Multi-Unit Dwelling Electric Vehicle Charging

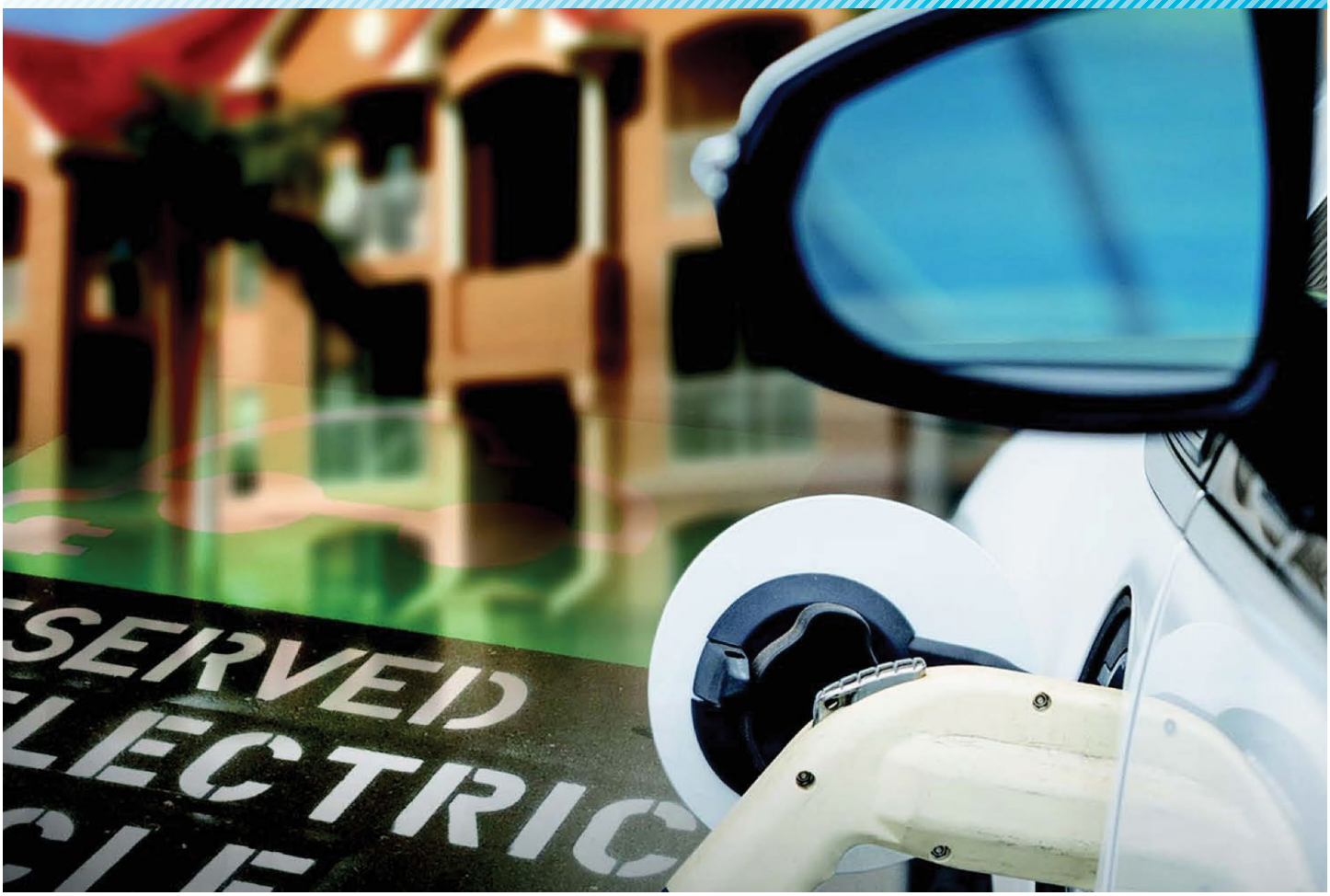


Table of Contents

Multi-Unit Dwelling Electric Vehicle Charging

Driving the San Diego Region Into the Future

About Plug-in San Diego (Plug-in SD)

Plug-in SD is a partnership between the San Diego Association of Governments and Center for Sustainable Energy with funding from the California Energy Commission. Its mission is to assist property owners in acquiring electric vehicle (EV) charging and better understanding the technologies, incentives and installation options available.

Among Plug-In SD's services, it provides no-cost consultations to property owners in San Diego County interested in installing EV charging infrastructure. While each installation is unique, many properties have similar questions and challenges when planning EV charging.
This document summarizes common **multi-unit dwelling (MUD) EV charging solutions**, with a focus on condominiums and apartment buildings where residents and tenants do not have garaged parking attached to their units. The following sections provide information, guidance and resources that can help you get started on installing EV charging at your MUD property, as well as tools to find incentives to help fund projects and identify vendors to design and implement EV charging solutions.

Background

EV adoption is experiencing rapid growth, especially in California. In 2018, nearly 8% of new car sales in California were battery electric (BEV) or plug-in hybrid electric (PHEV) vehicles.[1] While public and workplace charging play a significant role in allowing EV owners to recharge their vehicles, EV owners will want an option for charging their vehicles at home. As more and more drivers adopt EVs, the ability to charge these vehicles at their apartment or condominium will become increasingly important.

There are numerous benefits to installing EV charging at your property location(s). Providing charging can improve tenant retention, increase your property value and contribute to sustainability goals and count towards Leadership in Energy and Environmental Design (LEED) certification.[2]

Considerations important to EV charging

- **Estimate demand**
  What is your current EV charging need, and how will it grow into the future?
- **Choose ownership and billing model**
  Will electricity be supplied from residents' individual meters or from a common load meter? If from a common load, how will users be billed for their individual electricity consumption?
- **Choose design level**
  What charging speeds, controls and data-monitoring capabilities do you require? How will these considerations impact the cost of your EV charging project?
- **Determine who will cover costs**
  Will the property or Home Owners Association (HOA) own the EV charging equipment, or will individual residents own the equipment? How will the costs of electrical upgrades be covered?

[1] California New Car Dealers Association. California Auto Outlook. Vol. 15 No. 1. Available at: https://www.cncda.org/wp-content/uploads/Cal-Covering-4Q-18.pdf.

[2] USGBC Leadership in Energy and Environmental Design. https://www.usgbc.org/credits/schools-new-construction/v4-draft/ltc8

In addition to growing tenant demand for access to EV charging, recent policy and code developments encourage increased installation of EV charging at MUDs.

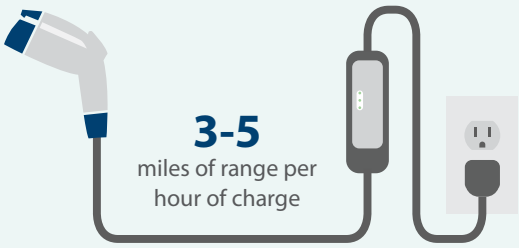
- **Senate Bill 880 and Assembly Bill 2565** – Together, these bills prevent MUD property owners from unreasonably restricting tenants from installing EV charging at their dedicated parking spaces.
- **CALGreen Building Code** – Under current CALGreen Building Code (Title 24, Part 11), new multi-family buildings with 17+ units must have electrical service panel capacity and electrical conduit installed to support a 40-amp dedicated branch circuit for 3% of total parking spaces. The 2019 CALGreen code will increase this requirement to 10% of total parking spaces.

Types of EV Charging

Electric vehicle charging is available at three levels, based on the rate at which a vehicle is able to recharge. Higher levels indicate faster charging rates but are also typically costlier and may require upgrades to a site's electrical infrastructure. The following sections provide a brief overview of the various levels of EV charging. Table 1 includes common use cases for each charging level.

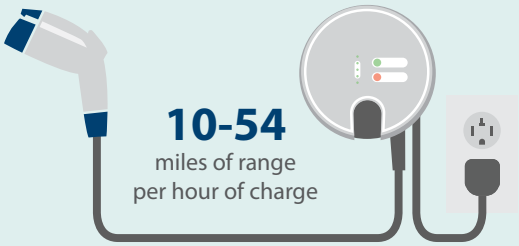
Level 1 charging

Level 1 charging uses a standard 120-volt alternating current (VAC) outlet available in all residential and commercial locations. Almost all EVs come with a Level 1 cord set charger as standard equipment. Level 1 charging is the lowest cost and slowest EV charging option, providing around 3-5 miles of electric range per hour. Level 1 charging is a good option for homes and workplaces, where a vehicle can charge for upwards of 8 hours at a time.



Level 2 charging

Level 2 charging uses 240 VAC and provides between 10-54 miles of electric range per hour. The amount of range gained per hour depends both on the capacity of the EV charging station (EVCS), as well as the capacity of the vehicle's onboard charger. Level 2 uses the same connector and charge port as Level 1. Level 2 charging units are more expensive than Level 1, are available with more advanced controls and monitoring capabilities and are a good option for homes and workplaces, as well as commercial properties that want to provide EV charging to customers.



Level 2 offers networked and nonnetworked charging. A networked EVCS transmits data over the internet to a network host, allowing for more advanced controls, billing options and usage analytics. A nonnetworked Level 2 charger will have no internet connection and essentially provides a driver with an access point to simply plug in and charge. A nonnetworked charger will be less expensive, with wall-mounted or bollard style Level 2 charging units costing between **$500-$2,000**, whereas networked Level 2 EV chargers typically cost between **$1,500-$6,000**.

Installation costs for Level 2 chargers vary greatly, depending on the site, but average around $3,000 per unit. The total cost for equipment and installation for nonnetworked Level 2 chargers is typically **$3,500-$5,000 per unit** and **$4,500-$9,000 per unit** for networked Level 2 chargers.[3]

DC fast charging (DCFC)

Direct current fast charging (DCFC) is the fastest and the most expensive EV charging option. DCFC uses commercial-grade 208, 440 or 480 VAC that is converted into direct current to add 75-300 miles of electric range per hour. Because of its high power demands, DCFC often requires upgrades to a site's electrical service. DCFC is ideal for sites where EVs need to gain a maximum amount of range in a short time, such as along highway corridors and some retail shops. DCFC is not appropriate for home charging and is typically not recommended for MUD charging, unless there is a specific need for rapid recharging of vehicles. Additionally, not all EVs are equipped with the hardware required for DCFC.

DCFC units range in price from $10,000-$40,000, and transformer upgrades to accommodate the increased power demands can cost between $10,000-$25,000. While average DCFC installation costs are around $21,000, they can range anywhere between $8,500-$51,000.[4] Including equipment costs, installing a DCFC can cost **between $30,000-$100,000 per unit**.

[3] https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf.

[4] https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf.

Table 1 EV charging levels and common use cases

	Level 1	Level 2	DC fast charging
Charging Speed	3-5 miles of range/hour	10-54 miles of range/hour	75-300 miles of range/hour
Typical Locations	Single- and two-family homes Townhomes Multifamily dwellings Commercial office buildings	Single- and two-family homes Multi-unit dwelling Commercial office buildings Retail shops Fleets	Highway corridors Public charging depots Retail shops Hospitality & recreation facilities

Typical Cost Drivers

The cost of EV charging installation varies considerably based on specific site requirements. Some typical cost drivers include upgrades to electrical service panels, trenching and drilling through walls for electrical conduit runs. A recent study of Level 2 installations found an average installation cost of $3,000 per unit, with costs ranging between $600-$12,700 per unit.

Site hosts also need to consider the ongoing costs of electricity associated with EV charging, as well as fees if contracting with a network service provider for billing and usage tracking services.

Trenching

Trenching for laying electrical conduit to an EV charging station typically costs around $100 per foot and can quickly add to the cost of installation. Wherever possible, Plug-In SD recommends running conduit above ground, and installing EV charging stations close to the electric service panel to reduce the length of electrical runs. If your project requires trenching, you may wish to consider future plans to expand EV charging and include extra electrical runs to avoid additional costs in the future.

Electrical service upgrades

The addition of EV charging can add significant electrical load to your site and may require upgrades to your electrical service panel. Larger Level 2 and DCFC installations may also require upgrades to the local electrical distribution grid, such as transformer upgrades.

For smaller installations, a typical breaker box (subpanel) may have room to install one or two Level 2 EV chargers without upgrading the panel size. A professional electrician can examine your subpanels to determine if you have room for additional capacity. You may need to replace thick breakers with thin breakers to make room for 2-pole 240V breakers. Should your current subpanels not have room for the extra breakers, you will need to upgrade your panels. Should your planned EVCS installation exceed the capacity of your main electrical service, you will need to request an increased supply from your electric utility and possibly upgrade your panel or add additional subpanels near the charging areas.

Ongoing costs

The primary ongoing cost for EV charging stations is the cost of electricity used to charge EVs and any other impacts on utility bills, such as increased demand charges. In the case of MUD charging, the property manager will typically select a networked charging solution by which electricity usage is tracked and EV owners pay for the cost of electricity associated with their individual charging. In this case, the property manager may need to cover ongoing network operation and data fees. Another cost to consider, especially with larger properties, is the use of security patrol to ensure that the designated EV charging locations are being used correctly.

Estimating Your Demand

An important first step to installing EV charging is to estimate current and future demand for EV charging. Conduct a simple **resident survey**, asking how many residents currently own or plan to purchase a BEV or PHEV, how far they drive in a typical day and if they have access to workplace charging. This will provide an estimate of daily miles traveled and can easily be translated into required charging capacity, based on the charging rates described on page 5.

Due to the rapid adoption of EVs, and the fact that EVCS have an expected useful life of at least 10 years, Plug-In SD recommends that you consider doubling the size of your installation to meet future demand.

Challenges Specific to MUD EV Charging

Deeded or assigned parking spaces present a unique challenge to MUD property owners when installing EV charging. Providing EV charging access to all parking spaces may be cost prohibitive, however, demand for charging may be spread across multiple nonadjacent parking spaces, resulting in costly electrical conduit runs and complicated installations. Clustering charging stations in one area near the electric service panel is ideal for controlling installation costs, however, tenants may not agree to having their assigned parking spots rearranged.

Recovering the cost of electricity for tenants' individual use of EV charging also presents a challenge for MUDs. Parking areas are often located far from the living units, meaning that the nearest electricity source is typically from a common load electric meter that is paid for by the property manager or HOA.

Finally, ownership of the actual EV charger equipment may vary based on whether MUD tenants own or rent their living units. Condo or townhome owners are typically willing to purchase and own the EV charger themselves, seeing their parking space as an extension of the property they own.

Renters, however, are unlikely to be willing to make that investment in an asset that they do not own. Managers of rental units will typically have to purchase and own the EV charger, with the risk being that the equipment effectively becomes "stranded" if the next tenant does not drive an EV.

While these challenges require careful consideration on the part of the HOA or property manager, they are not insurmountable. The following section describes some common solutions for MUD EV charging.

Common Solutions

Providing EV charging to MUD residents is determined largely by how the electricity will be supplied to the individual EVCS. Will the electricity come from a common load meter, for which the property manager or HOA pays the utility bill? Or will it be supplied from individual meters, for which individual users pay the utility bill? This section describes common EV charging designs for both scenarios.

Electricity supplied from a common load panel

The most common MUD charging scenario is where electricity is supplied to EVCS from a common load electrical panel or subpanel located near the parking area. The property manager or HOA will have electrical conduit installed from the panel either to a point near the parking area or to each individual parking space. Residents that wish to install an EV charger will then pay for any additional electrical conduit run to their parking space, purchase the EV charger unit and pay for installation costs.

Tenants that rent are less likely to purchase an EV charger or pay for the installation of electrical conduit to their parking space. In this case, the property manager may elect to absorb the entire cost of installation and amortize it in the form of higher rent.

Billing for usage

If electricity is supplied from a common load meter, the property manager or HOA will see increased electricity costs reflected in their utility bill. An EV that drives 10,000 miles per year will consume approximately 250 kWh of electricity per month, at a monthly cost of around $60.[5] These electricity costs can be recovered in one of two ways.

1. **Contract with a network service provider** – A network service provider monitors usage and collects payments from users through a user account. The network provider will typically charge a payment processing fee as well as a monthly service fee per user. Users create an account, link their payment information and access their charger using a radio-frequency identification (RFID) card or smartphone app — this is similar to using a public EV charger. Payments collected from users are then transferred back to the HOA, minus the network provider's fees. The HOA and network provider can establish a price for charging that covers the HOA's additional electricity costs and network provider fees. This option requires networked Level 2 chargers, which are typically more expensive than nonnetworked chargers. If residents are responsible for purchasing their own EV charger, it would also require that they purchase an approved model that can operate on the chosen network.
2. **Increase HOA fees** – Residents who use EV charging estimate their monthly usage and include an extra payment with their monthly HOA fees. While this method relies on estimates that may not accurately capture actual usage, it allows for the use of less expensive nonnetworked Level 2 chargers and avoids the fees associated with a network service provider. Under this arrangement, the property may simply install a series of 120-volt or 240-volt wall outlets next to parking spaces; tenants may then use the Level 1 charger supplied with their vehicle or purchase an aftermarket Level 2 charger that plugs into a 240-volt wall outlet, which typically cost around $300-$600.

Alternatively, some properties elect to simply cover the additional electricity cost and provide EV charging as an amenity to residents. This can improve tenant retention and increase the value of apartment units. Providing EV charging as a free amenity is common in higher-end apartment complexes but will increasingly be a desired amenity for tenants across socioeconomic groups as EVs become more affordable and the market for used EVs expands.

Electrical panel capacity

A Level 2 charger typically requires a dedicated 40-amp circuit in the building's electrical panel. While some electrical panels may have room for additional circuits, most will not have enough room to accommodate larger installations. A professional electrician can examine a panel to determine if there's room for additional circuits.

[5] This assumes an average electricity cost of $0.23/kilowatt hour (kWh) and that an EV will travel about 3.5 miles per kWh.

Should a panel not have room for the additional circuits, it may require a panel upgrade.

Alternatively, adaptive charging (also referred to as load management or charge management systems) allow multiple Level 2 chargers to operate on one circuit by modulating the power demand of each individual charger (Figure 1). Most EVs will remain parked and plugged in for 10-12 hours overnight. However, each vehicle may only require an hour or two of Level 2 charging to obtain a full charge. An adaptive charging system manages the power output across a series of chargers on the same circuit, allowing all connected vehicles to obtain a charge without the need to rotate vehicles.

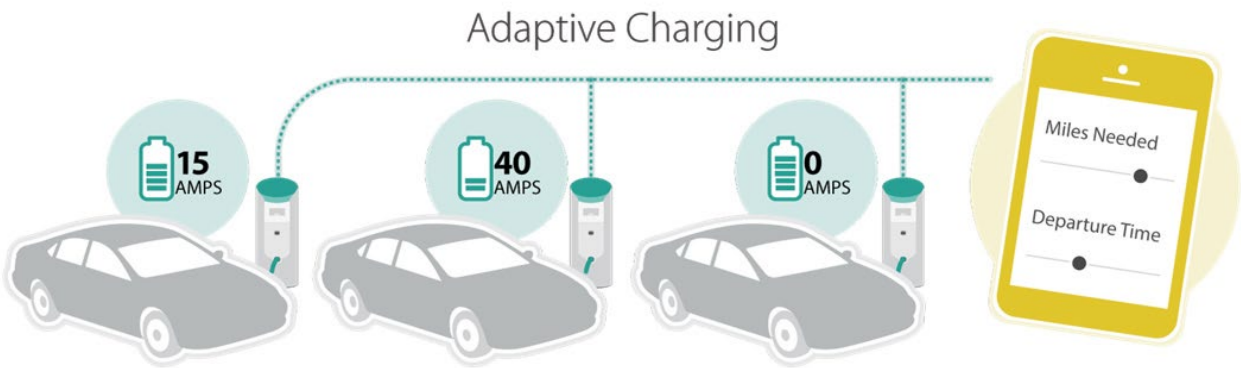


Figure 1 *An adaptive charging system shares electricity from one circuit across multiple EVCS, eliminating the need to rotate vehicles. A user can program desired range and departure time to ensure that EVs have an adequate charge by the required time.*

Similarly, a rotational charging system with an integrated charge controller rotates power supply from one circuit between multiple connected Level 2 chargers (Figure 2). The connected vehicles essentially take turns charging, without the need for drivers to rotate vehicles or move charge connectors. One apartment complex in San Diego was able to support 60 Level 2 chargers on electrical infrastructure that would normally only support 15 Level 2 chargers by using a load management solution like the one described.

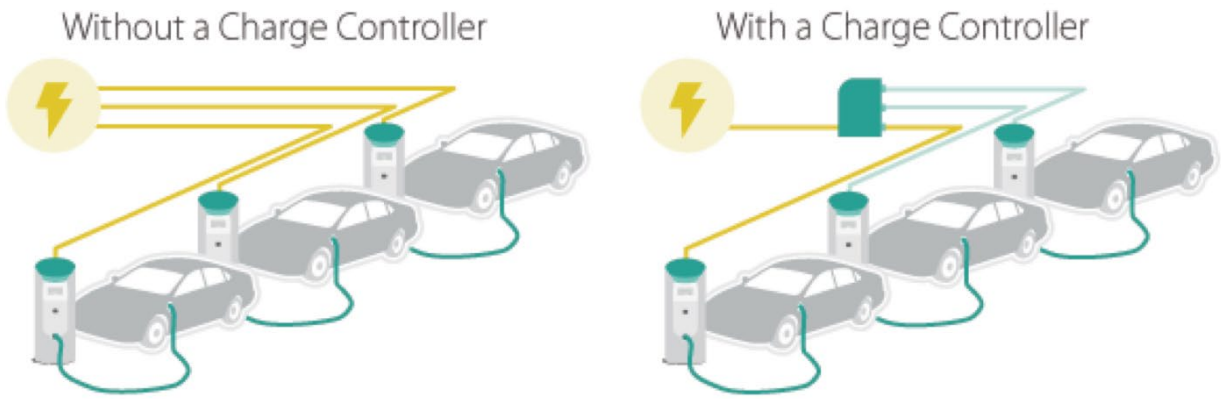


Figure 2 *A rotational charging system utilizes a charge controller to rotate electricity from one building circuit across multiple connected Level 2 chargers.*

Individually metered chargers

If electricity use by each EVCS can be metered individually, costs can be assigned to each tenant's utility account, eliminating the need for a network service provider or for recovery through HOA fees. While this simplifies billing users, it often proves impractical as a MUD tenant's electrical service panel is typically located inside their living unit, far from their parking space.

One option is for the HOA or property manager to have a new bank of electric meters installed off the property's utility switch gear. Each meter is then attached to a circuit that runs to an individual parking space and supplies an EVCS. The resident adds that meter to their utility account and pays all associated electricity costs through their monthly utility bill. Alternatively, a new electrical panel may be installed between each living unit's electric meter, typically located in the electrical room near the utility switchgear, and the unit's current electrical panel. This would allow for the installation of a new circuit to supply the EVCS from behind the resident's existing electric meter.

Consult with a professional electrician, as well as a utility account representative, to determine which type of installation is possible.

Cost Recovery

Most HOA-managed EV charging scenarios consist of the HOA providing the electrical conduit and associated capacity upgrades, while the tenants pay for the charger unit, subscription fees and electricity used. While the previous section discussed approaches to recovering the ongoing costs of providing EV charging, the HOA or property manager may still incur significant upfront costs related to providing electrical service to parking spaces or for purchasing and installing the actual EV chargers.

Incentive programs and tax credits can help recover some of the upfront costs of installing EV charging. The **California Electric Vehicle Infrastructure Project** (CALeVIP) offers incentives for Level 2 and DCFC in specific areas throughout the state. Incentive and tax credit availability changes frequently. The **CALeVIP** website maintains a list of additional incentive projects and the California Air Resources Board offers an incentive search tool on the **DriveClean.ca.gov** website. Consult with a tax professional when considering incentives like tax credits or accelerated depreciation to be sure your property qualifies.

In addition to incentives, programs like the **California Capital Access Program** (CalCAP) can provide financing with favorable terms for EV charging projects, lowering the overall cost of ownership.

For costs not covered by incentives, an HOA may opt to have EV drivers who will benefit from the availability of charging share the cost of upgrades or modifications to the electrical service panel and installation of conduit, in addition to having each individual resident purchase their own EV charger.

EV charger rental option

While most EV chargers are purchased, some equipment manufacturers offer rent or lease options as an alternative. This could be a good solution for property management that would like to reduce their upfront costs and instead account for the EV charging as a monthly expenditure. These units are offered on a 3-, 5- and 10-year limited term. When the agreement schedule is complete, the manufacturer will remove the chargers unless the rent/lease term is extended.

[7] https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf.

Getting Started – A Recap

Follow the four main steps to starting an EV charging project.

- **Estimate demand** – Conduct a resident survey to estimate the current demand for EV charging and anticipated future demand. Keep in mind that EV adoption is expected to grow rapidly as more models become available and as EVs enter the used vehicle market.
- **Choose ownership and billing model** – Have an electrician evaluate your property to determine if EV chargers will need to have electricity supplied from a common load meter or if it is feasible to have EV chargers individually metered. The metering arrangement will largely drive your decision on system design.
- **Choose design level** – Once you've determined how electricity will be supplied to EV chargers, either from a common load or from individual meters, determine what charging speeds, controls and data-monitoring capabilities you will require.
- **Determine who will cover the costs** – Once you have determined the general design of your EV charging setup, determine who will cover the costs of each component. Will the HOA or property manager cover the cost of electrical upgrades and conduit, while individual residents purchase and pay for installation of their own EV charger? Will the property manager recover all costs and recover these costs through increased rent or HOA fees? Research available incentives and tax credits that may help defray upfront costs.

Once you have worked through the four steps, you'll be well prepared to begin speaking with EV charging service providers and electrical contractors who will be able to recommend solutions suited to the needs and constraints of your property. The following Additional Resources section includes tools for finding incentives to defray costs and identify vendors to design and implement electric vehicle charging solutions.

CSE-PISD-0416

Additional Resources

CALeVIP – The California Electric Vehicle Infrastructure Project (CALeVIP) is a California Energy Commission-funded project that provides incentives for Level 2 and DC fast charging in select locations throughout the state.

CALeVIP Connects – CALeVIP Connects is a free online directory that allows you to connect directly with EV service providers and request information for potential EV charging projects.

Resident Charging Demand Survey – A sample resident survey from the Plug-In Electric Vehicle Collaborative that can be used to estimate the demand for EV charging at your MUD.

Incentive Search Tool – DriveClean.ca.gov provides a search tool to help you find incentives for EVs and charging infrastructure.

Plug-In SD FAQ – A list of frequently asked questions from Plug-In SD covering the basics of charging, costs, incentives and more.

The Alternative Fuels Data Center (AFDC) – An information clearinghouse maintained by the U.S. Department of Energy (DOE) that is home to useful resources, as well as a list of relevant laws and incentives.

Veloz/PEVC Case Studies – Veloz provides several useful case studies and fact sheets on their website.

CSE-PISD-06-19