San Joaquin Valley

PLUG-IN ELECTRIC VEHICLE (PEV) READINESS PLAN

Preparing the San Joaquin Valley for Plug-in Electric Vehicles

Center for Sustainable Energy® CALIFORNIA

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1 Executive Summary

The San Joaquin Valley Plug-in Electric Vehicle (PEV) Readiness Plan (the Plan) builds on previous PEV readiness efforts in the region. In December 2012, the San Joaquin Valley Air Pollution Control District (SJVACPD) released the San Joaquin Valley PEV Community Assessment, evaluating the level of PEV readiness among jurisdictions in the region. While the San Joaquin Valley strives to stay ahead of the PEV adoption curve, the assessment results showed that there are barriers that must be overcome to accelerate the adoption of PEVs in the region.

To address the assessment results, an advisory group of regional stakeholders from public agencies, local energy utilities and charging station manufacturers, organized as the Plug-in Electric Vehicle Coordinating Council (PEVCC), identified ten market barriers to the greater deployment of PEVs and public charging infrastructure in the San Joaquin Valley. The Plan provides background and analysis of each of these barriers and PEVCC-developed recommendations to overcome these challenges. Table 1 summarizes the barriers and resources for stakeholders.

In addition to the Plan, resources such as easy-to-read Fact Sheets, installation guidelines, and in-depth reports have been developed to address region-specific market barriers. These materials complement the Plan and are meant to be distributed among members of the community, city and county staff, and other stakeholders interested in growing the PEV market in the Valley. The Plan also provides guidance in the following areas:

- Identifying and mapping optimal locations for electric vehicle chargers in ten Valley cities and along the Highway 99 corridor (Section II)
- The impact of electric vehicle supply equipment Installations on the Local Workforce and Economy (Section III)
- The environmental benefits of plug-in electric vehicles in the region (Section III)
- The use of incentives to spur plug-in electric vehicle sales in the region (Section III)

Table 1: PEV Market Barriers in the San Joaquin Valley

Market Barriers	Description	Chapters and Resources
Outreach and Education	Public knowledge of PEV technology and charging infrastructure	Chapter 3 Appendix A- *The Basics: A Guide to Plug-in Electric Vehicles and Charging Infrastructure* *Charging Environments: Single-family Residences and Multi-Unit Dwellings* *Charging Environments: Retail and Public Locations* *Charging Environments: Workplaces* Appendix B – *Electric Vehicle Charging Station Installation Guidelines*

		Appendix E – Costs and Benefits of Switching to a Plug-in Electric Vehicle
Zoning Policies, Parking and Signage	Lack of standard ordinances in the region that facilitate the installation and access to publicly available charging infrastructure	Chapter 4 & Chapter 5 Appendix A – *Sample Zoning Code Provisions*
Training for Electrical Contractors	Electric vehicle infrastructure training for electrical contractors	Chapter 6
Permitting and Inspection	Lack of streamlined permitting and inspection processes and inconsistent (high) costs across jurisdictions	Chapter 7 Appendix A – *Permitting & Inspection Guidelines*
Utility System Impacts and Rate Design	Charging PEVs when electricity supplies are in high demand; Lack of consumer knowledge of special utility residential rates for charging	Chapter 8 Appendix A – *Local Utilities: Solutions and Programs for Plug-in Electric Vehicle Charging*
Workplace Charging	Lack of understanding regarding the benefits and steps to hosting charging infrastructure at workplaces	Chapter 9 Appendix A – *Charging Environment: Workplaces*
Building Codes for PEV Charging	Lack of adopted building codes in the region that accommodate charging infrastructure	Chapter 10
Charging at Multi-Unit Dwellings	Lack of knowledge regarding charging infrastructure installations at multi-unit dwellings	Chapter 11 Appendix A - *Charging Environments: Single-Family Residences and Multi-Unit Dwellings*
Fleet Electrification	Low PEV adoption in regional fleets	Chapter 12 Appendix B – *Electric Vehicle Charging Station Installation Guidelines: Fleet* Appendix D – *Fleet Electrification Case Study: UPS in the San Joaquin Valley*
Leveraging Renewable Energy	Lack of education on the use of renewables in PEV charging	Chapter 13 Appendix F – *Renewable Energy and Plug-in Electric Vehicle Charging Stations*
Regional Charging Station Siting Analysis	Lack of planning identifying locations for charging infrastructure	Chapter 15

The Plan will serve as a resource to support local government officials, including planners, code officials and building inspectors, and assist local policymakers in addressing the complexities behind each of the above barriers, educating constituents, streamlining permitting and developing policies to support electric vehicle charger deployment. With added infrastructure and greater community and local government awareness of PEVs, the region can foster a greater share of the California PEV market.

2 Introduction

The San Joaquin Valley Air Basin is made up of eight counties in California's Central Valley: San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare and the western portion of Kern. There are more than 60 incorporated cities within the Valley's approximately 27,000 square miles, which are home to approximately 4.1 million residents.

The characteristics that make the Valley the state's top-performing agricultural region and a beautiful place to live also create conditions for forming and trapping air pollution. Surrounding mountains, stagnant weather patterns, hot summers and foggy winters make the formation of air pollution in the Valley inevitable and prevent air pollutants from dispersing. In addition to local pollution created from industry and agriculture, air quality in the San Joaquin Valley is influenced by transported air pollution from the Bay Area and Sacramento.

Despite this uniquely difficult topography, the San Joaquin Valley Air Pollution Control District (SJVACPD) has a history of successfully developing and implementing creative and innovative strategies to reduce air pollution in the Valley. This includes the SJVACPD's 2007 Ozone Plan, which pledges to attain the federal eight-hour ozone standard through the adoption and implementation of pollution control technologies and new incentive funding. The mass adoption of plug-in electric vehicles is a key strategy to achieving reduced emissions and helping the Valley attain air quality goals.

2.1 Background

In order to address the region's poor air quality and encourage extensive PEV deployment, the SJVACPD Governing Board authorized the establishment of the San Joaquin Valley PEVCC in October 2011. The PEVCC was organized to provide policy direction and guide efforts to collaborate with regional stakeholders to address regional PEV readiness. The PEVCC and the Plan were made possible by funding from the California Energy Commission (Energy Commission).

The San Joaquin Valley PEVCC is a 28-member advisory group comprised of local Metropolitan Planning Organizations, cities, counties, utilities, the San Joaquin Valley Clean Cities Coalition, electric vehicle service providers, as well as local consultants and non-profit organizations. The PEVCC met during the course of 2013 and served as an advisory committee to ensure the plan is tailored to local conditions and responsive to local needs.

This Plan is part of larger efforts to prepare communities throughout the state and the country for plug-in vehicles. In early 2011, the US Department of Energy Clean Cities Program funded 16 grants for PEV

readiness planning in 24 states. The State of California was awarded one of these grants and funded PEV planning efforts in six regions across the state, including the San Joaquin Valley.

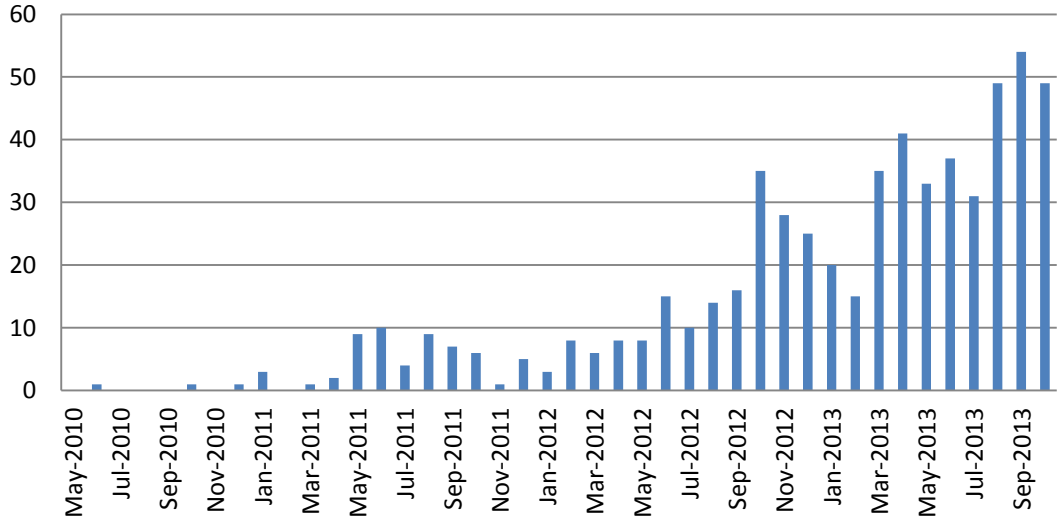
The Energy Commission provided a second round of investment to nine regions across the state in 2012 to fund the establishment of a local PEV infrastructure coordinating council tasked with creating a region-specific PEV infrastructure plan. The San Joaquin Valley PEVCC and this Plan were made possible by this funding. The Energy Commission will use each regional plan will be used to create a statewide PEV infrastructure plan.

This Plan also aligns with state policies for deploying PEVs across California. In March 2012, Governor Jerry Brown issued Executive Order B-16-2012, which calls for 1.5 million zero-emission vehicles (ZEVs) on California roadways by 2025 and directs state government agencies to incorporate ZEVs into their light-duty fleets. In addition, the governor executed Executive Order B-18-2012 that directs state agencies to "identify and pursue opportunities to provide electric vehicle charging stations, and accommodate future charging infrastructure demand, at employee parking facilities in new and existing buildings."

2.2 Regional Growth and Additional Challenges to Greater Adoption of Plug-in Vehicles

The San Joaquin Valley PEV market is slowly growing. Approximately 1.5% of the PEVs in California are found in the Valley. Although the Valley's adoption rate is slower than other regions such as the Bay Area or Los Angeles, the region has seen strong sales of electric vehicles since 2010. The table below displays the total number of newly purchased or leased PEVs in the San Joaquin Valley APCD territory by month.

Figure 1: San Joaquin Valley PEV Adoption[1]



[1] PEV adoption numbers were extrapolated from DMV and Clean Vehicle Rebate Project (CVRP) data. The CVRP participation rate was estimated from DMV data, which was used to determine the number of PEVs purchased and leased. The CVRP, funded by California Air Resources Board, provides rebates of up to $2,500 for the purchase or lease of zero-emission and plug-in hybrid light-duty vehicles.

To support this upward trend, a robust charging network will be needed alongside greater efforts to expand opportunities for low-income and diverse communities to enter the PEV market, which are often the most affected by air pollution.

Another challenge to PEV deployment in the San Joaquin Valley is that the region has not experienced as much public or private investment in PEV infrastructure and planning as other California markets. The Plan, however, will define strategies and ideas to support a growing PEV market to encourage investment and coordinated regional planning for charging infrastructure (also known as electric vehicle supply equipment or EVSE).

It should be noted that greater adoption of PEVs alone will not solve the Valley's air quality issues. Though strategies to increase the number of PEVs on the road and further deploy infrastructure is the focus of this Plan, plug-in vehicles are just one part of a broader strategy to make transportation systems more environmentally-friendly. Other strategies include investments in mass transit, car sharing, pedestrian- and bicycle-friendly infrastructure and continued development of more energy efficient transportation technologies.

3 Outreach and Education

3.1 Background

Understanding the San Joaquin Valley residents' perceptions of PEVs will be critical to influencing and advancing their deployment in the region.

BARRIERS

- Lack of consumer demand for PEVs in the San Joaquin Valley
  - Initial purchase expense
  - Limited driving range
  - Long recharging time
  - Perception of being a status symbol
- Lack of consumer knowledge of PEV technology, costs and benefits, available incentives and station installation process
- Current PEV models do not satisfy regional consumer desires

PEVs are expensive, which leads to slow adoption. Despite current federal, state and regional incentives and recent price drops on some new models,[2] many consumers in the San Joaquin Valley cannot afford these vehicles. Plug-in electric vehicle technology is unfamiliar and requires people to become aware of new ways to use and refuel their cars. People may also have concerns regarding vehicle range and limited availability of public charging. Research shows, however, that once people have a basic understanding of PEV technology and have the opportunity to drive PEVs, these barriers and concerns diminish considerably.

In order to address these challenges, the PEVCC held several meetings to brainstorm what were the likely key audiences to be reached, messaging that would resonate with these audiences and the mechanisms that would get more people into PEVs. Ultimately, the group decided to build a comprehensive outreach and communications strategy that would facilitate the cultural shift necessary to drive broad regional adoption of PEVs.

[2] Many auto manufacturers are decreasing the market prices of 2014 plug-in electric vehicles models.

The SJV PEVCC identified the need to begin on-the-ground outreach directed toward local elected officials, community groups, and consumers. This outreach will be concurrent with the development of a more robust and ambitious marketing plan. This will involve field-testing messaging and outreach approaches to inform the San Joaquin Valley Air Pollution Control District's long-term marketing strategy.

An example of a targeted marketing and outreach campaign for electric vehicles is the $1 million Bay Area Electric Vehicle Promotional Campaign, promoted and funded by the Bay Area MTC and the Bay Area Air Quality Management District, which seeks to increase the number of PEV owners in the Bay Area through social media and event outreach. Its comprehensive marketing plan consists of research on target audiences, brand strategies, and implementation strategies uniquely for PEVs and Bay Area residents.

3.1.1 Creating a Marketing Campaign

It is important to create a marketing campaign that achieves the following goals:

- Educates the public about the benefits of PEV ownership
- Helps shape the perception of PEVs as a viable transportation method
- Targets diverse communities with free ride-and-drive events and an outreach program
- Motivates Valley residents, especially those in diverse and low-income communities, to reduce mobile source pollution and improve air quality
- Leverages the existing incentives that the San Joaquin Valley Air Pollution Control District has in place to promote PEV affordability

A successful on-the-ground outreach program in the San Joaquin Valley will need to be directed to two audiences:

- General Public
- Elected Officials

3.1.2 Outreach to General Public

Based on PEVCC feedback, marketing focused on the environmental benefits of PEVs can be ineffective as a leading message. To connect with consumers in the Valley, effective messaging must consider the socioeconomic realties and ethnic diversity of Valley residents and work to convince audiences that PEVs are economical, fun to drive and provide freedom from purchasing gas. A successful campaign must acknowledge the existing barriers that inhibit Valley residents from PEV purchases and focus on efforts that change people's perceptions.

Key elements of the marketing campaign include:

1. Identifying and documenting the experiences of a diverse group of PEV drivers that live and commute in the San Joaquin Valley.
2. Connect with likely buyers through a campaign that helps engage consumers with individualized, personal PEV experiences — through free ride-and-drives, firsthand accounts of Valley PEV

drivers and an aggressive online engagement program that delivers culture-based messages and reflects audience desires.

3. Identify highly visited events or locations (e.g., farmers markets, cultural events) and set up a presence, again through free ride-and-drives and online advertisement.
4. Educate likely buyers by addressing key unknowns (e.g., range anxiety, charging infrastructure, incentives, safety, etc.). Conduct consistent outreach to the target audience through multiple media channels, such as online targeting, radio and mobile marketing.
5. Create an educational pamphlet to be placed in new PEVs. This will not only complement dealers' knowledge of PEVs, but will also guide new drivers to resources and provide them with information on incentives and charging infrastructure. (Costs and Benefits of Switching to a Plug-in Electric Vehicle Fact Sheet found in Appendix E)
6. Organizing and facilitating informational sessions and meetings for different community groups (e.g., car clubs, chambers of commerce, business associations, etc.) to engage with them about PEVs and ways in which they spur economic growth.

3.1.3 Engaging Elected Officials

Working with elected officials, from city council members to state representatives, is an effective way to raise awareness of PEVs and the challenges facing communities when adopting this new technology.

Local government staff and other stakeholders can educate their local elected officials by taking the following steps.

1. Give a presentation using the San Joaquin Valley PEV Outreach Presentation at a city council or county supervisor meeting.
2. Have a specific goal for the meeting; present the following topics to encourage PEV-friendly policy adoption:
    a. Model local ordinances, such as sample ordinances that can help local governments achieve consistent regional PEV policies by replicating or adapting best practices.
    b. PEV Definitions – A sample list of key vocabulary and industry terms.
    c. Building Codes – Adopting codes that support prewiring or installing EVSE during construction of commercial, public and residential structures to promote cost-effective EVSE deployment. Find more information in Chapter 10.
    d. Zoning and Allowed Uses – Zoning regulations can set safety and

The San Joaquin Valley PEV Outreach Presentation was created to educate local elected officials and community groups. It contains information on the types of PEVs, charging infrastructure technology, vehicle incentives and local partners in the PEV planning project. The presentation can be formatted and tailored to specific audiences.

accessibility standards for consistent parking and signage rules. Zoning codes establish allowable public EVSE locations according to density and land use. Find examples of a zoning policy for PEVs in Appendix A.6

3. Ask officials to take part in a National Plug-in Day or a local plug-in electric vehicle event.
4. Provide officials with the California Zero-Emission Vehicle Community Readiness Guidebook.

4 Zoning Policies for Plug-in Electric Vehicles

4.1 Background

The PEVCC supports consistency across jurisdictions and regional standardization of codes that facilitate the installation of and access to publicly available charging infrastructure. The regional adoption of zoning code provisions for electric vehicle charging stations will help expand the PEV market by ensuring that charging is an allowed land use in as many types of zoning districts as possible, either as an accessory or as a principal use as appropriate. This is because zoning generally determines the number of parking spaces required for a certain land use; although, some jurisdictions have used building codes to specify the number of spaces that need to have PEV-ready wiring in new construction.

4.2 Key Issues

Local governments can use zoning to leverage PEV charger installations using the following methods.[3]

- Allow charging as an accessory use that does not require more than a simple planning clearance, as long as charging is not the primary purpose of the site.
- Allow installation of chargers as an outright permitted or accessory use as appropriate in zones that present the most significant local opportunities for PEV charging.
- Charging spaces designated for PEVs or alternative fuel vehicles should be able to meet the minimum parking requirements for business owners and developers. Planners should consider reducing parking requirements in exchange for the site host providing PEV charging spaces.
- Require a minimum percentage of parking spaces in new construction be PEV-ready based on current and anticipated PEV demand.
- Zoning ordinances that allow charging as a permitted or accessory use should tailor any additional conditions of installation to the type of building specified in the ordinance. For example, it may not be necessary to require signage and protection against damage to the charging unit as a condition of permitting charging in single-family zones.

A sample zoning code provision for electric vehicle charging stations can be found in Appendix A.6.

[3] Adopted from the South Coast PEV Readiness Plan, UCLA Luskin Center

5 Parking and Signage

5.1 Background

There is an opportunity for PEVs to re-charge while they are parked. Unlike conventional internal combustion engines (ICE) vehicles that can refuel in a matter of minutes, PEVs need more time to get sufficient charge for the next part of their journey. Therefore, areas where people tend to be parked for long periods of time, such as gyms, parks and movie theaters, present an ideal location for EVSE. Proper planning can ensure that EVSE in public, retail and residential locations is accessible, visible and safe to use.

This chapter has been developed to guide planners and local jurisdictions on how to allocate public parking for PEVs, where to place public EVSE, and how to enforce PEV parking rules.

San Joaquin Valley Case Study

The City of Lodi introduced an ordinance amending a municipal code to address parking and PEV charging spaces. The ordinance states that parking spaces designated for PEV charging must be used exclusively for charging and parking a vehicle that is connected for charging. Any obstruction or blocking of PEV-designated stalls or spaces is prohibited.

5.2 Key Issues

5.2.1 Parking Space Requirements for Charging Equipment

Below are examples of state and municipal codes that require parking space requirements for charging equipment.

Table 2: Parking Space Requirements for Charging Equipment

Source	Building or Land Use Type	Number/Percent of Spaces Dedicated to EV Charging
CALGreen	One- and two-family dwellings	1 per dwelling unit
CALGreen	Multifamily dwellings	3% of all spaces; at least one space
CALGreen	Nonresidential	2% (varies by size of lot)
CALGreen	Nonresidential	10-12% (varies by tier and size of lot)
City of Sunnyvale Building Code	Single-family dwellings	1 per dwelling unit
City of Sunnyvale Building Code	Residential developments with common shared parking area	12.5% of all spaces
City of Emeryville Draft Planning and Zoning Code	Multi-unit residential and lodging with 17+ parking spaces	3% of all spaces
City of Los Angeles	Residential occupancies with common shared parking area	5% of total number of parking spaces

City of Lancaster	New multi-family projects with 10 dwelling units or fewer	20% of total parking spaces
City of Lancaster	New multi-family projects with 10 dwelling units or more	10% of total parking spaces

Adopted from the Bay Area and Monterey Bay Area Plug-in Electric Vehicle Readiness Plan (2012).

5.2.2 Accessibility Requirements

The Governor's Office of Planning and Research (OPR) has addressed accessibility requirements for EVSE in their document, "Plug-in Electric Vehicles: Universal Charging Access Guidelines and Best Practices," which expands upon the California Division of the State Architect's "Interim Disabled Access Guidelines for Electric Vehicle Charging Stations" (Policy #97-03), dated June 5, 1997.

While Policy #97-03 is only applicable to facilities under DSA's regulatory jurisdiction, it is possible that these voluntary 2013 guidelines will eventually become regulations within *California Building Code Chapter 11B Accessibility to Public Buildings, Public Accommodations, Commercial Buildings and Public Housing*.

The Governor's OPR guidelines address accessible PEV charging stations on both public and private sites and within public rights of way. The following chart is a guideline for the number of disabled access charger spaces required.

Table 3: Parking Accessibility Requirements

Number of Chargers Provided at a Site	Number of Disabled Accessible Charger Spaces Required
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4

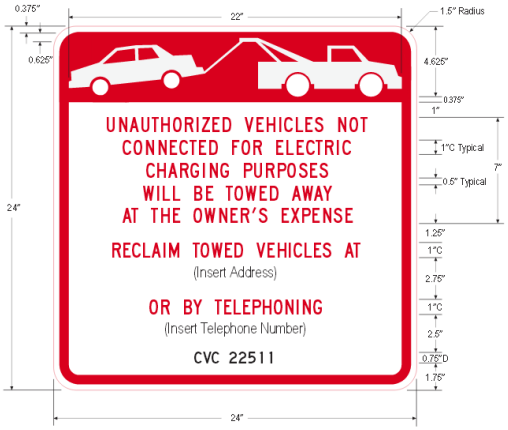
5.2.3 Signage

Signs for PEV charging should be visible to ensure utilization. The *California Manual on Uniform Traffic Control Devices* contains a series of signs and markings for PEV charging stations and parking stalls.

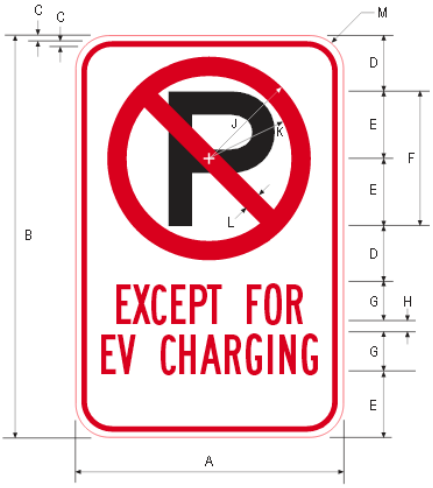
Below are examples of the recommended signs for EVSE provided by the California Department of Transportation.

Regulatory Signs

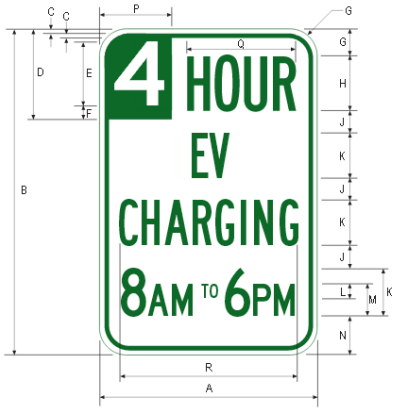
PEV Tow-Away Symbol: This sign indicates that vehicles will be towed if not utilizing the available charging station (per CVC 21511). This sign will include the tow-away symbol with the following language, “UNAUTHORIZED VEHICLES NOT CONNECTED FOR ELECTRIC CHARGING PURPOSES WILL BE TOWED AWAY AT THE OWNER’S EXPENSE…” with red text on a white background and be 24” x 24”.



No Parking Symbol: This sign indicates no parking is allowed unless it is for charging a PEV. This will include the following language, “EXCEPT FOR ELECTRIC VEHICLE CHARGING” with red text on a white background and be 12” x 18”.

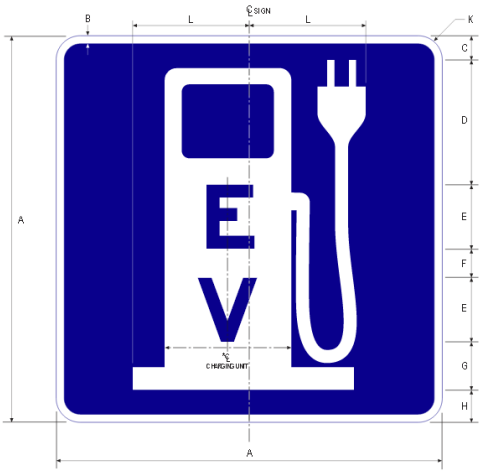


Permissive Charging Symbol: This sign indicates the time that charging will be available and will include the following language “[Electric Vehicle] __ HOUR CHARGING-__AM TO __PM” with green text on a white background and be 12” x 18”.



General Directional Signs

Electric Vehicle Charging Station Symbol and Word Message Signs: These signs will assist in directing PEV drivers to charging stations from the freeway, local streets and at charging locations. The sign includes the EV charging station symbol.



More examples and detailed information can be found at the California Department of Transportation.

5.2.4 Parking Enforcement Rules

Oftentimes, there are parking infractions that occur despite clear signage and rules. Whether it is a PEV not actively charging in a PEV-only space or a non-PEV parked in a PEV-only space, there must be a way to enforce PEV parking rules. Several cities and states have passed ordinances and bills concerning PEV-designated parking spaces. Below are examples of rules and enforcement that have been either passed or are in discussion.

Table 4: Examples of Parking Enforcement Rules

Agency	Description
City of Lodi	Amends Lodi Municipal Code Chapter 10.44 by adding section 10.44.125 "Electric Vehicle Charging Stalls," which states that parking spaces designated for PEV charging must be used exclusively for charging and parking a vehicle that is connected for charging. Any obstruction or blocking of PEV-designated stalls or spaces is prohibited.
City of Santa Monica	Code 3.12.835 notes that the Director of Planning and Community Development is authorized to designate parking spaces or stalls in an off-street parking facility owned and operated by the City of Santa Monica or the Parking Authority of the City of Santa Monica for the exclusive purpose of charging and parking a vehicle that is connected for electric charging purposes.
City of Laguna Beach	Passed a resolution to make PEV charging free for the first four hours, but for each additional hour after, a $5.00/hour fee will be in place to reduce long plug-in times.
City of Knoxville, Tenn.	Passed an ordinance that allows the city to ticket or tow any nonelectrical vehicle parked in a PEV-designated spot. In addition, the city will tow any PEV not plugged in and charging.
State of Washington	Senate Bill 5849 prescribes a penalty for vehicles that are parked in a PEV-only space or stall but not connected to the charging equipment. Infractions result in a $124 fine.
State of New York	Senate Bill 5190 establishes fines for vehicles parked in a PEV-only stall, but not actively charging, with fines set from $50 to $75 for a first offense

and $75 to $100 for a second offense.

5.2.5 Siting and Design Guidelines for Plug-in Electric Vehicle Parking

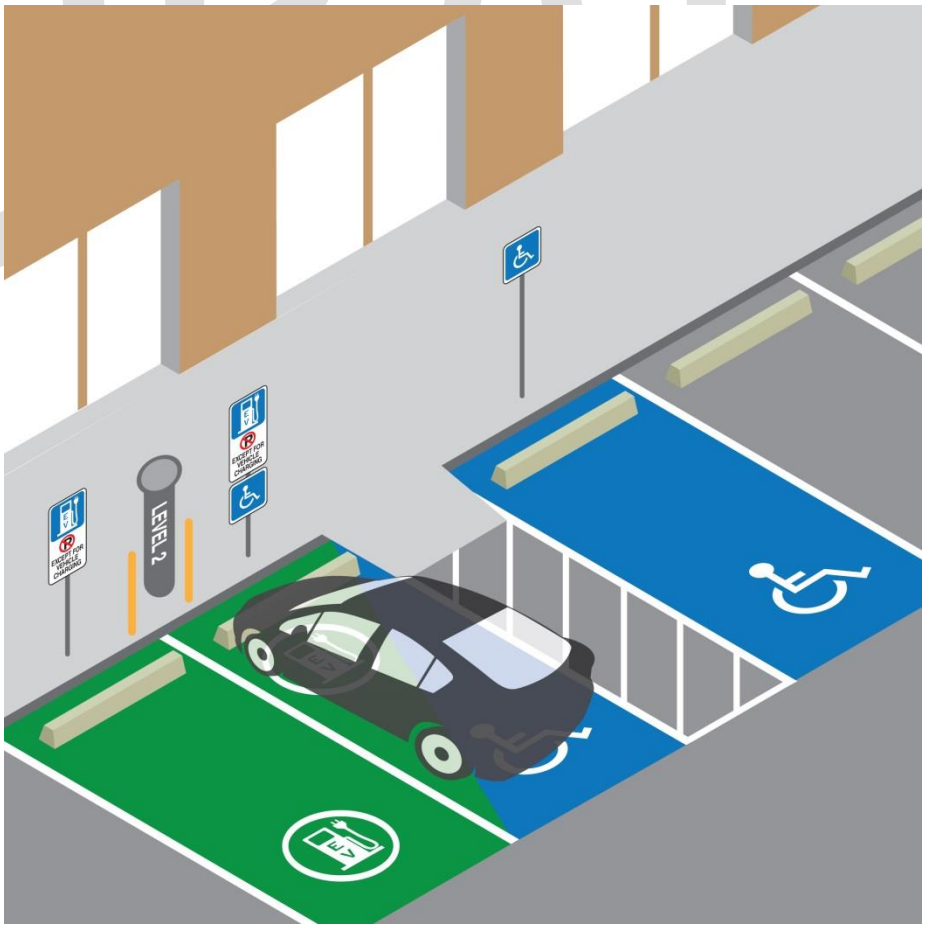
Local planners can decide between on and off street parking for PEVs according to the local environment, costs, and locations; however, on-street parking installations may face more considerations, such as the public rights of way and metered parking.

Before deciding where to place EVSE, there are several factors to take into consideration.

- The source of electricity and location of electrical panel/circuits
- The load level of the electrical panel and its capacity to handle charging
- The locations for disabled-accessible parking spaces for PEVs
- If cables from charging units will pose a safety hazard for pedestrian walkways
- The opportunity cost of parking spaces dedicated to PEV charging
- What kind of parking policies will be established

The following provides siting and design guidelines for PEV parking at commercial parking lots and on-street locations.

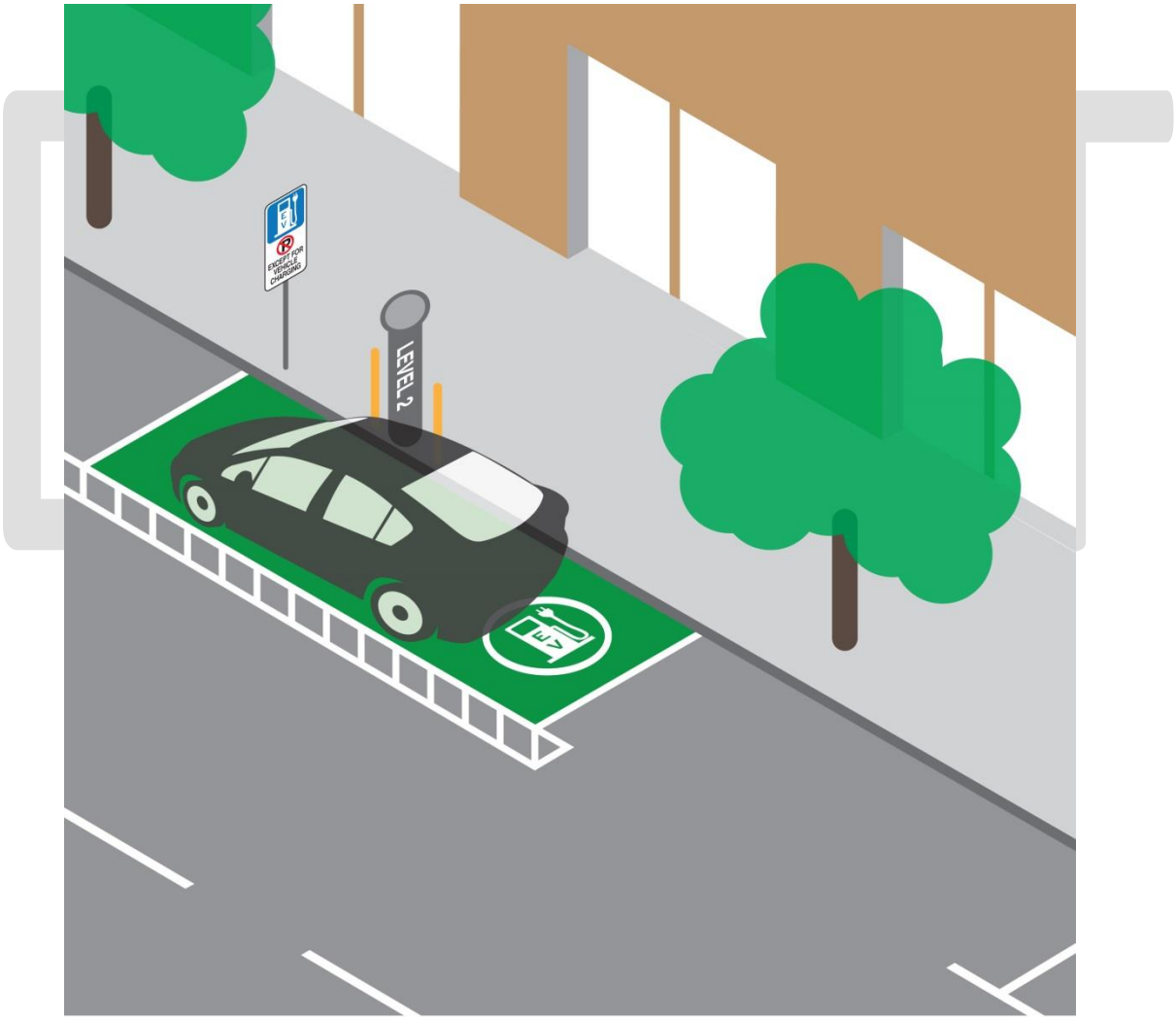
Figure 2: Commercial Parking Lot



For commercial parking lots, below are important factors to consider when placing charging units.

1. Include an ADA spot that is accessible to the charging equipment.
2. Make sure pedestrian walkways are unobstructed.
3. Place proper signage for the charging equipment.
4. PEV chargers at storefronts near the entrance is attractive for consumers, but installation may be more expensive. Electrical panels tend to be in the back of buildings, so adding wiring to the front could be costly.
5. Charging equipment at the front of a building may deter vandalism and other damage, but without proper signage, non-PEV drivers may take charging spots.

Figure 3: On-Street Parking



For on-street parking, below are important factors to consider when placing charging units.

1. Proper signage indicating where electric vehicle charging is located is important, especially in a crowded urban area.

2. Aside from signs, the parking space should be properly striped or painted to indicate that it is intended for PEV charging only.
3. Charging equipment should not interfere with pedestrian walkways.
4. The power supply for the charger can come from multiple sources. Nearby businesses and shops could provide electricity in partnership, or the electricity could come from existing on-street sources such as streetlights, phone booths or others.
5. Provide the charging space with enough room for the driver to safely insert and remove the charging plug.

5.3 Recommendations

The following recommendations will help local governments determine the best mechanism and language on how to allocate public parking for PEVs in their jurisdiction.

1. Create minimum parking requirements for PEV parking
2. Allow PEV parking spaces to count toward minimum parking requirements
3. Adopt regulations and enforcement policies for PEV parking spaces
4. Specify design guidelines for PEV parking spaces for on and off street EVSE installations

6 Training for Electrical Contractors

6.1 Background

With the growing number of PEVs in the San Joaquin Valley, there will be opportunities for qualified and properly trained electrical contractors to install PEV charging stations at residential and nonresidential sites. Due to the specialized requirements for EVSE, an electrical contractor is needed to not only ensure installations are completed safely and up to code, but are expected to perform the tasks below.

- Facilitate communication between the PEV owner, electric vehicle service provider, inspector and local government permitting officials
- Understand electrical requirements for EVSE installations
- Perform an accurate and thorough site assessment of existing electrical capacity
- Estimate the cost of an electrical upgrade
- Pull the proper permits and schedule an inspection

6.2 Key Issues

As the PEV market continues to grow, installers with the proper expertise, information, tools and training with EVSE will be in high demand. Below are further considerations for contractors when installing EVSE.

6.2.1 Regulation Compliance

All EVSE installations must comply with local, state and national codes and regulations. Electrical contractors can learn more about the codes and standards for EVSE on the Alternative Fuels Data Center website and from certain specialized courses (listings follow). Before installation, an electrician should consult with the EVSE manufacturer to determine the product's specifications.

6.2.2 General Installation and Inspection Process

A successful EVSE installation begins with a site assessment and planning for the appropriate EVSE. Common installation steps are provided from Advanced Energy's *Charging Station Installation Handbook for Electrical Contractors and Inspectors*.

6.2.3 Load Calculations

The National Electric Code (NEC) considers EVSE as a continuous load. EVSE-specific information is located in NEC Article 625. The City of Irvine provides an exemplary load calculation worksheet for EVSE.

Guides for residential and nonresidential installations can be found in Appendix B.

6.3 Electric Vehicle Infrastructure Training for Electrical Contractors

The International Brotherhood of Electrical Workers, in conjunction with the National Electrical Contractors Association, offers statewide EVSE installation training courses. The Electric Vehicle Infrastructure Training Program (EVITP) is designed for and available to all electrical contractors.

EVITP provides certification for electricians installing EVSE at residential or commercial locations. Courses are offered across the country at various regional community colleges and electric training centers. For information and a list of EVITP training opportunities, visit the EVITP website or email info@evitp.org.

Training benefits for electrical contractors include

- Learning about new and emerging technologies
- Gaining competitive knowledge
- Qualifying to submit for bids, RFQs and RFPs for EVSE installations
- Supporting California's goal to reach 1.5 million zero-emission vehicles by 2025

EVITP training is available at the following locations in the San Joaquin Valley. It is always good to call each center to verify the given information.

1. Fresno, Madera, Kings and Tulare JATC
   5420 E. Hedges Avenue
   Fresno, CA 93727
   (519) 251-5174

2. Alameda County Electrical JATC
   3033 Alvarado Street
   San Leandro, CA 94577
   (510) 351-5282

7 Permitting and Inspection

7.1 Background

Obtaining a permit is usually required when EVSE will be installed at home, commercial or public locations. Currently, there is no region-wide standard for permitting EVSE in the San Joaquin Valley. The

many differences among local jurisdictional processes and requirements for electrical permits, building inspections and permitting fees create confusion for new PEV drivers. Ultimately, these inconsistencies are a barrier to local PEV market growth. This chapter describes key issues of the permitting and installation process and provides best practices for specific charging situations.

7.2 Key Issues

San Joaquin Valley jurisdictions can facilitate PEV adoption and reduce the overall cost of EVSE installation by streamlining the permitting process and better educating local officials about PEVs.

Detailed information on EVSE installation and permitting guidelines for new PEV owners at single-family homes is included in Appendix B.

Following are some of the barriers identified in the EVSE permitting process.

- The number and type of permits required in order to install EVSE
- Whether permits are required for additional work to comply with the Americans with Disabilities Act
- The number of business days between permit request and issuance
- Whether there is a standard checklist for installing and inspecting charging installations

7.2.1 Types of Permits

There are no standard permits for the exclusive purpose of installing EVSE. Most often, local jurisdictions require only building permits, electrical permits and/or planning entitlements. Some jurisdictions in the San Joaquin Valley require inspections during pre-installation, post-installation or both. However, not all installations require a permit or inspection.

The California PEV Collaborative identified a range of charging permit options for installations depending on complexity; the more complex the installation, the more documents required. The following table provides a general idea of what types of inspections and permits should be required when installing EVSE.

Table 5: Installation Scenarios and Relevant Permits

Permits Needed	Installation Description
No Permit	Contractor pre-permits and self-inspects for standard installation
Online Permit	Standard installation, 120-volt outlet, panel upgrade, meter reprogram, charger specification sheet
Over-the-Counter Permit	Possible trenching, panel upgrade, line drawing, meter install, charger specification sheet
Over-the-Counter Permit w/Plan Check	Possible trenching, panel upgrade, detailed site plan, load calculation, wiring diagram, meter install, charger specification sheet
Plan Check Required	Trenching, panel upgrade, engineering drawings, load calculation, wiring diagram, meter install, charger specification sheet

Adopted from the UCLA Luskin Center Plug-in Electric Vehicle Readiness Plan (2012).

Creating a simplified, streamlined permitting system will provide clear guidelines and give local officials and other relevant stakeholders a better understanding of the issues and processes involved in EVSE siting and installation.

7.3 Recommendations

Local governments should consider the following actions in order to streamline the permitting process for residential and nonresidential EVSE installations.

1. Train staff and other stakeholders about the permitting process so that they can clearly explain it to any entity seeking a permit
2. Make online and over-the-counter permitting available for most basic installations
3. Avoid requiring an electrician to be present during inspection to decrease costs for the consumer
4. Waive plan check requirements if an installation does not require rewiring or panel upgrades
5. Remove inspections needed for simple installations
6. Establish a unique permit for installing EVSE

8 Utility System Impacts and Rate Design

8.1 Background

The role of the utility is to educate customers throughout the PEV purchasing decision, provide cost-effective home and business charging options, ensure grid reliability and support charging infrastructure. Utilities in the San Joaquin Valley, such as Southern California Edison (SCE), Pacific Gas and Electric (PG&E), and the City of Lodi Electric Utility have developed methods to manage these operations and plan for future PEV deployment.

8.2 Key Issues

Electric utility and power distribution companies work with local planners to deliver electrical power to residential neighborhoods, which is then delivered to individual homes. When several PEVs are in the same neighborhood and supplied power from the same electrical transformer, "clustering" occurs.[4] This is a concern to local electrical utilities, and to mitigate impacts, it is essential for them to estimate PEV charging demand in their territory.

Benefits of a second meter

- Ability to easily account for GHG emissions reductions for Low Carbon Fuel Standard
- Built-in assessment of need for local grid upgrades
- Ability to analyze real-time PEV charging behavior

Following are issues that utilities experience when managing PEV charging in their service territory.

[4] Studies show that PEV drivers tend to live in the same neighborhoods.

- Load Impacts – Increased electricity demand from PEV charging may strain current generation and distribution infrastructure, although current electric distribution is sufficient to handle PEV charging during off-peak hours into the near future.
- Rate Structure – The traditional tiered rate structure is helpful in promoting energy conservation, but it offers no incentive for PEV owners to charge during off-peak hours.
- Secondary Metering – Predicting and tracking impacts from PEVs will be especially challenging in single-meter dwellings. However, installing a secondary meter dedicated to a home charging station has multiple benefits that can help utilities manage PEV impacts.
- Infrastructure – Increasing demand from home PEV charging can overwhelm local-level infrastructure. As mentioned, this is especially problematic due to the propensity for PEVs to be clustered in specific neighborhoods, increasing the demand on local-level transformers.
- Renewable Energy Options – Many PEV owners are concerned about how the electricity they use to charge their vehicles is generated. There is increasing demand for the option of purchasing "green" electricity produced (all or partially) using renewable sources. Increasingly, states are pursuing renewable energy portfolios for electricity generation. California utilities, for example, are required to have 33% of their energy portfolio be renewable by 2020 (read more in Chapter 13).

8.2.1 Time-of-use Rates

Some utilities in the San Joaquin Valley have addressed the above issues. One important service that utilities have been providing to PEV owners is time-of-use (TOU) rates. TOU rates allow customers to obtain economic incentives from charging their vehicles during off-peak hours.

A PEV owner charging at home in Fresno using PG&E's TOU-EV rates can save up to $1,190 per year in fuel costs

Usually, there are two types of TOU rates offered: whole house TOU (TOU-WH) and EV TOU (TOU-EV).

- TOU-WH provides customers with savings by having their whole house on a TOU rate. This way, households get energy at a discount at when the entire house uses energy during off-peak hours.
- TOU-EV provides customers with savings by having their PEV charger on a TOU rate. This rate allows households to get energy at a discount only when their PEV is charging during off-peak hours.

Local utilities can look to Appendix A.7 to see what other utilities in the San Joaquin Valley are doing to accommodate PEVs.

8.3 Recommendations

The following recommendations are for utilities to better accommodate PEVs in their service territory.

1. Educate customers about local utility TOU rates and help them choose the appropriate rate for their household and PEV charging needs.

2. Understand the potential growth of PEVs in the utility service area and begin to reassess infrastructure and capacity for future PEVs.
3. Coordinate with local planning and building departments to assure utility notification when issuing new PEV charging permits.

9 Workplace Charging

9.1 Background

While the majority of PEV charging takes place at home, the workplace is also an ideal location for charging because of the long dwell time it offers. Charging at work can allow commuters the possibility of driving extra miles at the end of the day and help promote sustainability standards for the employer. In the San Joaquin Valley, there are existing programs supporting public charging stations, but very little is currently targeted directly at workplace applications.

9.2 Key Issues

Before installing workplace charging, many organizations should consider the following questions.

- Does the employer own or lease the building and parking lots?
- Is the electricity source easily accessible?
- What is the cost of the EVSE equipment and installation?
- Can the employer make accurate estimates of operating costs?
- Uncertainty about business models for charging — Is it better to own the EVSE or have a third party own and operate the EVSE?

Another question that employers will often have is whether or not to charge employees for charger use. Typically, employers who offer charging often want it to be seen as an extra employee benefit; however, employers do not want to solely bear the burden of electricity and maintenance costs. Despite the high upfront costs to employers, studies have shown that employers who do not charge their employees for charger use end up having employees use the workplace as their primary means of charging.

Workplace charging resources and tools that address these issues can be found in the Workplace Charging fact sheet in Appendix A.4 and the EVSE installation guidelines for nonresidential locations in Appendix A.5.

9.3 Planning for Workplace Charging in the San Joaquin Valley

Local government officials should consider these items when planning for workplace charging in the San Joaquin Valley.

- How many employees are there in different areas of the San Joaquin Valley region?
- Who are the largest employers?
- How significant are workplaces compared to other types of parcels?

Areas with many employers will allow planners and stakeholders to conduct concentrated outreach for workplace charging. Jurisdictions with a high density of employers and employees can benefit from targeted actions such as permit streamlining and PEV-ready building codes.

Outreach should be targeted to the largest workplaces in the Valley. Workplaces with large numbers of employees are more likely than small businesses to adopt new EVSE: they have more workers (and a higher probability of PEV owners) and more resources to devote to PEV charging. Another strategy for outreach is to focus on white collar workplaces and high-tech industries since early PEV buyers have tended to have high-incomes and work in technology industries.

Following is a table showing the number of employees per white-collar industry in each county.[5]

Table 6: Employee Numbers in the San Joaquin Valley

Industry	No. Employees							
	Fresno	***Kern***	***Kings***	***Madera***	***Merced***	***San Joaquin***	***Stanislaus***	***Tulare***
Information	3,500	2,700	200	400	400	1,700	900	900
Financial	12,800	9,000	1,100	800	1,700	7,400	5,400	3,700
Professional & Business Services	28,700	26,200	1,500	3,000	4,500	16,900	12,600	9,700
Educational & Health Services	42,400	28,800	4,600	6,000	6,300	29,600	24,100	10,900

9.4 Benefits of Hosting Workplace Charging

There are several reasons employers should consider workplace charging as a valuable proposition despite the installation costs. The availability of EVSE at workplaces helps attract and retain employees. Additionally, EVSE can contribute to company sustainability goals as well as green credentials such as LEED certification.

To take advantage of these benefits, employers can take a proactive role in installing charging stations at the workplace. Before actually installing equipment, employers can look into taking the Workplace Challenge pledge with the DOE under their Workplace Charging Challenge. This commits employers to developing a plan to install charging stations at work. A map of partner organizations and more information about the Workplace Charging Challenge can be found online.

For more guidance, employers can peruse the DOE's Plug-in Electric Vehicle Handbook for Workplace Charging Hosts.

[5] Source: California Employment Development Department, July 2013.

9.5 Recommendations

It is important to make workplace charging installations as easy as possible for widespread action. To enable swift installations, local governments should consider the following steps.

1. Provide an easy to fill out application for workplace permitting
2. Reduce permit fees for commercial installations to spur EVSE adoption
3. Incentivize workplaces to install EVSE through an installation rebate

Workplaces should follow these steps when making the decision to install chargers.

1. Identify and approach key stakeholders to serve as advisors or make decisions, such as a management-level designee, a sustainability lead, the building owner (if different from the employer), the parking lot operator (if different from the employer), facilities operations staff, human resources staff and legal counsel
2. Conduct an employee survey to gauge potential employee demand for charging
3. Contact the local utility to learn about tariff structure and potential rate impacts of EVSE use
4. Consider an 80/20 rule where 80% of charging equipment is Level 1 and 20% is Level 2
5. Consider providing Level 1 charging for free, while Level 2 can be used for a fee

10 Building Codes for Plug-in Electric Vehicle Charging

10.1 Background

Building codes can help accommodate PEV charging infrastructure in two ways. The first is to require that all new construction be prewired for EVSE to reduce future costs (prewiring consists of installing the conduit, outlets and space necessary for EVSE installations). The second is to ensure that EVSE installations are safe and accessible.

10.2 Key Issues

There is a lack of approved regional building codes to support charging infrastructure. Part 11 of the 2010 Title 24 Building Standards Code in California is the California Green Building Standards Code, otherwise known as CALGreen. CALGreen has voluntary EVSE-specific codes that local jurisdictions can choose to adopt.

Adopting EVSE requirements in building codes can help enable EVSE deployment by saving money on installation cost. Prewiring and installing EVSE during construction are significantly cheaper than retrofitting older buildings for EVSE because of the potential need for trenching, rewiring or upgrades to electric panels. The following table displays the average EVSE installation costs at commercial sites and single-family residences without prewiring.

Table 7: Installation Costs

EVSE Site	Costs
Commercial	Up to an additional $1,100 per station for surface lots and $800 for parking garages
Residential Single-family	Level 2 installations can cost $900 more than preparing the home during new construction.

10.2.1 Legislation

In October 2013, California Assembly Bill 1092 passed, requiring the next edition of California Building Standards Code to adopt, approve, codify and publish mandatory building standards for the installation of electric vehicle charging infrastructure for parking spaces in multifamily dwellings and nonresidential developments.

However, according to the San Joaquin Valley PEV Coordinating Council, the voluntary code in CALGreen to install one EVSE unit in new residential projects is already too aggressive in the region. Though there is little way to anticipate what will be required in the next edition of California Building Code, San Joaquin Valley jurisdictions can be proactive and begin to consider ways in which they can expand existing policies to encompass current voluntary codes.

10.3 Recommendations

Local government officials can follow the recommended steps below to update their building codes to support PEV infrastructure.

1. Require the installation of a raceway for future EVSE wiring for one parking stall for new commercial and nonresidential construction
2. In multi-unit dwellings, it may be useful to designate a common area for EVSE rather than handle resident-specific EVSE needs

11 Charging at Multi-Unit Dwellings

11.1 Background

Multi-unit dwellings (MUDs) pose unique issues for electric vehicle charging. Often, parking spaces are assigned to MUD residents and may be far from the resident's electricity meter, leading to high infrastructure and installation costs. Homeowner associations (HOAs) and property managers may not want to bear the installation costs of EVSE, especially if it is for limited use, so charger costs may become too high. In addition, there may be deficiencies with the electrical load of the property, lack of on-site parking to designate to EVSE and uncertainty in the type of EVSE ownership model to pursue.

This chapter describes the key issues and provides recommendations for property managers and local government planners to properly plan for charging infrastructure at multi-family communities throughout the Valley.

11.2 Key Issues

11.2.1 How many people will use the charger?

Before installing charging equipment, it is best to find out how many residents will actually use the charger. Property management should survey residential owners and tenants to learn more about their current and future charging needs. This entails asking how many residents and tenants already own a PEV and how many are planning to own one in the future.

Planners can also compare MUD data with the number of employees and single-family residences that exist in their vicinity. Cities and counties that have a large number of employees around areas with

MUDs may benefit from workplace charging initiatives. On the other hand, areas with high numbers of MUDs and low numbers of employees may be strong candidates for MUD charging.

11.2.2 What type of charging to offer?

Property managers can decide between offering Level 1 or Level 2 charging for their residents. Because of the low number of MUDs in the San Joaquin Valley, offering Level 1 charging may be a cost-effective option to increase charging opportunities at MUDs. Level 1 infrastructure is relatively cheaper than other equipment and may serve the majority of charging needs for many PEV drivers.

11.2.3 How to recover the cost of use

Aside from charging MUD tenants and residents to pay per charge, there is the option for property managers and HOAs to create paid use contracts with PEV owners. Such contracts with residents can help ensure that the EVSE is used regularly. In addition, there are three other fee strategies: an hourly use rate, an hourly rate plus a connection fee or slightly mark up the price of electricity. Property managers who want to offer charging opportunities for all of their residents will need to be careful to not price charging equipment use higher than what someone would pay for gas.

11.3 Multi-unit Dwellings in the San Joaquin Valley

MUD charging may not be a high priority for the San Joaquin Valley since the majority of residents live in single-family homes. The average percentage of California housing units in MUDs is about 31%, whereas Valley counties have an average of fewer than 18% of housing units in MUDs. However, it is still important to prepare for MUD charging because it poses the most complexities for installation.

The following ranks the counties in the Valley and the corresponding percentage of housing units in MUDs. This will help local governments with outreach and prepare for MUD EVSE permitting opportunities.

Table 8: Percent Housing in MUDs by County

Jurisdiction	Percent of Housing Units in MUDs (2007-2011)
Fresno County	25.6%
Kings County	18.5%
San Joaquin County	18.5%
Kern County	18.4%
Stanislaus County	16.6%
Tulare County	14.5%
Madera County	11.2%

Following are the top ten cities (with over 20,000 inhabitants) that have the highest percentage of MUDs as a share of housing.

Table 9: Cities with Highest Percentage of MUDs as Share of Housing

City	Percent of Housing Units in MUDs (2007-2011)
Merced	33.5%
Fresno	33.4%

Lodi	28.7%
Stockton	26.6%
Coalinga	25.3%
Bakersfield	24.3%
Clovis	24.0%
Modesto	23.5%
Madera	23.2%
Lemoore	23.0%

11.4 Recommendations

Property managers will need guidance on how to handle issues regarding installing and using EVSE in their parking lots.

Property manager recommendation

1. Survey residential owners and tenants to learn more about their current and future charging needs
2. If EVSE is installed at an MUD, add a pay-for-use meter to recoup costs

Local government officials can follow these recommendations to facilitate PEV charging at MUDs in their jurisdiction.

1. Adopt building codes that promote the prewiring of EVSE in new MUD construction (see Building Codes for Plug-in Electric Vehicle Charging)
2. Expedite the approval process for permit applications for MUD EVSE installations
3. Conduct targeted outreach to cities and communities that have a high density of MUDs

12 Fleet Electrification

12.1 Background

In the San Joaquin Valley, goods movement is a large contributor of greenhouse gas (GHG) emissions. Heavy-duty diesel trucks contribute 6% of particulate matter (PM) and 46% of the nitrogen oxides (NOx) emissions in the region. NOx leads to the formation of ground-level ozone, and high levels of NOx and PM put the local population at risk of asthma and respiratory infection.

Converting a conventional fleet into an electric fleet can bring substantial health benefits to the region by lowering emissions. In addition, PEVs also offer long-term savings for fleet managers and operators.

12.2 Key Issues

When switching to an electric fleet, it is important to make sure that the conversion makes economic sense and will not hinder fleet performance. There are a few factors to consider when adding PEVs to a fleet.

- If your fleet is small and the vehicles travel fewer than 100 miles per day with the opportunity to plug-in at night, BEVs can be a viable option. However, if your fleet vehicles travel more than 100 miles per day, a PHEV may be better suited.

- BEVs require less lifetime maintenance than a PHEV or a conventional gasoline vehicle and though up-front costs may be higher, on average a BEV costs about three times less to drive. (More information PEV costs and savings in Appendix E)
- The selection of PEVs available on the market (light and heavy duty) is growing. For an updated list, go to the Alternative Fuel Data Center's vehicle search tool to find heavy-duty vehicles and light-duty vehicles.

Fleets that are interested in adopting PEVs can follow the steps outlined in Appendix B.1.

12.2.1 Financial Incentives

California offers incentives for converting conventional fleets to electric vehicles. The state's Hybrid Truck and Bus Voucher Incentive Project offers between $8,000 and $45,000 for the purchase of eligible new hybrid or electric trucks or buses. Fleets in the Valley that redeem this incentive can also apply for up to $30,000 in additional funds for their vehicles.

In addition, the SJVACPD offers a Public Benefit Grant Program, which provides $20,000 per new alternative fuel vehicle purchased by a public institution. The SJVACPD DriveClean! rebate program also provides rebates for up to $3,000 for Valley residents who purchase a PEV.

12.3 San Joaquin Valley Examples

There are several examples of Valley companies beginning to integrate PEVs into their fleets.

- The City of Stockton adopted Northern California's first battery electric transit buses in May 2013.
- UPS deployed 100 EV vans (built in Stockton) and 40 serve the areas of Sacramento, Ceres, Fresno, Bakersfield and San Bernardino. (For a case study of UPS, see Appendix D)
- Ikea uses TransPower electric trucks at its distribution center in Tejon, Calif.
- Electric Vehicle International, a manufacturer specializing in trucks and vans, is headquartered in Stockton.

12.4 Recommendations

1. Fleet managers should conduct fleet analysis to determine whether or not they will benefit from electric vehicles
2. Use the Alternative Fuels Data Center's Petroleum Reduction Planning Tool to create a plan to reduce your fleet's petroleum usage.
3. When adopting PEVs into a fleet, all drivers must be trained on the technology to optimize battery performance
4. Distribute the UPS case study to regional stakeholders

13 Leveraging Renewable Energy

13.1 Background

One motivating factor for plug-in electric vehicle (PEV) adoption is the desire to reduce the volume of greenhouse gas emissions created by conventional gasoline-powered vehicles. While fully electric BEVs

produce no tailpipe emissions, there is concern that vehicle charging could increase emissions related to generating electricity from non-renewable sources. In California, however, utilities have a renewable energy portfolio mandate to increase procurement of energy from renewable resources to 33% of total procurement by 2020. Despite this policy, it is difficult for local PEV drivers to know exactly what type of resources is charging their vehicle.[6] One method of overcoming this situation is for PEV drivers to install and charge with a residential solar photovoltaic (PV) system.

13.2 Key Issues

13.2.1 Charging Plug-in Electric Vehicles with Residential Solar Systems

Electric vehicles and PV systems are compatible and complementary technologies. While charging a PEV will add an additional electrical load to a driver's home, a PV system can produce up to 100% of the power required for all household appliances and the vehicle. This will depend on certain variables including how much drivers charge their vehicle each day and the efficiency of the car, and the size (wattage) of the homeowners' solar electric system. As a long-term investment, PEV drivers with larger solar electric system, sized to meet their household needs and charge the PEV, can be considerably more cost effective than continuously buying electricity from a utility provider. After the system has paid itself off, the cost of powering a PEV will become minimal.

Solar-EV households can also take advantage of special TOU utility rates. TOU rates are usually the best choice for PEV owners because they offer very low electricity prices at night when PEVs are normally charged. On the other hand, TOU rates are significantly higher during the day. A solar electric system helps offset the higher-priced electricity consumed by the household during peak hours. In this way, homeowners can take advantage of inexpensive electricity at night and generate their own energy during the day when TOU rates are high.

13.2.2 Regional Landscape: Solar and Plug-in Electric Vehicle Adoption Rates

According to market research by Sunible, a California solar installer, the cities of Bakersfield, Fresno and Clovis are among the top ten solar adopters in the state. These top solar adopting cities are also the top adopters of electric vehicles in the San Joaquin Valley.[7] In fact, 36% of PEV owners in the San Joaquin Valley have a residential solar system installed at their homes, according to the California Plug-in Electric Vehicle Driver Survey Results (May 2013). More than half of these solar and PEV owners have sized their PVs for their EV load.

Overall, the rate of solar adoption is higher than the rate of PEV adoption in the San Joaquin Valley. In the City of Clovis, for example, nearly 4.5% of households have installed solar panels whereas only 0.11% are of Clovis residents are PEV owners. The data imply that many Valley residents are solar adopters. Effective PEV outreach strategies to solar adopters could spur PEV growth in the region.

[6] Appendix F shows in-depth information about SJV utilities' renewable energy portfolios.
[7] This uses rebate information from both the California Solar Initiative and the California Clean Vehicle Rebate Project. Number of rebate applications act as a proxy for number of solar and PEV adopters.

Solar adopters may consider PEVs as a viable transportation option, especially with the help of solar PV to reduce the cost of charging and electric vehicles.

Detailed statistics on regional solar and PEV adoption rates are in Appendix F.

13.3 Case Study: Manteca Unified School District

Manteca Unified School District (MUSD) has pursued a solar project that allows for electric vehicle charging. In September 2013, MUSD's $30 million solar energy project went online after a year of planning.

The project installed solar panels at 26 sites in the district and is expected to produce 6,720 MWh (6.72 million kWh) per year. In all, the district expects to reduce their electricity bill by more than 60%.

The energy savings and renewable energy usage will be tracked by students, and the energy technologies will be emphasized in classroom studies.

Solar panels at the school district offices, as well as at the Environmental Studies Center (see photo) will also power PEV charging equipment. Electric vehicles will be charged directly by the solar power generated during on-peak daylight hours and at night, during off-peak hours, by energy stored on site.

The funding for this project was provided by an ultralow interest (less than 1%) Qualified Zone Academy Bond (QZAB).

13.4 Recommendations

There are several ways for local governments, businesses and residents to leverage renewable energy for charging electric vehicles.

1. Renewable energy generation and storage technologies should be encouraged in incentive programs for electric vehicles
2. When installing renewable energy projects, such as larger commercial solar projects, add the necessary prewiring required for future PEV charging
3. Incentivize battery storage projects to spur investment and growth

14 The Road Ahead

The PEV market is expected to grow at a rapid pace. California, a leader in PEV adoption, represents up to 35% of the U.S. market. Projections indicate that California's PEV ownership could reach 100,000 by 2014-2015 and 500,000 by 2018-2020.

Currently, in the San Joaquin Valley, the adoption rate represents less than two percent of the California PEV market, but it has doubled each year since 2010.

Accordingly, infrastructure will be needed to support increased numbers of electric vehicles on the road. The following chart shows forecasted PEV numbers in the San Joaquin Valley and the estimated number of Level 1 and Level 2 publically available chargers needed to meet the charging demand.

Table 10: PEV and EVSE Forecasts

Year	PEV Forecast[8]	L1 and L2 EVSE Estimates		
		Low[9]	High[10]	Work[11]
2015	1,340	268	402	134
2020	4,919	983	1,475	491
2025	10,995	2,199	3,298	1,099

Considering that there are 36 public Level 2 chargers in the San Joaquin Valley at present, to meet the demands of the PEV forecast, the number of Level 1 and Level 2 chargers will need to be increased significantly. Additionally, creating an extensive network of fast charging infrastructure is important to support PEV drivers who travel throughout the San Joaquin Valley. Ideally, these fast charging stations would be placed along highways and between long stretches of open spaces. A regional siting analysis of fast charging infrastructure is provided in Section II.

[8] U.S. PEV light-duty stock is from http://www.eia.gov/forecasts/aeo/tables_ref.cfm. CA PEV stocks were estimated as being 1/3 of U.S. stock. San Joaquin Valley PEV stock was then calculated to be 1.6% of the CA stock.
[9] CPUC recommends two chargers per 10 PEVs
[10] EV manufacturers recommend three chargers per 10 PEVs
[11] The Idaho National Laboratory recommends one workplace charger per 10 PEVs

15 Resources

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16 Glossary of Terms and Abbreviations

Glossary of Terms, Abbreviations, and Acronyms Abbreviation or Acronym	Description
A	Amperes or amps. The International System of Units base unit of electric current.
AB	Assembly Bill
AC	Alternating current. It is the flow of electric charge which periodically changes directions.
ADA	Americans with Disabilities Act of 1990, which prohibits discrimination based on disability.
ATTE	Advanced Transportation Technology and Energy
BEV	Battery electric vehicle. A vehicle that derives power from battery packs and produces zero tailpipe emissions or pollution while operating. A BEV is a type of plug-in electric vehicle (see "Plug-in Electric Vehicle, PEV").
CALGreen	California Green Building standards
CAP	Climate Action Plan
CARB	California Air Resources Board
CCR, Title 24	California Code of Regulations, Title 24. Commonly known as the California Building Standards Code.
CEC	California Energy Commission
CCSE	California Center for Sustainable Energy
Charger	A device that is designed to charge batteries or other energy storage options within electric vehicles. Chargers vary in electrical force (i.e. voltage, see "charging levels") and charge through conductive or inductive means.
Charging level	Standardized indicators of electrical force, or voltage, at which an electric vehicle's battery is recharged and referred to as Level 1 (120 VAC), Level 2 (240 VAC), and Level 3 (or DC/AC Fast Charging).
Circuit breaker	A device that protects an electrical circuit from damage caused by overloaded electrical current by automatically interrupting the current flow.

CPUC	California Public Utilities Commission
CVRP	California Air Resource Board's Clean Vehicle Rebate Project
DC	Direct current. Electric current that moves in one direction from anode to cathode.
DMV	Department of Motor Vehicles
DOE	U.S. Department of Energy
EAA	Electric Auto Association
EPRI	Electric Power Research Institute
EVITP	Electric Vehicle Infrastructure Training Program
EVSE	Electric vehicle supply equipment. This includes all components required for the installation and use of an electric vehicle charging station, such as: conductors, plugs, power outlets, wiring, ground connectors, etc.
EVSP	Electric vehicle service providers
GHG	Greenhouse gas. Any of the gases (e.g., carbon dioxide, methane, ozone, and fluorocarbons) emitted that contribute to the greenhouse effect by absorbing solar radiation once in the atmosphere.
HEV	Hybrid electric vehicle. A motor vehicle that is powered by both an electric propulsion system with a conventional internal combustion propulsion system A hybrid electric vehicle does not plug into an off-board electrical source.
HOA	Homeowners Association
HVIP	California Air Resource Board's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
HOV	High occupancy vehicle
ICC	International Code Council
ICE	Internal combustion engine. An engine which combusts petroleum-based fuel as a means of delivering power.
IOU	Investor owned utility
J1772	Industry-wide standard EV connector for Level 2 charging.

kW	Kilowatt. A unit of power equal to 1,000 watts.
kWh	Kilowatt hour. A unit of energy commonly used for measuring the energy capacity of a battery. This is the normal quantity used for metering and billing electricity customers.
LEV	Low emission vehicle
MDU	Multi-family dwelling units
MOU	Municipally-owned utility
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electrical Code
NREL	National Renewable Energy Laboratory
OEM	Original equipment manufacturer
PEV	Plug-in electric vehicle. Any motor vehicle for on-road use that is capable of operating only on the power of a rechargeable battery or battery pack (or other storage device that receives electricity from an external source, such as a charger).
PEVC	California Plug-in Electric Vehicle Collaborative
PEVCC	San Joaquin Valley Plug-in Electric Vehicle Coordinating Council
PG&E	Pacific Gas & Electric
PHEV	Plug-in hybrid electric vehicle. A type of plug-in electric vehicle (see “Plug-in Electric Vehicle”) that is capable of running on both an on-board battery charged from the electrical grid or from gasoline.
Plan	Plug-in Electric Vehicle (PEV) Readiness Plan
Pre-wiring	The practice of providing sufficient basic infrastructure, such as conduits, junction boxes, outlets serving garages and parking spaces, adequate wall or lot space for future EVSE, and adequate electrical panel and circuitry capacity, to meet anticipated future demand for EVSE.
the Region	The San Joaquin Valley Air Pollution Control District jurisdiction
SAE	Formerly Society of Automotive Engineers
SCE	Southern California Edison

SJVAPCD	San Joaquin Valley Air Pollution Control District
SCS	Sustainable Communities Strategy
TOU	Time-of-use. An electricity billing method with rates based upon the time of usage during the day.
UL	Underwriters' Laboratory
VMT	Vehicle miles traveled
W	Watt. A unit of power, defined as one joule per second, which measures the rate of energy transfer.
ZEV	Zero emission vehicle. A vehicle that emits no tailpipe pollutants from the onboard source of power.