

Plugging in at Work:

How to Effectively Install, Share and Manage Electric Vehicle Charging Stations

November 2015



www.PEVCollaborative.org

This report is a product of the California Plug-In Electric Vehicle Collaborative, a public/private organization focused on accelerating the adoption of plug-in electric vehicles (PEVs) to meet California's economic, energy and environmental goals. Using the expertise of each member, the PEV Collaborative convenes, collaborates and communicates on emerging PEV market trends and works to address challenges and enable strong PEV market growth. Members played guiding and consulting roles in developing this report, although individual organizations may not formally endorse every aspect or recommendation.

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This report was developed by the working group co-chairs and volunteers; PEV Collaborative staff, Lisa Chiladakis and Gennet Paauwe; Advanced Energy and Winter Graphics.

To download the document, visit www.pevcollaborative.com/workplacecharging.

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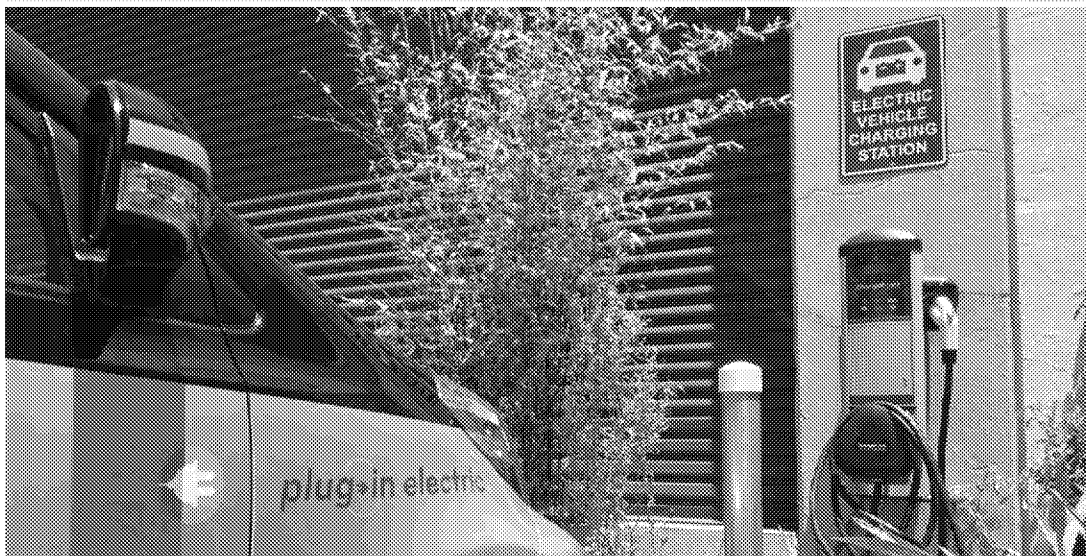
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Pat's Garage provides charging for employees and guests.

Introduction

Charging stations for plug-in electric vehicles are a rapidly growing amenity being added to workplaces across California and the United States. Numerous workplaces have installed stations for their employees and visitors to use. These decisions have been supported by a recent Idaho National Laboratory study, which concluded that “charging infrastructure should be focused at homes, workplaces and public ‘hot spots’ that serve multiple venues. When charged by drivers, battery electric and plug-in hybrid electric vehicles achieve significant petroleum reductions while meeting the public’s everyday driving needs.”

Through workplace charging installations, businesses have learned new lessons and established best practices. Workplaces have researched charging options and developed plans, chosen appropriate charging systems, followed installation directions and established policies and procedures. Many workplaces are continuing their efforts by monitoring charging station usage and evaluating their plans.



New challenges and creative solutions have emerged as more charging stations are being installed and workplaces plan for future growth. This document describes some of these challenges and shares solutions developed by workplaces. Each section below provides guidance and highlights additional resources and tools developed to complement the guidance. The topics addressed include:

- ☰ Plug-in electric vehicle and charging basics
- ☰ Facilitating charging at your workplace
- ☰ Planning for future growth
- ☰ Identifying the right charging equipment
- ☰ Managing the use of the chargers through etiquette guidelines, fees and human resources policies
- ☰ Equipment operations that include signage and maintenance

Use of This Document

This document builds on the previous work of the California Plug-In Electric Vehicle Collaborative to engage companies in providing workplace charging and to create case studies of deployment efforts. That foundation includes the following resources that can be found at www.PEVCollaborative.org/workplace-charging.

- ⚙️ Amping Up California Workplaces: 20 case studies on plug-in electric vehicle charging at work
- ⚙️ Why Employers Should Install Workplace Charging for Plug-In Electric Vehicles
- ⚙️ Employer's Guide to Installing Workplace Charging for Plug-In Electric Vehicles
- ⚙️ How Can I Get Plug-In Electric Vehicle Charging at My Workplace?
- ⚙️ Workplace Charging How and Why?

This document also builds on the work done by individual PEV Collaborative members and other stakeholders, which is provided in Appendix A.

Workplace Charging Benefits for the Employer

- ⊕ Recruit and retain employees by offering charging for PEVs
- ⊕ Green your company image
- ⊕ Improve employee productivity; PEV drivers can access carpool lanes allowing faster commutes and lower stress
- ⊕ Comply with local rules and regulations to reduce employee commuting emissions
- ⊕ Add Leadership in Energy & Environmental Design (LEED) points
- ⊕ Give employees a way to extend their electric miles

Workplace Charging Challenge

The United States Department of Energy (DOE) Workplace Charging Challenge is open to employers of all sizes and industry types in the United States whose charging stations are primarily for employee use. Taking the Challenge offers benefits to employers who are considering installing charging, as well as those who have successfully launched workplace charging programs. Go to the Workplace Charging Challenge website to learn more about the benefits of the Challenge and how to join.

<http://energy.gov/eere/vehicles/ev-everywhere-workplace-charging-challenge>



Plug-in Electric Vehicle & Charging Equipment Basics

Understanding the fuel source and power requirements of today's plug-in electric vehicles is essential for planning electric vehicle charging infrastructure at the workplace.

Plug-in Electric Vehicle Basics

There are two types of plug-in electric vehicles, battery-electric and plug-in hybrid electric.



Battery electric vehicles (BEVs) are powered solely by a battery recharged by plugging into the grid. BEVs typically get 70-100 miles of range with some going as far as 300 miles on a charge.



Plug-in hybrid electric vehicles (PHEVs) are initially powered by a battery that is recharged by plugging into the grid and then by a gasoline engine to extend the range of the vehicle. PHEVs typically get 15-50 miles of all-electric range and can refuel with gasoline when needed.

While a BEV may require workplace charging to accommodate the driving range of a daily commute, PHEVs are frequently recharged to avoid gasoline use and maximize electric miles driven.

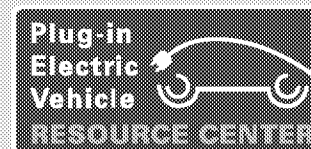
There are two types of charging that happen at work:

- **Necessary** charging – a charging session that is required to allow the driver to reach an intended destination.
- **Convenience** charging – a charging session used to provide extra charge to a PEV that does not need the range to make required trips.



Plug-In Electric Vehicle Resource Center

Both battery electric and plug-in hybrid electric vehicles vary widely in their battery size and all-electric driving range. To stay up to date on the vehicles available and their electric range, along with information on incentives, visit the PEV Resource Center: www.DriveClean.ca.gov/pev



Charging Equipment Basics

There are many different suppliers of PEV charging stations (also called electric vehicle supply equipment, or EVSE). The stations have varying functionality and charging levels that correspond to the power levels supplied and the rate at which the battery is recharged. See Figure 1 for more details regarding power levels and miles of range refilled by each hour of charging.

Current Charging Station Levels

AC Level 1: This type of charging can be accomplished using a portable “cordset” (provided with each PEV) that plugs into a standard 110/120-volt alternating current (VAC) three-prong wall outlet, or by a permanently installed charging station, which is recommended for workplace charging. Since cars are often parked at work for 8 hours a day, Level 1 is often sufficient for PHEVs and low mileage BEVs in the workplace.



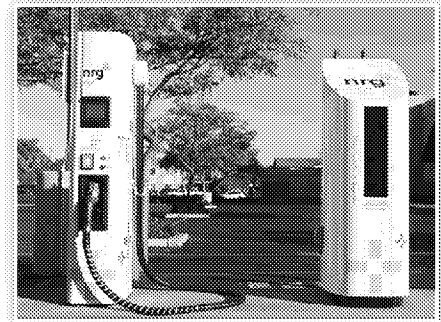
Level 1 pedestal at a workplace

AC Level 2: Uses 240VAC current and should be installed on a dedicated circuit by a qualified electrician. These are typically used for PEVs with larger batteries, such as battery electric vehicles, and in cases where plug-in hybrids may be parked for a short period of time and need to charge quickly.



Level 2 charger at Walgreens

DC Fast Charge: Uses commercial-grade 440VAC or 480VAC devices that use direct current (DC) to charge a PEV. These chargers provide approximately 50-64 miles of range for every 30 minutes of charge. The rate of charge is based on the power level delivery of the unit and the specifications of the vehicle being charged. Currently, none of the PHEVs on the market are capable of using DC Fast Chargers and many BEVs are purchased without this option as well.



NRG EVgo Freedom Stations

Type of Charging	Power Levels (installed circuit rating)	Miles of Range per Hour of Charging*
AC Level 1	110/120VAC at 15 or 20 Amps	~4-6 miles/hr.
AC Level 2		
3.3 kW (low)	208/240VAC at 30 Amps	8-12 miles/hr.
6.6 kW (medium)	208/240VAC at 40 Amps	16-24 miles/hr.
9.6 kW (high)	208/240VAC at 50 Amps	24-36 miles/hr.
19.2 kW (highest)	208/240VAC at 100 Amps	> 60 miles/hr.

* Refer to vehicle specifications for exact ratings.

Figure 1. Charging power levels and miles of range refilled.

Facilitating Charging at Your Workplace

There are many factors to consider when deciding on workplace charging for employees, including employee demand for charging, available parking and the available power supply.

Surveying Employee Demand

When trying to plan the number of chargers to install, it is good to first survey your employees to learn about current and possible future demand, the numbers and types of PEVs they may drive, and commute distance profiles and parking behavior. It is common for employees to purchase or lease more PEVs once charging is available at work. Remember to conduct the survey on a regular basis to stay up-to-date on employee use and future demand for the charging equipment. Below is an example survey for your employees. Other survey examples can be found in the additional resources section found in Appendix A.

Example Employee Survey

Do you own or lease a battery electric or plug-in hybrid electric vehicle?

- Yes, a battery electric vehicle
- Yes, a plug-in hybrid electric vehicle
- No

If yes, Make _____ Model _____

If no, are you considering purchasing or leasing, a battery electric or plug-in hybrid electric vehicle?

- Yes, I am considering purchasing one in the next 12 months
- Yes, I am considering purchasing one but I'm not sure when
- No

If yes, which type of vehicle are you interested in purchasing?

- Battery electric Make _____ Model _____
- Plug-in hybrid electric vehicle Make _____ Model _____
- Not sure

If you own a PEV now or are considering one in the future, would you use electric vehicle charging stations if they were available at work?

- Yes
- No

If you are not considering a PEV, would access to electric vehicle charging at work increase the probability that you would purchase/lease one?

- Yes
- No

How many miles is your commute one-way? _____

On average, how many hours are you parked each day at work? _____

Figure 2. Example employee survey.

Assessing Available Parking

Once you get a sense of employee demand, another key factor when planning charging is the availability of parking and the employees' behaviors around parking. The parking profile can drive charging system size and operational requirements of workplace charging infrastructure.

Workplace Parking Profiles

Parking capacity can vary widely across workplace locations. Some companies own and operate their parking lots and provide ample parking for employees, while other companies, such as those in downtown urban areas, may lease parking accommodations for employees or require employees to secure their own parking. Other companies may have limited parking capacity or restricted parking for certain employees. The parking situation is a significant factor in the employer's decision-making process on whether or not to provide workplace charging.

In determining the parking profile of your workplace, consider the following characteristics of the employee workforce and available parking amenities:

- ☐ Number of employees who park at the facility
- ☐ Number of available spaces
- ☐ Number of employees interested in workplace charging
- ☐ Profile of the average amount of time employees park per day

Below is an example of what levels of charging stations are recommended for a variety of parking profiles. Abundant parking is where parking availability exceeds the number of employees parking on site. Adequate parking is a relative match between number of employees and parking space availability. Finally, restricted parking is where parking spaces are at a premium, such as leased parking spaces, or where employee demand often exceeds parking space availability.

In many instances, the higher the charging level, the more costly the equipment and installation will be. For this reason, Level 1 or a mix of Level 1 and Level 2 charging is recommended for scenarios where parking is abundant or adequate and parking times are lengthy enough to recover the necessary vehicle miles.

Figure 3. Charging level recommendations based on parking profile. (Advanced Energy, 2015)

Parking Profile	Employees on Site	Parking Spaces	EV drivers	Park Time	Recommendations
Abundant	100	140	5	8 hrs	Level 1 and/or Level 2 Dedicated Parking or Shared
Adequate	100	100	5	8 hrs	Level 2 or a mix of Level 1 and Level 2 Shared Parking
Restricted	100	50	5	8 hrs	Level 2 Time Limits

Complying with ADA Requirements

When installing charging stations, it is important to consider the Americans with Disabilities Act's (ADA) standards for electric vehicle charging stations. Work with your local agency to learn how to meet these requirements. In California, the Department of General Services (<http://www.dgs.ca.gov>) is working on ADA Guidelines for vehicle charging that they hope to implement in 2017.

Accessing Available Power

Another key factor when planning workplace charging is the amount of available power and where the power is located. Installing a charging station near an existing power supply can help minimize the overall installation cost. It is important to understand your power availability, or capacity, to increase your available power by working with your electric utility provider. In general, the higher the level of charging, the more power required to supply the station. The table below illustrates the range of power requirements for the various levels of charging.

Station Level	Power requirements
Level 1	120 V, dedicated 15-20A circuit
Level 2	240 V, dedicated 30-80A circuit
DC Fast Charge	3-Phase DC power supply, 20-50 kW

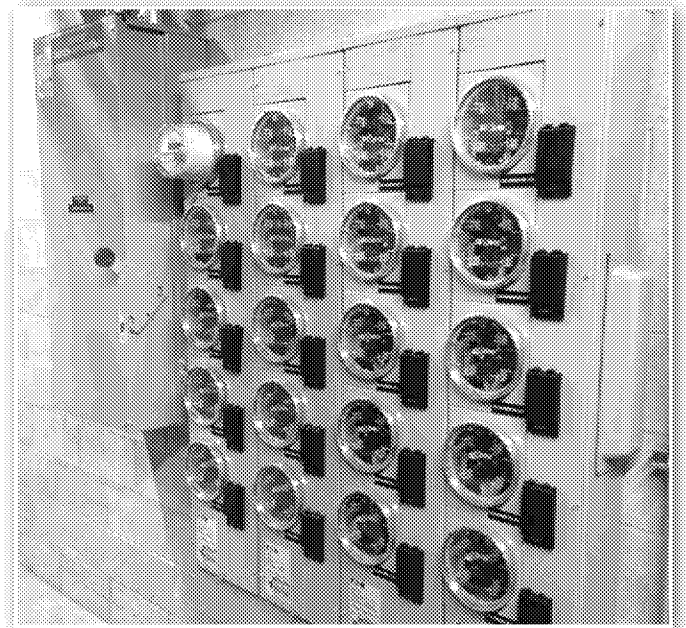


Figure 4. Power requirements per charging level.



Building Codes for PEVs

For all new construction of commercial buildings, the Title 24 Building Standards Code, Part 11, Green Building Standards (CALGreen) Code requires installing EV charging infrastructure in a percentage of total parking spaces. (For specific requirements, review Section 5.106.5.3 Electric vehicle (EV) charging in the CALGreen Code). Remember to check with your local jurisdiction to see if there are any additional requirements to exceed the CALGreen Code standards regarding the percentage of EV Capable parking spaces needed for your project.

Planning for Future Growth

The decision to provide workplace charging for employees starts with the planning process for serving today's PEV drivers, while also planning for the PEV drivers of the future.

There are a number of ways to plan for future PEV growth at the workplace, including pre-wiring for system expansion and leveraging existing infrastructure to serve additional employees.



☛ Pre-wiring, or conduit installation, for charging expansion can save a significant amount of money in the long run for the anticipated growth in the adoption of PEVs at the workplace. The cost of trenching, conduit and wire pulling to the charging locations is usually the highest cost of charging installations. Running additional wiring, or at least providing adequate conduit, while installing the initial charging stations will help reduce installation costs for future expansion.

☛ Leveraging existing infrastructure means making the most of the stations you have already installed. This can be accomplished by employing some of the following practices:

- *Time limits for charging* – limiting the total parking times for vehicles at a charging station can work to serve more vehicles per day.
- *Strategic siting of charging stations* – includes positioning charging stations between two to four parking spaces to maximize charging station access allows drivers to move cords, not cars. See Figure 4 below for an example.
- *Parking fees to limit convenience charging* – fees motivate drivers to vacate charging spaces to reduce fueling costs. This allows more drivers to use the stations. Fees can either be charged for the entire charging session, or they can be charged or increased after a specified time limit.

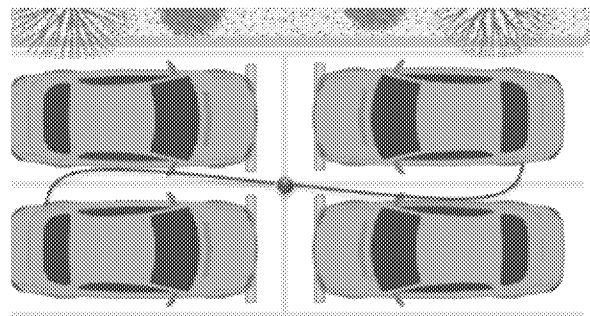


Figure 5. Strategic siting of charging stations maximizes use of the chargers. Image courtesy of EPRI and San Diego Gas & Electric.

Identifying the Right Charging Equipment

Selecting the station charging level is only the first step in equipment selection and purchase. Stations can be both fully owned and operated by a company or have a third-party owner who operates and maintains the systems. The equipment specifications, features and operating network are other decisions that need to be made during the decision-making process.

Equipment Specifications

There are several features to consider when selecting PEV charging equipment. Equipment options can be greatly narrowed by identifying the desired operational model and equipment features. Use the chart on the opposite page to select your charging station preferences. Once you have defined the preferred equipment specifications and operational requirements, you can use the EDTA tool (<http://goelectricdrive.org/charging/evse-product-supplier>) to identify vendors for your equipment needs.

Selecting a Networked or Basic Charger

Depending on your needs, you can decide to purchase networked or basic charging stations. There are different benefits associated with each type of equipment.

Networked Chargers

A networked charging station can help manage access, enable a fee for service, and provide usage data, including energy dispensed, time spent charging and number of sessions. Some considerations when evaluating a network provider are: equipment, access, operating cost, maintenance and warranties. Employers have a wide range of equipment options to choose from and can also select a simple unit with no network communications.

Some of the benefits of a networked station include:

- ☛ Seamless payment systems
- ☛ System status monitoring
- ☛ Data and records

Basic Chargers

If you are looking to install low-cost chargers without any network fees, a basic charger is also an option. These chargers can be good if charging a fee is not a priority. Some basic chargers, however, are equipped with keypads to allow access control and payment of fees with a smart phone. There are also ways to collect data from these chargers by adding special equipment.

Some of the benefits of a basic station include:

- ☛ Lower equipment costs
- ☛ Simple to operate
- ☛ Easy to maintain
- ☛ No network fees

When selecting a charging station and/or network provider, it is important to understand the equipment needs, access scenarios, operating costs, and maintenance. Here are some choices and options for each.

Feature	Options
Equipment	Charging station specific networks
	Charging stations with open charge point protocols – networking software that can be used with any equipment
	Basic charger
Access to Station	Open access
	Member only access RFID card Smart phone app Activation code
Operating cost	Monthly communications and data access fees
	Equipment activation fee
	Fee per charge session
	No ongoing fees
Maintenance	Included in contract
	Additional fee/contract

Figure 6. Equipment needs, access scenarios, operating costs, and maintenance options.

Figure 7. Charging equipment selection guide.

Charge Level	Level 1	Level 2	DC Fast Charger*
Power Supply	AC 110 volts: <input type="checkbox"/> 15 amps <input type="checkbox"/> 20 amps	AC 220 volts: <input type="checkbox"/> 30 amps <input type="checkbox"/> 40 amps	DC (20-150 kW) _____ kW
Mounting Type	<input type="checkbox"/> wall <input type="checkbox"/> pedestal	<input type="checkbox"/> wall <input type="checkbox"/> pedestal <input type="checkbox"/> floor (inductive) <input type="checkbox"/> pedestal	<input type="checkbox"/> pedestal
Connector Type	<input type="checkbox"/> SAE J1772	<input type="checkbox"/> SAE J1772	<input type="checkbox"/> CHAdeMO <input type="checkbox"/> SAE Combo <input type="checkbox"/> Tesla
Number Cords	<input type="checkbox"/> single <input type="checkbox"/> multi	<input type="checkbox"/> single <input type="checkbox"/> multi	<input type="checkbox"/> single <input type="checkbox"/> multi (connectors may be different)
Type of Cord	<input type="checkbox"/> retractable <input type="checkbox"/> coiled <input type="checkbox"/> straight	<input type="checkbox"/> retractable <input type="checkbox"/> coiled <input type="checkbox"/> straight	<input type="checkbox"/> retractable <input type="checkbox"/> straight
Cord Length	<input type="checkbox"/> 22 feet <input type="checkbox"/> 25 feet <input type="checkbox"/> other: _____	<input type="checkbox"/> 22 feet <input type="checkbox"/> 25 feet <input type="checkbox"/> other: _____	
Data Output Requirements	<input type="checkbox"/> manual	<input type="checkbox"/> manual <input type="checkbox"/> IP port	<input type="checkbox"/> manual <input type="checkbox"/> IP port
Payment Options	<input type="checkbox"/> card reader <input type="checkbox"/> networked <input type="checkbox"/> credit card <input type="checkbox"/> smart phone app	<input type="checkbox"/> card reader <input type="checkbox"/> networked <input type="checkbox"/> credit card <input type="checkbox"/> smart phone app	<input type="checkbox"/> card reader <input type="checkbox"/> networked <input type="checkbox"/> credit card <input type="checkbox"/> smart phone app
Network Features	<input type="checkbox"/> none <input type="checkbox"/> monitor remotely <input type="checkbox"/> payment options <input type="checkbox"/> limit access	<input type="checkbox"/> none <input type="checkbox"/> monitor remotely <input type="checkbox"/> payment options <input type="checkbox"/> limit access	<input type="checkbox"/> none <input type="checkbox"/> monitor remotely <input type="checkbox"/> payment options <input type="checkbox"/> limit access

*DC Fast Charge stations are not compatible with all PEVs.

Managing Charging Stations

Once the stations are installed, the use of the stations needs to be managed. This can include etiquette policies, if and how to charge a fee for using the chargers, and developing human resources policies around station use.

One of the most important factors in a successful workplace charging program is to have one point of contact responsible for the chargers and how they are used and managed by the employer and employees. If you have networked stations, this person can also keep track of usage in order to measure demand and calculate costs.

Etiquette Policy

In the electric vehicle world, charging etiquette practices have developed rapidly in response to increased demand for charging stations. In cases where charging infrastructure serves multiple drivers at one location, a well-defined charging etiquette policy can help avoid conflicts.

Opposite are different scenarios that may be experienced by PEV drivers as they are using the chargers and recommended practices or policies that a company can use to alleviate these situations

Vehicle information cards are an easy way to share information and display proper etiquette. Simply have your employees post the card on the dashboard of their vehicle to let others know when they can share the spot.

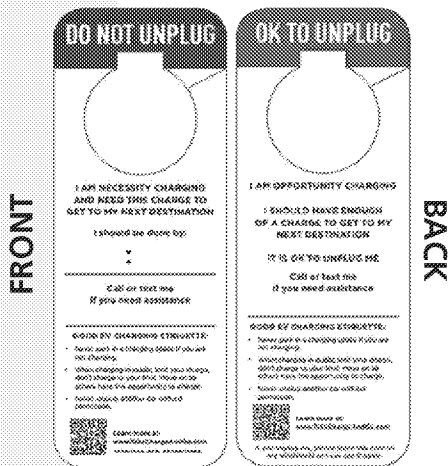
CHARGE TYPE: NECESSITY CONVENIENCE

OKAY TO UNPLUG? NO YES

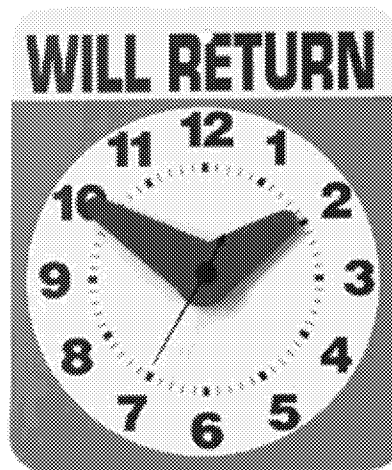
ESTIMATED DEPARTURE TIME: _____ AM
 _____ PM

CONTACT INFORMATION: _____

Figure 8. Sample vehicle information display card.



Take Charge and Go EV charging hangers are one example of how drivers are showing good etiquette toward other drivers.



Another option is to use a time wheel to indicate when the driver will return or when the vehicle can be unplugged. Drivers can write their contact information on the wheel if others need to reach them.

Scenario	What causes this behavior?	Recommended Practice
Charging station is not available		
Internal combustion engine (ICE) vehicle parked at the station	Not enough parking spaces for the number of employee vehicles	Establish a method for users to communicate and manage the charger as a company resource. For example, shared resource calendar or email group to help keep drivers informed.
PEV parked longer than needed	Lack of knowledge of PEV driver needs	
PEV drivers not following posted time limits	Drivers may not want to interrupt their day to move vehicles	Use vehicle time wheel or placards to note contact information and communicate charging need/ estimated departure times.
Vehicle unplugged from charging station		
Charge cords can be moved from one vehicle to another to allow charging of multiple vehicles.	Demand for chargers exceeds the number of available chargers.	Require explicit approval from vehicle drivers for any cord sharing activities. For example, a vehicle placard may be used to indicate approval and identify conditions under which the vehicle may be unplugged from the charging station.
	Drivers cannot tell if a vehicle is charging.	
		Make a company policy that vehicles that are not actively charging (dashboard or other indicator) may be disconnected and cord moved to another vehicle.
		Make a policy that does not encourage or promote unplugging PEVs and use a form of communication such as an email list to ask drivers to move their cars.
Not returning cord/connector to proper position		
Charge cords not properly wrapped on the charging station	Lack of understanding of proper equipment care.	To minimize safety hazards (tripping/falling), reduce liability, and improve user experience, drivers should be instructed on the proper use and care of the charging equipment. Care instructions can be placed on the charging stations themselves to remind users of proper etiquette.
Connector not fully engaged in holder, station off-line		

Figure 9. Typical PEV parking challenges and recommended solutions.

If and How to Assess Fees for Charging

There are multiple options for offering charging stations at the workplace. They can be free for employees, or employees can be assessed a fee for using the chargers. Both have their own advantages and disadvantages, and this determination should be based on your goals and reasons for installing the chargers. For California, Governor Brown and his administration have stated that charging an employee car at a state-owned charger is not a gift of public funds. However, each agency can establish their own policy and rate for charging (source: DGS Electric Vehicle Supply Equipment Guidance Document, February 2014).

There are a number of reasons that employers may decide to assess a fee for employee vehicle charging. These include:

- ☛ Recover equipment installation costs (including equipment cost and installation).
- ☛ Recover ongoing operating costs (including electric rates and maintenance personnel).
- ☛ Manage charging station use and limit unnecessary convenience charging.

Figure 10 provides different types of fees and the benefits of each.

Fee Examples	Details	Benefits
Free	No fee to charge	Attract and retain employees
Fee for Power	Assess fee per kWh used	Reimburse electric costs
Fee for Parking	Assess fee per time parked	Encourages drivers to move when finished charging
Variable Pricing	Increasing fees with time parked	Maximizes availability of charging stations by encouraging drivers to move when finished charging
Fees Paid to a 3rd Party Managing the Chargers	Monthly membership fee paid by employee	Employer not involved in taking payments from employees

Figure 10. Sample fee models for workplace charging.

Assessing the Cost of Electricity Used at a Charging Station

Before installing stations, it is important to understand how the system will operate and what the total electricity costs will be for the company. Below is a worksheet to assess per station electricity costs.

	Example	Enter Value
1 Station Output (kW)	Level 2 (240v) at 40A: 240V/40A x 90% efficiency = 5.4 kW	
2 Hours of operation	8 hours	
3 Multiply lines 1 and 2	5.4 x 8 = 43.2 kWh	
4 Electric rate (cost per kWh)	\$0.15	
5 Multiply lines 3 and 4. <i>This is your maximum electric cost per day for this station.</i>	43.2 x 0.15 = \$6.48	

Figure 11. Worksheet to assess per station electricity costs. Note this does not include other operating costs such as network fees if they are applicable.

How to Collect Fees

Fees can be collected in a number of ways. If the employer is collecting fees, it will depend on the equipment they purchase and if there is a network associated with the equipment. If a third party is collecting the fees, it will be decided by that third party how payments are made to them. Some examples are included in the following table.

Fee Collection Method	Description	Pros/Cons
Parking Permit	Company-managed parking permit to allow drivers to pay parking fees through company benefits department.	Pros: easily managed through company benefits. Cons: drivers may pay for services that they don't actually use.
Network Card	Prearranged network access through an RFID card or access number that allows drivers to bill station fees to their own network account.	Pros: Payment features are managed by third-party vendor. Cons: Cost of service may increase total fees.
Credit Card (card reader)	Pay per use model that allows drivers to use personal credit card to pay station fees.	Pros: Payment features are managed by third-party vendor. Cons: Cost of equipment and service may increase total fees.

Figure 12. Sample payment methods for workplace charging.

Human Resource Policies

With the continued growth of electric vehicles, it may be necessary for your organization to set policies and guidelines for PEV charging. Topics that could be covered include allotted time, parking requirements, vehicle charging as an employee fringe benefit, and answers to frequently asked questions.

Many companies offer specific-interest and cultural benefits to attract, support and reward skilled employees. Company human resource policies may include benefits for PEV charging for employees who use an electric vehicle to drive to work. The policy defines qualification requirements for the benefit and outlines the standard code of conduct.



Employees charge at the ChargePoint office.



Employees and fleet operators charge their PEVs at San Diego Gas & Electric.

Employee benefits may be reportable as a taxable benefit under IRS Publication 15-B: Employer's Tax Guide to Fringe Benefits. Check with your organization's accounting department to determine limits on taxable benefits and reference the table in Appendix B to determine fair market value of workplace electric vehicle charging.

Example Workplace Electric Vehicle Charging Policy

On-site electric vehicle charging is available to company employees who register their electric vehicle with human resources and agree to the standard code of conduct for electric vehicle charging.

For campus electric vehicle charging to provide service to the maximum number of employees and guests, each user needs to take responsibility for proper use and operation of the stations. This means ensuring that the charging station equipment is treated appropriately, that other employees' vehicles and station access are respected, and that network access accounts are maintained. By submitting your information to gain access to the charging stations and checking the box indicating you have read and understand this agreement, the employee agrees to the following code of conduct:

- I will make every effort to remove the charging plug and move my vehicle upon charging completion.

- I will treat the electric vehicle chargers and cables with care ensuring that I replace the charger plug in the station after use, do not drive over the charging cable, and do not in any other way damage the charging equipment.

- I will not remove the charger plug from another vehicle regardless of whether the charge is completed. If another individual is plugged into the charging station and the charge is complete, I will contact the appropriate contact so they can contact the individual and have the charging station made available.

- I understand that if I damage the charging equipment, another vehicle, or do not keep my account current, the EV charger team may notify my manager and disciplinary action may apply.

- I will take full responsibility for my network account and keep my account in good standing per the terms of the Network Membership Agreement.

- I will not allow any other person or unregistered vehicle use my network access card for charging.

- If I lose my network access card or it becomes damaged or non-functional, I will replace it immediately. I understand that it is my responsibility to request a replacement access card.

- I understand the charging stations are the property of my employer, and the privilege to access these stations may be revoked should the conditions stated above not be met. Further consequences may include termination of contract and/or employment.

Guests are any person not officially employed or contracted by employer. Guests may gain access to the charging stations for electric vehicles by contacting a designated person who must escort the guest to the charging station, confirm vehicle compatibility with the charging station, and provide access with a sponsored network access card. Charging for guests is free.

Employee Vehicle Registration:

Vehicle Make _____

Vehicle Model _____

Vehicle type (BEV or PHEV) _____

Charger speed _____

Battery size _____

Figure 13. Sample employee charging policy.

Equipment Operation

While companies currently providing workplace charging have reported few maintenance issues, there are operational considerations that should be taken into account for a reliable and problem-free system. Instructional signage and an annual equipment inspection can keep your stations up and running, while providing a reliable benefit to your employees.

Electric Vehicle Signage

Signs can be placed to inform drivers of time limits or remind them of etiquette issues, such as rewinding the cord after use to avoid tripping hazards.

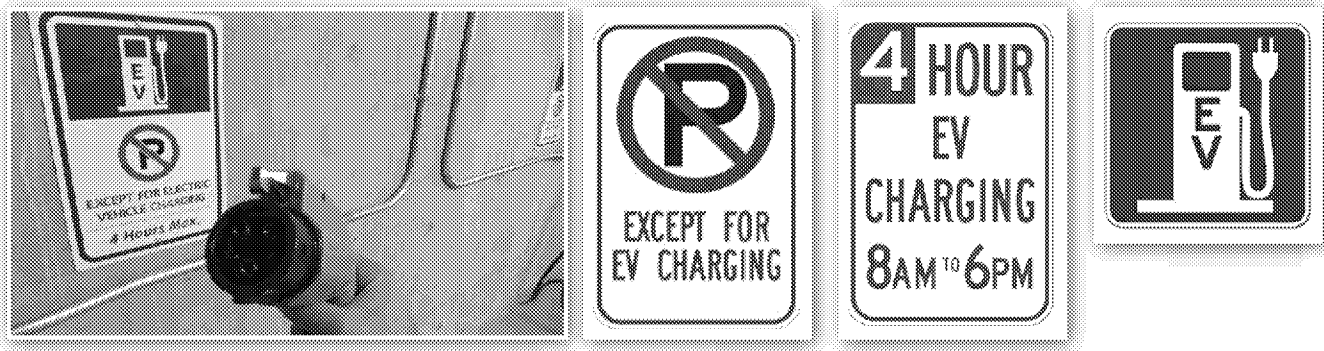


Figure 14: Example EV parking signs.

Equipment Maintenance

It is recommended that an annual inspection be implemented to ensure the connectors and cords are not showing any evidence of wear that needs repairs. A check to ensure actual charging operation on a real vehicle or test equipment is also beneficial.

Inspection	Item
Power supply	Is the station powered and operates when activated?
Display screen	Is the display screen readable?
Network device	Does the network activation device function properly?
Signage	Is signage up to date? Does it accurately display parking restrictions?
Lighting	Is there adequate lighting to operate the equipment at night?
Water drainage	Does water properly drain away from the station?
Cord condition	Is the cord in good condition? (not frayed or overly worn)
Connector condition	Does the connection device function properly? (handle is undamaged and device locks in place)
User safety	Is the surrounding environment safe for operation of the unit? (no obstacles/debris between vehicle and charger)

Figure 15. Annual equipment inspection checklist.

In addition to the annual inspection, it is important to identify an emergency contact for any issues regarding station operation or safety. Contact information should be posted at the charging station site and listed in the employee human resource policy.

Workplace Charging Company Profiles



GENERAL MOTORS

Focused on practicality, cost-effectiveness, and employee satisfaction

Number of Employees: 70,000 in United States

Number of Employees that drive a PEV: At least 600

Number of charging stations and types in United States:

Level 1 - 165

Level 2 - 348

DCFC - 1



General Motors (GM) is one of the world's largest automotive companies with operations in 120 countries. GM, its subsidiaries and joint venture entities, sell vehicles under the Chevrolet, Cadillac, Baojun, Buick, GMC, Holden, Isuzu, Jiefang, Opel, Vauxhall and Wuling brands.

General Motors originally began with only Level 2 charging stations, but has since incorporated many more Level 1 charging stations. They have also planned to spread out Level 2

charging stations in the future so that they can be shared across several parking spaces.

"Rarely do we implement networked solutions. We are trying to be as cost-effective as possible with our workplace charging solutions - and with the relatively small power load this represents today, we have not seen any issues with our non-networked solutions. We do acknowledge that as the PEV population grows we may need to revisit questions such as networked solutions or charging a fee for use. But for now our approach has been to focus on practicality, cost-effectiveness, and employee satisfaction."

GM has developed the Top 10 Workplace Charging Etiquette Tips found at <https://fastlane.gm.com/2014/06/03/top-10-workplace-charging-etiquette-tips/>



Cal/EPA
California Environmental Protection Agency

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY (CAL/EPA)

Successfully managing high demand for chargers

Number of Employees: 3,000

Number of Employees that drive a PEV: At least 100

Number of charging stations and types:

Level 1 - 16

Level 2 - 20

Cal/EPA was created in 1991 to restore, protect and enhance the environment, to ensure public health, environmental quality and economic vitality.



Several hundred Cal/EPA employees typically park in an eight-story public parking garage operated by the City of Sacramento, across the street from the Joe Serra Jr. Cal/EPA headquarters building. The garage has approximately 600 parking spaces, 20 of which have Level 2 charging stations and signage. Sixteen 120-volt outlets are also available at the same parking spaces; however, they have been deactivated due to excess power demand.

Cal/EPA has very high usage of the charging stations in the City of Sacramento parking garage.

Demand for the charging stations is greater than the supply, so the stations are fully used throughout the day. The chargers are free to use and are not networked. So, to help promote turnover of the charging spaces, time limits of 2, 4 and 5 hours have been implemented with signage that clearly states the time limits. The time limits and signage have been successful and results in approximately 2.5 swap-outs per day.

Since demand is so high for the chargers and there are so many new PEV drivers in this garage, there have been several challenges. These challenges include drivers unplugging other vehicles, drivers not following the set time limits, and drivers not replacing the charging cable correctly. To solve these issues, windshield flyers are often placed on cars and emails are sent out to educate drivers. The Air Resources Board staff member managing the chargers has also set up an email list so drivers can contact each other to ask permission to unplug a vehicle or request a vehicle to be moved.



POMONA COLLEGE

Managing their chargers by assessing a fee for use

Number of Employees: 700

Number of Employees that drive a PEV: 4

Number of charging stations and types in United States:

Level 1 - 3

Level 2 - 6

DCFC - 1



Founded in 1887, Pomona College is a private liberal arts college located in Claremont, CA. It offers its approximately 1,500 students a comprehensive curriculum in the arts, humanities, social sciences and natural sciences.

Pomona College charges employees 15 cents per kWh to charge their vehicles. They do this to compensate for the electricity used.

For visitors, the college charges \$1.25 per hour. This fee encourages visitors to move their cars after charging so that the charging stations are available for others to use.



CISCO SYSTEMS

Using a Good Neighbor Policy promotes charger etiquette

Number of Employees: 22,000

Number of Employees that drive a PEV: 1,500

Number of charging stations and types in United States:

Level 2 - 287

DCFC - 1



Cisco (NASDAQ: CS) is the worldwide leader in IT that helps companies seize the opportunities of tomorrow by proving that amazing things can happen when you connect the previously unconnected.

Cisco takes care of etiquette with their Good Neighbor Policy that must be signed before a charging station access card is activated for the driver. Once a PEV driver is signed up, they receive updates through email reminders and a quarterly update.

Conclusion

Now that you have a plan, remember to promote this great new amenity to your employees to let them know you have PEV charging and what policies and procedures you've introduced to make your workplace charging program a success. An inaugural event to kick it off (where you can also offer ride-and-drive experiences) is a great idea. The U.S. Department of Energy Workplace Charging Challenge has some great tools and resources to help you do this that can be found in Appendix A.

PEV charging at the workplace can benefit both the employer and employees. While many workplaces have already installed workplace charging stations for employee use, there still remain questions on how to make policies and develop best practices for these stations. While every workplace is unique, lessons learned from a few pioneering companies can help guide charging station deployment efforts for businesses large and small.

This document outlined some of the real world practices that are currently employed today in workplaces across the country and the state of California. For additional information on workplace charging, please visit the PEV Collaborative website at www.PEVCollaborative.org.



Appendix A – Resources

The additional resources provided below and organized by the chapter they relate to.

Plug-in Electric Vehicle and Charging Equipment Basics

Source	Materials
Business Council on Climate Change	www.BC35FBAY.org Information Sheets <ul style="list-style-type: none">• Benefits of Electrifying your Fleet: Benefits of electric fleets and common questions.
CALSTART	www.EVworkplace.org Web Pages <ul style="list-style-type: none">• Employer EV Initiative Website<ul style="list-style-type: none">◦ Frequently Asked Questions: Common questions from employers.
PEV Collaborative	www.PEVCollaborative.org Information Sheets <ul style="list-style-type: none">• Why Employers Should Install Workplace Charging for Plug-In Electric Vehicles: Benefits and incentives. Tools <ul style="list-style-type: none">• Webinar: Industry experts and company case studies on why install, the steps involved and what others are doing.• Workplace Charging Tip Card: Benefits to employers, list of online resources.
PEV Resource Center	www.DriveClean.ca.gov/pev Web Pages <ul style="list-style-type: none">• Consumer buying guide for plug-in electric vehicles and charging Tools <p>California Incentives: Search tool for finding California PEV incentives; includes charging equipment, vehicles, utility rates, and other discounts.</p>
U.S. Department of Energy Workplace Charging Challenge	www.energy.gov/eere/vehicles/ev-everywhere-workplace-charging-challenge Web Pages <ul style="list-style-type: none">• Greenhouse Gas Emissions Reduction Benefits of Workplace Charging: Details emissions reductions from workplace charging and electric vehicle adoption.

Facilitating Charging at Your Workplace

Source	Materials
Advanced Energy	www.advancedenergy.org Information Sheets <ul style="list-style-type: none">• Employee Guide to Workplace Charging: Talking points to address potential employer concerns.• Building Internal Support: Example employee survey and information from companies with workplace charging.

Appendix A – Resources (con't.)

California Department of General Services	www.dgs.ca.gov Information Sheets <ul style="list-style-type: none">• DRAFT CA Accessibility Standards – Draft accessibility building standards for Electric Vehicle Chargers and Vehicle Spaces.
California Energy Commission	www.energy.ca.gov/drive Web Pages <ul style="list-style-type: none">• Alternative and Renewable Fuel and Vehicle Technology Program: Learn about PEV related grants for charging infrastructure.
Center for Sustainable Energy	www.energycenter.org Information Sheets <p>Permitting and Inspection Checklist: Installation guidance and permitting requirements for San Diego California.</p>
Drive Oregon	www.driveoregon.org Presentations <ul style="list-style-type: none">• Drive Oregon's Workplace Charging Workshop: Overview of workplace charging 'how-to's for companies of all sizes.
Los Angeles Department of Water and Power (LADWP)	www.ladwp.com/ev Incentive <p>Charge Up L.A.!: Rebates are available to LADWP residential and commercial customers, who install qualified Level 2 chargers (240 Volt) within the LADWP's service area, which includes the City of Los Angeles and parts of the Owens Valley.</p>
PEV Collaborative	www.PEVCollaborative.org Information Sheets <ul style="list-style-type: none">• How Can I get Plug-In Electric Vehicle Charging at My Workplace?: Sample employee letter and employer concerns.• Workplace Charging How and Why?: Employer questions, ten steps to install, list of resources.
Sacramento Municipal Utility District (SMUD)	www.smud.org Web Pages <ul style="list-style-type: none">• PEV Pricing Plan: Learn about different rate plans for different customers
San Diego Gas & Electric (SDG&E)	www.sdge.com Web Pages <ul style="list-style-type: none">• Employers and Property Owners: Explains key points to know when considering workplace charging.
Southern California Edison (SCE)	www.sce.com Web Pages <ul style="list-style-type: none">• Electric Car Charging & Your Rate Plan: Discuss rates for electric vehicle charging at businesses. Handbooks <ul style="list-style-type: none">• Workplace: Employee Electric Vehicle Charging: Discusses station considerations and rate options.

Appendix A – Resources (con't.)

U.S. Department of Energy Workplace Charging Challenge	www.energy.gov/eere/vehicles/ev-everywhere-workplace-charging-challenge Tools <ul style="list-style-type: none">• Sample Employee Survey for Workplace Charging Planning: Example survey to gauge employees' interest in charging infrastructure.
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Planning for Future Growth

Source	Materials
Advanced Energy	www.advancedenergy.org Information Sheets <ul style="list-style-type: none">• Implementation Best Practices: Key implementation lessons learned from companies with workplace charging.• Planning Equipment Installation: Examples of installation planning from companies with workplace charging. Reports <ul style="list-style-type: none">• Workplace charging in the Real World: Analysis of real-world employee charging patterns and behaviors.
UC Los Angeles Luskin Center for Innovation	www.luskin.ucla.edu Reports <ul style="list-style-type: none">• Southern California Plug-in Electric Vehicle Readiness Plan: Contains a chapter on planning for workplace charging. Includes assessing opportunities, the installation process, planning, financial viability and recommended policies.

Identifying the Right Charging Equipment

Source	Materials
Advanced Energy	www.advancedenergy.org Information Sheets <ul style="list-style-type: none">• Choosing an Appropriate System: Overview of charging Levels 1, 2, DCFC and examples of company deployments.
Business Council on Climate Change	www.BC3SFBA.org Reports <ul style="list-style-type: none">• Electrify Your Business - A Bay Area Business Guide: Report on benefits, costs, selecting the number of chargers, station features and manufacturer information, ownership models, signage, incentives.
CALSTART	www.EVworkplace.org Guides <ul style="list-style-type: none">• Best Practices for Workplace Charging - Employer EV Initiative: Choosing a system; power requirements, cost of electricity, demand charges, TOU rates, network access fees, payment policies. Web Pages <ul style="list-style-type: none">• Employer EV Initiative Website<ul style="list-style-type: none">o Best Practices List/What Kind of System: Selecting the appropriate system for your workplace.o Suggested EVSE Vendor List: Listing of company names and contact information.

Appendix A – Resources (con't.)

Go Electric Drive

www.goelectricdrive.org

Tools

- [Charging Station Supplier List](#): Searchable EVSE database by make/model.

PEV Collaborative

www.PEVCollaborative.org

Information Sheets

- [Employer's Guide to Installing Workplace Charging for Plug-In Electric Vehicles](#): Process for installing workplace charging; includes Research Options, Choose a System (Level 1, 2, or DCFC), Create Installation Checklist, Establish Policies and Procedures, Evaluate and Monitor Program.

Tools

- [Vendor List](#): Related companies and contact information.

Plug In America

www.pluginamerica.com

Tools

- [Accessory Tracker](#): Charging station equipment guide.

Plugincars.com

www.plugincars.com

Web Pages

- [Electric Vehicle Charging for Business](#): Equipment considerations, features.
- [Ultimate Guide to Electric Car Charging Networks](#): Cost considerations and top network service providers.

U.S. Department of Energy Workplace Charging Challenge

www.energy.gov/eere/vehicles/ev-everywhere-workplace-charging-challenge

Information Sheets

- [Request for Proposal Guidance](#): Provides a description of the types of requirements to be included in an employer's workplace charging request for proposal.

Managing Charging Stations

Source

Materials

Advanced Energy

www.advancedenergy.org

Information Sheets

- [Charging Policies](#): Examples of charging policies from companies with workplace charging.

CALSTART

www.EVworkplace.org

Guides

- [Employer Policies and Incentives to Encourage EV Adoption](#): Policy support and sample workplace policies for electric vehicle charging.

Web Pages

- [Employer EV Initiative Website](#)
 - o [Workplace Charging Calculator](#): Calculates estimated installation and operating costs.

California Air Resources Board

www.arb.ca.gov

Information Sheets

- [Carpool Lane Eligible Vehicle List](#): Qualifying vehicles for California's single occupant carpool lane stickers.

Appendix A – Resources (con't.)

EV Rules.com	Information Sheets <ul style="list-style-type: none">• EV Charging Etiquette: Rules for EV Charging.
General Motors	www.Fastlane.GM.com Articles <ul style="list-style-type: none">• Top 10 Workplace Charging Etiquette Tips: Suggested workplace charging etiquette based on Plugincars.com "Eight Rules of EV Charging Etiquette".
Inside EVs	www.insideEVs.com Articles <ul style="list-style-type: none">• Workplace Charging Shouldn't be Free: Commentary on sizing and fee structures for workplace charging.
Pacific Gas & Electric Company (PG&E)	www.pge.com Tools <ul style="list-style-type: none">• Consumer Information on Electric Rates: Utility information for PEVs/Infrastructure for Non-Residential Customers. Includes PEV electric rate calculator, installation guide, and FAQs.
PEV Collaborative	www.PEVCollaborative.org Reports <ul style="list-style-type: none">• Case Studies – Amping Up California's Workplaces: 20 Case studies on plug-in electric vehicle charging at work. Including decision-making process, charging implementation and management, charging costs, employee benefits, challenges.
Plugincars.com	www.plugincars.com Web Pages <ul style="list-style-type: none">• Workplace Charging Etiquette: A California Company's Solution.
Southern California Edison (SCE)	www.sce.com Web Pages <ul style="list-style-type: none">• Keeping Your Employees Charged & Ready: Overview of workplace charging policies, installation and costs.
U.S. Department of Energy Workplace Charging Challenge	www.energy.gov/eere/vehicles/ev-everywhere-workplace-charging-challenge Handbooks <ul style="list-style-type: none">• Plug-In Electric Vehicle Handbook for Workplace Charging Hosts: Provides an overview of PEVs, charging basics, workplace charging benefits, planning, management and policies, and installation details. Web Pages <ul style="list-style-type: none">• Workplace Charging Management Policies: Administration: Discuss how to set clear guidelines around workplace charging administration.• Workplace Charging Management Policies: Registration & Liability: Discusses different employee registration options.• Workplace Charging Management Policies: Sharing: Details how employers can create a policy that specifies what employees should do when there are more PEVs that need to charge than charging stations available.• Workplace Charging Management Policies: Pricing: Guides employers on how to set a fee on charging.

Appendix A – Resources (con't.)

UC Davis Institute of Transportation Studies

www.its.ucdavis.edu

Reports

- [Charging for Charging: The Paradox of Free Charging and Its Detrimental Effect on the Use of Electric Vehicles](#): Study that focuses on workplace charging and makes a suggestion on how to charge while increase electric vehicle miles traveled.
- [Do You Mind If I Plug-in My Car? How Etiquette Shapes PEV Drivers' Vehicle Charging Behavior](#): Study that looks at the fact that workplace charging adds an additional layer of rules and possibly resources that may either inhibit or encourage PEV charging.

UC Los Angeles Luskin Center for Innovation

www.luskin.ucla.edu

Reports

- [Pricing Workplace Charging: Financial Viability and Fueling Costs](#): Assesses workplace charging from two perspectives, 1) employers investing in work place-charging facilities and pricing their use and 2) employee drivers.

Equipment Operation

Source

Materials

Advanced Energy

www.advancedenergy.org

Information Sheets

- [Maintaining and Evaluating your System](#): Example system evaluations from companies with workplace charging.
- [Operating Models](#): Ownership and accessibility examples from companies with workplace charging.
- [Publicity Opportunities](#): Examples promotion activities from companies with workplace charging.

California Department of General Services

www.dgs.ca.gov

Guides

- [Electric Vehicle Supply Equipment Guidance Document](#): California Department of General Services guide to implementing workplace charging for agency facility and fleet managers. Site assessment, placement, sizing, ADA, LEED, signage.

California Department of Transportation (CalTrans)

www.dot.ca.gov

Guide

- **Policy directive**: Zero emission vehicle signs and pavement markings.

U.S. Department of Energy Workplace Charging Challenge

www.energy.gov/eere/vehicles/ev-everywhere-workplace-charging-challenge

Web Pages

- [Workplace Charging Challenge: Signage Guidance](#): Gives examples of signage for PEV charging stations.

UC Los Angeles Luskin Center for Innovation

www.luskin.ucla.edu

Reports

- [Financial Viability of Non-Residential Electric Vehicle Charging Stations](#): Assesses the financial viability of non-residential EV charging stations in the Los Angeles metro area.

Appendix A – Resources (con't.)

Conclusion

Source

**U.S. Department of Energy
Workplace Charging
Challenge**

Materials

www.energy.gov/eere/vehicles/ev-everywhere-workplace-charging-challenge

Tools for

- [Plug-in Electric Vehicle Handbook for Workplace Charging Hosts](#): Use this handbook as a guide from workplace charging assessment and installation to charging includes other information to consider when educating employers about workplace charging.
- [Workshop Agenda Template](#) – Develop a streamlined workshop with this half-day agenda focused on introductory-level PEV education and firsthand employer workplace charging experience.
- [Workshop Host Outreach Letter Template](#) – Approach employers in your community that already have workplace charging to serve as a workshop host.
- [Workshop Speaker Outreach Letter Template](#) – Invite employers in your community that have charging to speak on an employer experience panel.
- [Workshop Speaker Instruction Letter Template](#) – Inform speakers participating in the employer experience panel about their role in the event.
- [Workshop Invitation Template](#) – Engage possible workplace charging event attendees with this template invitation.

Appendix B - Determining the Fair Market Value of Electric Vehicle Charging

The fair market value (FMV) of a fringe benefit is the amount an employee would have to pay a third-party to buy or lease the benefit. Employee benefits may be reportable as a taxable benefit under *IRS Publication 15-B: Employer's Tax Guide to Fringe Benefits*. Check with your organization's accounting department to determine limits on taxable benefits.

	Example	Enter Value
1 Station Output (kW)	Level 2 : 240V/40A x 90% efficiency = 5.4 kW	
2 On-board vehicle charger speed (kW)	Nissan Leaf: 6.6 kW	
3 Enter lowest value of lines 1 and 2	5.4	
4 Time parked (hours)	8 hours	
5 Multiply lines 3 and 4	5.4 x 8 = 43.2 kWh	
6 Battery size (kWh)	24 kWh	
7 Enter lowest value of lines 5 and 6	24 kWh	
8 Electric rate (\$/kWh)	\$0.15	
9 Multiply lines 7 and 8. <i>This is the vehicle's maximum benefit per day.</i>	\$3.60	
10 Multiply line 9 by the number of workdays per year. <i>This the vehicle's maximum annual benefit.</i>	240 days/year x \$3.60= \$864/year	



CALIFORNIA

PLUG-IN ELECTRIC VEHICLE
COLLABORATIVE

www.PEVCollaborative.org