mix of charging speeds will be required to suit the needs of charging types and user profiles ranging from slow – ultra-fast chargers.

It is expected however that a higher volume of slow – fast chargers will be required than fast/ultra-fast chargers.

Electricity network impacts

Grid impacts will depend on the variability between charging types and speeds provided in the future planning of mixed-use areas. While it is encouraged that barriers are removed for private investment in charging infrastructure, partnership with Western Power is recommended so that impact assessments can be carried out on a case-by-case basis to monitor impact.

Policies / interventions

Short-term	Medium-term	Long-term
• DA requirements/ planning scheme amendments for provision of EV chargers in buildings (see leading practice examples, section 1.3) • Partnerships with charging manufacturers • Encourage competitiveness of manufacturer contracts and private investment • Partnerships with Western Power to monitor grid impacts.	• Manage the access to the different charger types available, e.g. through higher tariffs for fast charging.	• Aim for integration of tariffs and payment mechanisms across the entire region.

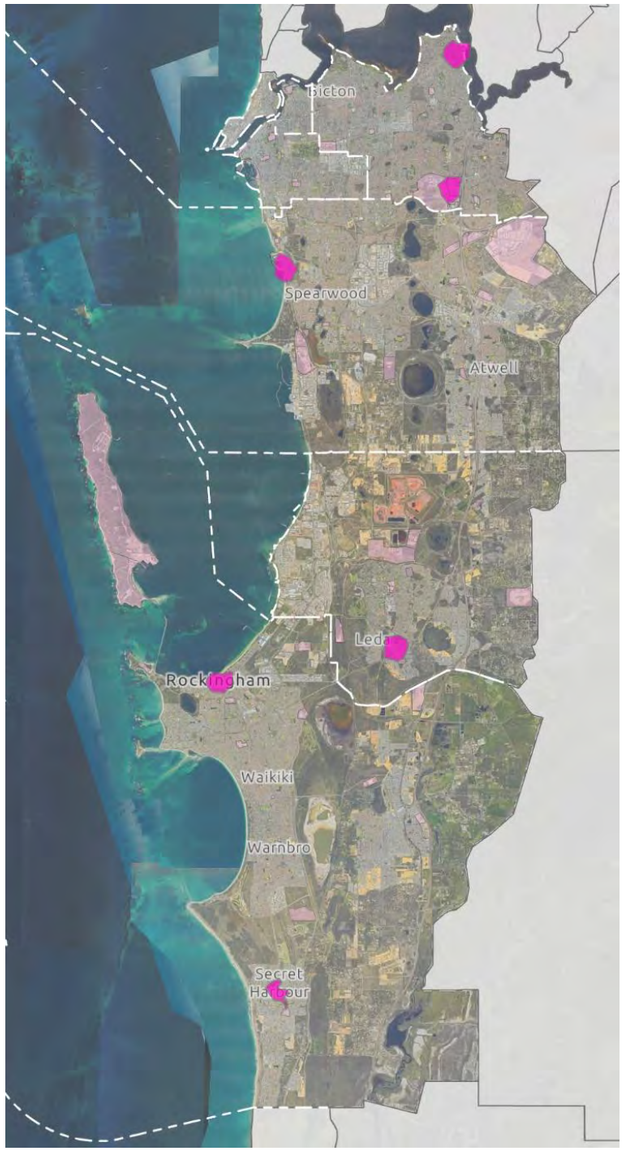


Figure 23 – High density residential/ Mixed-use/ Special use areas

4.4.4 Service layer 4 – Low density residential

Description

Much of the SWG consists of low density residential areas, characterised by large (>400sqm) single-dwelling lots with a high availability of off-street parking. These areas act as an origin point for many residents of the SWG, and are therefore the locations where the majority of vehicles are stored for the majority of their life cycle.

It is likely that users parking their EV in these areas will charge their vehicle either on their lot, or within a garage close to their dwelling, limiting the potential for the co-location of other land uses within the vicinity of chargers. For the purpose of the plan, low density residential areas are indicated as low service areas with limited potential for activation around public chargers.

Charging types

Low density residential areas have little requirement for public charging facilities as they consist largely of private dwellings. At-home charging will be the major source of charging for EV users currently and in the future.

For dwellings without the availability of off-street parking, users will need to be supported by destination charging facilities and charging hubs within surrounding neighbourhood and activity centres, or workplace charging given the availability of parking at work.

Charging requirements, including infrastructure

These charging types are not likely to require faster levels of charging than slow charging, due to the long dwell times associated with vehicles being parked overnight at residential homes.

Chargers capable of delivering power above 7kW are recommended to have low consideration in these areas, both to manage demand on the grid and align with expected charging behaviours.

Electricity network impacts

Impacts on the grid in low density residential areas can be dependent on numerous factors, including the availability of renewable energy sources, uptake of smart chargers and time-of-use tariffs.

While the addition of an EV charger at a property will have an impact on grid performance, it is not expected that slow chargers will have a noticable impact. Smart chargers will allow users to manage how and when to charge, allowing charging to occur in off-peak times depending on the availability of grid capacity at that time.

Policies / interventions

Short-term	Medium-term	Long-term
• Introduction of charging audit identifying locations where new chargers are being installed • Incentivise renewable energy (e.g. Solar PV) and battery storage purchase in homes • Encourage incentives for the installation of smart chargers in homes • Encourage and support ”charger-sharing”, or ”co-charging”.	• Lobby for introduction of time-of-use tariffs in peak energy consumption times • Bidirectional charging trials and pilots.	• Trial virtual power plant measures to monitor power usage on a large scale.

Figure 24 – Low density residential areas

4.4.5 Service layer 5 – Industrial

Description

The SWG consists of numerous strategically significant industrial parks including Kwinana and Bibra Lake, including smaller industrial areas of O'Connor, Myaree and Cockburn.

EVs accessing these areas in the future are largely going to be employees'private vehicles, service vehicles and heavy vehicles such as trucks.

It is unlikely that EV users will be accessing industrial areas for any other reason than industry, therefore opportunities for the co-location of other uses within proximity of the charger is not likely to be viable.

Charging types

Industrial areas will require a focus on at-work charging facilities within employee parking areas to suit the needs of employees driving to their place of work.

Charging hubs are also a viable option in industrial areas, particularly those suited towards the charging of service vehicles and heavy vehicles.

Charging requirements, including infrastructure

While industrial areas are likely to support a charging hub type facility to charge service vehicles and heavy vehicles, the need for fast – ultra-fast chargers is not as apparent as slow-fast chargers. This is due to these types of vehicles being able to be charged when not in use.

At-work chargers are likely to require the capability of slow-fast charging speeds (<22kW) to suit daily dwell times for employees wishing to fully charge their EV throughout the course of the day.

Electricity network impacts

EV charging requirements in industrial areas are not likely to pose significant impacts on the grid beyond today. This is due to the majority of charging to occur either at a slow speed with low power draw, or at off-peak times when vehicles are not in use.

Industrial areas in the SWG are also linked with substaton locations and are shown to have residual capacity through to 2031.

Policies / interventions

Short-term	Medium-term	Long-term
• Partnerships with Western Power to monitor grid impacts • Partnerships with charging manufacturers	• Allow access for public to industrial charging hubs in lower socio-economic areas to increase equal access to infrastructure	• Aim for integration of payment mechanisms across the entire region

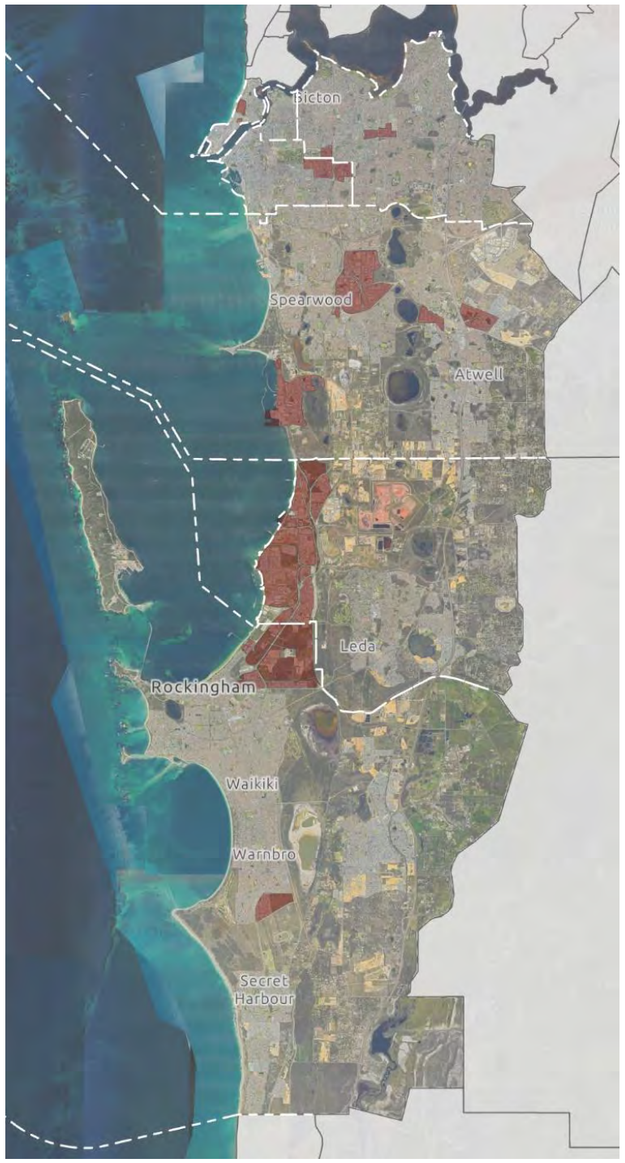


Figure 25 – Industrial areas

5. Partnerships and models of governance

5.1 Partnership opportunities

As part of the deployment of EV infrastructure within the SWG councils, there are opportunities for LGAs to partner with public or private entities in order to achieve mutually beneficial outcomes. The key partnership opportunities identified through the stakeholder engagement process are outlined in Table 4 below.

Table 4 – Partnership opportunities summary

Partnership category	Example opportunities	Principal stakeholder(s)
State run schools (primary/secondary)	Roll out of EV charging for staff and visitors	• Department of Education
Private schools (primary/secondary)		• Association of Independent Schools WA
Tertiary education providers	Deployment of EV charging within campuses for public use	• Murdoch University • Notre Dame University • TAFE South Metro
Shopping centres	Consultation with major shopping centres for a cohesive roll out of EV charging in proximity and within the centres	• Westfield • Cockburn Gateway • SCA Property • Private operators
Residential developers	Rollout of EV charging infrastructure within residential subdivisions and developments	• Development • Stockland • LWP • Lendlease

5.2 Ownership models

Governments around the world are exploring what role they should take in the supply of EV charging infrastructure. A variety of business models are emerging based, on local government interest and varying objectives LGAs want to achieve, which are assigning the responsibilities to different players in the EV ecosystem. Multiple risks exist for local government concerning charging networks due to high initial investment costs, revenue uncertainty, electricity tariffs and peak capacity contracts, including the involvement of multiple stakeholders.[9]

Given EV uptake is largely dependent on the availability of charging infrastructure, LGAs play a key role in providing support for the transition to electro-mobility, due to a lack of consistent and coherent incentives or policy support in Australia at both the federal and state level.

Dwyer et al. (2021) identified six types of charging infrastructure business models that could be suitable for Australian LGAs. These are divided into semi-public (e.g., patrons of a business) and public models (on-street access), based on the accessibility offered to end-users.

Under the public access business model, charging stations are available for use to all. The cost to the customer varies from free, pay per use, subscription/membership fees, or a combination of all. Three subtypes are outlined below.

[9] https://opus.lib.uts.edu.au/bitstream/10453/150279/2/sustainability-13-06590-v2.pdf

- ***Government-owned.*** Public-owned, public access charging points provided within a locally governed area for a charge or initially free to incentivise uptake
- ***Third party-owned.*** Private owned, public access charging points provided initially for free or for a fee.
- ***Energy utility-owned.*** Private owned, public access charging points provided by an energy retailer for a charge.

Table 5 – Comparison of EV charging ownership/commercial models

	Government-owned	Third party-owned	Energy utility-owned
Value proposition	Increase EV uptake, ensure access for visitors, create investment opportunities, support the local economy and benefit the community.	Increase public profile, increase consumer choice and increase membership for third party.	Increase electricity sales, gain new customers, bundle with new service offerings and demonstrate social responsibility.
Cost to customer options	Pay per use model or free. Standard parking charges/ parking permit requirements apply for on-street chargers.	Free for all, later potentially only free for members.	Pay per use model; time of use discounts possible in some cases to encourage off-peak charging.
Revenue model	• Council appoints contractors to install charging stations and pays for installation and operation. • Council partners with independent third parties to install additional stations. • Council pays for infrastructure and installation (potentially with government funding), and charges user for electricity and parking.	• Third party partners with Council to determine charger location and is then responsible for installation and operation.	• The utility owns and operates stations installed by third-party. • Utility supports electrical infrastructure development for third-party operated charging stations. • Utility builds underground and private company above-ground infrastructure. • Council could rent out public land to providers or partner with others to install additional stations.
Pros for council	• Council retains control. • Achieves high density of chargers through own and third-party roll out. • A revenue stream for the Council.	• Simple offering-free service for all. • Promotion of the private brand along with EVs. • Council has input on location and could potentially rent public land to third party.	• A flexible approach which also works with third parties. • Provision of green energy as option. • Provision of predominantly fast charging.
Cons for council	• Lots of risk reside with the Council (finance, own and operate EV charging stations).	• Depends on relationship with and interest of third party. • Council has limited control.	• Council has very limited influence on operations and location. • Many stakeholders involved.

In determining the suitable business model for LGAs, council will have to go through an extensive decision-making process to refine their desired level of control and involvement. The following questions will need to be considered:

- What are the council capabilities and resources available for this undertaking and what should be council key activities?
- What is the risk that council is willing to take, linked to the value proposition for council?

- What are the initial and recurring costs for council?
- What are quantitative and qualitative revenue streams for council?
- Who are the council key partners and where do relationships already exist?
- What is the value proposition to the customer? What customer segments is council looking to serve?

Council-led deployment of EV charging infrastructure is often focused on achieving the best value for money paired with the maximum amount of community benefit, while avoiding stranded assets or negative impacts on groups or individuals. To this end, considerations of ownership and operating models have been captured in the proposed Assessment Framework (see Table 6, section 6) with performance indicators 1.5, 2.2, 4.1, 4.2, 4.4 and 5.1.

6. Assessment framework

6.1 Overview

The SWG Charging Infrastructure Assessment Framework has been developed through alignment with the SWG visioning outcomes, vision statement and objectives, with a close appreciation of the context-specific problems and opportunities defined in the Background Report. The vision and objectives (provided in Section 2) was then developed through a process to deliver a series of network principles and performance indicators, which were to be read as assessment criteria and desired outcomes. These desired outcomes will assist in scoring potential interventions, while also outlining the needs that the network should address to deliver the vision.

Table 6 show the criteria and desired outcomes that build the assessment framework. Potential interventions will be scored against each criteria by assessing their performance against each indicator on the scale shown below. Interventions that are shown to lead to a majority of positive impacts against each desired outcome and satisfy the assessment criteria should be progressed for further investigation. It is appreciated that some interventions may not be able to provide responses for each performance indicator and it is recommended that this is noted and continued for further development.

Table 6 – Assessment framework for SWG charging infrastructure

Objectives	Network principles / assessment criteria	Performance indicators (desired outcomes)	
1. Sustainable	The network embraces renewables and circular economies to mitigate impacts on the grid, community and environment.	1.1	Promotes the use of renewable energy sources at all times of the day
		1.2	Aligns with local, state and federal sustainability action plans
		1.3	Can provide a critical asset within a circular economy structure
		1.4	Avoids significant impact/s on the grid, while optimising grid performance
		1.5	Has long-term economic feasibility
2. Convenient and consistent	The network is reliable, legible and simple for a diverse user-base, while maximising interoperability and consistency.	2.1	Increases interoperability of infrastructure
		2.2	The location of infrastructure provides amenity, and is not a constraint to efficiency, public space or the community
		2.3	Waiting times are reduced to maximise the widest user-base
		2.4	Can be implemented seamlessly across the whole region with limited barriers
		2.5	Provides consistency in the design and provision of infrastructure across the whole region
3. Future-ready technology	The network is futureproofed, encourages innovation, and trials emerging technologies.	3.1	Pilots or trials have or will be conducted, providing a wealth of data
		3.2	Improves adaptability and resilience to change by evolving possible land uses
		3.3	Considers forms of on-demand, carsharing and micromobility technologies
		3.4	Future retrofit costs are avoided/ minimised
4. Fair and equitable	Ownership and responsibility of infrastructure is clear and for the public, spreading benefits across the local community and economy.	4.1	There is a clear ownership model that is easily understood, outlining responsibility, payment and maintenance
		4.2	Allows for benefits to the local economy through establishing attractive public spaces and Activity Centres
		4.3	Creates protection for data, assets and legal
		4.4	Avoids the privatisation of public space
		4.5	Located in a way that provides access to all local demographics
5. Leverages partnerships	Collaboration and partnerships are encouraged, through delivery, education and incentives.	5.1	Allows for local government involvement
		5.2	Incentivises the uptake of EVs
		5.3	Provides education opportunities for the public and governments
		5.4	Allows for the delivery of infrastructure through partnership with developers (Development WA and private)
		5.5	Allows partnerships with Western Power to ensure grid stability and alignment with available and future capacity

Performance indicator scale					
Will disadvantage the relevant criteria and lead to a detrimental outcome	Negative impacts to the desired outcome	No impact on desired outcome	Positive impacts to the desired outcome	Directly advantages the relevant criteria and leads to desired outcome	TBD (further development required)

6.2 Worked example – Fremantle E-mobility Hub

To show how the Assessment Framework could be used, we have developed a theoretical option to run through the framework and score on its overall merit against each criteria and objective. The project shown below consists of an E-mobility Hub that has been proposed to be developed in Fremantle, adjacent to Esplanade Park on Wardan Lane. As shown, the hub will be primarily for EV charging purposes, however it provides opportunities for other services including a Smart Park, encourages the use of alternative modes of transport to improve mobility, and also provides increased permeability with the upgrades of the pedestrian network.

Key facets of the proposal have been used to run through the Assessment Framework and assess its feasibility to be included as a future development in Fremantle.

1. **EV Charging Hub –** *Showcase for zero-emission mobility and energy solutions*

The proposed site is highly visible and presents significant opportunities for integration with the surrounding infrastructure and urban amenity. Placemaking opportunities include canopy design and street and pavement art.

2. **Smart Park –** *Innovation and technology to drive community and sustainability outcomes.*

Increase the visibility of green technologies through interactive and kinetic displays, exercise equipment and pavement, as well as smart urban furniture, shade structures, lighting and wi-fi.

3. **Micro-mobility –** *Zero-emission mode of travel*

Leverage off and expand on existing cycle amenity (e-bike store and rental and shared path) improve connectivity and mobility through the City

4. **Pedestrian connectivity –** *A new Gateway to Bathers Beach*

A reimagined public realm to activate and improve connectivity between Bathers Beach and the West End.

5. **Mid-tier transit –** *Zero-emission future expansion*

There is a mid-tier transit solution under investigation within the region linking Fremantle with Murdoch. Future zero-emission public transit will likely require high-voltage power for charging, and energy infrastructure upgrades have wide-ranging benefits for the precinct.

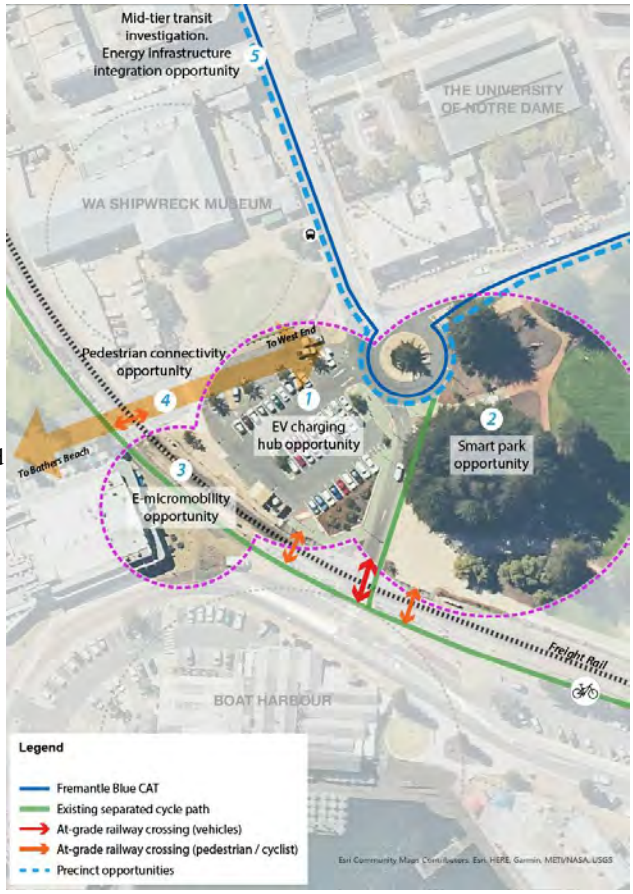


Figure 26 – Proposed Fremantle E-mobility hub

		Performance indicator	Score	Comment
1 - Sustainable	1.1	Promotes the use of renewable energy sources at all times of the day		Displays the benefits of completely renewable forms of transport.
	1.2	Aligns with local, state and federal sustainability action plans		Included within local plans.
	1.3	Can provide a critical asset within a circular economy structure		Repurposes existing land, while allowing for future relocation of infrastructure.
	1.4	Avoids significant impact/s on the grid, while optimising grid performance		Not the key aspect of proposal.
	1.5	Has long-term economic feasibility		Not the key aspect of proposal.
2 - Convenient and consistent	2.1	Increases interoperability of infrastructure		Uses technology-agnostic infrastructure and allows for interoperability between modes.
	2.2	The location of infrastructure provides amenity, and is not a constraint to efficiency, public space or the community		Fits within reserve and co-locates complementary uses.
	2.3	Waiting times are reduced to maximise the widest user-base		Availability of infrastructure suits demand while offering uses that diminish perceived waiting costs.
	2.4	Can be implemented seamlessly across the whole region with limited barriers		Hubs of this size cannot be implemented anywhere, and site selection will be key to their success.
	2.5	Provides consistency in the design and provision of infrastructure across the whole region		While it provides a benchmark, this design is strictly place specific.
3 - Future-ready	3.1	Pilots or trials have or will be conducted, providing a wealth of data		Can be used to inform future pilots and trials, while offering benchmarking.
	3.2	Improves adaptability and resilience to change by evolving possible land uses		Evolves an existing carpark into more sustainable uses.
	3.3	Considers forms of on-demand, carsharing and micromobility technologies		Encourages the use of alternative means of transport, while offering charging.
	3.4	Future retrofit costs are avoided/ minimised		Semi-modular, with limited permanent infrastructure and built form.
4 - Fair and equitable	4.1	There is a clear ownership model that is easily understood, outlining responsibility, payment and maintenance		Requires further development
	4.2	Allows for benefits to the local economy through establishing attractive public spaces and Activity Centres		Complementary to the Activity Centre, with the co-location of services in a highly accessible location.
	4.3	Creates protection for data, assets and legal		Required further development.
	4.4	Avoids the privatisation of public space		Surrounded by public space and does not lead to economic gain or privatisation of public space in proximity or within the hub.
	4.5	Located in a way that provides access to all local demographics		Centred in Fremantle's Activity Centre without hindering access for disadvantaged demographics, while providing increased security to high activity public spaces.
5- Leverages	5.1	Allows for local government involvement		Currently managed by Council.
	5.2	Incentivises the uptake of EVs		Provides opportunity for public charging.
	5.3	Provides education opportunities for the public and governments		Not the key aspect of proposal.
	5.4	Allows for the delivery of infrastructure through partnership with developers (Development WA and private)		Will require partnerships between various proponents to undertake.
	5.5	Allows partnerships with Western Power to ensure grid stability and alignment with available and future capacity		Ownership model to be explored in further detail and partnerships with energy supplier to be understood.

1 – Sustainable	2 – Convenient and consistent	3 – Future-ready technology	4 – Fair and equitable	5 – Leverages partnerships
✓	✓	✓	✓	✓

6.3 Decision making

To guide the decision-making process, Arup have indicatively provided a decision-tree in Figure 27. The purpose of the decision-tree is to step out the suggested method to respond to and investigate incoming proposals for EV projects/ infrastructure.

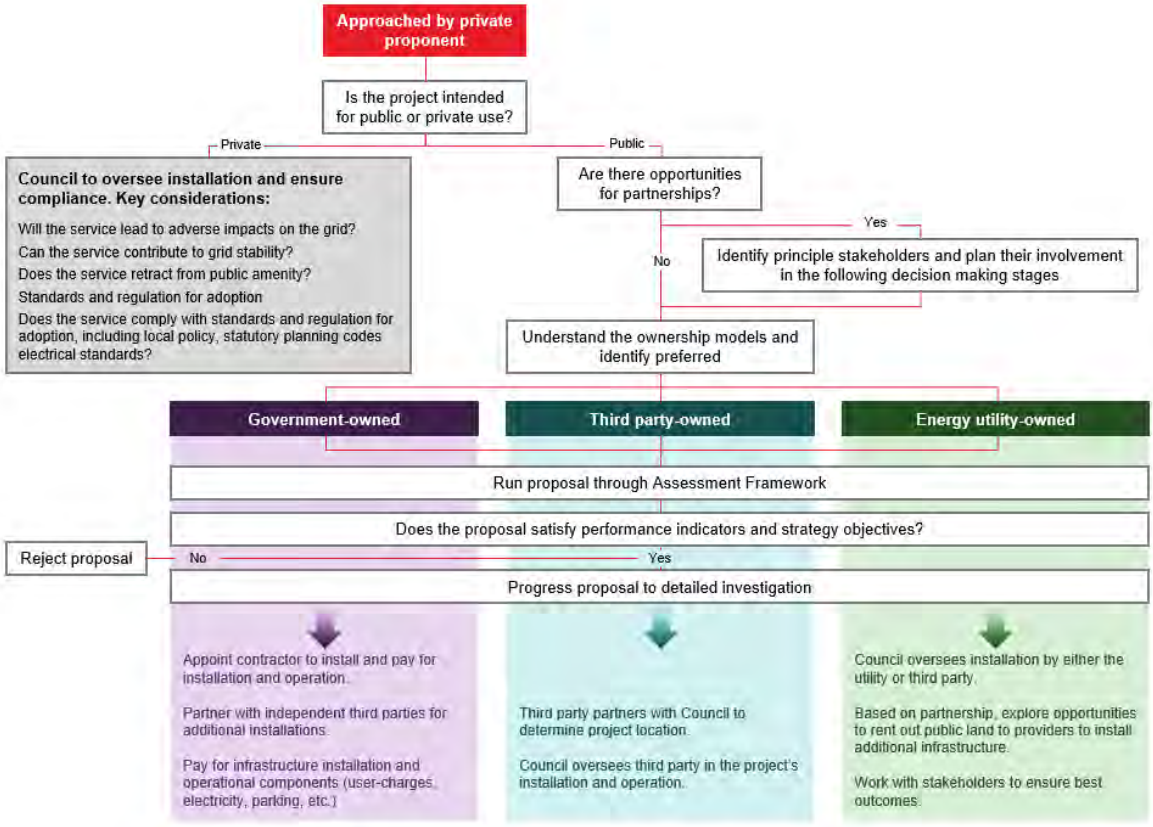


Figure 27 – Indicative decision-making process to inform incoming proposals

6.4 Indicative costs

The costs involved with the installation of EV charging infrastructure is not widely understood in Australia due to low uptake and limited recent international research. The manufacture cost of charging infrastructure is highly variable and constantly evolving, and any estimates for costs are only reflective of the snapshot in time they were recorded. In addition, installation costs are inherently dependent on the site, including factors such as availability of land, access to the grid, existing electrical capacity and provision of renewable energy.

Costs are however, one of the main influential factors and deterrents for the installation of charging infrastructure. To guide decision making, there are well understood levels of investment that scales dependent on the size and power of the charging station/s proposed to be installed. Generally, the cost of charging infrastructure increases with the power output, size and speed of charger, which in turn has flow on installation and connection costs to the grid, potential upgrades to electrical capacity and groundworks. An indicative scale of EV charging equipment costs has been provided in Figure 28 below.

Low cost ◄			► High cost
			
Level 1 (2.5 – 7kW)	Level 2 (7 – 25kW)	Level 3 (25 – 150kW)	Level 3 (>150kW)
General power outlet	Wall mounted EV charger	Rapid DC charger	Ultra-rapid DC charger
<$500 + installation	$900 – $3,000 + installation	$25,000 – $150,000 + installation	>$150,000 + installation

Figure 28 – Indicative investment cost scale

7. Recommendations

The following recommendations have been summarised from the plan for further investigation. They contain various strategies, targets and considerations for projects, partnerships and regulations, as recommended by the SWG under the following categories:

a) Actions for member councils (budgeting, planning instruments, community education pieces)

b) Advocacy actions for SWG

c) Further research.

Considered alongside the use of the Assessment Framework, the following recommendations will assist councils in increasing EV uptake, deliver the overall SWG vision and enable the rollout of context appropriate and well-planned EV charging infrastructure.

7.1 Actions for member councils

1. Set targets for net-zero carbon emissions by no later than 2050
2. Set a clear and concise standard for EV-Readiness, following the international standard categories of EV-Capable, EV-Ready and EV-Installed
3. Set targets to convert 100% of car and van fleets to zero emission vehicles by no later than 2030
4. Input and create an educational EV factsheet that communicates EV technologies, benefits and processes of installation to private entities and the public
5. Showcase demonstration projects and trials of EV technology within high foot traffic public areas to increase awareness and grasp educational opportunities. This includes infrastructure such as charging stations in high activity areas that can showcase how vehicles are charged, what charging stations look like and functionality.
6. Investigate minimum requirements for new developments and major restorations/ repurposing of existing developments aligning with the international standard categories for EV-Readiness (EV-Capable, EV-Ready and EV-Installed). Recommended benchmarks for new developments, starting from 2022 include:
    - 100% of permanent bays to be EV-Capable (Level 1) in residential apartment buildings, with 25% of visitor bays EV-Capable and a minimum of 1 fast charging (Level 2) visitor bay
    - 100% of temporary resident bays to be EV-Ready (Level 2) in hotels, with 20% of employee bays EV-Ready (Level 2)
    - 20% of employee bays to be EV-Ready (Level 2) in office buildings, with 100% of operational bays to be EV-Capable (Level 1)
    - 20% of employee bays to be EV-Ready (Level 2) in warehouses and factories, with 100% of operational bays EV-Ready (Level 2) and 100% of heavy vehicle bays (GVM >4.5 tonnes) to be EV-Ready (Level 2)
    - 20% of visitor bays to be EV-Ready (Level 2) at shops and supermarkets, with 20% of employee bays to be EV-Ready (Level 2)
    - 20% of visitor bays to be EV-Ready (Level 2) at hospitals and public buildings, with 20% of employee bays to be EV-Ready (Level 2).

    Note: These benchmarks are based on best practice and investigation of charging behaviour for 100% uptake of EVs. While they are a best reflection of likely requirements to support full uptake of EVs, they require lobbying with State government for support.
7. Recommend that all public charging stations are regulated to be hardware agnostic and allow universal access for different vehicles, plug types and user needs.

8. Recommend that the design and installation of public charging stations is regulated to allow universal access for people of all abilities.
9. Each member council to determine the most suitable business model for EV infrastructure provision, using the questions asked in Section 5.2.
10. For member councils that wish to provide EV charging as a service, apply the contents of Section 4.4 and 6.4, to budget accordingly for the roll-out.
11. Member councils apply the decision-making framework (Figure 27) when assessing third party proposals.

7.2 Advocacy actions for SWG:

1. Within jurisdictional powers, put in place policies and grants that enable, encourage, incentivise and accelerate the public and private transition to EVs outside of Local Government control
2. Encourage and incentivise the transition to renewable energy sources and storage in homes and developments to reduce the burden on the grid following increased uptake of EVs (further research and SWG advocacy)
3. Lobby for introduction of time-of-use tariffs in peak energy consumption times
4. Advocate for the adoption of standards for universal access to public charging stations for people living with disabilities within the Disability Discrimination Act. In general, accessibility for people living with disabilities has not been implemented by manufacturers or other jurisdictions to date in the public domain. However, numerous studies and thought pieces into how this could be implemented has been undertaken.

7.3 Further research:

1. Set up partnerships with manufacturers, suppliers and other partners identified in the plan to explore collaborative projects and trials.
2. Following outcomes from 7.2.2, investigate actions to encourage the transition to renewable energy sources and storage for member council residents and developers. This could be in the form of renewable energy information nights with local residents, an SWG branded renewable energy strategy or factsheet for circulation on the SWG/ Council websites.
3. Open up communications with the network distributor to understand existing and future capacity and collaborate on potential projects to create a streamlined grid augmentation and management stream.
4. Introduce a charging audit in collaboration with the network distributor identifying locations and volume where chargers (public and private) have been installed and where new chargers are proposed.
5. Investigate EVs as an input to virtual power plant (VPP) measures. Used like a household smart charger, EV batteries can be used to help stabilise the balance of electricity supply. EVs can be supplemented within a VPP system to manage power usage and optimise renewable energy generation and surplus on a multi-household, suburban scale.
6. Give thought and early planning for all-electric streets and neighbourhoods.

7.4 Reference projects

A number of innovative projects that member councils could investigate further have been included in the table below. Each project relates to one or more of the recommendations listed previously.

Project	Relevant recommendation/s	Description
Tesla Energy Plan on the Tesla Virtual Power Plant, South Australia and Victoria	7.2.2 7.3.3 7.3.6	Project involves the provision of Tesla Powerwalls at homes and businesses connected to solar PV. At the project's inception in South Australia, sites were chosen based on their susceptibility to power outages, where Powerwalls were used as a grid stability service on a VPP, to reduce cost and backup power to a home in case of a power outage. Following expansions through 2020 and 2021 to more sites, the project now acts as a time-of-use energy plan to both manage solar generation and power surplus, monetise generated electricity and create opportunities to stabilise the grid with introduced EV batteries and charging.
Source: https://www.tesla.com/en_au/tep		
Southwest Energy Efficiency Project (SWEEP) – EV-Ready Building Codes, Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming	7.1.2 7.1.6	The SWEEP – EV-Ready Building Codes establish infrastructure requirements for new construction projects, including electrical capacity, proportion of parking bays and cabling allowances to make the future installation of EV charging infrastructure easy and comprehendible. SWEEP have followed other state and local governments by defining three basic code options for the readiness of an EV charging bay; EV-Capable, EV-Ready and EV-Installed.
Source: https://www.swenergy.org/cracking-the-code-on-EV-Ready-building-codes		
Yarra City Council – EV-Ready factsheet and best practice requirements, Melbourne, Victoria	7.1.1 7.1.2 7.1.3 7.1.4 7.1.6	Yarra City Council have published best practice standards giving guidance to developers and residents on how to construct EV-Ready buildings such as homes, apartment buildings and mixed-use developments. The document outlines Council's permit condition for any new development with car park facilities to be EV-Ready as part of the compliance process, including requirements around charging stations, electrical capacity and pre-wiring.
Source: https://www.yarracity.vic.gov.au/-/media/files/news/attachments-for-news-items/2021/ev_factsheet_yarra_aug21.pdf?la=en		
Electric Vehicle charging infrastructure for people living with disabilities, Motability 2020, UK	7.2.4	Motability, a registered charity responsible for the strategic direction and oversight of the UK's Motability Scheme, have undertaken this piece of research outlining the potential barriers to EV charging infrastructure for people living with disabilities. The research piece summarises engagement with jurisdictions and manufacturers in this space and suggests policy levers that could be used to explore accessibility design standards to solve future barriers.
Source: https://www.mobilitygroup.eu/sites/default/files/inline-files/Motability_EV_Charging_FINAL.pdf		
City Fringe Ultra-Low Emissions Streets, London UK	7.3.6	Hackney and Islington Councils in London implemented a pioneering scheme in 2018 that only allowed low-emission transport (EVs, hybrids, e-bikes, scooters, etc.) on streets. The 'ultra-low emission streets' operated from 7-10am and 4-7pm Monday-Friday, restricting ICE vehicles using automatic number plate recognition. While generally supported by residents, the short term scheme was criticised for being introduced too early at a time when EVs were too expensive for the majority of drivers, offering unrestricted travel to those who could afford it. In 2022, with EV uptake growing and increasingly more affordable, schemes such as these can increase awareness and the benefits of EVs to suburban areas that may have little exposure to emerging technologies.
Source: https://www.bbc.com/news/uk-england-london-45394100		
Hornsby Council Electric Vehicle Charging Stations on Public Land Policy, NSW 2020	7.1.4 7.1.7	One of the first of its kind in Australia. It covers areas such as fair and equitable selection of providers, site selection criteria, charging station design considerations, parking configurations, charging technology and leasing arrangements. The policy is aimed at providing EV charging infrastructure for residents who don't have access to off-street parking for home charging; increasing visitation to town centres and retail hubs to improve economic development and tourism; and alleviating range anxiety.
Source: https://hscenquiry.hornsby.nsw.gov.au/temp/001_00DX_0K5X0QD02LAZ_LTOILSEU.PDF		

Appendix A

A.1 Centres and land use identification

Activity Centres

- Fremantle
- Booragoon
- Cockburn
- Kwinana
- Rockingham.

Neighbourhood Centres

- North Fremantle
- Petra St
- Melville
- Riseley St
- Kardinya
- Bull Creek
- Spearwood
- Wandi
- Baldivis
- Warnbro
- Brentwood
- South Fremantle
- Aubin Grove.

High density residential/ Mixed-use/ Special use

- Murdoch Uni
- Secret Harbour
- Canning Bridge
- Cockburn Coast
- Wellard
- Rockingham Beach
- Murdoch Hospitals.

Low density residential

- East Fremantle
- Beaconsfield
- Hamilton Hill
- Coogee
- Beeliar
- Hammond Park
- Parmelia.

Industrial

- Bibra Lake
- O'Connor
- Myaree
- Henderson
- Jandakot
- Kwinana Refinery
- Rockingham industry park.