EVERTY

# Electric Vehicle Charging for Local Governments

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# Executive Summary

This Guideline is designed to help Local Governments around Australia start thinking about how to build **electric vehicle (EV) charging networks.** Infrastructure that will be necessary in every community within the next decade.

Forecasts project **EVs will account for 30% of new car sales by 2030** (BNEF 2018)**.** To handle the expected growth, It is important that those considering their own network have best practice information to make the best decisions possible. Luckily there have been various case studies overseas pioneering the way for other jurisdictions. This Guideline is based part on overseas experience as well as Everty's knowledge of the Australian context.

**EVs have significant benefits over conventional internal combustion engined vehicles (ICE)** including reduced noise pollution, zero tailpipe emissions and lower health impacts. They are also quieter, more reliable and cheaper to run. Councils can take advantage of these by incorporating EVs not only into their fleet but supporting adoption in the community. Overseas experience shows that EV adoption is directly proportional to charging infrastructure. Therefore Councils can speed the transition to EVs by taking the lead in this area.

**There are several levels of chargers and plug types.** We recommend choosing high quality, networked chargers capable of being monetised and monitored. These chargers should be capable of servicing future EVs. Choose at least 7-22kW for AC Level 2 and at least 50 kW DC Level 3 for city placement and 50-350kW for highway placement. There are several recommended brands included in the Guideline. Most new EVs will come with plug Type 2, so Councils should focus on that plug for their rollout.

Developing a network involves **working with multiple stakeholders**. We have included a stakeholder flowchart that outlines the main stakeholders involved as well as their responsibilities. It's important to divide responsibilities early for smooth operation. It is also recommended to engage with an EV charging specialist/consultant to help with the process and for important network contacts.

**Goal setting is important** as it will help dictate the size and scale of the charger deployment. Issues to consider include the timescale of development, how many chargers are required and how the network contributes to overall goals like healthier communities, climate change mitigation as well as the future forecasted growth in the sector. At this stage it will help to develop internal momentum and 'buy-in' through consultations and briefings with important change agents.

**Take a strategic approach to charger deployment** rather than a demand response by asking key questions regarding your rollout such as; what kind of chargers you should choose, how many EVs you want to service and the period you wish to phase them in. It is important to conduct community surveys or research and then understand how that plays into your broader strategy.

**When designing a charging station**, consideration should be given to operational issues, price guidelines, security, adequate lighting, space requirements, signage, proper mounting, and protective measures like bollards. There are **several suggested siting factors** that will help optimise the selection of a physical location of the chargers. Councils should look at

existing infrastructure, location, electrical supply, access, physical safety, charging operations and site management.

There are **various sources of revenue, funds and finance** that Councils should investigate including public private partnerships, sales sharing models, grants from the CEFC and ARENA and low cost finance from Australia's banks. There are some costs unique to charging network operation and installation and councils will have to understand these as well as several recommended ways to reduce these costs.

Councils must have the **right permits and agreements in place** before undertaking installation. It's also important to choose a knowledgeable and up to date installer and where possible include a site plan or scope of works to minimise unforeseen costs. Councils should **regularly visit the site** to liaise with the site manager to eliminate any problems.

*Engaging a network manager like Everty to project manage planning, installation and monitoring can enable Local Governments to install and manage EV charging networks in the most efficient and cost effective manner.*

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# About Everty

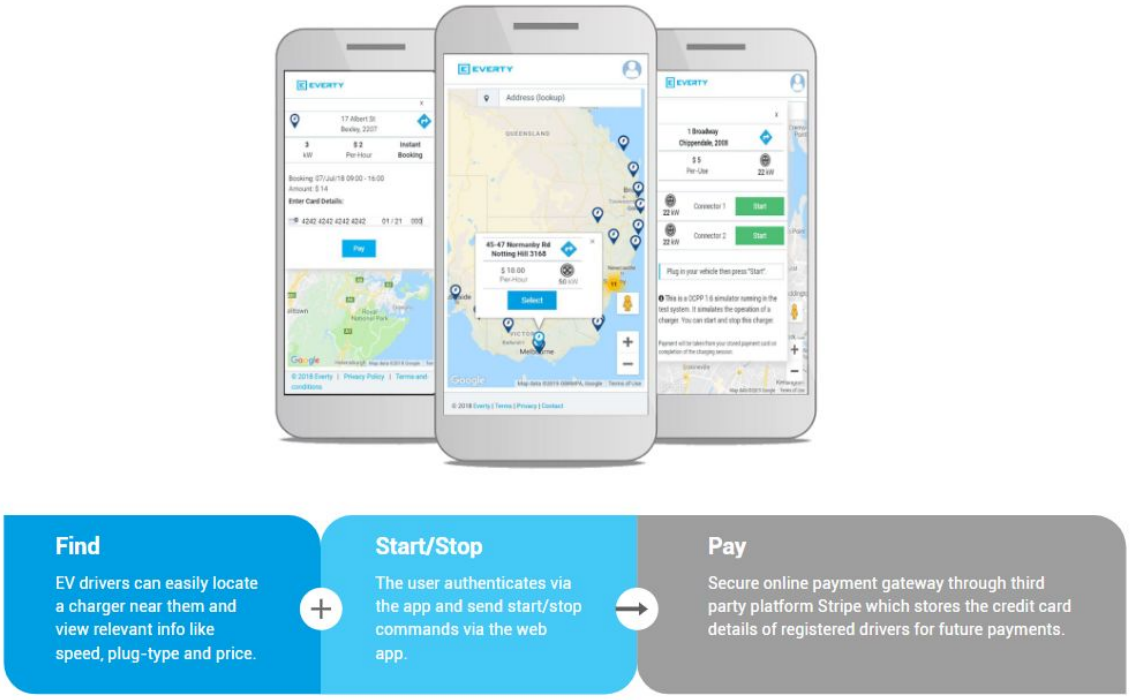
Everty Pty Ltd is an Electric Vehicle (EV) charging network operator based in Sydney. It was founded to foster collaboration in the electric vehicle (EV) community and empower consumers to actively participate in building a charging network.

Using Everty's platform, charging station operators can list their chargers, receive bookings (optional) and payments for the use of their chargers and are compensated for the electricity they provide.

Everty also works with developers, governments, utilities, networks and car-park operators, to make their chargers accessible and to get a return on their investment.

*Please contact Everty for your own charging solution.*

## The EV driver interface




# 1. Introduction

Electric vehicle (EV) uptake is accelerating globally. Last year was the biggest year to date with over 2 million sales globally. (BNEF 2018) Market disruption by startups like Tesla, worldwide diesel emissions scandals, downward pressure on battery prices, massive investment in EV technology and announcements of future bans on internal combustion engines (ICE) all signal a shift towards Battery powered Electric Vehicles. (BEV).

Bloomberg New Energy Finance now projects that EVs will be cost competitive with ICE vehicles by 2024 and account for 55% of new car sales by 2040 (BNEF 2018, Figure 1). Stakeholders, including local governments, must work together to ensure the policies, infrastructure and funding are in place to meet the future needs. This will include ensuring the public have adequate access to electric vehicle supply equipment (EVSE/chargers) to power their vehicles.

In Australia, the transition has already begun. with sales of BEVs like Tesla's Model S and X, Mitsubishi MiEV, Nissan Leaf, BMW i3, and Renault Zoe and a number of Plug-in Hybrid Electric Vehicles (PHEV) are all available for purchase. The number of available EV models in Australia grew by 44% to between 2016 and 2017. 9 more models are due in the next 18 months and there is potential to exceed 135 by 2040. (ClimateWorks 2018, p3)

Charging networks are also emerging lead by Tesla's 'supercharger' network on popular inter-state routes and destination chargers at some commercial locations such as shopping centres and hotels. Other OEMs like Jaguar-Land Rover are trailing closely behind with their own charger networks planned. State governments, including Queensland, ACT and South Australia and motoring groups like the NRMA and RACV and RACW are also working on EV charging networks.

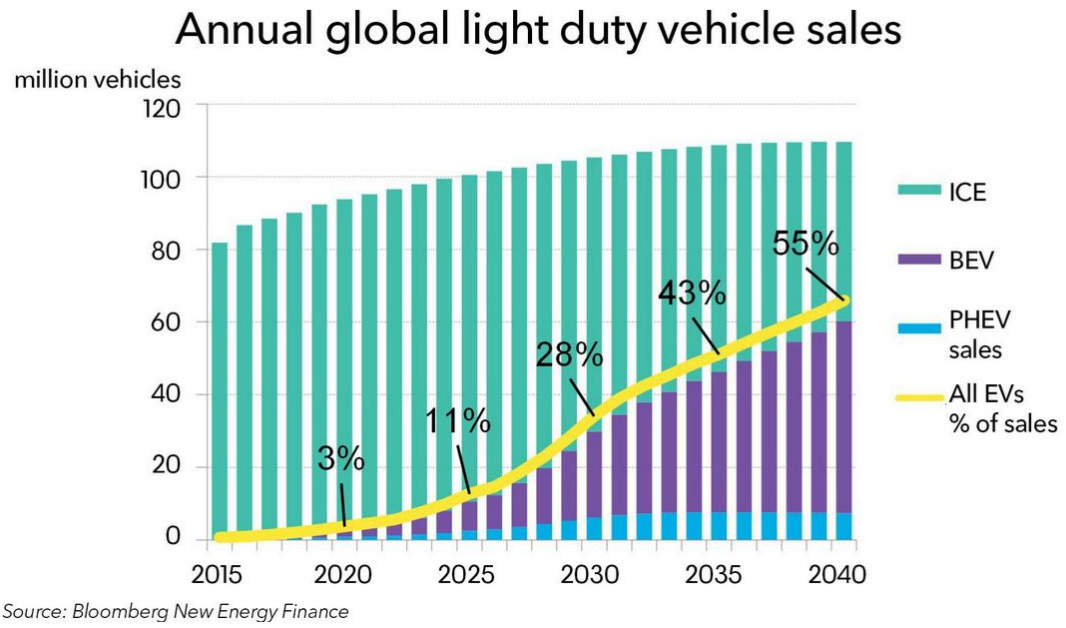



Image 1: Annual Global Light Duty Vehicle Sales (BNEF 2018)

## 1.1 EV Benefits

The benefits of the EV boom have been widely studied. Benefits for Australia include investment projected at $3.2 Billion going into charging infrastructure by 2030 (Electric Vehicle Council 2018, p4), innovations in smart grid integration, increased employment, energy independence and fuel security (ClimateWorks 2016) grid resilience, improvements in community health and smarter (and potentially autonomous), transport systems. (UK Office for Low Emissions Vehicles 2013, BNEF 2018)

For Local Governments, EVs provide a unique opportunity to improve the living standards of the community. Increasing the amount of EV's in the community will allow Councils to hit their sustainability goals. Benefits include reduced carbon emissions, whilst also improving local air quality, reducing noise for quieter and more peaceful suburbs, driving green business and tourism, and improving local transportation with more efficient mobility options (Fishbone et al. 2017; CleanTechnica 2018).

For Councils seeking to implement EVs into their own fleets, EV running costs are typically lower than their ICE counterparts with longer warranties, lower maintenance costs, low costs of charging, lower depreciation costs, (US Department of Energy 2012; The Climate Group, CENEX, Energy Saving Trust, 2012) and higher rates of user satisfaction (Williams 2018). This makes EVs an excellent investment for any fleet, especially those with high use.

It is axiomatic that EV uptake will be directly proportional to the amount of public charging infrastructure available (Cass & Grudnoff 2017; Hale & Lutsey 2017). Therefore Councils must plan, install and operate the chargers necessary to increase adoption and power new electric fleets.

Installing chargers has technical, planning, and financial considerations. This Guideline will outline these considerations and provide some recommendations to manage a rollout across local government areas. Ideally, Local Governments can then take an active role in the EV rollout and position themselves as the municipalities of the New Economy.

# 2. Charger Overview

EVs have different refueling patterns than ICE vehicles. Instead of refueling at a petrol station, EVs are more likely charged at home, work or in residential parking lots over a long periods. This convenience is one of the major advantages of EVs over ICE vehicles.

For people who do not have a charger in their home or work building, projected to be around 30% of EV owners (Energeia 2018, p5) drivers will charge their batteries at public chargers. These could be 'Level 2' chargers located on streets, in designated parking bays, at hotels, shopping centres, tourist sites and public spaces like parks, for shorter periods (0-4 hours).

For longer trips, most EV owners will use Level 3 'DC fast chargers' (DCFC) for a 30-90 minute charge at stations alongside major highways. In the future it is also likely DCFC will emerge in the inner city at stations (Energeia 2018). This change in refueling pattern requires local government to look at both hardware levels (Level 2 and Level 3) and then decide on the optimal ratio and placement. A brief overview of charging types is as follows.

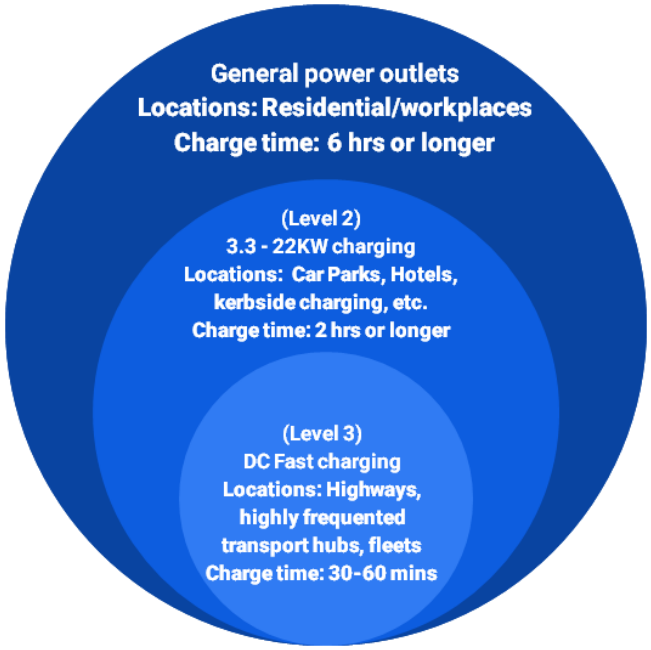



**Image 2:** Portion of Charger Types and Applications

## 2.1 Charger Type Overview

### 2.1.1 Level 1

Level 1 chargers can be plugged directly into a 240V wall socket. No dedicated circuitry is required. Level 1 cable adaptors are usually provided with EVs as a backup charger or as a standalone charger for those cars with smaller batteries like PHEVs. Level 1 chargers may take 12 hours to 24 hours to charge a vehicle. Level 1 chargers generally will not factor into local governments' mix as the rate of charge is slow. They may come into use with EVs purchased for Council fleets.

### 2.1.2 Level 2 AC

Level 2 chargers are directly wired into electrical networks on a dedicated circuit, of 16A to 40A, single phase or three phase. Most level 2 chargers are capable of between 3kW to 22kW of power, resulting in between 18 kilometres to 110 kilometres of charge per hour. With a total charge time of between 4 and 12 hours depending on the vehicle.

To future proof your network, it's recommended to install charging stations capable of 7-22 kW of power. This allows compatibility with the newest vehicles and a fast charging experience. For backwards compatibility, most EVs come with onboard software which allows the car to control rate of charge and power through level 1 or 2 chargers.

These chargers are suited to homes, multi-unit parking garages, retail centres, workplaces, cafes, restaurants and hotels etc. Anywhere with longer potential dwell times. With low costs associated with purchase and installation, Councils will likely have mostly Level 2 in their communities. Local Government should look at initially installing 1 charger per 5-10 EVs.

### 2.1.3 Level 3 DC Fast & Ultra-Fast

Level 3 DC fast chargers (DCFC) skip the car's inverter and power DC current straight into the car batteries. Current technology allows for up to 150 kW of potential power. Depending on the battery of the vehicle, future technology may allow for up to 350 kW of charge on 'ultra-fast chargers.' DCFCs are capable of charging a car to 80-90% of battery capacity in 40-50 minutes. In future with improved batteries and charging technology, it is anticipated that this will drop to as low as 5 to 10 minutes.

These chargers will be found on major highways and transport hubs. Companies like Tesla and others are now experimenting with deploying these in high density urban areas in shopping centres and parking lots in the US and Europe. Urban DCFC are projected to make up for the majority of charging in the coming years (Energeia 2018).

These chargers have high purchase and installation costs (>$50,000) and it is likely Councils will only have a handful of these across the community until hardware costs come down. A procurement ratio used in European and American cities is at least 1 per 50 EVs. For Councils which link up to major tourism areas i.e Sapphire Coast, Blue Mountains, or Snowy Mountains, 'range extension' DCFC allowing access to these areas may be a valuable tourism solution.

Table 1: Charger Level Overview

| Level | Cost | Location | Technical Specifications | Installation |
|---|---|---|---|---|
| Level 2 AC | $2000-10000 | - Parking garages<br>- Hotels<br>- Airports<br>- Retail centres<br>- Town centres<br>- Tourist areas<br>- Off-street parking<br>- Kerbside parking | Dedicated circuitry<br><br>3.3- 22kW, 240V, 16-32A,<br><br>Single phase or three phases,<br><br>Hardwired | *Medium difficulty*<br><br>One or two should not require too much planning, more than two may require site plan and potential electrical upgrades |
| Level 3 DC | >$50000 | - Alongside major highways<br>- Transportation hubs<br>- Parking lots<br>- Inner-city rapid recharge points | Dedicated circuitry<br><br>50kW up to 400kW, 200-600V, up to 1000A<br><br>Hardwired | *High difficulty*<br><br>Electrical upgrades may be necessary and consultation with the network provider is recommended for consultation and site plan/scope of work. |

### 2.1.4 Equipment Costs

Prices for hardware increase with technical capability including power capacity and network augmentation. Prices also vary between states and countries and are also projected to decrease over time, (Energeia 2018) so past figures do not reflect current trends. This will be a consideration for Councils balancing needs, costs and goals.

## 2.2 Future Technologies

### 2.2.1 Wireless Charging

Rapid innovation in the EV sector means charging technology will improve. One emerging technology is wireless charging. Wireless charging works by rolling the vehicle onto an induction pad on a ground surface, electricity is then sent directly to the underneath of vehicle via a coil or pad usually installed on the vehicles underside.

Some OEMs, including Audi and Mercedes, have announced future vehicles will have wireless charging compatibility. For others, products like ‘Plug Less’ and ‘Qualcomm Halo’ provide a wireless charging adaptor to install underneath the vehicle. Wireless charging is still in the initial stage of development. It is likely a government initial roll out will not include wireless charging but it may be added to charging networks in the future.

### 2.2.2 Vehicle to Grid

Networks are currently assessing the impact that EVs will have on electricity grid management due to the extra load they will pose to the system as well their impact shifting grid peak times.

One innovative technology which is being developed is 'Vehicle to Grid,' (V2G). V2G will allow some EVs the ability to feed energy stored in batteries back into the grid at a tariff rate. There are a number of innovative business models already evolving around this technology due to its potential to make the grid more reliable and resilient.

In future, advanced networked chargers are likely to be able to be upgraded to support this technology. No vehicle currently available allows for vehicle to grid, however several OEMs such as BMW and Nissan are investigating it's application.

V2G is still being trialled and while commercially it will be available next year, implementation is likely to be several years away for mainstream use as regulators and networks grapple with how to regulate it. So it is not recommended to focus on it in local government's initial charging network.

### 2.2.3 Integration with Renewable Energy and Storage

Given the current energy mix in Australia, with some States leaning heavily towards fossil fuels, an ideal EV charging scenario would pair the chargers with solar and battery systems. Companies like Tesla and others are experimenting with connecting chargers to solar and batteries however this does significantly increase the cost of the installations. Due to the power requirements of faster chargers it is not likely that such an arrangement would be able to power a vehicle without grid assistance.

Battery costs are also not at the level were the cost per kWh of storage capacity is low enough to be a sensible investment given the huge amount of storage capacity that would be needed to power several vehicles. While solar should be an inclusion on most buildings due to its relative cost, having a dedicated system for EVs is not recommended at this point.

## Recommendations

- *Have one level 2 AC charger per 5-10 EVs, and 1 DCFC per 50 EVs*
- *Focus on DC fast chargers with at least 50 kW of power, to balance speed and costs in the city and 50-350kW on highways*
- *Concentrate Level 2 chargers around shopping, retail areas and the town centre*
- *Councils close to tourism areas or along major highways should consider, 'range extension' DCFC to allow for access,*
- *Do not worry about future technology like wireless charging at this point*

## 2.3 Plug types

One barrier to EVs is the proliferation of different plug types across the Australian EV market. As EVs are an emerging technology, there currently is no 'standard' plug type. There are currently two main Level 1 and 2 plug types, *SAE J2772* (type 1) and *IEC 62196* (type 2), as well as several fast charging (level 3) standards such as CCS Combo and CHAdeMO.

### 2.3.1 SAE J2772 (Type 1)

Type 1 is found in American vehicles like the Chevy Bolt and Japanese vehicles like the Mitsubishi Outlander and Nissan Leaf. Type 1 is capable of handling 240V, 7.4 kW at 32A on a single phase. Most recent Type 1 vehicles come with CHAdeMO plug compatibility to support DCFC. In Australia, plug Type 1 is phasing out and the general consensus from car OEMS and EVSE suppliers is to move to Type 2.

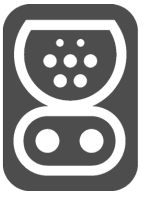
### 2.3.3 IEC 62196 (Type 2)

Type 2 is mostly found in European and American vehicles. Most EVs in Australia are now Type 2 and there is general consensus that Type 2 will be standardised across the country. This plug type allows for up to 22 kW of power through AC Level 2 or up to 43 kW through a DCFC.

### 2.3.2 CHAdeMO Plug

CHAdeMO plugs are found in Japanese and Korean vehicles (Toyota, Mazda, Kia, Nissan and Mitsubishi) and some European vehicles (Peugeot and Citroën). CHAdeMO plugs are fast charging compatible and allow up to 125A for 62.5 kW of power. Future CHAdeMO 2.0 chargers may be able to handle 400 kW of power. Manufactures have included CHAdeMO in recent EVs to allow for fast charging alongside the Type 1 plug.

### 2.3.4 CCS Combo 1 and 2



CCS Combo 1 is the standard DC plug in Europe. It's current capability includes, up to 1000V, 200A, of 50-350 kW of power resulting in charge times of 30-50 minutes. Future plug types may allow for charge in as little at 5-10 minutes. Most future EVs in Australia will likely come side to side packaged with Type 2 and CCS 2. Councils should focus predominantly on this plug with their roll out.

## Recommendations

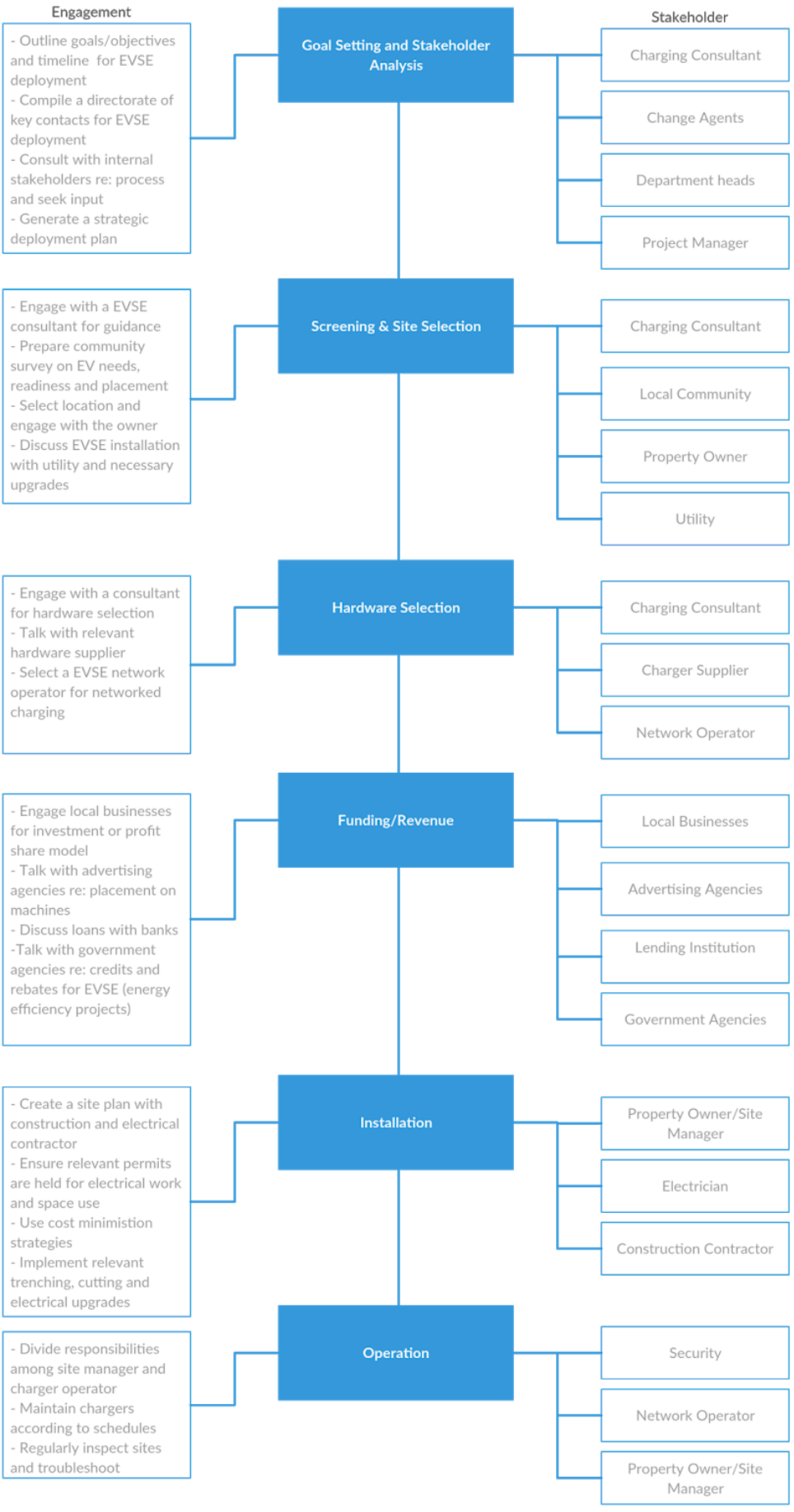
- *Most chargers will come with dual compatibility with both Type 1 and Type 2,*
- *Variants of Type 2 and CCS Combo will be able to service up to 400 kW of power and future vehicles*
- *It is recommended that Councils should focus rollouts on Type 2 chargers*


# 3. Project Stakeholder Engagement and Process

Before undertaking the proceeding steps, Councils should engage the various stakeholders involved and compile a directorate (spreadsheet) of important contacts. This is essential to smooth operation, division of responsibilities and legal purposes. The Project Manager for the chargers should take control of the communication with the stakeholders.

It would be beneficial for Councils to also engage with charging consultant to help with the process. This consultant will have key contacts in their own network for each stage and can act also as project manager.

Below is a basic process outlining the stages/responsibilities of EVSE deployment and the relevant stakeholder.


Engagement
- Outline goals/objectives and timeline for EVSE deployment
- Compile a directorate of key contacts for EVSE deployment
- Consult with internal stakeholders re: process and seek input
- Generate a strategic deployment plan
Goal Setting and Stakeholder Analysis
Stakeholder
Charging Consultant
Change Agents
Department heads
Project Manager
- Engage with a EVSE consultant for guidance
- Prepare community survey on EV needs, readiness and placement
- Select location and engage with the owner
- Discuss EVSE installation with utility and necessary upgrades
Screening & Site Selection
Charging Consultant
Local Community
Property Owner
Utility
- Engage with a consultant for hardware selection
- Talk with relevant hardware supplier
- Select a EVSE network operator for networked charging
Hardware Selection
Charging Consultant
Charger Supplier
Network Operator
- Engage local businesses for investment or profit share model
- Talk with advertising agencies re: placement on machines
- Discuss loans with banks
-Talk with government agencies re: credits and rebates for EVSE (energy efficiency projects)
Funding/Revenue
Local Businesses
Advertising Agencies
Lending Institution
Government Agencies
- Create a site plan with construction and electrical contractor
- Ensure relevant permits are held for electrical work and space use
- Use cost minimistion strategies
- Implement relevant trenching, cutting and electrical upgrades
Installation
Property Owner/Site Manager
Electrician
Construction Contractor
- Divide responsibilities among site manager and charger operator
- Maintain chargers according to schedules
- Regularly inspect sites and troubleshoot
Operation
Security
Network Operator
Property Owner/Site Manager


# 4. Initial Steps

## 4.1 Goal Setting and Consultation

At the beginning, it is essential to outline the goals of the deployment including both core KPIs for charger penetration and the timeline. It is helpful to link these to larger more aspirational goals including climate change and community health. Goal setting, will help both set the intention internally and then guide the decision making when it comes to setting strategy for scale/timeline, placement and selection of chargers.

Project managers and key individuals will also have to build internal momentum for change. This involves a consultative approach including meetings with teams, managers, department heads and change agents. Meetings should look at evaluating goals and the process, whilst also seeking constructive input from each party regarding viability, challenges and overall strategy outlined in this guide.

## 4.2 Community Demographics

After goal setting, It is important to understand community demographics which will inform charger selection, rate of deployment and charger placement. This will be essential to maximising revenue from the chargers.

It is important to research residents' weekday and weekend commuting patterns, existing local charging infrastructure, business activities and overall community support. By the end of the research process, Councils should have an idea of the ratio of slower to faster chargers to install, approximate location of each type of charger as well as overall community EV knowledge for awareness and education purposes.

Key information collected should include:

- EV charging knowledge of residents
- EV driver profile
- Likely commuting stops
- Duration of stops
- Kept location of car (on street, carport or residential apartment parking)
- Level of willingness to pay for services
- Critical traffic corridors, i.e stretches of highly utilised highway or busy intra-city routes
- Key site scoping
- Existing chargers in the area
- Local business support/partnerships in EV Charging
- Parking turnover at identified site

Example findings from this process that will inform strategy may include:

- Most EVs are street parked and therefore need provisions for curbside parking charging
- Residents may visit the local shops for long periods over the weekend, so retail shopping chargers may be included
- Local businesses may show interest in partnering with the Council for charging thus reducing the initial investment burden on the Council
- The EV charging knowledge of the community is low and education campaigns may be necessary

Each Local Government area will have its own specific requirements. A data driven approach will be helpful in creating a tailored charging solution for the community.

## 4.3 Driver Profiles

In strategising deployment, it is helpful to categorise driver profiles and the implications of each. There are three broad categories: 'short city commuters;'; 'long commuters;' and 'long haul or intra-regional drivers.' In a community there will be inevitable overlap and a driver's behaviour may alternate between profiles on any given day.

Councils will have to think about how their community demographics fit these categories and how that will shift the mix of chargers and locations they choose.

Table 2: EV Driver Profile

| Profile | Associated with | Charger type needed | Primary Concern | Pricing | Duration of Stop |
|---|---|---|---|---|---|
| **Short-City Commuter (<40kM)** | - Multi-unit dwelling owners<br>- Street parkers<br>- Office workers<br>- Grocery shoppers | - Day fast charger *(level 3, 50W)*<br>- Night charging stations off-street or kerbside *(level 2, 7.2-11 kW)*<br>- Daytime off-street or kerbside (level 2, 7.2- 22kW) shopping district, town centre etc. | - Range anxiety<br>- Convenience<br>- Extensive variety of locations | Willing to pay premium price for convenience factor<br>Level 3 and level 2 should be priced differently due to speed<br>Incorporate meter fee in pricing | 0-2 hours on-street faster charging<br>0-4 hours daytime whilst shopping<br>4-12 hours nighttime hours, car left overnight or for several hours |
| **Long Commuters (>80kM)** | - Taxi, limousine, Uber drivers,<br>- Delivery drivers<br>- People with home chargers<br>- Long distance work commuters | - Day fast charger *(level 3, 50kW)*<br>- Night charging stations off-street or kerbside *(level 2, 7.2-11 kW)*<br>- Daytime off-street or kerbside shopping district areas /town centre (level 2, 7.2-22kW) | - Range anxiety<br>- Stop on route to destination<br>- Variety of locations | Price sensitive and may charge at home, low priced, widely dispersed<br>Level 3 and level 2 should be priced differently due to speed<br>Incorporate meter fee in pricing | 0-2 Hours at normal stops for a top up or fast charge<br>0-4 Hours daytime, whilst shopping<br>4-8 Hours, night time, car left overnight or for several hours |
| **Long Haul Drivers (>110kM)** | - Tourists<br>- Freight<br>- Rural workers<br>- Inter-regional transport | - Day and night range extension *(level 3, 50-350kW)*<br>- Day and night chargers upon arrival (level 2, 7.2-22kW) | - Range anxiety<br>- Stop on route to destination | Charge often and will pay a premium out of necessity | 30-90 Minutes for fast charges<br>0-2 Hours, at tourist destinations or truck stops<br>4-12 Hours, upon arrival |

## 4.4 Deployment Strategy

Deployment strategy will take into account goals, and the information collected in the community survey. Councils can pursue a demand driven strategy initially focusing on providing enough infrastructure for existing EV drivers or Councils could utilise a strategic approach, which builds a network based on forecasted growth and their goals for EV uptake.

It may be helpful to think of the deployment strategy in these ways:

- What is the timescale; fast (<1 year) or measured rollout (2 to 5 years)?
- Where do you think EV uptake will be in several years time?
- How many EVs do you want in the community?
- What is your emissions reduction target?
- Will you focus on the inner areas of the suburb and then grow outwards?
- WIll you need to link the chargers to other networks?
- Is there an option to partner with other Councils?
- What are the key locations and routes?
- How long do you want people to stop for?
- How will you deal with the potential for non-EVs to park in those spaces?
- Will you focus mainly on fast chargers or slower chargers?
- What is your overall budget?
- Are you also looking to include EVs in your own fleet?
- How are you going to manage EV community education and awareness?

Studies have suggested that initial infrastructure is necessary to spur adoption. Therefore, It is recommended to take a strategic approach and plan for more than current business as usual growth in the space. Doing so will likely create a upward spiral which results in more models in the local market, more infrastructure and favourable policies for EV uptake.

If the right strategy for the community is adopted, key markers of success will be high utilisation, high willingness to pay and high parking turnover.

## 4.5 Hardware Selection

The data discovered by research and strategy developed will inform the choice of hardware. There are currently many offerings in both AC and DCFC from domestic and international hardware suppliers at various price points.

It is recommended Councils install chargers likely to be able to service upcoming cars, up to 5 years into the future. This will mean spending more initially on advanced chargers, including those with the ability to connect with the internet. Typically, the faster and more networked the charger, the costlier the unit. However, operating costs, like maintenance on low quality units can outweigh the upfront and ongoing costs of a more expensive unit over the unit lifetime.

It is important to note that every building will have unique circuitry and the hardware should be selected specifically for each. That may mean looking at the location's ability to be retrofitted with the necessary circuitry and upgrades to meet added demand.

Older buildings may necessitate less powerful chargers that take up less supply and Amps across the phases. Newer buildings may be able to take several more powerful system before nuisance tripping happens. To mitigate these risks, more advanced chargers are now coming bundled with load management capability which can manage supply to the chargers.

Like any investment, Councils will need all the information necessary to make an informed purchase. Some basic information that should be researched includes:

- Power, voltage and amperage levels
- Wall mounted, free standing, or stand alone
- Additional plug outlets
- Plug type compatibility and adaptors
- Cable type and length inclusion
- Weatherproofing capability
- Warranty information and length
- Maintenance schedules
- Network capabilities/Level of OCPP (Open Charge  Point Protocol) compliance
- A contact number for hardware support
- Case studies of existing hardware deployments

There are a variety of appropriate chargers for different use-cases. Please contact Everty or your charging consultant for more information.

## 4.6 Networked Charging

Currently chargers come in two categories. Those that are networked, which connect with the internet and those non-networked. Non-networked chargers are cheaper to purchase and deploy but they have several disadvantages such as not being able to be monetised, no real-time monitoring,d less smart charging capabilities and maybe more expensive in the long run.

Networked chargers access the internet via an ethernet cable routed to a 3G or wireless router, or built in 3G capability.

Experience in overseas markets suggests that chargers should be networked so that they can communicate with fleet management tools as well as charging station management systems. The benefits of such a system include:

- Monetisation and user invoicing with web app integration
- Ease of access via a web app
- Behaviour and electricity consumption analysis of the user
- Electricity metering and reporting, made available to the network manager
- Monitoring for energy balance and load management
- Monitoring and reporting capabilities for offline chargers and maintenance
- Real-time charger availability for charger maps
- On-demand and monthly summary reporting
- Future readiness capability with improved protocols and technologies

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Networked charging allows a data driven approach that will lead to the best possible user experience with reliable, easy to use chargers. It also gives Councils the ability to easily scale, monetise and integrate future chargers into existing networks.


# 5. Site Selection and Station Design

## 5.1 Site Selection

Finding the right site is crucial to facilitating community utilisation which in turn will enhance the return on investment. This will involve consideration of various factors. When screening a site, considerations should include the following:

**Existing infrastructure**
Construction and labour costs including building new amenities, pathways or removing obstacles will be the leading driver of charger costs. Creating a site plan and scope of works for the selected site is vital. beforehand. Decide on a site where trenching, curb cutting or concreting can be kept to a minimum. This will go a long way to keeping costs down.

**Location**
Select a site in a visible, high utilisation area. This could include a public parking lot, alongside a shopping area or a alongside a main street, away from existing chargers. It is important to understand how the charging station will change existing activity in the area and how that will impact on the site plan and/or modifications.

**Facilities and amenities**
Make sure the charger has surrounding facilities like restrooms, access to cafes and shops. Providing opportunities for recreation and for access to local business is important for increasing the use of chargers and revenue maximisation.

**Access**
Ensure the site meets all the requirements for an ideal user experience. This includes making access easy by not obscuring it visibly, having bi-directional road access, near elevator access if necessary, not placing behind booms gates, or in a closed of area. If in a building, place the chargers towards the entrance. The area also may require improvements in pedestrian access, the elimination or relocation of obstacles and the installation of traffic diversions. Ensure the area meets all the regulatory requirements for disability access.

**Physical size of charging, wall or standalone,**
The physical size of the charging space matters. Ensure that the site selected has ample room to move around the vehicle. Decide whether a wall mounted or stand-alone charger will be most appropriate when optimising the space and access. Make space provisions for the inclusion of protective bollards and car stoppers.

**Power and energy audit**
Find the source of electricity and electrical panel/circuits and confirm that the existing infrastructure is capable of handling the load. A dedicated circuit is required for all installations. Canvas proposed site upgrades with the energy utility and investigate what service, circuits, transformer upgrades and metering will be necessary. Ensure large cable diameters of are used to reduce overheating. Residual current devices (RCD) should also be fitted to each charger. Choosing a location with panels and circuits close to the intended bays will significantly reduce installation costs.

**Safety**
Chargers should be located in areas with adequate lighting and ventilation. Sites should be away from potential hazards like busy roads, active construction sites, and areas with potential gas and liquid/flooding exposure. Ensure the site looks and feels safe to approach.

**Charging operations and site management**
Involve the property owner/site manager early in the charging installation planning process. Discuss operations including division of responsibilities for maintenance, monitoring, vandalism and security. In the event of liability, delegate the party responsible for the necessary insurance. Research and implement what agreements and contracts are necessary to operate the chargers.

## 5.2 Station Design

Having a well-designed EV station is critical to both utilisation and seamless operation. Every design and installation scenario is different. Each will have its own considerations. There are several resources available that can assist with site specific parking scenarios such as mid-lot, fleet, kerbside, multi-unit dwelling, commercial retail and service station parking.

Some general guidelines are as follows:

**Signage and Wayfinding**
Install EV signage for designated parking bays. Include EV charging station signage, time limits on charging, removal of unauthorized vehicles notice or infringement, regulatory signage including parking restrictions, hours and days of operations.

**Space Size**
Allocate for mid to large sized bays for all EV types. More space is also required to allow for movement around the charging stations and the installation of protective measures like bollards. Plan so that the charger does not interfere with other traffic or unloading/loading of the vehicle.

**Lighting**
Minimize risk of damage, vandalism and boost safety by having the EV station well lit, including light on the frontward facing panelling of the charger for operations.

**Mounting**
Choose a charger design that maximises the useability and space of the site. EVSE can come in wall mounted, ceiling mounted or standalone formats. Wall mounted EVSE can be a great way to reduce installation costs.

**Cables**
Ensure that the charger comes with Type 1 and Type 2 plug compatibility. If not, adaptors can be attached for conversion. Confirm that the charger comes with thick durable cables for outside operations and with the required length for charging, preferably 5m long.

**Cable holders**
Attach cable holders or a retraction device to keep cables off the ground when not in operation for product durability and trip hazard safety.

**Operation Guidelines**
Install clear graphics showing operation/app instructions including how to download or access app to operate charging or paying as well as safety precautions.

**Protection and safety**
Install protective bollards or car stoppers to protect the charging unit from reversed or parallel parking. Design may be subject to safety by design and crime prevention requirements depending on the state.

**Security**
Charging station vandalism can impact the reliability of the station as well as potentially make operation dangerous for users. Security including closed-circuit-television or security guards may be necessary. Some states like Queensland and New South Wales require ‘Crime Prevention by Environmental Design.’

**Pricing Guidelines**
Place clear information (either on screen or off) showing cost of charging per kWh and/or connection fees/subscription service fees.

**Contact numbers**
Provide numbers or a control buttons on the machine for 24/7 technical support and for emergency services. Availability of technicians for on or off-site support should be part of a service plan from installers.

**Regulations and Permitting**
Research what codes and ordinances apply to the site with specific reference to building, construction and electrical codes. For electrical installations, AS3000 now has specific wiring and socket requirements for EVs. Choose an electrician familiar with the new regulatory requirements. For any DCFC installations contact a Level 2 accredited installer who can manage meter/ transformer upgrades that will be necessary with more powerful installations. Research and apply for the relevant permits for the site.

# 6. Economics of Charging

At this point Councils should have an idea of location, approximate number of chargers to be deployed and site specific planning/design requirements. It is important to understand the costs involved in installing, operating, and maintaining the proposed network in order to assess viability.

Councils can minimise costs by utilising low cost finance and employing site specific cost minimisation approaches, whilst maximising revenue by utilising tax credits, government grants, and employing alternative ownership models.

Table 4 below is a summary of the costs, revenues and funding that could go into EVSE ownership:

Table 4: Charger Costs and Revenues Overview

| Costs | | Revenues/Funding | |
|---|---|---|---|
| Capital Expenditure | Operating Expenditure | Revenues | Funding |
| *Equipment* | *Electricity costs* | *Direct* | Grants |
| AC Level 2 | Capacity charges | Customer use revenue | Tax credits |
| DC Level 3 | Power costs | Subscription fees | Low interest finance |
| *Installation* | Demand charges | Marketing and advertising | OEM partnerships |
| Host site screening | *Other variable costs* | *Indirect* | Retail partnerships |
| Lease and rent | Charging network operator fee | Tourism | Utility partnerships |
| Construction | Maintenance and repairs | Retail sales | |
| Electric utility upgrades | Warranties | | |
| Signage and markings | Interest expense | | |
| Traffic protection | Tax expense | | |
| Lighting | Permitting | | |

## 6.1 Revenue Maximisation and Pricing

The key determinants of charger profitability and revenue will be utilisation, willingness to pay, and parking turnover. All the factors as previously discussed in siting and community demographics are important for revenue maximisation. Although possible, it is not recommended that Councils provide the chargers as a free service due to expectation setting for EV owners and revenue loss (Fishbone et al. 2017, p22).

Councils must think about the balance between the application of the specific chargers and pricing. Do you keep prices low initially to incentivise use and encourage EV adoption? Keeping in mind this may set a negative precedent with low payment for a charge. If you were entering the market at a later date you may set the prices lower to grow the user base.

There will be tension between how long you want people to stop and shop or visit the site and how fast the chargers will power the vehicle. For example if you are installing chargers at a shopping district you will not want the user charged within 1 hour, so they have to come back and move the vehicle or leave and not spend at the stores. This must be also weighed with allowing the opportunity to charge for other EV owners and not allowing one user to dominate the space.

One other risk to revenue is use of the EV space by ICE vehicles. Councils will have to think about how they manage this and penalise ICE vehicles for using the space. (The same goes for EV owners who are not using the chargers but just the space). This may mean educating rangers on the visible differences between vehicles. Some jurisdictions use EV number plates or EV stickers to help with this.

### 6.1.1 Direct Revenue

- Using networked chargers it is straightforward to monetise the network by having a pay per time system. For Councils, this may also involve incorporating additional parking rates for the space into this fee.

- An alternative model is to have a flat monthly subscription fee. Operators in the US and Europe have had success with either one or a combination of fee and subscription.

- Charger operators have experimented with having third party advertising on the units themselves or on the graphics that appear on the unit or point of sales/separate screens.

- Local governments could partner with retail shops to increase revenue through a sales sharing model or for upfront initial investment. Studies have shown that having charger close to retail areas increases the dwell time and spending. (Nigro et al. 2015, p26) For Councils, this could be a percentage of the increased sales or a fee for retail centres. For retail centres, loyalty rewards systems have been effective i.e. spend $20 and receive free charging.

- As with the retail sales model, partnering with car OEMs who are seeking to increase support for their EV models in the local market, could be beneficial for both revenues and funding for the network.

- In other jurisdictions, some charger operators are partnering with network utilities to subsidise upfront purchase costs. In Australia, there are a few trials experimenting with utility involvement, especially in regards to innovative technology like demand response management.

### 6.1.2 Indirect Revenues

Indirect revenues are harder to calculate but should be considered with charger deployment. EV drivers carefully select where to charge their vehicle, often going out of their way to get to a location.

Councils have the unique opportunity to attract people from within and outside the community to specific locations, be they tourist areas like national parks or shopping areas with restaurants, retail shops or attractions. This is a unique opportunity for councils in rural areas or tourism regions which have the ability to draw people away from the major highways to towns.

With the high upfront costs of EVs, it is also likely that the drivers have higher than average incomes and may contribute more than the average driver to the specific location.

## 6.2 Funding

### 6.2.1 Grants and Funding

Councils have access to various means to fund public the installation of EV charging stations, grants and low interest finance. There are several federal government options including:

- ARENA Innovation Fund,
- Advancing Renewables Grant
- Distributed Energy Resources Grant
- Emissions Reduction Fund
- Sustainable Cities Fund

Councils should also investigate state and city level grants available to them:

- Victorian Public Sector Innovation Fund, Victoria Sustainability Programs, Future Industries Fund
- New South Wales Energy Efficiency and Climate Change Fund
- Queensland Community Sustainability Action Grant

### 6.2.2 Low cost finance

Finding the lowest cost finance will reduce interest expense. The CEFC and Australian banks have low interest financing for energy related assets across Australia. Visit CEFC online for more information. According to the CEFC, some basic ways to debt fund the project through major Australian banks are as follows:

- The **$300 million Energy Efficient Bonus** equipment financing program by **National Australia Bank (NAB)** to accelerate the uptake of energy efficient vehicles and clean energy equipment by businesses and agribusinesses. The program is designed to boost the switch to low emissions and cleaner vehicles, as well as help businesses upgrade industrial and agricultural equipment and increase their uptake of solar and battery storage.

- The **$150 million ANZ Energy Efficient Asset Finance Program** is supporting ANZ customers by reducing interest margins when they invest in energy-efficient and renewable technologies with the purpose of reducing carbon emissions.

- The **$50 million Macquarie Leasing Asset Finance** program offers discounted financing rates for businesses and consumers who choose to finance electric and plug-in hybrid electric vehicles, as well as a range of qualifying energy efficient and renewable energy equipment; and

- The **$200 million Westpac Energy Efficient Finance** program will assist businesses to lower their energy costs and improve their competitiveness using clean energy. Westpac will use the CEFC commitment to provide its customers with a 0.7 per cent

discount on finance for qualifying projects supporting investment in solar, energy efficient technologies and low emissions vehicles.

- **Metro Finance,** which has an extensive broker network across Australia, is offering a 0.7 per cent discount on the standard rates offered to customers who purchase lower emissions passenger and light commercial vehicles that meet predetermined standards.

- The CEFC's finance allows **Eclipx Group**, one of Australia's largest independent fleet leasing companies, to offer favourable loan interest rates for customers when they invest in passenger and light commercial vehicles satisfying low emissions benchmarks.

(CEFC 2018)

## 6.3 Costs

There are a variety of costs associated with installing . Installation, including construction and electrical labour and materials, (Alexander 2014), accounts for between 60-80% of all costs. Hardware, maintenance, operator fees, permitting and other costs make up the remainder (Snyder UCLA 2012).

In terms of operating expenditure, if lower quality units are selected, maintenance costs may balloon to 30% of total cost so it is essential to choose high quality, networked chargers (Ensto 2016).

See Figure 3 below for an example breakdown of charger installation costs in the State of California in the US. The actual dollar cost breakdown varies, however, labour costs and their dominant proportion hold constant between countries, state and local government areas. Therefore the same cost minimisation principles will apply.

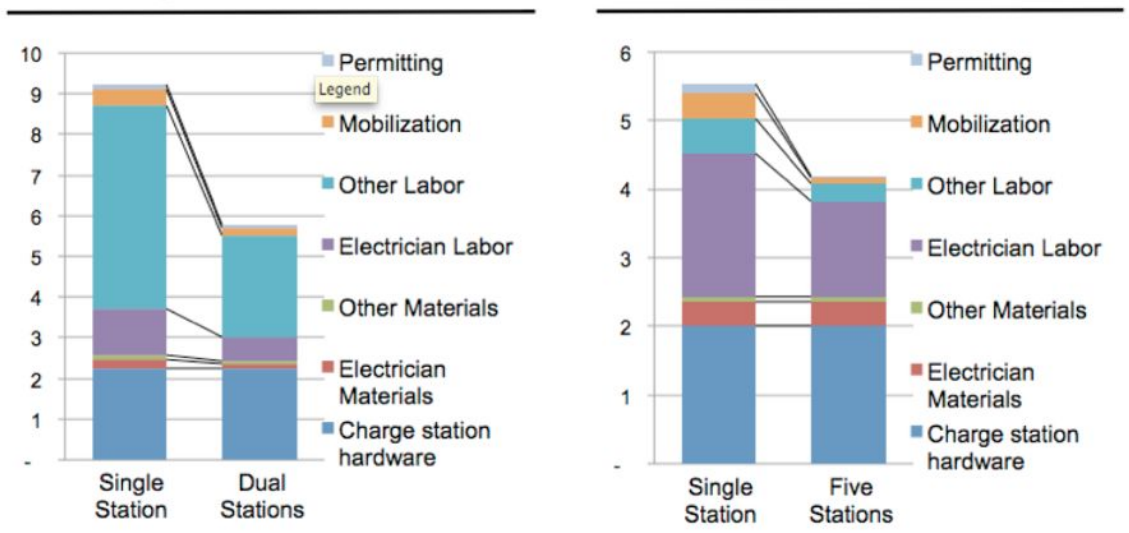


Figure 3: Kerbside and Parking Garage Cost Breakdown (RMI 2014)

### 6.3.1 Sources of High Costs

Based on overseas experience in this area, the scenarios that make charger deployment high cost include the following:

- The need for an upgrade due to lack of available capacity on the existing electrical panel
- Long distances from the electrical panel to the proposed charging location
- Need for electrical panel rework or the addition of a sub-panel
- Need for the installation of a transformer or other electrical infrastructure equipment
- Need for trenching through concrete or asphalt
- Siting decisions that increase the distance from the electrical panel
- The cost of labor where the installation is sited
- Previous wiring for a charger installation
- The number and type of Level 2 charger units installed at each site

(Alexander 2014)

### 6.3.2 Other Costs

Costs that are unique to chargers are network operator fees. Operator fees are incurred for third parties, such as Everty, to manage the networked charger including monitoring, billing, data analysis, and reporting. This cost may come as a percentage of the charging revenue on a monthly basis or as one-off fees.

Other costs may include energy such as demand charges and electricity consumption costs, maintenance and repairs (scheduled and unscheduled) such as new cables and or unit vandalism cleaning, extra warranties available at purchase, leasing of the parking space and permitting.

### 6.3.3 Cost Minimisation Strategies

Despite high potential outlays, Councils can take steps to minimise electrical and construction costs. Some actions include:

- **Choosing a wall mounted design** to minimise trenching or boring
- **Choosing a high quality charger** to minimise unscheduled maintenance and repairs
- **Choosing a dual port charger** to spread the costs between charging ports
- **Installing more than one unit** at a time to reduce costs associated with future installation and increase economies of scale
- **Determining electrical load available** to the site and choose quantity and level of chargers fit within the current parameters without having to upgrade electric panelling or transformer
- **Choosing a location with the necessary circruity** to handle extra demand
- Understanding and **balancing the trade-off** between **visibility** of the charger and **proximity** to electrical panelling

- Ideally **placing the charger close to the electrical panels** to minimise boring/trenching and resulting extra electrical cabling to the unit
- **Choosing a location with existing space** on the electrical circuit
- **Finding a spot away from barriers** or obstacles which may have to be removed
- **Remotely manage the chargers** through the network operator to monitor, and update the system. This will save frequent and expensive site visits


# 7. Installation and Operations

With a strategy in place, stakeholder requirements having been satisfied, sites, hardware selected and funding available then the network is ready to be installed.

The next step is to ensure all the documentation like permits, agreements and contracts are in place. Elect an installer with knowledge and experience with chargers, especially one up-to-date with current regulatory requirements and hardware technicalities. There are new requirements in appendix P. of the AS3000 for Electric Vehicle chargers.

*Everty have several preferred installers, so please reach out and we can advise at this stage.*

Outline the site and cost requirements to the installer and consult with them regarding cost minimisation strategies. For larger installations with multiple Level 2 or level 3 DCFC, ask for a site plan or scope of works identifying proposed activities like trenching, boring or any upgrades required. This will help avoid incremental costs when obstacles are encountered. Maintain open communication for any modifications that may be necessary.

Once the chargers are installed, keep up to date with regular maintenance schedules, firmware updates, regularly inspect the site and communicate with the site manager or property owner for troubleshooting. Take advantage of your network operator and receive updates on unit operation through regular monthly reports.

*If this party is not identified, please contact Everty for a custom solution.*

# 8. Conclusion

Australian Local Governments have the opportunity to support and benefit from a greener transport future. To enable this, thousands of dedicated charge-points for EVs will have to be installed in` the coming years. The benefits are many yet there are technical, planning and economic barriers. With this Guideline ideally the job should be made easier.

## 8.1 Primary Recommendations

1. Use a **charging consultant** to help plan and outline the process
2. Goal set and manage the change internally by **educating and consulting**
3. Build out **external stakeholder contacts** and internal core competencies
4. Engage in research into **community demographics**
5. **Devise a deployment strategy** including timeline, scale, and locations
6. Select **high quality chargers** to minimise ongoing maintenance costs
7. Select **future-proof chargers** for future EV compatibility for up to 5 years
8. Use **networked chargers** to monetise, manage and monitor the network
9. **Find the right site** with the relevant electrical and construction infrastructure
10. Create a site design for **high utilisation, access and safety**
11. Look for **innovative ways to fund** the network. Engage with stakeholders like local businesses, advertising agencies and OEMs for alternative revenue models
12. Look for **low cost finance** through existing CEFC lending instruments and government grants.
13. **Minimise installation and operations costs** through cost saving techniques
14. Engage with **the right installer**, if necessary create a site plan or scope of works
15. **Maintain the charger** according to schedule and do regular site inspections in consultation with the site or project manager
16. Have the network operator create **regular reports** and distribute among stakeholders.

*For more information and assistance with your network, please contact Everty for a seamless charging solution.*

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