

# Deploying EV Charging Infrastructure: What Site Hosts Need to Know



## Driving to Net Zero

Submitted to: Santa Clara  
County  
Submitted by: ICF

County of Santa Clara Office of Sustainability

FUNDED THROUGH A GRANT  
AWARDED BY THE CALIFORNIA  
STRATEGIC GROWTH COUNCIL

MARCH 9, 2018



## Acknowledgements



The work upon which this publication is based was funded in whole or in part through a grant awarded by the California Strategic Growth Council.

Santa Clara County would like to acknowledge the cities of Cupertino, Morgan Hill, Mountain View, Palo Alto, San Jose, and Sunnyvale for their contributions and support as partners in the Driving to Net Zero Project.

## Disclaimer

The statements and conclusions of this report are those of the County of Santa Clara and/or ICF and not necessarily those of the California Strategic Growth Council or of the California Department of Conservation, or its employees. The California Strategic Growth Council and the California Department of Conservation make no warranties, express or implied, and assume no liability for the information contained in the succeeding text.

## Introduction

Santa Clara County currently has the highest adoption of electric vehicles (EVs) in the entire United States. Although most charging currently occurs at homes (about 70-80%), there will likely be an increased demand for away-from-home charging. This will present an opportunity for potential sites hosts, including developers and municipal governments. However, potential site hosts may struggle with the myriad issues to navigate in the process of installing EV charging infrastructure. This toolkit summarizes the key issues for potential site hosts to be aware of when installing EV charging infrastructure—focusing on municipal governments and developers. It includes checklists, procurement recommendations, and other considerations for staff when they ask: “How do I start?”

This document is structured as a question and answer format, with five questions that should be addressed as site hosts consider deploying EV charging infrastructure.

## What are the basics?

Most toolkits will get confusing for an interested site host: we’ve tried to simplify things for potential site hosts. In short, site hosts do not need to become EV experts to install EV charging infrastructure. Rather, site hosts need to know a handful of basics: there are two types of EVs and there are several different ways to plug in.

**Electric vehicles:** There are battery electric vehicles (BEVs) and there are plug-in hybrid electric vehicles (PHEVs). The former only uses electricity and the latter has an electric motor that provides 20-55 miles of electric range before a gasoline engine powers the vehicle. For the sake of reference, the market is currently split nearly 50-50 between these two types of EVs as of early 2018.

**Charging equipment:** There are three levels of charging equipment

- Level 1 delivers the same amount of electricity as a standard outlet—it is the slowest way to charge an EV; you get about 2-5 miles per hour of charging.
- Level 2 requires dedicated equipment and delivers electricity at a rate of about 10-25 miles per hour of charging.
- DC fast charging equipment is specialized and requires more access to power than Level 1 or Level 2 fast charging. Furthermore, only BEVs can use DC fast charging equipment today because of the way the vehicles are designed. Drivers can usually expect 50-70 miles of range per hour of charging using this equipment.

Most initiatives today focus on deploying either Level 2 or DC fast charging equipment.

## How much is it going to cost?

Site hosts need to understand two types of costs as they consider deploying charging infrastructure: Capital costs of installing the equipment and the ongoing operations and maintenance costs. In short, the low cost of the charging hardware, referred to as Electric

Vehicle Supply Equipment (EVSE) is much smaller than the lifetime costs of installing, owning, and operating a charging station.

## Capital Costs

Charging infrastructure costs are primarily comprised of hardware, permitting, and installation. Total costs vary by charging level, site characteristics, and equipment features. The table below summarizes the expected costs of Level 1, Level 2, and DC fast charging installations in non-residential applications.

Cost ranges for single port EV charging stations<sup>1</sup>

Cost Element	Level 1		Level 2		DC fast charge	
	Low	High	Low	High	Low	High
Hardware	\$300	\$1,500	\$400	\$6,500	\$10,000	\$40,000
Permitting	\$100	\$500	\$100	\$1,000	\$500	\$1,000
Installation	\$0*	\$3,000	\$600	\$12,700	\$8,500	\$51,000
<b>Total</b>	<b>\$400</b>	<b>\$5,000</b>	<b>\$1,100</b>	<b>\$20,200</b>	<b>\$19,000</b>	<b>\$92,000</b>

\* The \$0 installation cost assumes the site host is offering an outlet for EV users to plug in their Level 1

The values presented in the table above are developed assuming single charge ports being installed at each location. As more charge ports are included, the installation costs go down on a per unit basis. Key factors that affect the cost of EV charging infrastructure include:

- **Location:** The further away the charging station is from the electrical panel, the higher the installation costs. This is due to the need to trench or bore long distances to lay electrical supply conduit from electrical panel to the charging location.
- **Electrical needs:** In most cases, charging stations need a dedicated circuit for each EVSE unit on the electrical panel, sufficient electrical capacity from the utility connection to the electrical panel, and sufficient electrical capacity at the panel. If the selected site does not meet these three key electrical needs, then electrical upgrades are required. The most common electrical upgrade for installing a L2 electric vehicle charging station is a re-organization of the panel to create space for a 40 amp circuit. However, more significant electrical work such as upgrading transformers is more expensive.
- **Type of mounting:** Charging hardware are available as wall mounted or pedestal mounted units. Pedestal mounted units typically costs \$500-\$700 more than their wall mounted counterparts due to material, manufacturing, and install construction costs.
- **Technological Features:** The simplest units provide a charging port and electricity, however there are many amenities and features that can be included in hardware and subscriptions such as data collection, usage monitoring, user communication, and billing options.
- Another consideration is **ADA compliance** which can require special curb cutouts, van accessible parking spaces, level parking spaces, and specific connector heights, all of which affect the design and cost.

<sup>1</sup> Cost ranges are based on data from [U.S. Department of Energy. 2015. Costs Associated With Non-Residential Electric Vehicle Supply Equipment](#) and [EPRI. 2013. Electric Vehicle Supply Equipment Installed Cost Analysis](#).

## Operation & Maintenance Costs

Operation and maintenance (O&M) costs of EV charging stations vary depending on the type and quantity of charging equipment, station utilization, and ownership structure. Typical ongoing O&M costs include electricity charges, station management and maintenance, and network fees.

**Electricity Costs:** EV charging station owners pay for the cost of electricity supplied by the equipment. These costs are comprised of two separate factors—the electricity consumption charges and demand charges. Electricity consumption charges are determined by the utility rate (\$/kwh) and the amount of electricity consumed. Large commercial and industrial electricity rate structures also have demand charges that can be costly if not managed properly. Demand charges are additional fees based on the maximum energy load drawn by a customer during the billing period.

**Maintenance:** Maintenance and repair costs vary on the type and features of charging equipment deployed. Basic L1 and L2 chargers (non-networked) do not generally require regular maintenance. Basic equipment is typically modular in design, so any malfunctioning components can be replaced separately rather than replacing an entire unit. Networked chargers with advanced features or communications systems may require more periodic maintenance. The most common issue with these is wear on the pins in the connector due to frequent use which may eventually not make a good connection and need to be replaced.

Depending on the station ownership structure, maintenance and extended warranties may be included in agreements or provided as a fixed annual fee by charging network companies.

**Network and Charging Session Fees:** If the EV charger unit is networked, station owners will have to pay a fee that covers the cost for cellular/Wi-Fi network communications and back office support. Network fees will vary from \$100-\$900 annually, depending on the type of EVSE unit (Level 1, Level 2, DCFC), the EVSE unit features, and the EVSE manufacturer or provider. Typically for L2 chargers, network fees are around \$250 per charge port. Networked charger owners may also be responsible for paying a charging session fee to the network provider, which is typically 10% of the total fees.

## Sharing the Cost Burden

There are a variety of initiatives in Santa Clara County that might help reduce the cost burden for site hosts.

**PG&E's EV Charge Network** program is designed to help accelerate "California's transition to a clean transportation future by offering electric vehicle charger installation at select locations in PG&E's service territory." The current program is focused on deploying charging infrastructure at workplaces and apartment complexes.

**Electrify America** has multiple phases of funding and its California-specific plan for deploying EV charging infrastructure has identified San Jose as one of the five initial metropolitan areas to focus on charging infrastructure deployment.

There may be opportunities for funding from regional organizations like the Bay Area Air Quality Management District. Site hosts are encouraged to seek opportunities that can reduce the costs of installing charging infrastructure.

## How can I make sure the equipment is used?

Ultimately, the answer to this question comes down to how much the EV user is charged. Station hosts can own and operate the station, or transfer ownership to a third party. Under some contracts, the charging station provider may retain ownership of the charging equipment and provide compensation to the host for the use of the site. The charging station provider then may be responsible for the maintenance and operation of the equipment.

Some charging infrastructure business models provide charging at no cost to the driver, whereas others seek revenue through a subscription method or pay per use. This revenue may be shared with the charging site host; some ownership models will provide a percentage split with the host based upon negotiated terms with the charging station provider. This method encourages the host to maximize the utilization of the equipment. Other contracts may provide a fixed rate to the host, and is typically designed to compensate for the host's identified costs associated with hosting the charging infrastructure and/or rent for the parking space. The balance of any revenue then would be retained by the charging station provider.

### Establishing a fee for charging

Often, owners of charging spaces contract with electric vehicle service providers or third party operators who install, operate, and set the fees on charging equipment. However, when owners do have the ability to set fees—either explicitly or implicitly through their choice of operator—they face conflicting goals. Site hosts often need to recoup the costs of installing, maintaining, operating chargers, and may also wish to price charging strategically encourage turnover so chargers are available to those who need them most. On the other hand, pricing charging so that driving an electric vehicle is cheaper on a per-mile basis than a gasoline-powered vehicle creates an incentive for people to purchase electric vehicles or charge plug-in hybrids so that they use more electricity and less gasoline.

Charging stations typically include a fee. These are summarized here:

- **Access Fee:** Charged based on gaining access to the charging station irrespective of if the vehicle is charging and/or how long it remains connected. It is essentially a flat rate for initiating a session by connecting to the charging station.
- **Station or Time Based Fee:** Collected based on the length of time a connection is established with the station, irrespective of whether the vehicle is charging or not (typically \$1-2 per hour). As long as the vehicle is connected to the charging station this fee would apply. A fixed rate fee may be charged if high utilization and turnover of vehicles is desired. Fees may be charged per hour or other intervals for Level 2 charging and a per minute basis for DC fast charging.
- **Energy Fee:** Collected based on the amount of energy consumed by the connected vehicle. This is based on a per kilowatt-hour flat rate and only applies when the vehicle is actively charging. This fee is typically not applied when the vehicle is not receiving power even if the vehicle remains connected to the EV station. A multiplier on this cost may be applied to recover other operational costs.

Some jurisdictions have implemented graduated pricing schedules to increase vehicle turnover so that there is greater availability of charging and utilization of assets. Typically, the fees are

increased after a two to four hour period of charging at a lower rate. Fees should be periodically reassessed to ensure that costs are being recouped and stations are utilized.

## What are the most important siting considerations?

The specific location of charging equipment can impact station utilization and installation costs. Placing chargers in locations convenient to drivers is important. The most cost-effective charging installations are those in close proximity to an existing electrical panel that has the capacity to handle the additional load required for EV charging. The California Department of General Services recommends that the following factors should be accounted for when choosing a location for charging equipment:<sup>2</sup>

- Existing electrical panel distribution voltage: Does the existing voltage meet the requirement of the desired charging station? If not, can transformers be added to obtain the desired voltage?
- Existing panel capacity evaluation: The sum of the proposed charging equipment full load amperage and existing loads may overload the existing electrical distribution equipment. Load testing can potentially determine if the panel will exceed the capacity.
- Distance between the electrical panel and charger location: The length of the conductors will affect installation design and material costs. Factors such as conduit size, conductor sizing, trenching, circuit voltage drop and other requirements will need to be assessed, especially if additional future charging equipment is planned.
- Networking access: If “smart” chargers are planned, strong reception of cellular phone signals or wired phone lines are needed.
- Lighting: charging locations should have illumination levels that meet or exceed the minimum necessary for operation of the equipment.

## What types of EV charging equipment should I invest in?

As site hosts seek out vendors to install charging equipment, there are a handful of critical equipment specifications that should be considered—some of these are technical, but are important for site hosts to include in procurement:

- The equipment should be intended for installation following the National Electric Code (ANSI/NFPA 70) and indoor/outdoor rated.
- The equipment should be new and designed to pass inspection according to the National Electrical Code, Article 625. This includes the requirement that the equipment be certified by a National Recognized Testing Laboratory (for example, UL category FFWA).
- L2 equipment should include only connectors that are SAE-J1772 standard compliant

---

<sup>2</sup> California Department of General Services. 2014. Electric Vehicle Supply Equipment Guidance Document. Retrieved from <https://www.documents.dgs.ca.gov/green/EVSE.pdf>.

- DC fast charging equipment should include connectors that are compliant with either CHAdeMO or Combo Charging System (CCS) standards.
- Communications protocol requirements.
  - Networked equipment should have an open protocol for communication with a back-end network services provider. “Open protocol” means that equipment owners should be able to select the charging equipment and the back-end network service provider independently from one another. The most common open protocol is called Open Charge Point Protocol (OCPP).
- Cable management:
  - At a minimum, the management system should be such that provides a holster for the connector, to protect the connector from the elements and help keep it off the ground. If connector holsters are not integrated as part of the equipment, vendors should offer them as accessories and include them in the base price.
  - Either as an integrated feature of the equipment or as an accessory, vendors should also offer for all their models a cable management system that helps keep the cable off the ground to minimize tripping hazards. Such cable management systems can include cable retraction systems, cable cradles, or other.
- Warranty: Charging equipment and all accessories should be with a warranty of 24 months or longer. The warranty period should start the day that the equipment is installed and ready for use.