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ReadySet Charge California

Association of Bay Area Governments • Bay Area Climate Collaborative
Clean Fuel Connection • EV Communities Alliance • LightMoves Consulting

A Guide to EV-Ready Communities

Ready, Set, Charge California! was a collaborative project of the following organizations under the leadership of the Association of Bay Area Governments. It was made possible with the generous support of the Reformulated Gasoline Settlement Fund and developed in partnership with the PEV Collaborative. — November 2011



The Association of Bay Area Governments (ABAG) is the official Council of Governments representing the Bay Area's 101 cities and towns and nine counties (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma). Formed in 1961, ABAG, as the region's planning agency, initiates innovative programs and projects, and builds partnerships to address regional economic, social and environmental challenges. Its award-winning research and analysis, financial services and other cost-effective local government service programs are widely recognized. ABAG is a co-founder of the Bay Area EV Strategic Council, sponsor of the EV Corridor Project deploying over 400 public chargers in the Bay Area and sponsor of Ready, Set, Charge California! www.abag.org



The Bay Area Climate Collaborative (BACC) is a 501c3 public-private partnership accelerating the clean energy economy and providing replicable models of scalable climate action. Partners include Bank of America, Pacific Gas & Electric, clean energy companies and local governments representing over 70% of the Bay Area population. The BACC drives practical market-oriented and cross-sector initiatives that reduce carbon, advance economic development, and accelerate penetration of climate solutions. Initiatives include co-facilitation of the Bay Area EV Strategic Council, the \$5 million Local Government EV Fleet national demonstration project to catalyze adoption of EVs in fleets and the Bay Area Next Generation Streetlight initiative aimed at upgrading 200,000 streetlights to LED and generate \$15 million in annual savings. The BACC is a project of the Silicon Valley Leadership Group Foundation. www.baclimate.org



Clean Fuel Connection, Inc. (CFCI) has been providing alternative fuel infrastructure products and consulting support for more than a decade. CFCI installed electric vehicle charging for most of the major automakers during the first market introduction of plug-in vehicles in the late 1990s and early 2000's. Today, with the introduction of many new plug-in electric vehicle models, they continue to install infrastructure for homeowners, businesses and local governments. CFCI is also a nationally recognized leader in the EV readiness arena, where they have used their experience of the last 15 years to provide pragmatic guidance to policymakers and local governments. www.cleanfuelconnection.com

Electric Vehicle Communities Alliance

EV Communities Alliance is a public-private collaborative that assists metropolitan regions to accelerate the mass deployment of Electric Vehicles. Current projects of the Alliance include development of the Bay Area EV Strategic Council and the Bay Area EV Corridor Project, a \$4 million dollar EV infrastructure deployment effort; leadership of EV strategic planning efforts in the Monterey Bay and Central Coast regions; development of the Ready, Set, Charge California! EV-ready community guidelines project; and EV-readiness initiatives in the Los Angeles/ South Coast region. The Alliance is also developing the Vehicle-to-Grid Consortium to accelerate V2G market structures in California and nationwide.



LightMoves Consulting founded in 2010 by James Helmer, former Director of Transportation for the City of San Jose, has as its mission to assist local governments achieve sustainable transportation and lighting solutions. LightMoves' Vision is to bring innovative, integrated strategies to transportation, energy and buildings. Mr. Helmer participated in the development of the Puget Sound Electric Vehicle Infrastructure: A Guide for Local Governments. He also authored the County of Sonoma Electric Vehicle Charging Station Program and Implementation Plan. www.lightmoves.us.com

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DISCLAIMER

The Association of Bay Area Governments (ABAG), EV Communities Alliance, the Bay Area Climate Collaborative, LightMoves Consulting, and Clean Fuel Connection prepared these guidelines with funding received from the Reformulated Gas (RFG) Settlement Fund to guide California jurisdictions in the development of communities that are plug-in electric-vehicle (PEV)-ready, and to provide a consistent framework for the deployment of PEV infrastructure.

These guidelines have been prepared at a time when PEV-related laws, regulations, and industry practices are undergoing rapid change. As a result, California local governments and the organizations that serve them must strive to continuously update their knowledge regarding industry, consumer, utility, and government expectations and requirements for the deployment of PEV infrastructure. These guidelines are intended to assist public agencies throughout California to advance community PEV readiness. However, they do not represent a definitive legal framework for the installation of charging infrastructure.

Neither the sponsoring organizations of the Ready, Set, Charge, California! Guidelines, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed within this document. Local agencies may or may not adopt similar methods of PEV infrastructure planning, installation and operations. The views and opinions of authors expressed herein do not necessarily state or reflect those of the organizations who developed the document.

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RECOMMENDATIONS FOR EV-READY COMMUNITIES

Moving away from hundred-year-old internal combustion technology to advanced plug-in electric vehicles (PEVs) will provide enormous economic, health, security and environmental benefits. To develop EV-ready communities, local government leaders are working closely with industry and community partners to address five broad domains of work. Through city- and county-specific initiatives, and through regional EV Coordinating Councils, communities working toward EV-readiness are:

- Streamlining residential electric vehicle supply equipment (EVSE) installations
- Accelerating EVSE deployment in multi-unit dwellings (MUDs)
- Developing comprehensive regional charging networks
- Integrating PEVs in regional transportation systems, buildings, and energy grids
- Accelerating PEV adoption by consumers, fleets, and car-sharing organizations

To assist stakeholders in advancing EV-readiness, *Ready, Set, Charge, California! A Guide to EV-Ready Communities* offers a suite of Recommendations for consideration, adaptation, and potential adoption by local governments. The Recommendations are grouped by work stream, and those considered most essential are designated with a green check as Primary Recommendations. Since the work of EV-readiness is dynamic and ongoing, these Recommendations should be viewed as a starting point and not an end-point.

Many of the Recommendations can be implemented to a modest level or to a comprehensive degree. For example, a City Council may set a goal to purchase 100% PEVs for their light-duty fleet effective in 2012, or to phase in their PEV purchases over a period of years. The Recommendations do not typically address the issue of speed or degree of implementation but recommendations of greater near term impact are designated as Primary Recommendations. These carry a check mark in the text. Policy leaders are encouraged to take stock of the total PEV “value proposition” as described in the introductory sections of this document when considering the value of these actions.

As in all complex transformations, the success of the PEV acceleration effort will depend on the sum of many individual policy and program pieces, and appropriate attention to detail in each. Accordingly, each of the Recommendations summarized briefly below is accompanied by a reference to text describing a range of implementation strategies and options. Readers are encouraged to follow the thread both within the document and in the many resources and websites referenced throughout the text. Whereas these guidelines are specifically focused on local governments, other resources of special importance the overall PEV transition include:

- National policy: *Electrification Roadmap: Revolutionizing Transportation and Achieving Energy Security* by the Electrification Coalition
- State strategic plan: *TAKING CHARGE: Establishing California Leadership in the Plug-In Electric Vehicle Marketplace* by the PEV Coalition
- Market and Policy Strategy: *Accelerating California’s EV Transition: A Core Strategy to Enhance Our Economy and Environment* by EV Communities Alliance

Through your work, that of the Regional EV Coordinating Councils and the California PEV Collaborative, we look forward to sharing the lessons learned in these pioneering days of the PEV era.

— The Authors

PRIMARY RECOMMENDATIONS

EV-READY COMMUNITY POLICIES, ACTIONS, AND INCENTIVES

1. Develop policy for electrification of fleets.
2. Update standard plans and details for EV infrastructure (EVI).
5. Develop community-wide Electric Vehicle Charging Station (EVCS) Siting Plans.
6. Provide charging and parking incentives.
7. Reduce parking requirements for Electric Vehicle Supply Equipment (EVSE) implementation

SAMPLE DEVELOPMENT REGULATIONS AND GUIDANCE

6. Count EVCS toward minimum parking requirements.
11. Require sufficient space in the electrical room for EVI.
12. Encourage single-family residential EVSE and photovoltaic “pre-wiring” readiness.

INSTALLATION STREAMLINING FOR RESIDENTIAL PEV CHARGERS

13. Implement online permitting for residential charging.
14. Provide outreach and resources on residential EVSE requirements.
17. Establish flat fees for standard residential installations.
18. Waive plan check requirements for simple residential installations.
21. Condense compliance review inspections for complex installations.
25. Develop and deploy an EVSE permit checklist.
26. Adopt and publicize building code enhancements for multi-unit dwellings (MUDs)
27. Publish submittal and plan check requirements for EVSE projects.
28. Fast-track approval of MUD EVSE projects.
29. Develop written procedures to ensure early contact with local utilities for MUDs.

CHARGING STATION INSTALLATION STRATEGIES

30. Provide effective education and training on charger installations.
 31. Provide EVSE installation process checklist for homeowners
 32. Outreach to HOA's and property managers to offer MUD solutions.
 33. Include charging solutions for garage-less drivers in EVI siting plans.
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SECONDARY RECOMMENDATIONS

3. Initiate procedures or franchise agreement amendments with utilities.
 4. Provide incentives for use of PEV taxis.
 9. Require EVCS for new development.
 10. Incentivize EVCS installations in existing large parking lots.
 15. Prioritize EVSE permitting.
 16. Employ universal permit applications.
 19. Encourage use of an existing unused electrical circuit where feasible in residential use.
 20. Consider spot inspections for standard installations.
 22. Establish flexible inspection request systems.
 23. Provide shorter inspection windows.
 24. Unify building and utility inspections.
 34. Notify utility of charger installations.
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1 INTRODUCTION

Historians of the future are likely to look back on 2012-13 as “tipping point” years – the moment in time when mass-market plug-in electric vehicles (PEVs) first began to overturn the century-long dominance of oil and the internal combustion engine. Throughout the United States, and throughout the world, PEVs are an integral part of the solution to reduce dependence on oil, improve air quality, enhance economic security, and help “turn the curve” on greenhouse gas (GHG) emissions. Today, some mass-market PEVs are competitive with conventional vehicles in long-term cost and performance. As gas prices increase and battery prices decrease, this advantage will likely grow over time. With appropriately targeted PEV-friendly policies, communities in California can build on existing marketplace momentum and help accelerate the mass adoption of PEVs. These Guidelines will help your community become “EV-ready” – and help establish California as a global leader in the new era of sustainable mobility.

1.1 DOCUMENT PURPOSE

The Purpose of These Guidelines: *Ready, Set, Charge, California! A Guide to EV-Ready Communities* is intended to support the national goal set forth by President Obama to deploy 1 million PEVs by 2015, which corresponds to 200,000-300,000 PEVs in California, and to support implementation of the State’s Zero Emission Vehicle (ZEV) policy goals. In addition, the development of robust EV-ready communities will help achieve the objectives set forth by the California PEV Collaborative, a multi-stakeholder public-private effort to ensure a strong and enduring transition to a PEV market in California. According to their objectives, the following goals are to be achieved by 2020:

1. Consumer experiences with PEVs are overwhelmingly positive
2. Ownership costs of PEVs are competitive with conventional vehicles
3. PEV charging integrates smoothly into an increasingly clean, efficient, reliable, and safe electricity grid
4. PEVs advance energy security, air quality, climate change, and public health goals
5. Early strategic action creates jobs and economic benefits in California
6. The PEV market moves beyond early adopters to mainstream consumers

The Audience for These Guidelines: To achieve these federal and state goals, *Ready, Set, Charge* addresses the full spectrum of PEV-related policy issues -- from the perspective of regional and local policy-makers, industry and community leaders, and on-the-ground practitioners in the fields of transportation and city planning, architecture and engineering, climate and sustainability, energy systems and utility operations, buildings and facilities, parking and traffic, public works, and fleet management. All these disciplines and more

will need to be engaged at both the senior management and staff level if California is truly to become a global PEV leader.

EV-readiness issues covered in this guide include high-level policies to encourage PEV deployment at the regional level, and local issues regarding infrastructure, siting, signage, and access issues. It should be emphasized, however, that electric vehicle infrastructure (EVI) planning and investment is a new discipline and that real-world data on many aspects of EVI utilization is very limited at the present time. Therefore, this guide is intended to serve as a *starting point* for action, and planners and policy makers are encouraged to consult other reference materials and updates as they become available.

These guidelines target the issues and challenges that local governments face with regards to PEVs and PEV-related infrastructure. For the purposes of this document, the term EV is synonymous with PEV and is used throughout these guidelines to refer to both Plug-in Hybrid Electric Vehicles (or PHEVs), which include a supplemental internal combustion engine as well as a grid-connected battery – and Battery-Electric Vehicles (BEVs) which are “100% electric,” with no backup gas engine. Similarly, while the term charger is technically a component within a PEV, the document follows common usage as meaning the charging equipment.

1.2 INTRODUCTION TO PEVS

Plug-in electric vehicles hold considerable promise for lowering total ownership costs,ⁱ strengthening national security, improving community health, and reducing negative climate impact. The inevitable rise in gasoline costs and the pace of PEV technology development make the future of PEVs bright. Moreover, there is a great deal that regional organizations, counties, cities, and business and community leaders can do by working together to accelerate the

ⁱ Total ownership costs include vehicle purchase, operations, maintenance, and depreciation.

mass adoption of PEVs. The key to this process of acceleration can be found in the concept of the *PEV ecosystem*.

1.2.1 OVERVIEW OF PEV ECOSYSTEM

The basic idea behind the *PEV ecosystem* is that – unlike other vehicles – PEV purchase decisions will not be made only on the basis of how much a particular PEV model costs, how it looks, and how it performs. Rather, PEV purchase decisions will also be significantly influenced by the answer to this question: “Is my home, my community, and my state truly *EV-ready*?” To answer that question, consumers will be looking at issues unique to PEVs, such as:

- How long does it take and how much will it cost to charge?
- How many EV charging stations are there available in my area?
- Is it easy to get a residential PEV charger installed in my garage?
- How will I charge if I live in an apartment or condominium?
- Will I get any kind of driving privileges by driving a PEV – such as HOV lane access?
- Will my employer provide workplace charging?

Thus, the *PEV ecosystem* is more than just electric cars and charging stations – it includes PEV-related policies, incentives, and communications that inform the total PEV customer experience.



Figure 1 - Map of Bay Area EV Charging Stations

1.2.2 CORE PEV TECHNOLOGIES

As noted above, Plug-in Electric Vehicles (PEVs) consist of two principal variations. Pure “all-electric” Battery Electric Vehicles (BEVs) are exclusively powered by electric motors, while Plug-in Hybrid Electric Vehicles (PHEVs) – sometimes called Extended-Range Electric Vehicles (EREVs) -- combine an electric motor and a gas-powered engine. Accordingly, BEVs and PHEVs have very different performance parameters, both within and between their respective automotive categories. For example, the 2011 Chevrolet Volt PHEV can travel between 25-50 miles¹ (EPA-estimated 35 miles²) on all-electric range and, when the battery is depleted, a small gas generator creates electricity to extend the vehicle’s total range to 379 miles.³ The upcoming Toyota Prius PHEV is likely to have an all-electric range of about 15 miles⁴ until the gas-powered engine takes over, extending the vehicle’s total range to 475 miles.⁵ In the BEV category, the Nissan Leaf has an all-electric range of 70-100 miles,⁶ while the high-end Tesla Roadster has an all-electric range of more than 200 miles⁷ (EPA-estimated 244 miles⁸).

PEVs also include low-speed Neighborhood Electric Vehicles (NEVs), which are small, lightweight vehicles limited to roads with posted speed limits of 35 miles per hour or less, such as college and corporate campuses, downtown shopping areas, or residential zones.

Vehicle range for BEVs varies significantly depending on driving conditions. Factors that significantly impact driving range include speed, traffic, payload, rates of acceleration, hills, temperature, and use of heating and air conditioning equipment. For example, the range of the Nissan Leaf BEV is nominally defined as 100 miles, but the EPA rating is 73 miles.⁹ For all PEVs, users may encounter reduced electric range under conditions such as very high heat, steep climbing, or very high speed driving. Higher-capacity batteries of up to 300 miles are expected to enter the market in late 2012, with the release of the Tesla Model S. However, these batteries will likely be relatively costly. In the 2015-2020 period, new battery architectures may permit batteries in the 300-500 mile range,¹⁰ while costs per kilowatt hour of energy capacity (kWh) are expected to decline steadily.^{11,12,13}

While the driving range of BEVs is generally sufficient for typical commutes,¹⁴ which constitute the majority of driving, the limited all-electric range of BEVs can lead to so-called *range anxiety* – perception regarding the vehicle’s capability to get users where they need to go and back before recharging is needed. In most cases, range anxiety diminishes greatly once users get used to their specific vehicle attributes, and plan their trips accordingly.^{15,16} In response to range limits, vehicle manufacturers are working on a number of strategies. For shorter-range BEVs, some manufacturers are intentionally targeting the second-car owner in a household. Others are bundling rental services for conventional vehicles, with gas-pow-

ered vehicles available for the occasional long-distance trip with the family. In some markets, the PEV services company Better Place is working to market “swappable” batteries enabling BEV owners to switch out depleted batteries for fully charged batteries in just two or three minutes. The San Francisco Bay Area’s Metropolitan Transportation Commission (MTC) is funding a test pilot for Better Place “battery-switch” stations to demonstrate this technology for possible mass deployment in California.

Another key response to the range anxiety challenge is widespread deployment of DC Fast Chargers – which can “fuel up” a nearly depleted Nissan Leaf battery to 80% capacity in under 30 minutes¹⁷ (or provide almost 50 miles of additional range in approximately 10 minutes.) In the Bay Area, communities are working to deploy approximately 100 DC Fast Chargers throughout the region to ensure that DC Fast Chargers will be widely available throughout the nine-county region.

It should be noted that some regions have been much slower to adopt DC Fast Chargers, out of concern that DC Fast Charge connection standards may shift. As of the writing of this Guide, Japanese automakers have agreed on a DC Fast Charge connection protocol (known as the CHAdeMO standard),¹⁸ while American automakers (via the Society of Automotive Engineers or SAE) are still deliberating on their final standard.

Further research and analysis on *range anxiety* over the next 12 months will help determine whether the concern dissipates as con-

sumers become comfortable with PEV operating characteristics. Regional agencies and industry will gather data on this issue to inform future investments. In the interim, public and private investments are already underway to deploy initial needed infrastructure. This document provides guidance on how to deploy that infrastructure successfully.

1.2.3 SIGNIFICANCE OF PEVS FOR ENVIRONMENTAL, ECONOMIC AND COMMUNITY BENEFIT

As local leaders take on the challenge of PEV-readiness, it is critical to understand what is at stake in the PEV transition. The most obvious benefits of PEVs are significantly reduced total ownership costs, reduced emissions, and reduced dependence on expensive and uncertain fossil fuel supplies.

The long-range outlook for oil indicates that exportable supplies are under intense pressure due to growing global demand, even within key exporting countries, declining productivity of existing oil fields, and a growing gap between newly discovered resources and rising demand in rapidly industrializing countries, including China and India. These trends are likely to cause the price of gasoline to continue to rise over the long term. Within California, consumers, businesses, and government agencies are spending nearly *\$60 billion annually*¹⁹ on gasoline, much of which is imported from potentially unstable regimes. Mass adoption of PEVs will help to relocalize these fuel investments, with significant multiplier effects as consumers reinvest their fuel expenditures in the local economy.

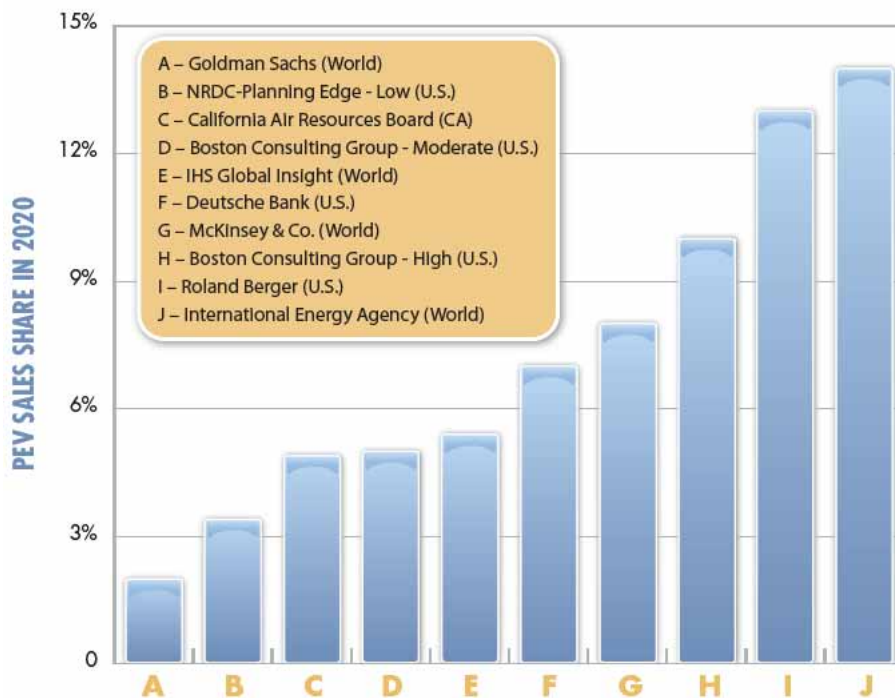


Figure 2 - PEV Market Projections for 2020
Source: Taking Charge

Taking into account the greenhouse gas (GHG) emissions caused in the production, transport, and utilization of gasoline vs. the average emissions per kWh delivered on California's power grid, BEV emissions are estimated by the California Air Resources Board to be 75% lower than the average conventional gasoline-powered vehicle, and 55% lower than the average conventional hybrid vehicle.²⁰ A PHEV with a 20-mile all-electric range reduces GHGs by 60% compared to a conventional vehicle, and 30% compared to a conventional hybrid.²¹ (Typically, a longer all-electric driving range is associated with greater GHG reductions.)

It is especially noteworthy that the PEV emissions advantage will increase over time. By 2020, California's grid is expected to have 40% lower emissions than in 2008,²² due in large part to an increase in near-zero carbon renewable generation from 11% to 31%. This will reduce grid carbon emissions from 447 grams/CO₂ per kWh to 261 grams/CO₂ per kWh.²³

The emissions advantage of PEVs in turn translates into both reduced GHGs – the principal catalyst of global warming – and reduction in criteria pollutants (EPA-regulated, common air pollutants) that are responsible for thousands of premature deaths in California, and the serious epidemic of asthma.^{24,25} In addition, the reduction of foreign oil consumption facilitated by PEV adoption will boost American energy independence, reduce the risk of oil-related conflicts, and increase job creation by re-investing transportation fuel expenditures into domestic sources of energy, including wind and solar.

1.2.4 MARKET ADOPTION

There is a broad array of factors that will likely influence mass PEV adoption. Gas prices, technology developments, customer value perception, macroeconomic conditions, and legislative action such as state assembly bill (AB) 631²⁶ are all key variables, and these are largely outside the control of local authorities. However, many market drivers can be influenced by local action through policies and incentives. By aligning regional initiatives with state and national efforts, local stakeholders can help advance their own regional goals for PEV adoption.

Forecasts for PEV growth referenced by the California PEV Collaborative vary widely. At the lower end of the range, the California Air Resources Board projects PEV penetration rates of approximately 5% of new car sales by 2020.²⁷ At the high end of the range, the International Energy Agency projects penetration rates of nearly 15% globally (Figure 1). Typically, the low-range estimates assume that PEVs will continue to command a significant initial price premium, that governments will limit subsidies, and that gas price increases will be moderate. The high penetration scenario assumes significant consumer interest, rapid PEV cost reductions, significant government subsidies, and a major increase in gasoline prices. With

the development of regional PEV Coordinating Councils throughout California's major metro areas, however, regionally driven initiatives may help tip the balance toward faster adoption.

1.3 PEV POLICY

1.3.1 STAKEHOLDER ROLES

With encouragement and funding from the California Energy Commission (CEC), California regions have begun to organize *PEV Regional Coordinating Councils* to bring together stakeholders across the public and private sector to guide EV-readiness policies and infrastructure. This regional approach is consistent with the fact that PEV drivers are typically concerned with the availability of charging infrastructure on a region-wide (and even a state-wide) basis, rather than just in the local communities where they live. Likewise, many PEV-friendly policies are optimally deployed on a region-wide basis to achieve a consistently positive PEV ownership experience.

The importance of both public and private sector participation in a regional approach is clearly evident in the case of charger deployment. If market forces alone dictate the PEV charger siting process, then the PEV ecosystem may suffer from over-building in some areas, and deficiencies in others. However, if the public sector steps in too aggressively to pay for charging infrastructure in every location, taxpayers may end up paying for EV charging infrastructure in locations that the private sector would have paid for on its own, even without special subsidies. The key to addressing these potential imbalances lies in the development of an effective multi-stakeholder coalition to help guide PEV ecosystem development on a region-specific basis.

With recent grant support from the CEC, eight regions in California now have PEV Coordinating Councils. If your community is not yet engaged in such a regional PEV Coordinating Council, you may wish to contact the CEC or the California PEV Collaborative to determine the steps you may take to join an existing collaborative or create one for your region.

PEV Councils have broad mandates to drive EV-related strategic planning in their region, and to coordinate charging infrastructure and PEV-friendly policy deployment. There are a variety of resources available to inform this work in the appendix to these guidelines, which includes a compendium of PEV ecosystem initiatives in leading metro regions around the world. These initiatives range from ubiquitous PEV car sharing networks (Paris), to differentiated congestion and parking charges for EVs in center cities (London), to massive EV bike and scooter deployments (Beijing). A review of these initiatives may inspire California regions to experiment with new strategic approaches.

2 EV-READY COMMUNITY POLICIES, ACTIONS, AND INCENTIVES

Across the United States, local governments have developed a broad array of PEV-friendly policies, actions, and incentives suitable for incorporation into General Plans and Climate Action Plans. Incorporation of program-level guidance in support of widespread PEV adoption is a crucial initial step for local governments, which will help establish the policy framework for subsequent adoption of implementing ordinances. The following examples of PEV-related policies are meant to be illustrative rather than comprehensive. This summary includes programmatic guidance at the level of both internal and community-wide programs, policies, and incentives.

2.1 INTERNAL PROGRAMS, POLICIES AND INCENTIVES

Recommendation #1 – Develop policy for electrification of fleets.



Public agency administrations can shape and introduce public policy for local elected officials to adopt, calling for public fleets to be powered by electricity and other alternative fuels.

Government agencies are discovering the environmental, fiscal, and community relations benefits of utilizing alternative fuel vehicles (AFVs). Many agencies have set targets for fleet conversions, and have adopted “clean vehicle” policies that guide the decision-making process on all new vehicle acquisitions or conversions of existing hybrid electric vehicles (HEVs) to plug-in operation.

Example Policies:

- Achieve a 100% alternative fuel vehicle public fleet by 2025.
- Make EV charging stations for fleets publicly available whenever feasible.

Example Actions:

- Make PEV and other AFV fleet planning, design, operations, and maintenance a structural component of the agency’s Capital Improvement Program.
- Where viable and funding permits, replace the agency’s public vehicle fleet with alternative fuel vehicles, or convert existing vehicles to partial AFVs, such as diesel to bio-diesel, or HEV to PHEV.

Recommendation #2 – Update standard plans and details for EV infrastructure.



Local agency engineering and planning staffs are encouraged to update their standard plans, details and specifications for public infrastructure projects to accommodate EV infrastructure.

EV-readiness is now becoming part of the design review for certain capital improvement projects. To accelerate and lower the cost of EV-readiness, local governments are encouraged to change design guidelines, standard drawings, specifications and details for qualifying public works infrastructure projects.²⁸

Example Policy: Include the installation of low cost EV-readiness infrastructure as a component of qualifying Capital Improvement Projects.

Example Actions:

- Update design guidelines, standard drawings, specifications and details for qualifying public works projects to facilitate the installation of EV readiness infrastructure.

IN PRACTICE

Berkeley and BART Electric Charging Infrastructure

Berkeley, California’s plan to work with Bay Area Rapid Transit (BART) to plan for and provide electric charging infrastructure at new and existing stations is an example of planning for EV-readiness.

- In coordination with the local utility company, install a second electrical conduit and junction boxes in trenches with street light conduits on blocks where EV charging stations are planned for future installations. (See Charging Station Siting Plans in Section 2.2)

Recommendation #3 – Initiate procedures or franchise agreement amendments with utilities.

Local agency public works staff is encouraged to initiate procedures or franchise agreement amendments to accommodate planned EV infrastructure installations.

Cities and counties have franchise agreements with utility companies, which allow entry into public rights-of-way. CPUC Rulemaking 09-08-009²⁹ directs electric utilities to collaborate with automakers and other stakeholders on a notification process regarding the location of electric vehicle charging stations (EVCS). Consistent with the ruling, local public works and planning staffs are encouraged to advise utilities where new charging systems are being planned so that upgraded energy storage, local distributed generation, facility energy management solutions, or electrical supply infrastructure can be incorporated into utility service plans.

Recommendation #4 – Provide incentives for use of PEV taxis.

Agencies responsible for taxi oversight are encouraged to develop a suite of incentives for companies that choose to buy and operate plug-in electric vehicles.

Vehicles in taxi fleets accumulate mileage at a very high rate, generally in excess of 50,000 miles annually.³⁰ Permitting agencies, often cities or counties, can adopt policies to create incentives for taxi companies and private taxi owners to purchase plug-in hybrid electric or all electric vehicles. These incentives range from lowered permitting costs, inspection changes, preferred route and zone selection, airport and destination center access, and staging area advantages. For example, the City of San Francisco³¹ permits certain alternative fuel vehicle taxi drivers one “front of the line” trip per driver, per shift as an incentive to use alternative fuel vehicles. Other sample incentives are listed in appendix 8.4.

2.2 COMMUNITY-WIDE PROGRAMS, POLICIES AND INCENTIVES

Recommendation #5 – Develop community-wide Charging Station Siting Plans.



Working through a regional planning agency and with utility service providers, local agencies and other stakeholders including neighboring cities are encouraged to create 3- to 5-year short range siting plans for high priority public charging stations. Localities are also encouraged to disseminate level of charge and locational information to relevant regional, state, and national PEV charging mapping initiatives.

In many regions where grant funds for PEV charging equipment have been awarded, multi-stakeholder teams have been formed to develop regional Charging Station Siting Plans.

In developing siting plans, key siting factors include:

- Site visibility and exposure
- PEV driving ranges
- High volume destinations
- Locations where there is high ownership/interest in PEVs
- Ensuring geographical equity of charging station installationsⁱ
- Land use
- Cost of Investments
- Optimization of charging timesⁱⁱ



Figure 3 - Directional Sign to EVCS
Newport Beach, CA. Photo by LightMoves

To increase the probability of successful public PEV charging station deployment, ample directional signage should be included to inform motorists of the location and type of charging equipment. In some localities, some initial signage already exists. In the 1990's, many street and freeway guide signs like figure 3 were installed in Southern California to direct drivers to EV charging stations (EVCS).

ⁱ Determine geographical equity based on zoning, roadway classifications, tourism, and PEV owner input.

ⁱⁱ For example, if a fee is to be assessed for public and workplace charging, it should be priced to encourage charging during off-peak electrical load periods.

IN PRACTICE

Charging Station Siting Analysis Project

The recently completed Puget Sound Regional Council Charging Station Siting Analysis Project³² addresses site visibility and exposure, PEV driving ranges, locations with high hybrid/PEV ownership or interest, high volume destinations, dwell time, and parking.

IN PRACTICE

Incentive for EV Purchases

The City of San Jose's Clean Air Vehicle Parking Program³² has a temporary incentive that allows free parking for qualifying vehicles at city owned garages, parks and the downtown core. Modification of the program is considered annually by the Director of Transportation.

Recommendation #6 – Provide charging and parking incentives.



Local agencies may consider adopting policies and enabling ordinances that promote installation of charging infrastructure, charging or parking incentives for PEVs, and that establish penalties for the misuse of charging stations.

A range of parking incentives has been established in some jurisdictions for low-emission vehicles, primarily hybrids. As hybrids have now become mainstream, agencies might consider shifting from hybrid to PEV incentives. In particular, incentives with built-in sunsets may be needed to accelerate charging station deployment in public parking areas.

Example Policy: Encourage the use of BEVs by providing incentives for free or reduced priced parking, and minimal charging fees for a set number of years.

Recommendation #7 – Reduce parking requirements for EVSE implementation.



Local agencies are encouraged to explore a range of incentives that result in reduced parking requirements for developers where significant investments for EV charging stations and/or PEV car-sharing agreements are being implemented.

Local regulations may be established to reduce parking requirements for private development when substantial numbers of EV charging stations are installed. This concept could be expanded upon significantly in downtown core areas or near job centers where new housing developments could rely on both car-sharing programs and shared parking agreements with existing public or private parking facility owners for nighttime and weekend use. Developers making arrangements for PEV car-share parking on-site could receive even greater reductions in required parking.

3 SAMPLE DEVELOPMENT REGULATIONS AND GUIDANCE

The automotive industry, EV supply equipment (EVSE) manufacturers, and government agencies have been working together to establish common standards for battery charging systems. This has resulted in a uniform approach to charging connections, centered on the “J1772” universal connector standard for AC Level 1 and 2 charging. However, there is a need for corresponding harmonization of EV charging station installation, permitting, and inspection procedures, so that ease of charging station deployment will match the ease of use. This section of the guidelines provides:

- Sample definitions to be used in codes and development regulations
- Sample language for Municipal or County Code Chapters on *Zoning, Vehicles and Traffic* and *Streets, Side walks and Public Places*
- Site Selection, Accessibility and Building Code Guidance
- Guidance on Signage

3.1 DEFINITIONS

As local jurisdictions adopt ordinances, codes, standards, and regulations, every effort should be made to utilize standard definitions. To assist in the deployment of standard terminology, a list of definitions is provided that would likely be contained in municipal or county code chapters pertaining to PEV regulations. This list is a subset of the definitions and comments contained in the *Sonoma County Electric Vehicle Charging Station Program and Installation Guidelines*;³⁴ however, not all the definitions herein are consistent with Sonoma County’s. An extended list of terms is provided in Appendix 8.1

During the writing of these guidelines, AB 475³⁵ was signed into law on September 07, 2011, which in essence omitted the need for displaying a zero emission decal to fuel an electric vehicle in a designated parking space containing charging equipment. The new

law would instead only allow a vehicle that is connected for electric charging purposes which includes both EVs and PHEVs as defined below.

Battery Charging Station: an electrical component assembly or cluster of component assemblies designed specifically to charge batteries within plug-in electric vehicles.

Battery Electric Vehicle (BEV): any vehicle that operates exclusively on electrical energy from an off-board source that is stored in the vehicle’s batteries, and produces zero tailpipe emissions or pollution when stationary or operating.

Charging: Occurs when the connector from the battery charging station (or standard outlet) is inserted into the electric vehicle inlet, and electrical power is being transferred for the purpose of recharging the batteries on board the electric vehicle.

AC Level 1	120V AC single phase current (12 amp); power 1.44kW current (16 amp); power 1.92kW	DC Level 1	200-450V DC rated current ≤ 80 amp rated power ≤ 36 kW
AC Level 2	240V AC single phase rated current ≤ 80 amp rated power ≤ 19.2 kW	DC Level 2	200-450V DC rated current ≤ 200 amp rated power ≤ 90kW
AC Level 3	To be determined AC Single Phase or three phase?	DC Level 3	To be determined 200-600V DC rated current ≤ 400 amp?

Table A - AC and DC Charging Levels

Charging Levels: standardized indicators of electrical force, or voltage, at which an electric vehicle’s battery is recharged (see SAE charging levels in table A.)

Electric Vehicle (EV): any motor vehicle registered to operate on California public roadways and operates either partially or exclusively on electrical energy from the grid, or an off-board source, that is stored on-board for motive purpose. Electric vehicle includes: (1) a battery electric vehicle (BEV); (2) a plug-in hybrid electric vehicle (PHEV); (3) a neighborhood electric vehicle (NEV); (4) an electric motorcycle; (5) a fuel cell vehicle (FCV).

Electric Vehicle Charging Station (EVCS): a public or private parking space that is served by battery charging station equipment that has as its primary purpose the transfer of electric energy (by conductive or inductive means) to a battery or other energy storage device in a plug-in electric vehicle.

Electric Vehicle Supply Equipment (EVSE): the conductors, including the ungrounded, grounded, and equipment grounding conductors and the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle. (California Electric Code, Article 625, NEC, Article 625).

Fuel Cell Vehicle (FCV): a vehicle that uses electricity produced by an on-board fuel cell to power electric motors for the vehicle’s wheels. The fuel cell is powered by fueling the tank with hydrogen.

Hybrid Electric Vehicle (HEV): a type of hybrid vehicle which combines a conventional internal combustion propulsion system with an electric propulsion system.

Neighborhood Electric Vehicle (NEV): an electrically powered, four-wheeled self-propelled low-speed vehicle whose speed attainable in one mile is more than 20 miles per hour and not more than 25 miles on a paved level surface and has a gross vehicle weight of less than 3,000 pounds. (California Vehicle Code Section 385.5)

Non-Electric Vehicle: any motor vehicle that does not meet the definition of “electric vehicle” or “plug-in electric vehicle”.

Plug-in Electric Vehicle (PEV): any motor vehicle registered to operate on California public roadways and operates, either partially or exclusively, on electrical energy from the grid, or an off-board source, that is stored on-board for motive purpose. Plug-in Electric vehicle includes: (1) a battery electric vehicle (BEV); (2) a plug-in hybrid electric vehicle (PHEV); (3) a neighborhood electric vehicle (NEV); (4) an electric motorcycle.

Plug-In Hybrid Electric Vehicle (PHEV): an electric vehicle that (1) contains an internal combustion engine and also allows power to be delivered to drive wheels by an electric motor; (2) charges its battery primarily by connecting to the grid or other off-board electrical source; (3) may additionally be able to sustain battery charge using an on-board internal combustion-driven generator (EREV); and (4) has the ability to travel powered by electricity.

3.2 ZONING

Zoning code provisions can encourage appropriate placement of EV infrastructure (EVI) in various land-use designations. Table B below provides sample “Allowed Uses” for EVI placement in typical zoning

Zoning District	AC Level 1 and 2 Charging Station	DC Level 2 (DC Fast Charging) Station	Battery Swap Station
Low Density Residential	P ¹	P ¹	
High-Density Residential	P ¹	P ^{1,3}	
Mixed Use	P	P or P ³	
Commerical	P	P	P
Industrial	P	P	P
Institutional	P	P	P
Recreational	P ¹	P ¹	

Table B -Sample Zoning Districts and Allowed Electric Vehicle Infrastructure Uses

¹Allowed only as an accessory to a principal outright permitted use

² DC Level 2 is synonymous with DC Fast Charge.

³Local jurisdictions may choose to allow DC Level 2 charging stations as an outright permitted use or to adopt development standards applicable to high-density residential, mixed-use residential or other zoning districts.

districts. Adopted zoning ordinance amendments are also included from cities and counties throughout the U.S. and Canada, as well as recommendations regarding how these amendments could be incorporated into a local agency’s zoning ordinance.

3.2.1 SAMPLE ZONING CODE PROVISIONS

Electric Vehicle Infrastructure—Allowed Uses

Purpose: This section provides sample regulations and guidance for when a jurisdiction chooses to regulate where, what type, and how many electric vehicle charging stations will be permitted in different land uses.

Definitions: (See Section 3.1 for applicable definitions)

Zoning District Tables

EVI, in the form of charging stations of various electrical levels, is permitted in zoning districts as identified in Table B. The first column designates the zone, the second, third and fourth columns indicate the type of EVI. For each zoning district, the table identifies the type of infrastructure permitted and the process by which it is permitted. A “P” represents that the EVI is a permitted use in the corresponding zone. A column left blank indicates that type of EVI is not permitted in that district.

Design and Installation Criteria

- A. **Size.** Electric vehicle charging stations may be the same size as standard parking spaces or accessible parking spaces. The installation of a charging station should not reduce the electric vehicle charging station length to below minimum local zoning requirements for off-street parking spaces.
- B. **Signage**
 - a. Each electric vehicle charging station should include guide signage identifying the space as an “Electric Vehicle Charging Station”.
 - b. If time limits or vehicle removal provisions are to be enforced, regulatory signage including parking restrictions, hours and days of operations, towing and contact information shall be installed immediately adjacent to, and visible from the electric vehicle charging station. (See Section 3.6 Signage)
- C. **Accessibility.** Where charging station equipment is provided within an adjacent pedestrian circulation area, such as a sidewalk or accessible “path of travel” to the building entrance, the charging station must be located so as not to interfere with minimum pedestrian clearance widths as defined in Chapter 11B of the California Building Code or ADA. Cords, cables and

connector equipment shall not extend across the path of travel within sidewalks or walkways. (See Section 3.5.2.1 Accessible Electric Vehicle Charging Stations)

- D. **Number of Accessible Electric Vehicle Charging Stations.** At each public parking site, the first two charging stations equipped with card-reading devices must be accessible (a charging station equipped with card-reading controls that can simultaneously charge two or more PEVs would qualify to meet this requirement)
- E. **Lighting.** Where charging station equipment is installed, lighting levels should be compliant with local codes. Higher lighting levels are encouraged to improve visibility of cables, charging equipment and vehicle inlets.
- F. **Maintenance.** Charging station equipment should contain a phone number or other contact information for reporting malfunctioning equipment, other problems or to seek information.

3.2.2 SAMPLE ZONING ORDINANCE AMENDMENTS

Zoning ordinance amendments can be utilized as an effective mechanism to incentivize charger installation. Specific examples are provided below. Note that the adopted code language samples contain actual code language adopted by the public agencies denoted.

Recommendation #8 – Count EV Charging Stations towards minimum parking requirements.

Public agencies may adopt zoning code amendments that allow for the inclusion of EV Charging Stations in the calculation of minimum required parking.

Electric vehicle charging stations should be included in the calculation for minimum required parking spaces pursuant to established zoning ordinances.

Adopted Code Language: *City of SeaTac, Washington*

Electric Vehicle Charging Station Spaces – Allowed as Required Spaces (15.40.040)

Electric vehicle charging station spaces shall be allowed to be used in the computation of required off-street parking spaces as provided under SMC 15.15.030; provided, that the electric vehicle charging station(s) is accessory to the primary use of the property.³⁶

Recommendation #9 – Require EVSE for new development.

Local agencies are encouraged to adopt ordinance language requiring the installation of EVSE in new residential, office, lodging, industrial or other land uses.

Adopted Code Language: *CALGreen Standards, Tier 1 (Voluntary)*

Electric vehicle (EV) charging

Dwellings shall comply with the following requirements for the future installation of electric vehicle supply equipment (EVSE).

One- and two-family dwellings. Install a listed raceway to accommodate a dedicated branch circuit. The raceway shall not be less than trade size 1. The raceway shall be securely fastened at the main service or subpanel and shall terminate in close proximity to the proposed location of the charging system into a listed cabinet, box or enclosure. Raceways are required to be continuous at enclosed or concealed areas and spaces. A raceway may terminate in an attic or other approved location when it can be demonstrated that the area is accessible and no removal of materials is necessary to complete the final installation.

Multi-family dwellings. At least 3 percent of the total parking spaces, but not less than one, shall be capable of supporting future electric vehicle supply equipment.³⁷

Comment: CALGreen Tiers are not mandatory but municipalities may make them mandatory. Local enforcing agencies may wish to have additional requirements as has been done in some communities such as pre-wiring, charging station installation or oversizing conduits to the utility service point for future expansion purposes.

Adopted Code Language: *City of Mountlake Terrace, Washington Ordinance, Tier 2 Requirement*

Required facilities:

- A. Beginning July 1, 2011, development for each of the land uses identified in Table 1 of subsection B of this section shall be required to provide electric vehicle infrastructure as shown in the table. For purposes of Table 1, electric

Land Use Type	Percentage of Parking Spaces
Multi-household residential	10%
Lodging	3%
Retail, eating and drinking establishment	1%
Office, medical	3%
Industrial	1%
Institutional, Municipal	3%
Recreational/Entertainment/Cultural	1%

Table C - Table 1: Required number of electric vehicle charging stations

vehicle charging stations shall be provided when the development is 10,000 square feet or more and one of the following occurs:

- a. A new building or a new off-street parking facility is developed;
 - b. An addition or improvement to an existing building is made that meets a certain threshold, pursuant to (insert relevant code section); or
 - c. The parking capacity of an existing building, site, or parking facility is increased by more than 50%.
- B. The first column in Table 1 shows the type of land use for which electric vehicle charging stations shall be provided, pursuant to this section. The second column shows the minimum percentage of the facility's parking spaces that shall provide a connection to electric vehicle charging stations.
 - C. Design for Expansion. To allow for additional electric vehicle charging in the future, beginning [insert date], all development that meets the criteria of subsection A of this section shall be designed to allow for double the amount of electric vehicle parking shown in Table 1.
 - a. Site design and plans must include the location(s) and type of the EVSE, raceway methods(s), wiring schematics and electrical calculations to verify that the electrical system has sufficient capacity to simultaneously charge all the future EV charging stations at Level 2 charging levels with (240V/40 amperes per station).³⁸

Recommendation #10 – Incentivize EVCS installations in existing large parking lots.

Local agencies are encouraged to adopt zoning amendments that incentivize the installation of EVSE in large existing parking facilities.

Local agencies should encourage or incentivize owners and operators of existing large public parking facilities to provide an appropriate number of EVCSs based on local and regional infrastructure planning efforts. The following sample code language signed into law in the State of Hawaii, requires large parking facilities to add EVSE.

Adopted Code Language: *Hawaii, State Statutes*

Designation of parking spaces for electric vehicles; charging units
All public, private, and government parking facilities that are available for use by the general public and have at least one hundred parking spaces shall designate one per cent of the parking spaces exclusively for electric vehicles by December 31, 2010, provided that at least

one of the parking spaces designated for EVs is located near the building entrance and is equipped with a electric vehicle charging unit. Spaces shall be designated, clearly marked, and the exclusive designation enforced. Owners of multiple parking lots within the jurisdiction may designate and electrify fewer parking spaces than required in one or more of their owned properties as long as the scheduled requirement is met for the total number of aggregate spaces on all of their owned properties. The electric vehicle charging units shall meet recognized standards, including SAE J1772 of the Society of Automotive Engineers.³⁹

3.3 VEHICLES AND TRAFFIC

Local governments can discourage non-electric vehicles from occupying charging stations and regulate days and hours of operation for chargers. These regulations apply only at charging stations intended for public use in **public parking facilities** or on **public roads**.

Purpose: This chapter provides sample regulations on the noticing and enforcement of parking related to chargers in any off-street parking facility owned or operated by a public agency or at any on-street parking space designated as an EVCS.

Definitions: (See Section 3.1 for applicable definitions)

Electric Vehicle Charging Stations reserved

The Director is authorized to designate parking spaces in any off-street parking facility owned or operated by the public agency, or any on-street parking space as being exclusively for the charging of electric vehicles.

- A. Director. The “Director” means the head of the local jurisdiction department responsible for administering the off-street and on-street parking programs.
- B. Charging. For the purposes of this Chapter, “charging” means any parked PEV connected to the charging station. (See Section 2.1 for definition of “charging”)

Noticing

The Director should have the exclusive power and duty to place and maintain or cause to be placed and maintained signs at each electric vehicle charging station. Each electric vehicle charging station should include guide signage identifying the space as an “Electric Vehicle Charging Station”. To reserve the space for the exclusive use of charging electric vehicles, to regulate time limits on charging, or to remove unauthorized vehicles, regulatory signage including parking restrictions, hours and days of operations, towing and contact information shall be installed immediately adjacent to and visible from the EV charging station. (See Section 3.6 for applicable signs)

Markings

The Director is authorized, on the basis of necessity to allocate electric vehicle charging stations by space markings. When such markings have been placed, only one plug-in electric vehicle should occupy such space, and no person should park except within the boundaries of the space defined.

Prohibitions

When signage is utilized that indicates that a space is reserved as an electric vehicle charging station, no person shall park or stand any non-electric vehicle in such space. Any non-electric vehicle is subject to fine or removal.

Violations and Penalties

- A. Violations of the Chapter should be punishable as infractions. The amount of fine should not exceed the fine prescribed in the rate of fines resolution or ordinance.
- B. Any person who has parked or left a vehicle standing at an electric vehicle charging station is subject to having the vehicle removed by any peace officer or other person designated by the Police chief or designated law official in the manner and subject to the requirements of the California Vehicle Code.

3.4 STREETS, SIDEWALKS, AND PUBLIC PLACES

Local governments can modify code chapters to include regulations and guidance on the installation, operation and enforcement of charging infrastructure intended for public use on public roadways or in public parking facilities. Section 3.1 of the guidelines contains definitions, and Section 3.6 contains guidance on signage installations. Applicable information from both of these sections can be inserted into code chapters as determined appropriate by local agencies.

3.4.1 ON-STREET ELECTRIC VEHICLE CHARGING STATIONS

Purpose: This chapter provides sample regulations and guidance on the installation, operation and enforcement of EVCSs intended for public use on public roadways.

Definitions: (See Section 3.1 for applicable definitions)

Permitted Locations

Any local authority, by ordinance or resolution may designate by the posting of signs adjacent to on-street parking spaces on roadways under the jurisdiction of that authority; that such spaces are for



Figure 4 - Two publicly available EVCS in private off-street parking facility.
IBEW offices in Castroville, CA. Photo by LightMoves Consulting

the exclusive purpose of charging electric vehicles. Public parking spaces reserved for the exclusive use of charging electric vehicles should be referred to as “electric vehicle charging stations”. Figure 4 illustrates EVCS with combination signs identifying the two spaces as EVCS and requiring PEVs to be in the act of charging. Charging station equipment installed adjacent to electric vehicle charging stations is reserved solely for the charging of electric vehicles.

Design and Installation Criteria

- A. **Size.** An Electric vehicle charging station may be the same size as a standard parking space.
- B. **Signage.**
 - a. Each electric vehicle charging station should include guide signage identifying the space as an “Electric Vehicle Charging Station”. To reserve the space for the exclusive use of charging electric vehicles, to regulate time limits on charging or to remove unauthorized vehicles, regulatory signage including parking restrictions, hours and days of operations, towing and contact information should be installed immediately adjacent to and visible from the electric vehicle charging station. (See Section 3.6 on Signage).
 - b. Advance Signage. Installation of signs at important decision points to guide motorists to electric vehicle charging stations may be provided.
- C. **Location.**
 - a. When installing only one EVCS, utilizing the last space on a block face in the direction of travel reduces cable management issues and places the EVCS closer to crosswalks and curb ramps.
 - b. An EVCS with a single connector is generally recommended for parallel parking configurations, and should be installed

near the front of the electric vehicle charging station based upon the direction of travel.

- c. Battery Charging Stations serving perpendicular or angle parking configurations should be centered, or to the left in front of the electric vehicle charging station for single connectors, (applies when the curb is on the right hand side of the direction of travel), and placed between two electric vehicle charging stations for dual connectors.

- D. **Obstructions.** When charging station equipment is placed in a sidewalk or walkway adjacent to the on-street charging station, it should not interfere with minimum pedestrian clearance widths as defined in Chapter 11B of the California Building Code or ADA Standard. Cords, cables and connector equipment should not extend across the path of travel within the sidewalk or walkway.
- E. **Clearance.** When charging station equipment is placed in a sidewalk or walkway adjacent to roadway, it should have a minimum clearance of 24-inches from the face of the curb.
- F. **Protection.** When charging station equipment is placed in a sidewalk or walkway adjacent to perpendicular or angle on-street electric vehicle charging stations, protective guard posts should be installed. (California Fire Code Part 9, Title 24)
- G. **Controls and Equipment.**
 - 1. Charging station card-readers, controls and connector devices should be no lower than 36-inches or higher than 48-inches from the pedestrian surface.
 - 2. Retraction devices or a place to hang permanent cords and connectors when not in use sufficiently above the pedestrian surface should be provided.
- H. **Area Lighting.** Well-lit lighting should exist where charging station equipment is installed to minimize risk of tripping or damage to

charging station equipment from vehicle impact.

- I. **Maintenance.** Charging station equipment should contain a phone number or other contact information for reporting malfunctioning equipment, other problems or to seek information on charging procedures.
- J. **Notification.** Information on any fees or terms of use should be clearly visible in day or nighttime conditions.
- K. **Communications.** Charging station equipment should be equipped with cellular phone service, wired or wireless communications.

Comment: The rationale for the requirement for charging station equipment communications or networking requirement, on publicly available stations, is two-fold: 1) For PEV driver convenience, it is essential that charging station operational status be communicated via web-based and mobile communication based devices that are now being routinely deployed on PEVs and cellular phones. 2) As PEVs are more broadly deployed, utilities and charger owners may need to regulate charging rates during peak hours to better manage grid impacts.

3.4.2 OFF-STREET ELECTRIC VEHICLE CHARGING STATIONS

Purpose: This chapter provides sample regulations and guidance addressing electric vehicle charging stations intended for public use in publicly-owned parking facilities.

Definitions: (See Section 3.1 for applicable definitions)

Permitted Locations

Any local authority, by ordinance or resolution may designate by the posting of signs adjacent to parking spaces in public parking facilities under the jurisdiction of that authority; that such spaces are for the exclusive purpose of charging electric vehicles. Off-street public parking spaces reserved for the exclusive use of charging electric vehicles should be referred to as “electric vehicle charging stations”. Charging station equipment installed adjacent to electric vehicle charging stations is reserved solely for the charging of electric vehicles.

Design and Installation Criteria

- A. **Size.** Electric vehicle charging stations may be the same size as standard parking spaces or accessible parking spaces. The installation of a charging station shall not reduce the electric vehicle charging station length to below minimum local zoning requirements for off-street parking spaces.

B. Signage.

1. Each electric vehicle charging station should include guide signage identifying the space as an “Electric Vehicle Charging Station”.
2. If time limits or vehicle removal provisions are to be enforced, regulatory signage including parking restrictions, hours and days of operations, towing and contact information shall be installed immediately adjacent to, and visible from the electric vehicle charging station.
3. **Advance Signage.** Installation of directional signs at important decision points to guide motorists to Electric vehicle charging stations may be provided. (See Section 3.6 on Signage)

C. Location.

1. An EVCS with a single connector is generally recommended for parallel parking configurations, and should be installed near the front of the electric vehicle charging station based upon the direction of travel.
2. Charging stations serving perpendicular or angle parking configurations should be centered, or to the left in front of the electric vehicle charging station for single connectors (applies when the curb is on the right hand side of the direction of travel), and placed between two electric vehicle charging stations for dual connectors.

- D. **Accessibility.** Where a battery charging station is provided within an adjacent pedestrian circulation area, such as a sidewalk or accessible “path of travel” to the building entrance, the charging station shall be located so as not to interfere with minimum pedestrian clearance widths as defined in Chapter 11B of the California Building Code and ADA Standard. Cords, cables and connector equipment shall not extend across the path of travel within sidewalks or walkways. (See Section 3.5.2 on Americans with Disability Act and Reasonable Accommodations)

- E. **Lighting.** Where charging station equipment is installed, lighting levels should be compliant with local codes. Higher lighting levels will improve visibility of cables, charging equipment and vehicle inlets.

- F. **Maintenance.** Charging station equipment should contain a phone number or other contact information for reporting malfunctioning equipment, other problems or to seek information.

- G. **Notification.** Information on any fees or terms of use, voltage or amperage levels should be clearly visible in day or nighttime conditions.

- H. **Communications.** Charging station equipment should be equipped with cellular phone service, wired or wireless communications.

3.5 BUILDING AND ELECTRICAL CODE GUIDANCE

3.5.1 GUIDANCE FOR EVALUATING PARKING FACILITIES FOR EVSE INSTALLATIONS

Before deciding to install EVSE, property owners and/or parking lot operators should first determine if the parking facility is a good candidate site. To assist in this assessment, this section of the guidelines addresses key planning factors in three specific areas: site location, user base, and parking lot features. To assess the suitability of a privately-owned site, four key questions should guide the decision-making process.

- Does my community have a Charging Station Siting Plan that has been developed as part of a regional effort --or is one being created?
- Does my property meet the long term needs of a particular user base?
- Is there sufficient electrical supply to provide charging services, and if not how feasible will it be to expand the supply?
- At my location, what is the average length of time that PEVs needs to charge? (potentially allows for use of less costly AC Level 1 versus AC Level 2 charger)

Site Location

Appropriate planning is essential for successful charger siting and installation. A community-wide master plan for chargers, now underway in most metropolitan regions, will assist site owners to better understand supply, demand, and the potential aggregate user base. Additional key siting considerations include:

- Ability to economically obtain sufficient electrical energy
- Visibility and ease of driving and walking access to the parking facility
- Distance and relationship to other parking facilities and land uses
- Occurrences of flooding or ponding of water on the parking lot
- Availability of wired or wireless communications at the site

User Base

Parking lots often target multiple categories of users. For instance, a shopping mall would generally target convenient customer parking and long term employee parking. A downtown surface lot owner will often provide short-term hourly parking for shoppers and monthly parking for employees of nearby businesses.

When considering the addition of EVSE in a parking lot, the owner/operator has an opportunity to attract new customers. The operator

should look at all possible users, types of equipment, and classes of electrified vehicles, including electric bicycles and scooters. Since electrical rates are lower at night than during daytime peak demand periods, operators may want to explore offering nighttime charging services for nearby residents that do not have charging opportunities at their residence or multi-unit dwelling (MUD).

Key user base considerations are:

- Hours and days of parking facility operations
- Customers' typical driving distances and frequency of use
- Expected PEV product mix and resulting needs
- Likely peak use days/times and duration of stay
- Day and night walking conditions and distances to nearby attractions
- Perceptions of site safety
- Method of assessing and collecting charging fees
- Opportunities for valet parking/charging service

Parking Lot Features

The third important planning consideration is the features of the parking facility and its operations. Having a clean, safe and secure lot, that provides convenient access to charging equipment, pedestrian exits and building entrances, is much likelier to be used than one that is remote, dimly lit and is prone to vandalism. Having assurance the charging equipment will be available for use upon arrival, or that a valet service will move and charge the car for a certain period of time is a convenience that will attract regular users. If the parking lot is provided primarily for nighttime parking, for instance hotel guest parking, having the guarantee of a fully or partially charged vehicle the next morning is critical to the success of any overnight charging service. Many on-site factors listed below need exploring when considering charger installations.

- Will clustering chargers in one area be better than dispersing them?
- Where is the source of electricity and electrical panel/circuits?
- Is there enough electrical power capacity beyond the existing electrical loads?
- Location of existing accessible parking spaces and determining location of accessible battery charging stations
- Ensuring cables will not infringe upon walkways and high pedestrian traffic areas
- How will charging electric vehicles change the nature of the existing operations?
- Should lighting, shelter, signage or pedestrian improvements be installed with new charging stations?

3.5.2 AMERICANS WITH DISABILITIES ACT (ADA) AND REASONABLE ACCOMMODATIONS

The ADA became federal law in 1990 with the intent to prohibit discrimination of individuals on the basis of disabilities. Title I of the ADA prohibits private employers, state and local governments, employment agencies and labor unions from discriminating against qualified individuals with disabilities in job application procedures, hiring, firing, advancement, compensation, job training, and other terms, conditions, and privileges of employment. The ADA covers employers with 15 or more employees, including state and local governments.

An employer is required to make a reasonable accommodation to the known disability of a qualified applicant or employee if it would not impose an “undue hardship” on the operation of the employer’s business. Reasonable accommodations are adjustments or modifications provided by an employer to enable people with disabilities to enjoy equal employment opportunities. The Equal Employment Opportunity Commission (EEOC) is the enforcing agency for Title I.

Title II of the ADA addresses State and local government services,

and Title III addresses places of public accommodation and commercial facilities. Under titles II and III of the ADA, the Access Board develops and maintains accessibility guidelines for buildings, facilities, and transit vehicles and provides technical assistance and training on these guidelines. The Department of Justice (DOJ) is the enforcing agency for Title II, and the Department of Transportation, along with the DOJ are the enforcing agencies for Title III.

3.5.2.1 ACCESSIBLE ELECTRIC VEHICLE CHARGING STATIONS

Since public charging stations offer a service to the general public, the ADA prohibits discrimination of individuals on the basis of disabilities. Accessibility standards specific to public chargers do not currently exist in California except in some fashion through Chapter 11C of the California Building Code—*Standards for Card Readers at Gasoline Fuel-Dispensing Facilities*.⁴⁰ The interpretation of the 11C Standard is that it applies to card readers not only on liquid fuel pumps, but also on charging stations, because it lists electricity as a motor fuel.

There also exists a State of California Internal Policy 97-03⁴¹—Interim Disabled Access Guidelines for Electrical Vehicle Charging

	New Construction ¹	Existing Parking Facility
1st EVCS	The first EVCS shall be accessible, and be installed in an existing van-accessible parking space or in a new 17-foot wide EVCS meeting all requirements of a van-accessible parking space. If in a new space it does not have to be designated with D9-6/R7-8b signs (disabled parking symbol/VAN-accessible) or contain a striped access aisle.	The first EVCS should be accessible, and may be installed in the existing van-accessible space, in an existing accessible parking space, in a standard parking space (9-foot wide minimum) adjacent to an “access aisle”, or in a standard parking space with a 3-foot wide (minimum) unstriped path of travel between the battery charging station and the vehicle inlet.
2nd EVCS	The second EVCS should be accessible and be installed in an existing accessible parking space or in a new 14-foot wide charger meeting all requirements of an accessible parking space. If in a new space it does not have to be designated with a D9-6 (disabled parking sign) or contain a striped access aisle ² . The first two accessible chargers may share the same access aisle.	The second EVCS should be accessible, and may be installed in a standard parking space (9-foot wide minimum) with a 3-foot wide (minimum) un-striped path of travel ² . The first two accessible EVCS may share the same path of travel.
3rd EVCS	The third EVCS and beyond may be installed in a standard parking space no less than 9-foot wide.	The third EVCS and beyond may be installed in a standard parking space no less than 9-foot wide.

Table D - Installation Options for Accessible EVCS

¹ Includes existing facilities increased in size by 50% or greater or by 30 parking spaces or greater (percentage size increase or number of parking spaces to be determined by local agency)

² If the first battery charging station can simultaneously charge two PEVs, the card-reading device would qualify as accessible for each vehicle

Stations that was developed in 1997 (last revised 2-10-2005) by the State Department of General Services. The Policy was developed to provide guidance for the installation of charging equipment on state-owned parking lots, including public schools. It states that local agencies are granted latitude to adopt similar methods of administering code requirements. While the Policy references the California Building Standards Code, it does not reference the California Electrical Code, Fire Code, Vehicle Code, or Manual on Uniform Traffic Control Devices; all of which must be considered when providing safe, accessible and enforceable public charging infrastructure.

The inconsistencies and incompleteness of both the standard for card-reading devices on fuel dispensers and the State's internal policy on accessible chargers has resulted in local agencies developing broad interpretations of the documents. The result has been widespread confusion and inconsistent applications of policy across the State, as well as across the nation. Until such time that a federal or State standard is developed that takes into consideration all necessary codes and modern equipment with varying charging levels, the guidelines below are being made available as a resource for local jurisdictions to consider using when designing, reviewing, installing and operating electric vehicle supply equipment. They should not be interpreted to dictate the manner in which a public agency chooses to administer the installation of public and restricted charging infrastructure.

An important objective of these guidelines is to ensure that accessibility provisions are met whenever possible and feasible. The guidelines take into consideration that planning EVI in new construction allows architects and engineers to match up the source and level of power supply, building use(s), and parking lot design with desired EVCS locations and charging levels. The guidelines also take into consideration the installation challenges in existing parking facilities such as uneven topography, use of existing electrical service, location of power supply, or space limitations. Because there are no definitive standards for the design and installation of EVCS, careful planning and consultation with local building officials is highly recommended before proceeding in both new and existing developments. In all cases the agency having jurisdictional authority will make the ultimate determination on permitted installations.

These guidelines identify the "battery charging station" as the accessible element, or as the point of service (see Appendix 8.1). It is recognized that in conforming existing public parking facilities at least one van-accessible space already exists. By locating the first battery charging station within a van-accessible parking space, the requirement that the first battery charging station be accessible would likely be met. In doing so however, it would likely result in the van-accessible space closest to the building entrance having a very low turnover rate and less overall availability to disabled users that depend upon lift equipment, because of the long periods of time needed to charge electric vehicles. It may also result in unexpect-

ed "cable management" and tripping concerns as van-accessible parking is often on the shortest pedestrian route to the main building entrance.

Provisions for accessible card-reading equipment in the Chapter 11C standard apply to battery charging station installations as they do to liquid fuel pumps, because the standard defines electricity as a motor fuel. Chapter 11C requires that the card-reading controls of the first two dispensers of any type of motor fuel need to be accessible in new or existing facilities.

For the next several years it is expected the vast majority of public EVCS will be installed in existing private surface lots. Therefore, EVCS will likely take the place of existing standard parking spaces (assumed 9'-0" wide). The first EVCS should have accessible equipment, thus a path of travel (see Appendix 8.1) is required on either side of the space leading to the battery charging station. It is here where some agencies may require a path of travel as wide as an 8'-0" access aisle so as to accommodate an electric van with lift equipment. However, lack of definitive standards for the installation of accessible battery charging equipment is resulting in some agencies authorizing the minimum 3'-0" path of travel between the equipment and vehicle inlet.



Figure 5 - Example of an accessible liquid fuel dispenser

Until such time as Accessible EVCS installation standards are developed and adopted by the State, two courses of action may be considered by local agencies; one for new construction and one for existing parking facilities (see Table D). As local agencies eventually adopt ordinances, codes, private & public development standards and regulations, every effort should be made to update these guidelines to reflect current laws and regulations.

3.5.2.2 EQUIPMENT REACH AND APPROACHABILITY

Key challenges facing property owners, engineers, architects, contractors and others are how to place charging equipment near a convenient and sufficient power source, protect the equipment from possible vehicle damage, and still ensure that the equipment is accessible for persons with disabilities. These guidelines identify the battery charging station as the accessible element. Below is a summary of the primary design requirements in Chapter 11C⁴² for accessible fuel-dispensing equipment as revised to coordinate with Title 24 and ADA Standards and other recommendations in the document:

- At each parking site, card readers serving the first two EVCS must be accessible (a battery charging station that can simultaneously charge two or more PEVs from one card reader would qualify to meet this requirement)
- A level accessible area (see definitions) measuring no less than 30-inches by 48-inches (with the long dimension being parallel to and centered in front of the equipment, plus or minus 9-inches on either side) must exist.
- If on a raised surface, the face of the card-reading controls must be within 10 inches in plan view from the face of curb and be no higher than 54-inches from the level accessible area in front of the controls. The 2010 ADA Standard lowers height reach ranges to 48 inches maximum, except that the operable parts of fuel dispensers shall be permitted to be 54 inches maximum measured from the surface of the vehicular way where fuel dispensers are installed on existing curbs.
- Where protective posts or other guard devices are provided they shall not obstruct accessible EVCS paths of travel or other accessible routes and shall not be located within 3-feet of the battery charging station controls and connector handle(s).
- In new construction a path of travel (see Appendix 8.1) no less than 3-feet in width must exist between the level accessible area in front of the charging station and an exterior accessible route of travel to the main building entrance.
- The electric cable and connector may cross over the level accessible area when inserted in the vehicle charging inlet.

Figure 5, a gasoline dispenser with two hoses, protected by guard posts provides an illustration of the front of the controls where the gas handle and card-reader are situated, with a recessed curb centered beneath the card-reading device.

Figures 6, 7, and 8 and accompanying comments that follow provide guidance for accessible electric vehicle charging stations in various parking lot configurations. The examples are based upon conventional parking lot designs, review of ADA design standards,

Chapter 11C of the CBC and the State’s internal Policy 97-03. If a local jurisdiction in California finds that compliance with accessibility and building standards would make the specific work of the project affected by the building standard unfeasible due to one or more factors cited under “unreasonable hardships” section of the State Building Code, the details of the hardship should be recorded and entered in the files of the enforcing agency.

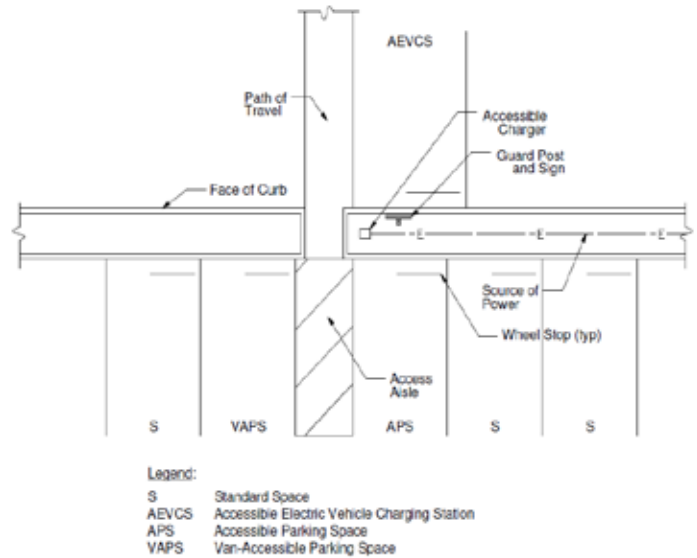


Figure 6 - Example of first EVCS in Existing Parking Facility

Dual Port Charging Station on Extended Island Configuration: This example illustrates how placement of dual port charging station in an existing parking facility can accommodate an accessible EVCS on one side of an island, as well an accessible parking space on the opposite side. Any vehicle displaying a Disabled Person (DP) placard or DP license plates may occupy the Dual Port Charging Station on Extended Island Configuration: This example illustrates how placement of dual port charging station in an existing parking facility can accommodate an accessible EVCS on one side of an island, as well an accessible parking space on the opposite side. Any vehicle displaying a Disabled Person (DP) placard or DP license plates may occupy the accessible parking space including a PEV that could utilize the accessible battery charging station. Signs identifying the accessible parking space as an “Electric Vehicle Charging Station” would be added to the existing ADA signage. The accessible EVCS must meet the reach, height, clearance and slope requirements of accessible fuel-dispensing equipment (Chapter 11C, CBC) and ADA standards. This figure is patterned after Sonoma County EVCS Program and Installation Guidelines.⁴³

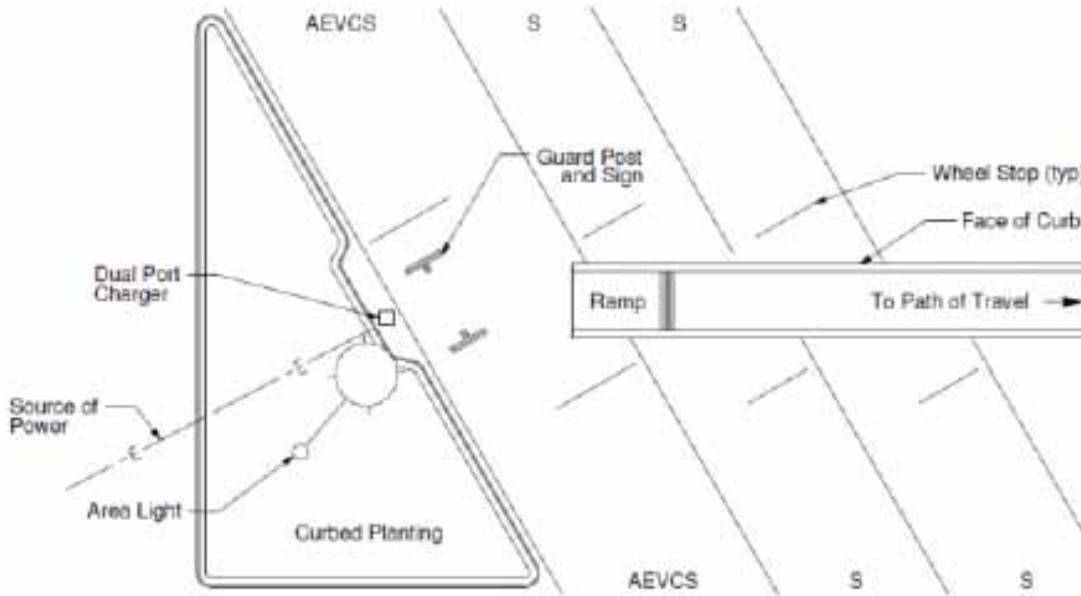


Figure 7 - Example of First Two EVCS in Existing Parking Facility

Dual Port Charging Station on Planted Island Configuration: This example in an existing parking facility takes advantage of a planted island at the end of a parking bay, where a dual port charging station is installed in a recessed section behind the curb line. The two accessible EVCS are a minimum of 12 feet wide (9' for parking and 3' for maneuverability), and have an unobstructed route from any side of the vehicle to the charger and to the ramp leading to the path of travel. Because the charging station is installed at the same elevation as the parking lot surface, guard posts containing signage are installed to protect the equipment and keep the ramp clear. This figure is patterned after Sonoma County EVCS Program and Installation Guidelines.⁴⁵

Charging Stations on Paved Area Configuration: Figure 8 illustrates an accessible EVCS adjacent to a wide level paved area between the EVCS and sidewalk, where the sidewalk serves as the path of travel. Two EVCS are also shown. This figure is patterned after Sonoma County EVCS Program and Installation Guidelines.⁴⁴

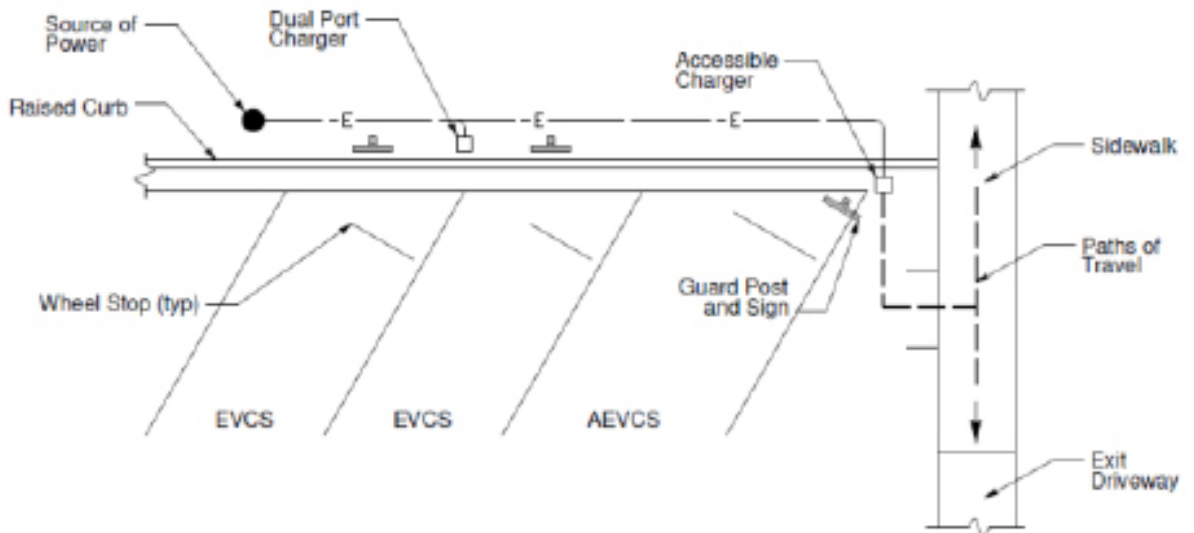


Figure 8 - Example of Accessible EVCS and Two EVCS

Legend:
 EVCS Electric Vehicle Charging Station
 AEVCS Accessible Electric Vehicle Charging Station

3.5.3 SAMPLE BUILDING CODE AMENDMENTS FOR PEV AND ON-SITE ENERGY SYSTEM READINESS

The following section of the guidelines offers examples of building code amendments pertaining to EV charging station installations and energy/storage management systems. The two are grouped so that local agencies can consider aligning the goals of sustainable transportation, energy efficient buildings, and reduced emissions. Building ordinance amendments can be utilized as an effective mechanism to require the installation of EV charging stations. In examples that follow, deployment recommendations are followed by actual language cited from existing codes and amendments in the U.S. and Canada.

Recommendation #11 – Require sufficient area and electrical infrastructure for charging PEVs.



Properly size all electric vehicle supply equipment, the electrical room wall, and floor area to accommodate the charging of PEVs.

In new multi-unit, commercial or industrial developments, local agencies may choose to require all conduits leading to the electrical room including electrical service conduits, and the electrical room to be appropriately sized to accommodate future electrical equipment necessary for electric vehicle charging stations, and the voltage and amperage capability of other anticipated infrastructure.

Adopted Code Language: *Vancouver, B.C. Building By-law*
Electric Vehicle Charging: Electrical Room:

The electrical room in a multi-family building, or in the multi-family component of a mixed use building that in either case includes three or more dwelling units, must include sufficient space for the future installation of electrical equipment necessary to provide a receptacle to accommodate use by electric charging equipment for 100% of the parking stalls that are for use by owners or occupiers of the building or of the residential component of the building.⁴⁶

Recommendation #12 – Encourage single-family residential chargers and PEV “pre-wiring” readiness.



Local agencies may wish to include basic infrastructure, such as conduits, junction boxes, wall space, electrical panel and circuitry capacity to accommodate future upgrades for solar systems and PEV charging.

Most PEV charging will occur at night at homes when vehicles are parked for long periods of time and when electric utility rates are often the lowest. Some local agencies have already adopted requirements that new residential developments contain basic infrastructure to capture roof top solar power. Producing renewable energy during peak use periods and charging during off-peak periods is an ideal way to power PEVs. Buyers of new homes may seek those where low cost solar readiness improvements have been put in place.

Adopted Code Language: *City of Chula Vista, California. Planning Ordinance*

Photovoltaic pre-wiring:

All new residential units shall include electrical conduit specifically designed to allow the later installation of a photovoltaic (PV) system which utilizes solar energy as a means to provide electricity. No building permit shall be issued unless the requirements of this section and the jurisdiction’s Pre-Wiring Installation Requirements are incorporated into the approved building plans. The provisions of this chapter can be modified or waived when it can be satisfactorily demonstrated to the Building Official that the requirements of this section are impractical due to shading, building orientation, construction constraints or configuration of the parcel.⁴⁷

Adopted Code Language: *CALGreen, Tier 1 (Voluntary)*

Electric vehicle (EV) Charging: One-and two-family dwellings.

Install a listed raceway to accommodate a dedicated branch circuit. The raceway shall not be less than trade size 1. The raceway shall be securely fastened at the main service or subpanel and shall terminate in close proximity to the proposed location of the charging system into a listed cabinet, box or enclosure. Raceways are required to be continuous at enclosed or concealed areas and spaces. A raceway may terminate in an attic or other approved location when it can be demonstrated that the area is accessible and no removal of materials is necessary to complete the final installation.⁴⁸

3.6 SIGNAGE

Local agencies may choose to post signs to notify of, or regulate the use of electric vehicle charging stations intended for public use. Local and State agencies posting guidance or regulatory signs on public roadways, must do so in conformance with the current edition of the California Manual on Uniform Traffic Control Devices (CA MUTCD). Sign sizes, shapes and colors vary based upon the type of message, whether an international symbol exists, and the type of roadway where the sign is to be used. Local authorities may use additional or alternative signs, not approved in the CA MUTCD in public parking facilities.

General Service Signs

General service signs that are currently contained in the MUTCD and CA-MUTCD are intended to provide general guidance to the charging station and should be installed at a suitable distance in advance of the turn-off or intersecting roadway, or at the charging station and should be considered for use when meeting the qualifying criteria in chapter 2F of the CA MUTCD. The color format for general service signs is as follows:

Letters	Symbols	Arrows	Borders	Background
White	White	White	White	Blue

Table D - Color format for general service signs

Below are the General Service Signs with recommended sizes currently approved in the CA MUTCD. The G66-21 (CA) sign was added to the CA MUTCD to be used on conventional roads. It may also be used in public parking facilities at all decision points and at the electric vehicle charging station. The D9-11b sign can be combined with either the G66-21 (CA) or the D9-11bP.

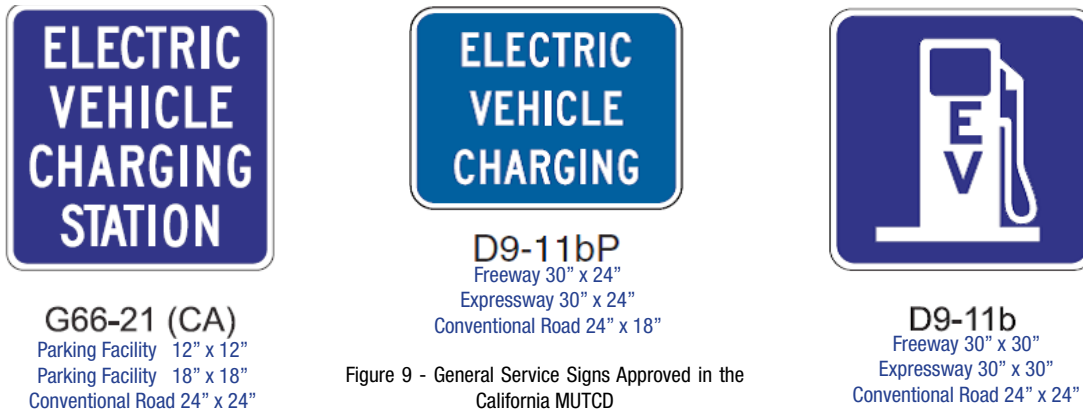


Figure 9 - General Service Signs Approved in the California MUTCD

Below are the typical types of advance turn and directional arrows used with the electric vehicle charging signs:

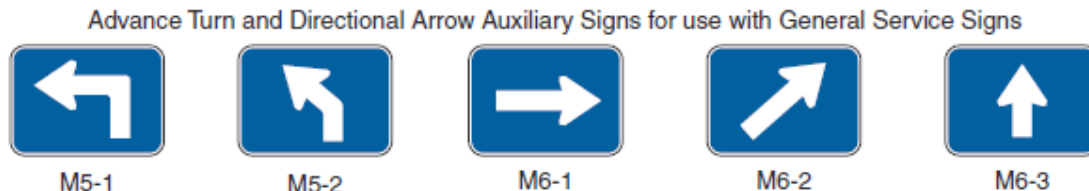


Figure 10 - Advance Turn and Directional Arrows used with PEV Vehicle Charging Signs

Comment: The above sections are modeled after the Sonoma County Electric Vehicle Infrastructure Guidelines Report⁴⁹ and the Puget Sound Regional Council EVI Deployment Guidelines Report.⁵⁰

Guidance: On April 1, 2011, the Federal Highway Administration (FHWA)⁵¹ issued an Interim Approval for use of an alternate D9-11b sign to the States of Oregon and Washington (see figure on right). The FHWA considered the substitution of the electrical cord in place of the gas hose and nozzle as a more appropriate representation of a battery charging station. The use of this sign as an alternate to the D9-11b will be granted to other states or public agencies that submit a request to FHWA. When, and if an official rule making occurs and the sign is included in the MUTCD, then it can be used as a permanent sign on public roadways by any agency in the United States. The same dimensions of the D9-11b apply to the alternate sign.

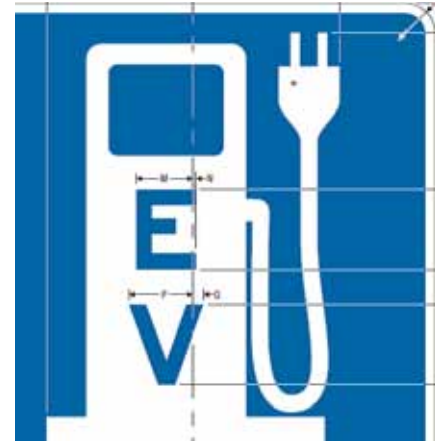


Figure 11 - D9-11b (Alternate)

Regulatory Signs

Regulatory signs are required for enforcing the time duration and days that electric vehicles are permitted to park and/or charge at public charging stations. In compliance with AB 475⁵², qualifying electric vehiclesⁱ that are in the act of charging status may legally park in a public EVCS. Currently, no regulatory signs exist for electric vehicle charging purposes in either the California MUTCD or the federal MUTCD. However, Figure 11 illustrates signs that have been developed for testing in Oregon and Washington, as well as a regulatory sign approved for use in Michigan. It is recommended

ⁱ Any electric vehicle that produces no tailpipe or evaporative emissions, or is a PHEV, as defined by the State Air Resources Board, and used in AB 475.

that those signs be utilized in California until such time as California adopts standard signs. New signs can be added to the federal MUTCD or California MUTCD through the “experimentation” process which is described in each manual.

Regulatory signs are generally prohibitive or permissive, and there are certain color designations for each. Green/white regulatory parking sign like the one in figure 12 is considered a permissive sign and is intended to provide motorists with the allowable time and days to park. Red/black/white regulatory parking signs like the two there are prohibitive and are intended to advise motorists of an action that should not be taken.

To be enforceable, each of the above signs should be no smaller than 12”W x 18”H and placed immediately adjacent to the electric vehicle charging station at heights as prescribed in the CA MUTCD. The permissive sign on the left was developed by the City of Auburn Hills, Michigan in July of 2011. It includes the D9-11b (Alternate) and is being added to the Michigan MUTCD. The prohibitive sign second to the right would allow for the parking of a PEV without being plugged in (it could be used as an incentive in parking spaces where charging station equipment does not exist) whereas the sign on the right would require the electric vehicle to be plugged in and charging (see definition for “charging”). Both of the prohibitive signs above are intended to make it unlawful for any non-electric vehicle to occupy the space. If a permissive sign is used in combination with a prohibitive sign it should be installed below or to the right of the prohibitive sign.

Local authorities or property owners, after notifying the police or sheriff’s department, may cause the removal of an unauthorized vehicle from an electric vehicle charging station, if appropriate language is adopted in the agencies’ municipal code. The process for posting and notification is described in the California Vehicle Code (CVC) Section 22511, and recommended ordinance language to authorize the enforcement of these signs is included in section 2.3 of this document.



Figure 12 - Examples of regulatory signs being tested in Oregon and Washington and used in Michigan

4 INSTALLATION STREAMLINING FOR RESIDENTIAL PEV CHARGERS

The local permitting authority for EVSE installation plays a vital role to protect public safety by ensuring that electrical work is done properly and that all applicable codes are met. With the introduction of the new PEVs, local jurisdictions may be faced with an influx of EVSE permit applications for home charging of PEVs. Rapid installation of these stations is critical to new PEV owner⁵³ as home charging represents the primary way to refuel a PEV.⁵⁴ Various issues may arise when streamlining residential EVSE installation, particularly when installing EVSE in multi-unit dwellings (MUDs). With the majority of charging expected to take place at home and a significant portion of Californians living in MUDs,⁵⁵ it is important to address this group in particular when developing EVSE installation streamlining. A number of professional organizations are developing guidelines for local building departments; some cities have already adopted ordinances or procedures to expedite the installation of EVSE. These initial efforts will help shape more formal training programs in the next few years.

This section seeks to address these and other key challenges to installing residential EVSE and to document the leading edge practices so that these practices may be adopted and improved upon by other jurisdictions. Section 4.1 captures the more successful efforts throughout the State to streamline residential EVSE permitting and inspection processes, while section 4.2 focuses on the challenges that face MUD EVSE installation and possible solutions based on leadership from other jurisdictions. While this chapter does not attempt to resolve all of these challenges, it is apparent that local governments can play a crucial part in fostering solutions by educating and reaching out to their communities about options and solutions.

4.1 RESIDENTIAL PERMITTING AND INSPECTION BEST PRACTICES

To expedite charger installations, it is helpful to understand challenges currently faced by contractors, permitting authorities, and consumers. These include infrastructural issues related to electrical load and capacity, as well as permit processing issues themselves.

Increase in electrical load. Electric vehicle supply equipment represents a significant increase in residential load, ranging from half of a typical household's peak electrical load to three times the peak electrical load.⁵³ In fact, many older homes may not have the necessary spare capacity in their existing electrical panel for the new EVSE. These homes may require substantial additional work at significant cost to the customer. Installation costs can vary dramatically depending on the condition of the existing wiring, panel upgrades, and conduit runs: from as little as \$400 if all conduits are in place and ample panel capacity exists, to \$5,000 or more if extensive equipment replacement is required. A study of data from infrastructure installations in the 1990s found that the drivers for higher installation costs were panel upgrades, long distances from electrical panel to charger, trenching or underground work.⁵⁷

Permit processes vary across jurisdictions. Any electrical work, including the addition of a 120V or 240V outlet, requires an electrical permit from the local building department and a subsequent inspection to verify that work has been completed in compliance with the approved permit. Obtaining a permit generally requires the completion of an application describing the work to be completed and payment of a permit fee. Some jurisdictions allow permits to be requested online; others require a personal visit to City Hall. In many cases, simple hand-drawn layouts of the proposed installation and load calculations will be required for residential permits; on the other hand, commercial permits may require engineered drawings and a wait of several weeks while the plans are checked by various local government departments.

As a result of the combination of infrastructure and permit challenges, long inspection and installation timelines can frustrate PEV customers. Several efforts around the State to streamline EVSE permitting and installations are summarized below, with key documents relevant to these efforts included in the appendix of this document, or available online.

Examples of EVSE Permitting

- **The City of Los Angeles** has committed to a 7-day approval process⁵⁸ for installation of EVSE, providing the customer's electrical system can support the charging requirement. In addition, Los Angeles has an online permitting process which greatly expedites residential permits. www.ladbs.org/LADBSWeb/e-permit.jsf
- **The County of Los Angeles'** Public Works Department has drafted a simple checklist for permitting and inspection to provide consistency throughout the greater Los Angeles area. The checklist will be used by LA County building inspectors and other local jurisdictions to train their Building Inspectors. The checklist is included in appendix 8.7 of this document.
- **The Tri-Chapter Uniform Code Council** representing building departments in the greater Bay Area has adopted uniform guidelines for both residential and commercial EVSE permits that provide guidance for the 55 jurisdictions in the South Bay region of the Bay Area. These guidelines are included in appendices 8.8 and 8.9, respectively, of this document.
- **The City of Riverside** has prepared a guide to EVSE permitting for local residents. The document is available on the city's website.⁵⁹

Based upon the successful work being done in these and other communities, the following recommendations are offered to facilitate streamlined permitting and inspections state-wide. The recommendations can be implemented individually or collectively on an agency-by-agency basis. However, regional consistency in implementation of these measures will maximize effectiveness.

4.1.1 REDUCING THE TIME TO OBTAIN AN EVSE PERMIT

Lengthy permitting processes for residential EVSEs can result in serious inconvenience and increased costs for the customer and the installer. It may also discourage potential buyers and pose a serious impediment to the market success of plug-in vehicles. To address this challenge, a number of organizations and jurisdictions have already taken action to expedite EVSE permitting.

- The National Renewable Energy Laboratories in conjunction with the U.S. Car GITT Permit Working Group have developed a recommended universal permit application for adoption by local jurisdictions (the permit application can be found in Appendix 8.10).
- The City of San Diego is working toward an online version of the permitting template (with NREL's permission) for use as a web-based tool for communities. San Francisco allows for prioritization of some permits, but requires permit applicants to trigger the expedited process by requesting prioritization. (Ideally, prioritization of permit processing for PEV chargers would be automatic.⁶⁰)

These and other model practices are reflected in the recommendations that follow.

Recommendation #13 – Implement online permitting residential charging.

Cities and counties are encouraged to enable homeowners and licensed contractors to submit PEV charger permit applications online for installations at a pre-determined complexity level to reduce the number of time-consuming visits to government offices.

Recommendation #14 – Provide outreach and resources on residential EVSE requirements.

Local governments are encouraged to provide information on their web sites as resources for defining residential EVSE requirements. Outreach material may also include PEV benefits and types, available EVSE options and other PEV resources to prepare homeowners and licensed contractors for the permitting process.

Recommendation #15 – Prioritize EVSE permitting.

To promote adoption of PEVs, cities and counties may process charger permit applications on a priority basis.

Recommendation #16 – Employ universal permit applications.

Regions may seek to adopt standardized permitting checklists such as the one issued by the Tri-chapter Uniform Code Committee (TUCC), and included in Appendix 8.8 of this document or the one created by the Los Angeles Department of Public Works and Los Angeles County Chapter of the International Code Council, included in appendix 8.7.

Recommendation #17 - Establish flat fees for standard installations.



Currently, many jurisdictions set permit fees based on a percentage of the overall cost of the project. This penalizes homeowners that have more costly installations. Cities and counties may adopt flat fees that are cost recovery-based.

Recommendation #18 - Waive plan check requirements for simple residential installation.



Many cities and counties do not require formal drawings for a standard installation that do not require re-wiring or panel upgrades. A permit application and a sketch of the installation location are usually sufficient to obtain a permit.⁶¹ Other cities do not require plans for minor residential electrical work such as water heater installations or repairs.⁶²

4.1.2 REDUCING THE NEED FOR ELECTRICAL UPGRADES

Recommendation #19 - Encourage use of an existing unused electrical circuit where feasible in residential use.

Some customers may have an unused dryer circuit in the garage that can be used for EVSE. Others may be willing to switch to a gas dryer to free up the dryer circuit for installation of EVSE and avoid a panel upgrade. Even if a 30 amp dryer circuit is not available, residents may have an existing 120V outlet available and find that AC Level 1 charger is sufficient for their needs.

4.1.3 REDUCE THE TIME ASSOCIATED WITH COMPLETING REQUIRED INSPECTIONS

Applying for a permit and waiting for an inspector can be time-intensive. As many as three separate visits by the installer may be required to apply for the permit, perform the work, and complete the inspection. In addition, a fourth visit by the installer is needed if the utility requires a separate inspection. All of these costs are typically passed on to the customer. However, a variety of steps can be taken by localities to reduce these delays and accelerate handoffs between local inspectors and utility planning and metering departments. Recommended practices are noted below:

Inspections may include a progress inspection of wiring or panel upgrades, a progress inspection of any trenches or underground conduit and a final inspection. The electrician's site visits include the preliminary site survey, the work time, and all required inspections as well as a potential meeting with a utility planner and a return visit after a second meter is installed by the utility. The City of Los Angeles has created a separate EVSE inspection division to help reduce the time associated with EVSE inspections.⁶⁵

The following flow chart illustrates the sequence of events and the potential number of electrician visits 4-6, utility site visits (0-2) and inspector site visits (1-3).

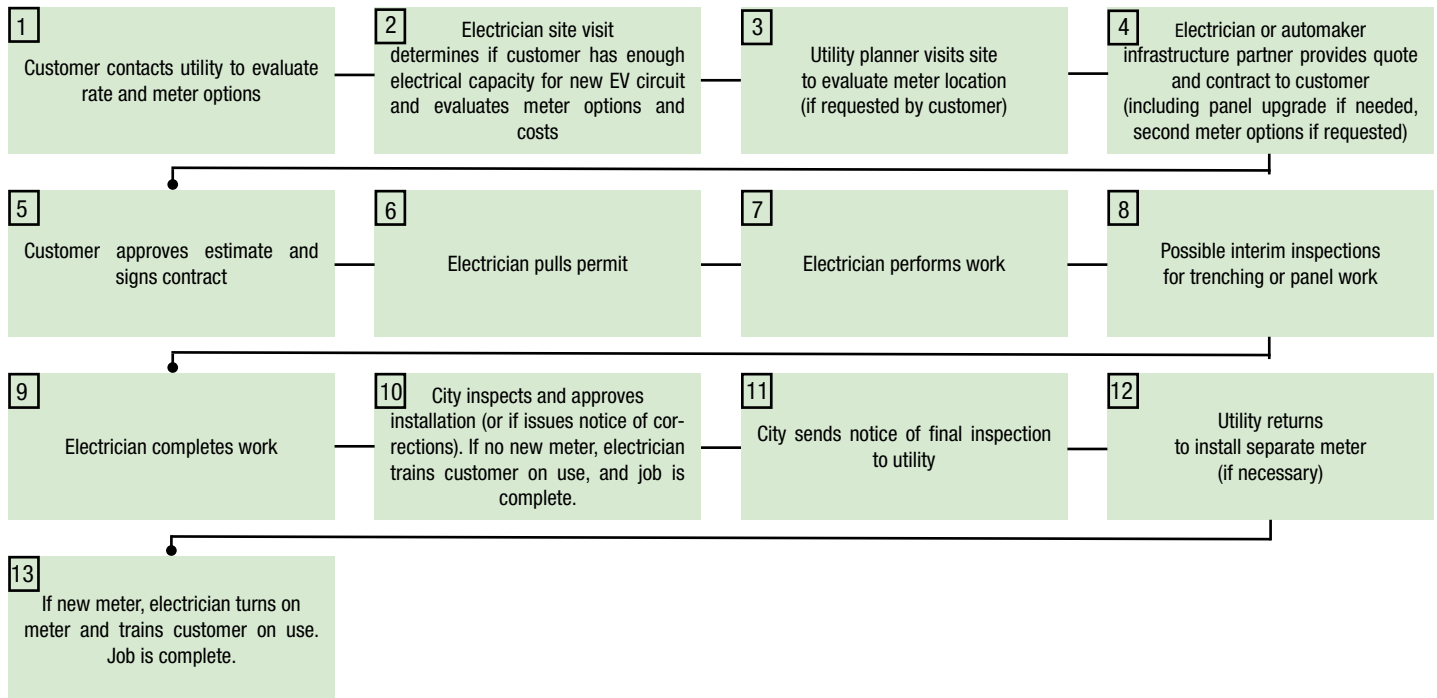


Figure 13 - Residential Installation Process

Recommendation #20 - Consider spot inspection for standard installations.

To speed up standard installations that do not require an electrical system upgrade, cities and counties may consider adopting a process whereby registered, licensed, and appropriately screened electricians can self-certify that they have installed equipment according to code. This approach treats standard EVSE like a large appliance, such as an electric water heater.⁶³ Licensed electricians pre-purchase minor installation labels, enabling them to assess a site and perform standard EVSE installations at the same time.

Recommendation #21 - Condense compliance review inspections for complex installations.



Since multiple home inspections can cause time lags in the installation process, cities and counties that require interim inspections of upgraded electrical equipment are encouraged to eliminate progress inspections for standard installations that do not include panel upgrades or underground conduit.⁶⁴

Recommendation #22 – Establish flexible inspection request systems.

Cities and counties are encouraged to establish online or 24-hour voicemail systems through which PEV permit applicants can schedule inspections. Although a number of Bay Area cities and counties already have such systems in place,^{66,67} others offer only restricted daytime hours for scheduling. Local jurisdictions may also allow same day inspections when workload permits.

Recommendation #23 - Provide shorter inspection windows.

Establish 2-hour windows for site inspections to limit customer wait time.⁶⁸

Recommendation #24 - Unify building and utility inspection.

Cities are encouraged to establish a specific EVSE installation process with their local utility to ensure that there are no delays due to either utility or city actions.⁶⁹

4.1.4 STREAMLINE PERMIT REVIEW, ISSUANCE, AND INSPECTIONS

Recommendation #25 - Develop and deploy an EVSE permit checklist.



Develop and utilize an EVSE Permit Checklist that references all required elements for approval of a permit:

- Provision of a site plan illustrating project location and identifying the proposed location of the EVSE
- Demonstration of physical protection of EVSE (CEC 110.27)
- Electrical load calculations of existing and/or proposed electrical system, including EVSE model number and full load amperage

- Electrical single line diagram of proposed work

4.2 MULTI-UNIT DWELLING (MUD) CHARGER INSTALLATION PROCESS

According to the California Department of Finance, some 31 percent of Californians live in MUDs.⁷⁰ There is a wide range in density among counties and cities, however, from a low of 9 percent in the city of Carson to a high of 77 percent in Santa Monica.⁷¹ In addition, many single-family dwellings in densely populated areas do not have individual garages or off-street parking. Based on available data from the American Housing Survey for Metropolitan Statistical Areas, 22 percent of residents in the Los Angeles area and 26 percent of residents in the San Francisco area did not have a garage or carport at their place of residence.⁷²

Governmental and property management policies related to installing charging in multi-unit dwellings are still “a work in progress.” Some multi-unit installations are straightforward, yet many are complicated both by physical space limitations and ownership/management issues.

The physical challenges faced by MUD residents, owners and management groups include:

- **Limited parking:** In most multi-family complexes, especially older ones, parking spaces are at a premium and there may not be room to install charging stations.
- **Long distance between utility meters, parking spaces and unit electrical panels:** A new 208/240V PEV charging circuit requires connection between the charger location and the tenant’s/owner’s electrical panel. In MUDs, the electrical panel may be in the residential unit and located hundreds or even thousands of feet from the parking area. This can impose significant cost barriers.
- **Inability to take advantage of off-peak charging rates:** A new meter and utility service may be required to take advantage of off-peak PEV charging rates. Since most multi-family units have meters that are clustered together in a central location, there may not be space to add another meter. In addition, the new electrical panel for the EVSE might need to be installed hundreds of feet away in the individual residential unit.
- **Limited electrical capacity:** Older buildings typically have limited electrical capacity. Level 2 chargers typically require a minimum of a 40 amp circuit (with the exception of the Voltec charger which requires a 20 amp circuit). Older apartments or condominium units may have only a 60 amp service or less. Upgrading electrical capacity may be very costly and may also trigger requirements to bring the property up to today’s building codes.

- **Variable costs associated with installation:** Costs for MUD installations are largely determined by existing electrical capacity and distance from the electrical panel to the parking space. Cost mitigation strategies can include placement of charging equipment in guest parking spaces or other common areas. Selection of a charging unit with a billing system will ensure that PEV drivers pay-as-they-go and do not place a financial burden on non-PEV drivers. In any case, residents should consult their utility for local options.

The most difficult issues around installing EVSE in multi-unit dwellings relate primarily to the governance structure of these properties. Rental units are controlled by property managers or property owners. Condominiums and townhomes have Homeowners' Associations (HOAs) with elected Boards of Directors and contracts that govern the use of both private and common area space. Installing charging units at the deeded or assigned parking spaces may be physically impossible or impractical requiring alternative options such as use of visitor parking, common space or other options. Any of these options will require approval by property managers and homeowners' associations.

While many of the solutions are still to be determined, what is clear is that local governments can play a key role in this effort. In some cases, the solutions may involve adjusting local regulations such as new construction codes to require pre-wiring of EVSE. However, in many situations, the most effective role of local government may be outreach to residents and property managers alike, and education about options and solutions. Partnership with utilities and PEV advocacy organizations can be an effective method to reach customers. A 2011 forum with Plug-in America in Santa Monica, for example, attracted some 80 city officials, residents, and property managers to discuss the issues related to MUD EVSE installations.⁷³

4.2.1 PERMITTING MULTI-UNIT INSTALLATIONS

Multi-unit installations fall into the category of commercial electrical work -- even though the EVSE is used by residents. Like workplace or retail installations, multi-family installations typically require engineered drawings that include:

- A site plan showing the geographic location of the property and the location of the building on the site (see Figure 13 for a sample)
- A layout showing the electrical work to be accomplished and
- Specifications for the equipment.

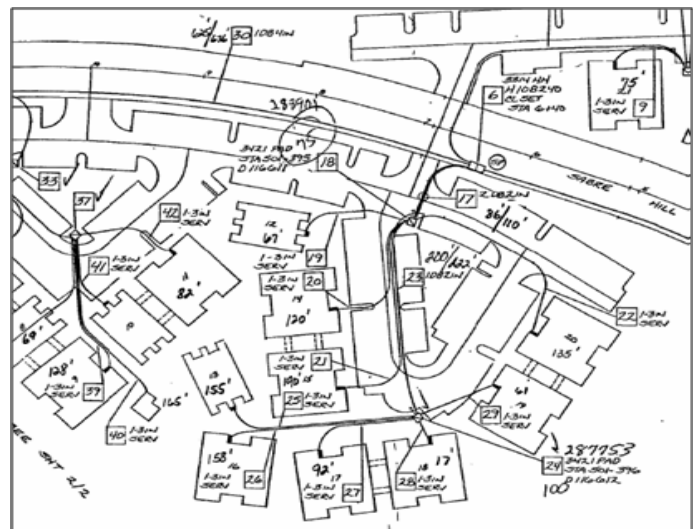


Figure 14 - Sample Site Plan, Courtesy of San Diego Gas and Electric

Tri Chapter Uniform Code Council

The Tri-Chapter Uniform Code Council (TUCC) has created guidelines for its 55 member jurisdictions regarding commercial EVSE installations (including multi-family). The guidelines state that: "Charging system equipment, EVSE (Electric Vehicle Service Equipment), installed inside individual garage of multi-family dwellings shall follow TUCC policy #17 for EV charging system in single family dwelling, with the exception that Homeowners' Association or owner's approval (in the case of rental property) is required." See Appendix 8.9 for a copy of these Guidelines.

Plan check is usually required, including review and sign-off from a city engineer, planning and/or building departments, and the city or county fire marshal. Multiple submittals may be necessary before final approval of the plans. The utility may also need to be involved if a new meter is required.

Unfortunately, PEV drivers may become discouraged by the lengthy and potentially costly process of permitting and installing EVSE in a MUD. Local governments can help streamline the process by means of the following recommendations:

Recommendation #26 - Adopt and publicize building code enhancements for MUDs.



Local agencies are encouraged to adopt building codes amendments that specifically address MUD installations.⁷⁴ For example, cities may require all installations to have protective bollards.⁷⁵

Recommendation #27 - Publish submittal and plan check requirements for EVSE projects.



Local agencies are encouraged to make informational materials available (for over-the-counter and online distribution) containing the requirements for EVSE permitting and installation. Given the complexity of MUD EVSE installations, these materials may include options and best practices for MUD installations. Agencies are encouraged to collaborate with local PEV coordinating councils and utilities to provide outreach and education for the general public and contractors to enhance understanding of MUD EVSE installation and permitting requirements.⁷⁶

Recommendation #28 - Fast-track approval of MUD EVSE projects.



Local authorities may give priority to MUD permit applications since these EVSE installations are necessary for home charging. In addition, MUD inspection approvals may be fast-tracked.

and cost among residents. If the common area meter is on a time-of-use (TOU) rate, adding new load could increase demand charges for all usage. An unintended consequence is that purchasers of PEVs may have to forfeit any incentives targeted at residential rate-payers such as low off-peak TOU rates or installation incentives. See Chapter 6 for more discussion on metering and special EV rates.

Submetering is another area of concern. Submeters are meters that measure only a part of a customer's electricity use. In California, submeters are not currently permitted for utility revenue collection purposes in single family or multi-unit dwellings although they are sometimes used by private parties to track individual usage—for example at trailer parks.⁷⁷

The issue of EVSE metering and submetering is being addressed by the California Public Utilities Commission (CPUC). In its Phase 2 of Rulemaking 09-08-009,⁷⁸ the CPUC directed California investor-owned utilities to develop a submetering protocol while creating a framework that can incorporate emerging metering technologies and encourage innovation. The submeters may be owned by various parties including the end-user or a third party service provider.

Submetering may help some single family and multi-family residents by allowing PEVs to be measured and billed separately from other usage. Submetering may also have a significant impact on the ability of MUD residents to take advantage of special charging rates. Eventually, as the smart grid becomes a reality, smart meters may be able to identify individual home circuits and bill accordingly. Solutions are several years away and MUD residents and property managers would be wise to contact their local utility as options are expected to change over the next few years.

Recommendation #29 - Develop written procedures to ensure early contact with local utilities for MUDs.



Working cooperatively, local agencies and utilities are encouraged to develop procedures acceptable design and metering options.

4.2.2 UTILITIES AND METERING IN MULTI-UNIT DWELLINGS

Due to the complexities that MUDs bring to the EVSE installation process, local agencies and utilities are encouraged to work cooperatively to develop procedures for acceptable design and metering options for MUDs.

MUDs present special challenges for utility metering and rates as well. The property may have two different types of meters and rates—one residential meter and rate for individual units and a second commercial meter and rate that covers services to all residents such as outdoor lighting, common area lighting, irrigation, swimming pools, spas, laundry rooms and security gates. Adding EVSE to the house meter creates many issues such as how to allocate use

5 CHARGING STATION INSTALLATION STRATEGIES

As local governments prepare for the deployment of PEVs in their communities, leaders will have opportunities -- in partnership with regional PEV Coordinating Councils -- to develop effective strategies for the siting and installation of publicly accessible charging stations. In this chapter, information and recommendations are provided regarding charger equipment (EVSE) and electrical requirements, charger location and distribution, installation design criteria, and implementation processes.

5.1 EQUIPMENT

Dozens of companies are currently manufacturing electric vehicle supply equipment (EVSE) and the number is growing rapidly. In September 2010, the Electric Power Research Institute (EPRI) counted 27 EVSE manufacturers. The list grew to 37 just six months later.⁷⁹ Unlike the competing designs that characterized the PEV industry in the 1990s, virtually all AC Level 1 and 2 EVSE manufactured today comes with a connector that meets Society of Automotive Engineers (SAE) Standard J 1772. The adoption of a universal connector standard for 120V and 240V charging was a major industry breakthrough that ensures that virtually all vehicles will be able to use all EVSE, regardless of brand name.

Equipment capabilities and prices vary widely. As described in Section 6, charging equipment is categorized by voltage and amperage, which translates to speed of battery recharging. Typically, the faster the charging, the more complex (and costly) the equipment and the installation are. The equipment that drivers plug into at home or at commercial locations includes various features and communication protocols to ensure safety. Some units are simple, low-cost devices that are designed for relatively protected locations and in-house use by fleets. Others include advanced features such as subscription packages, websites for tracking charger locations and availability,

credit or debit card billing systems, sophisticated energy management and two-way power flow capabilities, and even reservations systems.

Laboratory Certification Requirements: Virtually all local jurisdictions require electrical equipment to be certified by a national testing laboratory. In the past, only Underwriters' Laboratories (UL) was an acceptable certification but in recent years, other labs such as Intertek Testing Services that test to UL standards have been accepted. A recent EPRI survey⁸⁰ found 15 nationally-recognized testing laboratories. Each local jurisdiction should make available a list of national test labs that it will accept as certifying bodies for EVSE.

5.2 DEVELOPMENT OF GUIDING PRINCIPLES FOR SITING STATIONS

Based on local factors and priorities, local jurisdictions may wish to develop and adopt a set of guiding principles for identifying potential public charging stations (EVCS) sites that can also be applied to multi-unit dwellings (MUDs) or fleet installations.

The following principles have been developed by the Transportation Authority of Marin (TAM)⁸¹ for use in guiding their charger deployment strategy, and reflect much of the latest thinking from projects across the nation. The Marin principles include primary global principles, secondary global principles, and site-specific principles and are defined belowⁱ:

1. Primary Global Principles – Those factors that are of highest importance when deciding on overall sites to locate EVCS.
2. Secondary Global Principles – Additional factors of secondary importance to consider when selecting overall locations for EVCS.
3. Site Specific Principles – Priority factors to consider when determining the specific location within a general site where the EVCS(s) will be installed.



Figure 15 - Connectors meeting SAE Standard J1772

ⁱ Note that minor changes have been made in this document to the original principles.

Primary Global Principles

Location: Select a high-demand, high-visibility location (especially for the first few chargers). Better placement of EVCSs can come from data collection and polling of EV owners.

Electricity: Select a location where AC Level 1 (120V/15A) or AC Level 2 (240V/40A) electrical supply is or can be made available with relative ease and minimal cost.

Economics: The costs of charger installation and potential loss of parking space revenue should be weighed against the benefits of projected revenues, positive publicity, and increased visitor spending in the jurisdiction, as well as the broader societal benefits of spurring the transition to clean, low-carbon transportation.

Access: Consider and comply with ADA guidelines for disabled access, and take precautions to ensure that chargers are placed with the user's convenience in mind (avoiding injury from tripping on cords and cables, etc.)

Security: Select a secure location with adequate lighting to enhance security and provide the customer with a good charging experience.

Signage: Provide enforcement and other signs that comply with the Manual on Uniform Traffic Control Devices (MUTCD) and California Vehicle Codes (CVC), ensuring that signs are high enough, easily visible, and provide clear and accurate information.

Equipment Protection: EV chargers should be placed where they can be best protected from physical damage by such measures as curbs, wheel stops, setbacks, bumper guards, and concrete-filled steel bollards, while simultaneously taking into consideration ease of access to the charger, mobility of users, and foot traffic in the area.

Fleet Use: Consider "dual purpose" sites that could also benefit the jurisdiction's fleet vehicles, as well as the general public, where feasible and appropriate.

Secondary Global Principles

While the principles above received the highest priority ratings from Marin jurisdictions, many other criteria are also to be considered in the siting of PEV chargers, including:

Diversity of Intended Users: PEV chargers should (progressively) be located in sites that will appeal to the diversity of PEV users (e.g., local residents, visitors and tourists, and fleet drivers)

Public Safety: Chargers should be located in areas with proper ventilation and away from potential hazards including traffic, explosive materials, flammable vapors, liquids and gases, combustible dust or fibers, materials that ignite spontaneously on contact with air, flood-prone areas, and areas that might be prone to vandalism.

Duration of Use: AC Level 1 charger sites should focus on locations where vehicles will be parked for six or more hours, while AC Level 2 charger sites should focus on locations where PEV owners will be parked for significant, though shorter, periods of time (e.g., one to six hours). DC Fast Chargers sites should focus on locations where the PEV owner will be parked for a relatively short period of time (e.g., 15 minutes).

Location Markings: Indication of parking spaces, striping, driveways, and walkways.

Cord Management: To avoid injury from tripping, cords should not cross sidewalks or pedestrian traffic patterns.

Shelter: When possible, shelter is desirable to protect users from weather when connecting their vehicle to the charger. (However, chargers are designed to be safely operated in exposed locations in the rain, with no danger of electrical shock.)

Aesthetics: Some areas may benefit from the installation of landscaping or screening walls to shield the electrical transformer, panel, or other equipment from the public eye.

Solar Power: Some jurisdictions may choose sites where solar panels can provide energy to power the charging unit.

Other PEVs: Locations may be chosen to cater not only to freeway-capable Battery-Electric (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) -- which typically utilize the 240V volt "AC Level 2" connections for faster charging -- but also to slower-speed Neighborhood EVs (NEVs), electric bicycles, electric scooters, and electric motorcycles which typically utilize a 120V electrical connection.

Site Specific Principles

Accessibility: EV charger location within a site should comply with ADA access requirements. Specifically, the first two EV chargers installed in any one location should take into consideration requirements in California Building Code Chapter 11C and DSA 97-03.

Electrical Supply: Select a location where it is as inexpensive as possible to provide AC Level 1 (120V) or 2 (240V/40A) electrical supply.

Benefits vs. Loss of Revenue: When selecting the specific location of an EV charger at a particular site, a jurisdiction should consider the balance of anticipated benefits (including “EV readiness”, revenue potential, and increased patronage of nearby business) versus potentially negative aspects of taking an available parking space (including negative impact on conventional vehicle drivers and lost revenue.)

Cord Management: When determining where to install an EV charger, a location should be selected where cords will not interfere with the path of travel of the user or other pedestrians in the vicinity.

Security: A location should be selected that is secure for users at all times of day and night and relatively secure from vandalism (e.g., in a well-lighted area; and in well-traveled areas.)

5.3 ELECTRICAL REQUIREMENTS

As shown in Table A in Section 3.1.1, typical residential charging equipment is either 120V (AC Level 1) or 240V (AC Level 2). Nearly all vehicles come with a standard 120V cord that can plug into an available wall outlet with sufficient capacity. As shown in Section 7.9, the complete charge time for AC Level 1 can be lengthy, ranging from about 5.3 hours for a 50 percent charge of a Chevy Volt to 20 hours for a Nissan Leaf and 38 hours to fully recharge a Tesla Roadster. Despite the longer charge time, 120V charging may be a low cost solution for some individuals who have with lower “refill” requirements due to short driving patterns, limited options or expensive requirements for 240V upgrades.

Higher amperages and voltage translate to faster charging. To illustrate, the GM Voltec charging station draws 16 amps of current, while the charger for the Nissan Leaf draws 30 amps and the Tesla sports car draws 80 amps. A home with the 100 amp panel typical of mid-century houses may not be able to accommodate the more powerful chargers. Most vehicles available on the market today charge at 3.3 kWh at 240V. At this rate, a Chevy Volt will charge in 4 hours and a Nissan Leaf in a little over 7 hours. Many AC Level 2 chargers can accommodate 6.6 or 7.2 kilowatts of power, even

though the battery may be programmed to draw less. Some industry groups are assessing the potential for even faster home charging; these standards have not yet been finalized.

For public or workplace charging, designers should include 120V, 20 amp circuits for each AC Level 1 charging outlet and 240V 40 amp circuits for each AC Level 2 charging unit.

Level 2 Charger Plug Connections: It was previously assumed that due to the higher voltage associated with EVSE, safety required that the 240V AC Level 2 units be permanently connected or “hard-wired” so they could not readily be moved from place to place. A re-examination of the applicable electrical codes resulted in test lab approval of charging products that can be attached to a wall or other structure and plugged into a special receptacle with the appropriate amperage rate. As of 2011, there is no receptacle standard and the proper receptacle will depend on the voltage, current and phase of the EVSE. As an example, ECotality is installing the BLINK 30 amp AC Level 2 charging unit using a NEMA 650R receptacle.⁸² Leviton uses NEMA 6-20 for its 16 amp unit.⁸³ The goal of these manufacturers is to make the installation of charging equipment similar to the installation of familiar appliances such as refrigerators, electric stoves and clothes dryers.

5.4 DESIGN AND INSTALLATION

One of the many benefits of driving a PEV is the ability to refuel at home, at work and at play. While the majority of charging is expected to take place at home,⁸⁴ workplace and public charging will play a key role in encouraging consumers to purchase PEVs.

The figure below⁸⁵ illustrates the anticipated distribution of where PEV charging will take place.

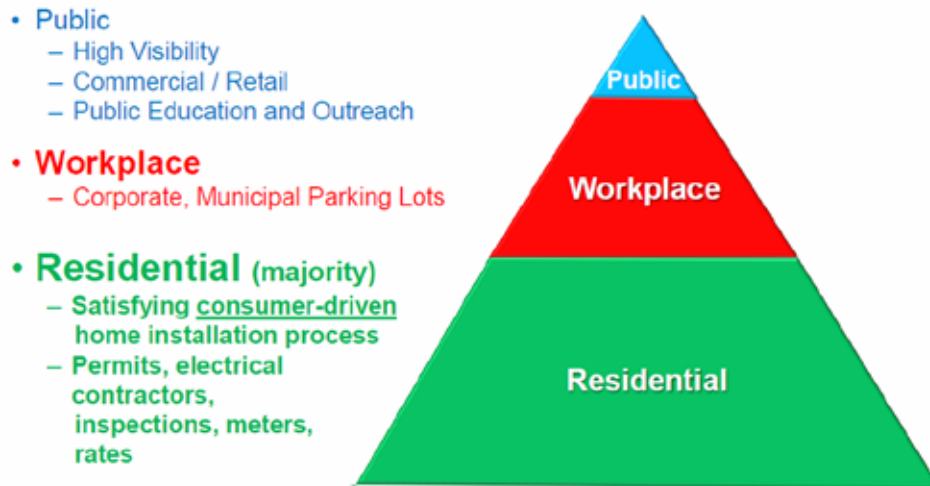


Figure 16 - Charging Infrastructure Prioritization
Diagram from EPRI

When designing charging installation strategies, it is imperative that they address all three categories of charging: residential, commercial and public. Designs must be flexible to accommodate the anticipated growth in the number of PEVs as well as changes in usage of infrastructure as drivers become acclimated to PEVs and more adventurous in extending their driving range.

5.5 CHARGING INFRASTRUCTURE DESIGN CRITERIA

Approach and design of charging infrastructure differs between single-family residential homes, MUDs, and commercial settings. Suggested design criteria for these categories are presented below.

5.5.1 RESIDENTIAL INSTALLATION DESIGN

Residential installation costs (and speed of installation) can vary dramatically based on these key factors:

- The location of the garage or other charging location in relationship to the electrical meter and panel
- The ability of the existing electrical panel to handle the additional charging load which is in turn tied to the age and size of the house and the other electrical loads
- Local utility options for reduced PEV charging rates and metering requirements for those rates

To ensure a cost-efficient and customer-friendly installation pro-

cess, the following recommendations are offered for local governments to create a PEV-friendly installation process.

Recommendation #30 – Provide effective training on charging station installations.



Provide training and consistent procedures to local plan-checkers and building officials. Training curricula may address where and how equipment can be mounted, clearances around windows or other electrical equipment, protection of equipment from damage by the vehicle, emergency disconnects, and guidance to homeowners regarding electrical capacity needs. Develop a checklist for building inspectors on what to look for in approval of charging equipment installation.⁸⁷ (See sample in appendix 8.7 from the County of Los Angeles and International Code Council Southern California Chapter).

Collaborative training programs such as Electric Vehicle Infrastructure Training Program⁸⁶ (EVITP) provide a structured platform for delivering training and certification for the installation of electric vehicle supply equipment. They address the technical and safety requirements, as well as performance integrity of industry partners and stakeholders across residential, commercial and public markets.

Recommendation #31 – Provide an installation process checklist for homeowners.



This checklist may include simple “how-to” information for consumers to determine if they can safely accommodate charging equipment.

Consumers ought to be advised that installation costs vary widely based on key variables that include:

- The distance between the electrical panel and the garage EVSE
- The size and loading of the existing panel
- Whether conduit can be mounted to the structure’s exterior, must be buried in a trench or run through walls, basements or attics
- Local utility costs and billing options available for their local serving utility for charging PEVs. (See Section 6.1 below.)

5.5.2 MULTI-UNIT DWELLING CHARGING INSTALLATION DESIGN

MUDs, whether rentals, condominiums, townhomes or cooperatives, come in a wide variety of configurations. These range from former single family homes that have been subdivided into individual units, to low-rise apartments with separate covered outdoor carports, to high-rise apartment complexes with subterranean parking and everything in between. Installations of EVSE at MUDs can be very challenging. As mentioned in Section 4.2, the challenges generally fall into two categories: the physical layout and existing electrical infrastructure.

The image below, an electrical room typically found in MUDs, depicts one of the physical challenges in MUD charger installations. These electrical rooms involve high voltage main electrical panels,



Figure 17 - Electrical room with Limited Accessibility to Individual Meters or Electrical Panels, Photo Courtesy of Todd Ritter AST



Figure 18 - Aerial Photo of a Multi-Unit Dwelling show several physical barriers to charger installation

Courtesy of San Diego Gas and Electric

subpanels, transformers, and other equipment. Meters are often located in a way that makes access to individual unit meters or electrical panels impossible.

The above image of a MUD illustrates another physical barrier that largely contributes to a rise in MUD installation costs. As the distance from the electrical panel to the parking space increases, costs also increase.

SB 209 and MUD EVSE Charger Installations: As a result of concerns about the access of apartment and condominium dwellers to home charging a bill was introduced and passed in 2011 by California Legislature to protect the rights of these residents. SB 209, a California bill signed by the Governor in July 2011 seeks to ensure that EV charging is not prohibited at MUDs. The bill states that Common Interest Developments (community apartment projects, condominium projects, planned developments, and stock cooperatives) may not impose any condition that effectively prohibits or restricts the installation or use of an electrical vehicle charging station. The bill allows these common interest developments to impose “reasonable restrictions” on the stations including a specified approval process. In addition, if the station is placed in a common interest area or an exclusive use common area, the homeowner is responsible for maintenance and repair costs to the unit and the common area. The legislation also allows associations to require an umbrella liability coverage policy of \$1,000,000 that names the common interest development as an additional insured entity.

It is not clear whether the provisions of SB 209 will encourage or

discourage the installation of EVSE in MUD units. For example, the requirement to provide a million dollar liability policy may have a dampening effect. Also, the ambiguity in the legislation may create conflict between PEV drivers and property managers or homeowners' associations (HOAs). It is also expected that additional legislation will be required to further define reasonable restrictions, particularly around common area use. Local governments should follow the debate over EVSE in MUDs as it may impact local plans for public charging.

Implementation Process

Below are suggested steps that property management companies and HOAs can take today to sort out the charging options for MUD residents with PEVs.⁸⁸ The following information can be used by local jurisdictions to assist property management companies and HOAs in their community.

Key questions to determine policy approach to EVSE installation: Reaching out to MUD stakeholders can provide a foundation for determining the best policy approach for property management companies and HOAs. There is no uniform set of policies that multi-unit building managers or owners can (or should) impose. Instead, there is a set of questions that building owners, managers, and associations must address to determine their own policy approach on MUD charging. Questions that will need to be answered include the following:

1. Does the HOA or building management want to offer charging services to all residents or should each resident be responsible for their own installation?
2. Who owns the chargers—the resident, the HOA or the property management company?
3. Is there sufficient capacity either on the unit electrical panel or common area electrical panel to install EVSE (usually a 240V, 40 amp circuit is required for Level 2 charging unless the driver is willing to charge at Level 1 on 120V circuit).
4. Who pays for any increase in electrical capacity needed i.e., transformers, new panels, engineering, construction, etc.?
5. Who pays for individual EVSE installations?
6. Who pays for monthly electricity usage?
7. Who pays any membership, subscription or software license fees?
8. Who pays for maintenance, repair and replacement?

These questions, along with a more complete list in appendix 8.5, may be answered by following the process below to help MUD property managers and owners determine the best policy approach.

Suggested Implementation Process for MUD Installations

- Survey current residents and owners to determine how many already have PEVs or are likely to purchase them in the next 12 months. Determine if multiple dwellers are likely to want to charge at the same time requiring one EVSE per resident or if EVSE can be shared among multiple drivers.
- Consult with the electric utility on existing service capacity (i.e. transformer loading), metering options and rate options. What rates are individual residents on for their individual units? Is there a house meter for common areas? What rate is that on? What are the cost impacts of placing EVSE on individual unit meters vs. the house meter?
- Assess the electrical characteristics and capacity of the property, both individual units and common areas. For example, is the parking located in the same building as the electrical meters and panels? Are panels located in individual units or clustered in an electrical room? How far is it from the electrical room to the desired EVSE location? Is the parking located in separate structures or an open lot? Is there electrical power to the location? Are there existing 120V outlets available?
- Using in-house facilities management personnel or an electrical contractor, evaluate existing capacity of individual unit electrical panels and common area panels. Can individual unit panels accommodate EVSE without upgrades? Is it physically possible to connect wiring from the unit panel to the parking area? Will that require trenching through hundreds of feet of concrete or asphalt? Is a new electrical service specifically for EVSE an option? In regard to common area electrical panels, are they physically accessible to the parking area?
- Evaluate existing policies and constraints including CC&Rs, architectural or design issues, and policies regarding property use. What are the existing policies regarding cost recovery for electrical upgrades, installation work, ongoing electricity costs and service?
- Assess the options from least costly to most costly. Is plugging in to a dedicated 120V outlet for Level 1 charging an option? How many Level 2 EVSE can be accommodated without major customer or utility electrical upgrades? Is it viable to install EVSE for individual residents or on the house meter? Which is preferable? Which is most cost-effective?
- Make any necessary property management company or HOA adjustments. Are the solutions in line with current policies? Are there policies or CC&Rs that need to be amended in order to permit the installation of EVSE and establish cost recovery procedures?
- Establish budgets and funding. For example, which costs are paid by the residents and which by the property owners collectively? What technology is needed for measuring costs and col-

lecting revenue? If the existing house meter can accommodate two EVSEs, who pays for the third installation?

- Establish policies for the ongoing operation of EVSE. For example, who owns the equipment? What happens when the driver moves? Is any special insurance coverage required? Who is responsible for repairs?
- Develop necessary documentation (i.e., engineered drawings if required), solicit construction quotes and obtain all necessary internal and local jurisdictions approvals (i.e. HOAs, property owners, city building department).

**In Practice
MUD Charger Installation Workshops**

San Diego Gas and Electric is holding monthly workshops and collecting information on issues and suggested approaches to an MUD charger installation process. The following flowchart was presented by Joel Pointon of SDG&E at Plug-in 2010.

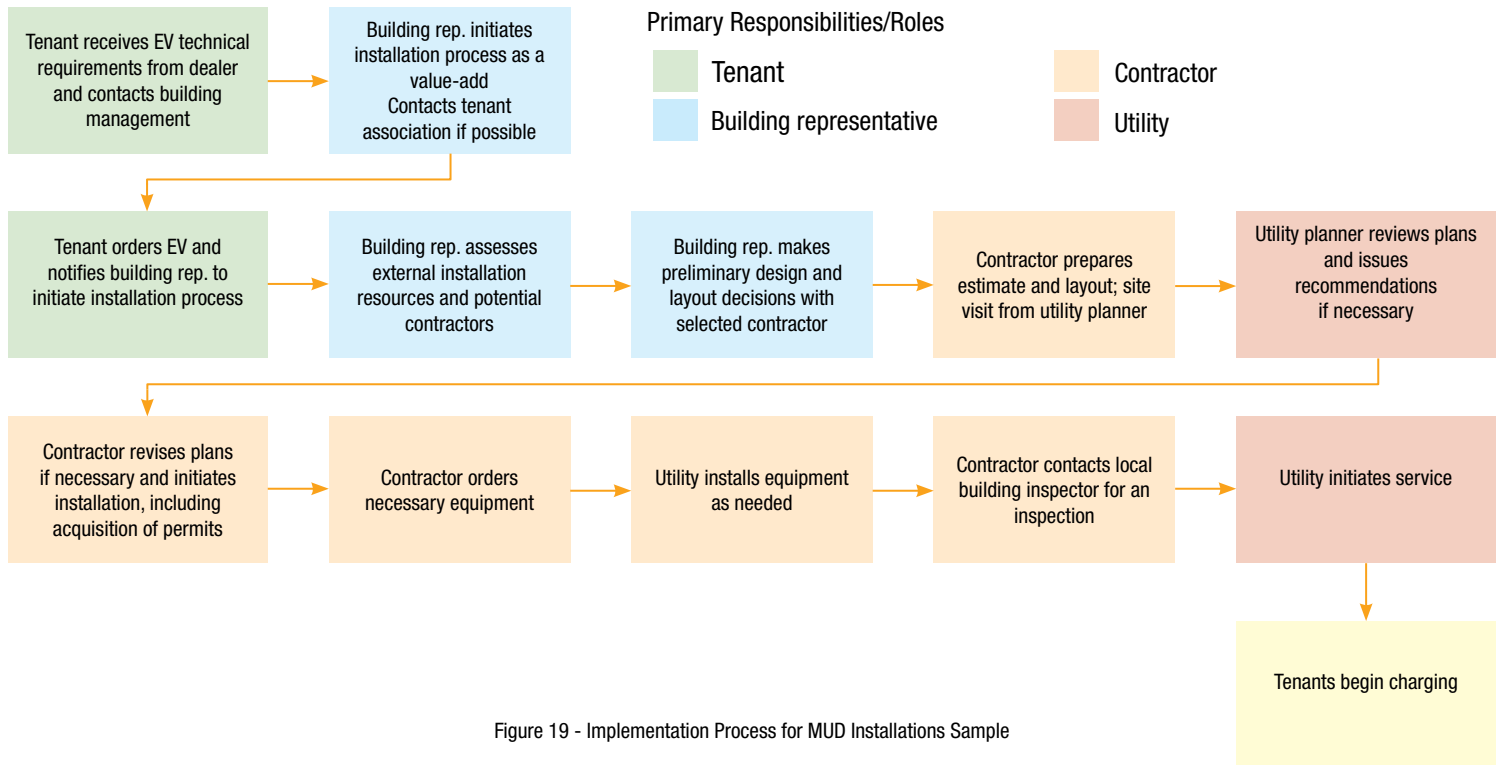


Figure 19 - Implementation Process for MUD Installations Sample

Finally, implement the solutions and policies developed and re-assess in 12 months to see what is working and what is not.

Recommendation #32 – Outreach to HOA’s and property managers to offer MUD solutions.

Local or regional government entities, in cooperation with utilities and regional PEV consortia are encouraged to reach out to HOAs and property management groups to help develop solutions for multi-family dwelling units.

Drivers without Garages: As discussed above, a significant percentage of drivers do not have a garage or assigned parking space.⁸⁹ This is particularly true in dense urban areas such as San Francisco, and areas of Los Angeles, San Jose, and Santa Monica. These drivers typically park on public streets or in public garages. In some areas, residential street parking is governed by permits issued by

the local jurisdiction. Accommodating plug-in drivers without garages requires innovative solutions that will be specific to each local area. Recommendation #33 offers a starting point for solutions that will require a high level of customization to meet locally-specific customer demand and resource constraints.

Recommendation #33 – Include charging solutions for garage-less drivers in EVSE siting plans.

Potential solutions include: 1) Providing public charging nearby public right-of-way or in public garages; 2) Encouraging widespread deployment of charging at workplaces; 3) Encouraging widespread deployment of Fast Charging at commercial centers. Charging network access fee structures can be developed to help recoup capital costs, maintenance, and electricity costs. Partnerships with private charger network site operators may also provide sources of funding for MUD charging station infrastructure.

5.5.3 COMMERCIAL INSTALLATION DESIGN

Charger siting strategies for commercial installations typically involve trade-offs between highly visible locations which can showcase the host site's commitment to the environment vs. lower-visibility locations that may be less costly and less prone to pre-emptive occupancy by internal combustion engine vehicles (also known as "ICE-ing"). As a rule of thumb, distance equals cost, so the longer the conduit run, whether horizontal or vertical, the higher the cost. In general, indoor locations tend to have better access to power than outdoor sites, but outdoor sites may have better cellular reception for units that are wirelessly networked.

The availability of sufficient existing 240V power at the site is a key cost factor. The parking lots and garages of large corporate campuses and retail locations may have sufficient capacity only for the parking lot lights that were installed when the facility was built. Installation of EVSE may require trenching hundreds of feet back to the main electrical room and major electrical upgrade work, which can sometimes build into the tens of thousands of dollars, depending on local conditions. To decrease costs for installing charging infrastructure, businesses should consider 120V plug outlets for long term parking.

Installation of EVSE in new construction is far more cost efficient than retrofitting existing buildings or facilities.ⁱ A number of green building guidelines encourage architects and engineers to include charging infrastructures in their building designs. The best known of these are the California Green Building Code⁹⁰ (CALGreen), and the Leadership in Energy and Environmental Design⁹¹ (LEED) standards developed by the U.S. Green Building Council.

ⁱ Retrofitting entails the costs of deconstruction in addition to reconstruction, as opposed to starting anew.

5.5.4 CHARGER INSTALLATION AND GREEN BUILDING

The U.S. Green Building Council rates new and existing commercial and residential construction based on the inclusion of energy saving features and the use of energy efficient construction techniques. Installing an EVSE can earn the following points toward LEED Basic, Silver, Gold, and Platinum certifications:

- Any size commercial building and any multi-family residence over 4 stories that installs one or more chargers qualifies for up to 3 points under the New Construction (NC) program or between 3 and 15 points under the Existing Building (EB) program.
- Single family homes and MUDs under 4 stories that are new or under major renovation qualify for 1 credit under "Innovative Design" criteria.

The 2010 California Green Building Standards Code,⁹⁰ CALGreen, which went into effect January 1, 2011, also includes EV charging as a voluntary measure. Nonresidential voluntary Tier 1 of the Code stipulates that 10 percent of the spaces be wired with a 120V circuit and a 240V grounded AC outlets or conduit and panel capacity installed for future outlets. Voluntary Tier 2 of the Code stipulates that 12 percent of the spaces be so configured.

The State of California is currently reviewing these requirements to determine if they should be made mandatory.

Some local jurisdictions have created their own PEV charging requirements. For example, the City of Los Angeles adopted Section 99.04.106.6. requiring:

- One 208/240V 40 amp, grounded AC outlet for each dwelling unit; or
- Panel capacity and conduit for the future installation of a 208/240V 40 amp, grounded AC outlet for each dwelling unit.

For residential dwellings with a common parking area, the code requires:

- A minimum of 5% of the total number of parking spaces be equipped with 208/240V 40 amp, grounded AC outlets; or
- Panel capacity and conduit for future installation of electrical outlets equal to the simultaneous charging of 5% of parking spaces; or
- Additional service capacity, space for future meters and conduit for future installation of electrical outlets equal to the simultaneous charging of 5% of parking spaces.⁹²

5.6 INVESTMENT AND REVENUE SHARING MODELS

Most equipment and installations are currently subsidized through a variety of grants from the federal government, state government, and regional air districts. Federal tax credits of 30% are still currently available under the Alternative Fuel Vehicle Refueling Property Credit provisions of the IRS code,⁹³ although these will require renewal after 2011.

A number of manufacturers are adding features to their equipment that allow sites to collect a fee for the use of the charger. These chargers may also have internet capability for collecting and viewing data on usage, fees collected, and even greenhouse gas reductions.

As the market grows, other financial models including leasing and subscription based models are starting to emerge. The energy services company known as NRG⁹⁴ is currently investigating the deployment of their charger program in California. It is currently deployed in Houston and other metro markets under the eVgo brand. This program provides low-cost residential charger installations to customers who sign up to access their large-scale public charger networks based on three-year “cell phone style” access packages that range from \$49 to \$79 dollars a month, with electricity usage included in the higher cost packages. There may be state utility commission restrictions on the ability of NRG or others to offer these charge network subscription packages until CPUC rule-making is further clarified. In the meantime, some local governments and public utilities may be able to develop creative approaches along these lines.

6 UTILITY CONSIDERATIONS

As previously noted, electric vehicle charging adds significantly to a typical household's electrical usage, with the potential to double the existing load.⁹⁵ It is therefore critical that California utilities anticipate and plan for the deployment of PEVs so that they can manage the increased load. Coordination with local governments can facilitate the preparation for anticipated increase in electrical load to ensure the continued availability of safe and reliable electricity.

Studies and modeling by a number of groups including the Electric Power Research Institute,⁹⁶ have shown that California's electrical grid can easily handle large numbers of PEVs; however, isolated problems could occur in neighborhoods that have a concentration of PEVs if the utility is not made aware of local EVSE installations and locations in which a large number of vehicles plug in during peak utility load periods. This section covers local governments' collaborative role with utilities, efforts utilities have undertaken to assess local electrical capacity, electricity rate options including special PEV time-of-use (TOU) rates that could mutually benefit both customers and utilities, as well as the importance of educating customers about off-peak charging. In addition, other charging system approaches such as photovoltaic integration and DC Fast Charging are addressed.

CPUC Regulation and Guidance

Utilities in California are divided into municipal- and investor-owned groups. Municipal utilities are governed by a local district board or City Council. Investor-owned utilities are private corporations governed by their Boards of Directors and regulated by the California Public Utilities Commission (CPUC). The CPUC has been investigating issues related to the implementation of PEV charging for approximately two years under Rulemaking 09-08-009 and has issued two decisions that are important to industry stakeholders and PEV drivers.

The first major policy decision (Phase 1, issued June 2010)⁹⁷ addresses the issue of whether private businesses that sell electricity for the purchase of vehicle charging should be considered utilities and therefore subject to regulation by the CPUC. In its decision, the CPUC set a goal of encouraging competition in this new market and determined that businesses that sell PEV charging services should not be defined as utilities.

The second decision of the CPUC (Phase 2, issued July 2011)⁹⁸ provides additional direction to utilities on PEV-related charging issues, including rate design, provision of sub-meters to track PEV energy use, involvement of utilities in the promotion of PEVs, and other issues. Municipal utilities, while not subject to CPUC regulation, are closely watching the direction that the CPUC is taking, as they are often required by the state legislature to implement policies similar to those required of the investor-owned utilities.

Utility Notification of EVSE Installations

Recommendation #34 – Notify utility of charger installations.

Utilities have been working closely with automakers and local governments to prepare for the deployment of PEVs. They have reached agreements with GM and Nissan on an "automatic opt-in/ affirmative opt-out" notification system, in which automakers will notify utilities of PEV purchases (unless customers specifically ask the automaker not to do so). Utilities have also been active in educating consumers and local governments on the importance of providing notification of EVSE installations so that utilities can plan for necessary infrastructure upgrades. The current system, while helpful, does not capture all PEV purchases. A useful addition to the existing communication between utilities and local governments would be for local jurisdictions that issue EVSE installation permits to notify utilities when permits have been issued.

As part of a standardized permitting application and checklist, include a check box that permits the local agency to share EVSE information with the local utility, and establish a process for efficiently sharing that information with the local utility. While permit information itself is already a matter of public record, this will provide the timely information utilities need to promptly and effectively accommodate for the additional electric load that chargers present.

6.1 ELECTRICITY RATE INFORMATION AND METERING

Many California utilities offer special TOU rates to encourage PEV owners to charge during nighttime “off-peak” hours when utilities have surplus capacity. Most PEV users, including fleet and residential customers, may find it convenient and cost-effective to charge overnight. Some TOU rates, however, require additional electrical equipment to be installed by customers and additional metering equipment to be installed by utilities. A careful analysis of the costs and benefits of off-peak rates is required to determine the best option for each customer. Some utilities have created excellent on-line rate calculators to help customers evaluate their options. Utilities encourage customers to contact them for more information.

PEV Charging Habits and Impact on Residential Rate Options

There are more than 50 electric utilities in California and each has its own unique electricity rate structure. In general, residential rates fall into three categories:

- **Flat rate** — The same price per kilowatt-hour is paid, regardless of how much is used or when it is used;
- **Tiered or block rate** — The more electricity used, the more is paid per kilowatt-hour. These rates are designed to encourage conservation. There is no difference in cost based on time of day, however costs are higher in the summer months. Typical residential rate structure offered by most utilities (both municipal and investor-owned).
- **Time-of-use (TOU) rate** — This lower rate rewards customers who use electricity when it is most available and cheapest for utilities to produce – generally, at night (also known as an off-peak rate).

PEV drivers typically have several rate choices. The best rate for their individual situation will depend on a number of factors, including:

- Frequency that PEV will be charged at home
- Daytime vs. nighttime charging
- All other electric household load tendencies
- Total electrical load

The table below summarizes various rate options available to California PEV drivers.

Rate	Optimal benefits to PEV drivers when:	Considerations
Tiered Rate	(i) current usage is fairly low, or (ii) solar panels are installed at a home.	Adding PEV charging to the household load has the potential to shift a household into a higher tier, raising the per kWh cost for household electric usage.
Whole House Time-of- Use (TOU) Rate	Most or all electricity usage is during off-peak hours (i.e., family members are not at home during the day)	Daytime cost per kWh may be higher than daytime tiered or flat rates. Existing utility meter is replaced by a utility TOU meter but no other upgrades are necessary.
PEV Time-of-Use (TOU) Rate	(i) Current residential electricity bill is already in higher tiers, or (ii) PEV charging could shift household into a higher tier.	There may be a cost to the PEV driver to install a separate meter and/or service, or other equipment needed to take advantage of the low off-peak charging rate.
Flat Rate per kWh	The rate is low.	No penalty for using more electricity. Does not encourage a shift to charge during off-peak hours

Table F - California Residential Electricity Rate Options

Special Utility PEV TOU Rates

At the present time, customers who purchase a PEV have 2 or 3 rate options available depending on the utility:

1. Stay on the current tiered or flat rate plan
2. Change to a TOU rate for the entire usage (requires new time-of-use meter)
3. Change to a TOU rate for the EVSE usage only (requires new utility service and panel and new TOU meter)

Most PEV drivers may wish to change to one of the TOU rates, assuming that the majority of residential charging will occur during off-peak hours (after 6 pm and on weekends.) By contrast, customers that charge primarily between 10 am and 6 pm, when demand and TOU rates are highest, may want to stay with a regular rate plan.

The first TOU option places the entire house—including the EV charger—on the special PEV TOU rate, which varies significantly depending on when power is utilized. For example, in PG&E territory, the “Experimental TOU Low Emission Vehicle rate” known as Schedule E-9⁹⁹ provides electricity at night at a significantly lower rate than the peak period rate. The Southern California Edison (SCE) rate plan¹⁰⁰ provides off-peak EV charging at a rate of 11 cents/kWh for charging between 9 pm and noon, 22 cents/kWh for day-time

charging in the winter, and 28 cents/kWh in the summer.ⁱ

The second TOU option places only the EVSE on the TOU rate. Currently this requires a second electrical panel, utility service, and meter. To assess specific conditions in a customer’s home, the customer will likely need to pay a licensed electrician for an analysis. Depending on the evaluation results, the utility may install a second electrical service conforming to local jurisdiction and utility requirements, including local permitting and inspection guidelines. Once an electrician confirms that a second meter and panel installation is feasible and appropriate, some utilities will install the second meter at no charge, while others may impose some fees.

In order to take advantage of special PEV TOU rates, recommended practices to be used in conjunction with time-of-use rates include setting thermostat timers for off-peak hours; using washing machines, dryers, and dishwashers during off-peak; using timers on the electric water heater; and timers and photocells on lights and sprinklers.

Table G presents websites that provide information on relevant programs for the major investor-owned and municipal utilities in the state. Customers of smaller utilities should consult their local utility [website](#) or [call the customer information center](#).

ⁱ PG&E and SCE allows customers to opt out of the TOU rate if it is not suitable for customers’ electricity use patterns, but there may be some time constraints in terms of how often they can change.

Utility	Options	Website
Southern California Edison	SCE offers customers a choice of a whole house time-of-use rate that meters the home and PEV together— or a time-of-use rate for the PEV only. SCE also provides an online rate calculator and encourages customers to call for a customized, free rate analysis to determine best options.	www.sce.com/PowerandEnvironment/PEV/rate-charging-options.htm
Los Angeles Department of Water and Power	Los Angeles Department of Water and Power offers a \$0 .025 cent per kWh rate reduction for off peak charging. Customers can chose to install a separate meter and service to take advantage of inexpensive off-peak rates plus the PEV charging discount. Or customers can choose a time-of-use rate without a second meter and receive a 500kwh per month discount of \$.025 per kWh.	www.ladwp.com/ladwp/cms/ladwp014298.jsp
Pacific Gas and Electric	Pacific Gas and Electric Company offers a special discounted rate for Electric Vehicle (EV) customers, the Experimental Time-of-Use Low Emission Vehicle rate (Schedule E-9A or E-9B).	www.pge.com/electricvehicles www.pge.com/PEVcalculator
San Diego Gas and Electric	SDG&E has two residential PEV charging rates. The first EV-TOU rate allows customers to take advantage of lower off-peak (night-time) rates. The second rate, EV- TOU-2, places the entire home on TOU rates. Special metering may be required. An experimental sub-metering rate is also available.	www.sdge.com/environment/cleantransportation
Sacramento Municipal Utility District	An optional discounted electric rate is available for charging PEVs. The Residential Time-of-Use Electric Vehicle (RTEV) rate offers a \$.0243 (winter) to \$.0271 (summer) discount per kWh and requires a separate meter and service.	www.smud.org/en/residential/environment/plug-in-electric-vehicles/PEV-rates.htm

Table G - Incentives to PEV owners by utility

Sub-metering

The California Public Utilities Decision in Phase 2 of Rulemaking 09-08-009¹⁰¹ directs utilities to explore another option—sub-metering. Sub-metering allows the utility to direct a portion of electrical usage to a separate meter with a different rate. For example, San Diego Gas and Electric has implemented an experimental rate program that allows customers to choose a sub-metered off-peak EV charging rate. The amount of electricity used for EV charging is then subtracted from the total electricity used in a month and billed at a separate rate. Sub-metering is a major shift in utility rate structures and there are many issues to be decided before these new options are implemented.

Commercial charging and demand response programs

There are currently no special PEV rates for commercial customers. Most commercial rates vary by time-of-day and season. Commercial rates also include monthly demand chargesⁱⁱ based on the maximum amount of electricity or peak load. To save money, some customers choose rates that allow the utility to interrupt service when supply circumstances demand it.

Many sophisticated building energy management systems also enable managers to balance a variety of loads to ensure that demand charges are minimized even if there are several chargers being accommodated on a single campus or property. Some chargers also incorporate software that can communicate with corporate energy management systems. Software has also been developed to send a shut down signal to the chargers as requested by the utility.

As discussed above, utilities throughout the state are offering special rates to encourage PEV use and to establish incentives for PEV owners to recharge in off-peak hours when the utility has surplus distribution capacity, and greener renewable electricity is more widely available. Table 2 summarizes the current offerings of the largest utilities throughout the state.

ⁱⁱ Demand charges are calculated by using the highest level of usage during a 15 minute period out of an entire billing cycle. That usage (in kW) is then multiplied by the demand charge rate. Demand charge rewards customers who, more or less, use a constant lower rate of electricity throughout the month and encourages customers to be cautious of their energy use. See <http://www.pge.com/mybusiness/myaccount/explanationofbill/mediumbiz/3/> for more information.

6.2 INTEGRATION OF PEVS WITH RENEWABLE ENERGY AND EFFICIENCY STRATEGIES

Many utility industry experts have expressed concern that PEVs could create problems for the utility grid if deployed in large numbers without adequate provision to spread charging to off-peak periods. At the same time, PEVs have the potential to help utilities balance their load across peak and off-peak hours through demand response programs that can modulate charging rates. In addition, as technologies evolve, some vehicle batteries could eventually serve as distributed energy storage assets that can help provide a variety of grid services – including frequency regulation (balancing supply and demand) – via two-way connections to the grid. Thus, PEVs represent both a challenge and a potential asset for grid operators. It is likely that the gradual pace of PEV deployment will give utilities sufficient time to adapt their operations to ensure the most efficient utilization of PEVs, and to deploy the smart charging and vehicle-to-grid (V2G) controls and communications needed to ensure that PEVs are seamlessly integrated into the power system.

The most important issue in PEV integration on the grid is ensuring that customers charge at off-peak times. In California, the largest peaks occur in the summer when air conditioning load is highest, typically in the 2pm to 6pm timeframe. Some utilities have reported that even a single 240V PEV charger could overload transformers during peak hours, under heavy air conditioning or other loads.¹⁰² To mitigate the effects on transformers and other distribution equipment, utilities are striving to make their grids “smarter” – by installing smart residential chargers and metering to ensure that existing transformers are not overloaded.

Another option that many commercial and residential customers will find attractive is integrating solar photovoltaic power into their home energy mix. To the extent that solar power can substitute for more expensive grid-tied power, utilizing solar power to directly charge vehicles may be a cost-effective option, with the added benefit of further reducing greenhouse gas (GHG) emissions. In addition, through vehicle-to-building (V2B) connections, it will be possible for some future PEVs to provide back-up power to homes or offices during a power outage. Finally, as utilities and auto-makers begin to implement full vehicle-to-grid (V2G) connections, PEV drivers and charge station owners may be able to provide a range of ancillary grid services in return for payment from energy service providers.

In the PJM utility system territory in the mid-Atlantic states, for example, a utility-university-industry coalition known as the Mid-Atlantic Grid Interactive Car Consortium¹⁰³ (MAGICC) has demonstrated that specially equipped PEVs can provide frequency regulation services to the grid from the vehicle (when plugged into a charging

station) by turning on charging to balance excess supply on the grid, and providing energy back to the grid to balance excess load. This service, when aggregated across many vehicles, can be sold into the wholesale energy marketplace, with payments arranged by an energy aggregation company. According to the MAGICC Consortium, the commercial payments now being provided to fleet owners in the MAGICC pilot test area amount to nearly \$2000 per vehicle per year. This kind of compensation for use of PEV batteries could – over the long-term – help transform PEV economics. However, numerous technical and commercial hurdles need to be resolved to make V2G connections a reality in the near-term.

In California, a variety of pilot V2G projects are underway within the Bay Area, at the University of California at Los Angeles, and at UC San Diego. In addition, NRG Energy has announced its intention to enter the V2G market with a product offering that may provide up to \$1000 per vehicle per year, once the necessary equipment and communications standards have been adopted by automakers, utilities, and energy service companies.¹⁰⁴ Finally, both Nissan and Mitsubishi have announced support for V2B services,¹⁰⁵ and GM is participating in research.¹⁰⁶ These activities suggest increasing industry movement towards enabling PEVs to participate in the energy services market.

6.3 DC FAST CHARGING

Unlike 240 volt AC Level 2 chargers that take 3 to 8 hours to fully recharge a depleted battery pack, DC Fast Chargers can recharge a Nissan Leaf battery pack from 20% capacity to 80% capacity in just under 30 minutes.¹⁰⁷ While DC Fast Charging is unlikely to be installed in homes due to the high cost of equipment and installation, some commercial enterprises are viewing DC Fast Charging as a business opportunity.

A number of manufacturers have developed DC Fast Chargers for release late in 2011 or early 2012. Most manufacturers are currently going through national laboratory testing and listing. Since no U.S. SAE standard for DC Fast Charging connectors currently exists, early units will be fitted with connectors that meet the Japanese CHAdeMO standard. The Nissan Leaf has DC Fast Charge connectivity available as an option,¹⁰⁸ while the Mitsubishi “i” will have DC Fast Charge as standard equipment.¹⁰⁹ Other automakers have not yet announced their DC Fast Charge plans. Consumers are advised to check with their vehicle manufacturer regarding the appropriate frequency of DC Fast Charging, as some manufacturers indicate possible degradation of battery life if DC Fast Chargers are used as the primary mechanism for charging.¹¹⁰

While rapid charge times are beneficial, DC Fast Charging installations raise a number of challenges for property owners and utilities, specifically:

- The power requirements of DC fast charging—anywhere from 50 kilowatts to over 150 kilowatts at 480 volts may require costly electrical upgrades
- The demand on the utility of instantaneous high voltage may require utility upgrades to existing infrastructure
- The current rate structure can result in high electricity demand charges.

Despite these challenges, some regions – notably San Diego and the Bay Area – are moving rapidly to deploy large numbers of DC Fast Chargers, with over 100 DC Fast Chargers planned for the Bay Area in 2011-2012.¹¹¹ The U.S. based Society of Automotive Engineers is considering adoption of a new Fast Charge standard (known as Combo-2) that could be adopted by some US and European automakers.¹¹² Timelines for adoption are uncertain, with estimates varying from three to six years for complete testing, validation, and production of vehicles equipped with a new standard. In the event that an additional DC Fast Charge connector standard is added to the marketplace, vendors anticipate that new chargers would be deployed to meet the additional charging demand from new models, much as diesel and biofuel pumps have been added to many fueling stations. In the absence of a published SAE standard, existing charger makers are not able to determine whether retrofits of existing chargers would be feasible, or how much they might cost.

7 GREENING THE FLEET

While charger infrastructure is essential, the ultimate driver of the PEV transition is vehicle adoption itself. Moreover, local governments often operate their own sizeable vehicle fleets. Thus, greening the fleet with PEVs is a key part of becoming EV-ready, and will give local government staff invaluable hands-on experience with the benefits and challenges of making the PEV transition.

7.1 THE PEV ROLE IN GREENING THE FLEET

Public and commercial fleets that include medium- and heavy-duty trucks are responsible for a disproportionate share of both greenhouse gas (GHG) emissions and fossil fuel consumption. Accordingly, greening the fleet is a high-priority for fleet operators in response to California state regulatory mandates (AB 32)¹¹⁴, and steeply rising gasoline and diesel fuel costs. At the regulatory level, fleet operators are being pressed to reduce both Category 1 Criteria Pollutants¹¹⁵ harmful to human health – which include particulate matter (PM), carbon monoxide (CO), volatile organic compounds (VOCs), sulfur oxides (SOX), nitrogen (NOX), and lead (Pb) – as well as Category 2 – greenhouse gases – which are causing disruptive changes in the climate system. Historically, “clean fleet” or “green fleet” efforts have focused on fuel and emissions reduction, conventional hybrid vehicles, and natural gas vehicles (NGVs).

What distinguishes green fleet initiatives in the era of electrified transportation is that new PEV models are beginning to appear with significantly improved environmental and operating cost advantages over conventional hybrids and other alternative fuel vehicles, including biofuels and NGVs. Given the increased diversity of available PEVs and their steadily improving price/performance profile relative to conventional vehicles, green fleet programs are increasingly focused specifically on accelerated integration of PEVs into the fleet mix. These initiatives also increasingly include analysis and testing of the potential for PEV conversions of existing vehicles to reduce fleet operating costs.

While PEVs are a logical focus for green fleet programs, the structure of green fleet initiatives can best be stated in terms of overarching goals, rather than the specific technology choices deployed to achieve those goals. Thus, green fleet programs are typically focused on:

- Enhancing fleet impact on human health and the environment
- Reducing costs
- Preparing for future conditions (including potential fuel price spikes or supply disruptions) and regulatory requirements.

7.2 VEHICLE TECHNOLOGY TYPES AND TRENDS

It is important to emphasize that available and forthcoming BEVs, PHEVs, or conversions address most classes of vehicles, including many specialty vehicles, such as bucket trucks, shuttle buses, airport equipment, off-road “Class 8” port operations (drayage vehicles), and more.

At current prices, PEV trucks’ typical fuel costs are significantly less than diesel. In addition, PEVs offer reputational benefits for customers and other stakeholders who are looking to public agencies and corporations to show meaningful signs of responsible action on the climate and sustainability agenda.

7.3 LIFE CYCLE COSTING AND MAINTENANCE/SUPPORT IMPLICATIONS

While the initial purchase price of PEV fleet vehicles is typically higher than comparably equipped conventional vehicles, PEV buyers do enjoy lower fuel costs, insulation from fossil fuel price shocks, and significantly lower maintenance costs (in the case of BEVs). These advantages are leading many fleet managers to embrace PEVs as a core element in their green fleet plans. For BEV fleet vehicles, the maintenance burden is significantly reduced. BEV motors have fewer parts than internal combustion engines. Exhaust systems are non-existent, cooling systems radically simplified, and complex clutches and transmissions replaced with simplified units.

Developing a green fleet may require a re-consideration of how capital and operating expenditures are allocated. With fueling costs that are much lower than ICEs, yet initial purchase prices that can be considerably higher, many fleet managers have pointed out that much or all of the battery expense may need to be re-configured as an operating expense, taken out of the fuel budget.

Accordingly, some vehicle manufacturers are offering to separate the battery from the vehicle and bundle this resource on a separate financing schedule, in some cases with a charger subscription contract.

Operating Cost Comparison ICE vs. BEV	Internal Combustion (ICE) TYPE: 5 passenger RANGE: 400 mi. (16 Gallon tank) GASOLINE: \$3.50/Gallon FUEL COST/TANK: \$56.00/400 mi.	Battery Electric Vehicle (BEV) TYPE: Nissan LEAF ~ 1kWh = 4 mi. driving distance RANGE: 73 mi. (24kWh battery) ELECTRICITY: \$0.056/kWh (off-peak PG&E summer rate with "E9B" Plan)	Usage Pattern TERM: 6 Yrs. USAGE: 18,000 mi. / Year TOTAL Mileage: 108,000
Fuel	Gasoline (ICE)	Electric (BEV)	Fuel Cost Savings
Cost (per mile)	\$0.140 Avg. 25 MPG – regular gas Cost per mi.: 14 cents per mi.	\$0.014 Electricity cost of 5.6 cents per kWh. 1kWh = 4 mi. of driving distance = 1.4 cents per mi.	10x less
Lifetime Costs (6 yrs./108k miles)	\$15,120	\$1,512	\$13,608 savings in 6 Yrs.
Maintenance	Gasoline (ICE)	Electric (BEV)	Maintenance Savings
Est. routine service and engine wear Lifetime Costs (6 Yrs./ 108K mi.)	~\$6,000	~\$2,000	\$4,000 savings in 6 Yrs.
Ownership	Gasoline (ICE)	Electric (BEV)	Ownership Savings
Est. Insurance (6 Yrs./108K mi.)	~\$6,000	~\$5,000	\$1,000 savings in 6 Yrs.
Est. DMV Smog (6 Yrs./108K mi.)	~\$400	~\$0	\$400 savings in 6 Yrs.
TOTALS	~\$27,520	~\$8,512	~\$19,008/6 Yrs.

Table H - Operating Costs for ICE v BEV

When batteries are de-coupled financially from the vehicle, many of the PEVs available today, even in the commercial class, are cost-competitive with ICE purchase prices. Further, with fueling costs typically falling below \$1/ gallon equivalent for PEVs vs. comparable ICEs, there is a \$3+/gallon difference between PEV and ICE costs that can be accessed to repay the full battery cost on the “fuel” budget.

Even with a \$10,000 to \$15,000 or more price differential between a light-duty BEV and the equivalent ICE vehicle, total life-cycle cost savings based on the heavier usage typical of many fleet vehicles can be compelling. The above example from the Business Council on Climate Change uses a conservative \$3.50/gallon gasoline cost and still produces a substantial savings over the vehicle life-cycle that more than makes up the difference in initial purchase price.

7.4 GREEN FLEET PLAN DEPLOYMENT

To work through the specifics of PEV fleet greening efforts, a typical planning effort involves these elements:

- Developing a GHG emissions inventory (baseline)
- Developing GHG and fuel efficiency targets
- Analysis of fleet duty cycles and comparison with available electric vehicles with regard to range, charging requirements, and operating costs
- Development of a comprehensive green fleet plan that includes goals, milestones, staff responsibilities, commitments from top management, and monitoring and implementation strategies.

Greening the fleet efforts typically involve the integration of several

“value streams” and functional areas across an organization, including fleet operations, environmental health, and marketing/communications. At the City of San Francisco, for example, the Clean Fleets Team includes representatives from fleet management across a variety of departments, environmental services, finance, the City Manager’s Budget Office, and transportation planning and public works (to address charging station issues).¹¹⁶ A project lead should have strong knowledge of fleet operations while being both pragmatic and enthusiastic in their communication of the environmental and economic benefits of PEV approaches. With a team-based approach, all of the various components of the PEV ecosystem – including charging infrastructure, supportive policies, economic analysis, workforce training, and operational management changes – can be fully integrated into a compelling value proposition for decision-makers. Also, the project lead should be aware of forthcoming funding opportunities, especially from state and federal sources. For example, the California Energy Commission has planning grants available not only for regional PEV Coordinating Councils, but also for workforce training related to PEVs, which could help fleet managers with their green fleet transition plans.

7.5 COMMERCIAL PEV TECHNOLOGIES AND FLEET CHARGING CHALLENGES

As noted above, commercial classes of PEV vehicles are evolving rapidly and encompass nearly every class of vehicle. By late 2012, PEV models will include examples from every class of vehicle – from high-performance motorcycles (Vectrix, Zero, et. al.) to medium-duty cargo vans (Smith Electric) to heavy duty Class 8 (Navistar), to SUVs, cross-overs, pickups, mini-vans, vans, compacts, sports cars, and luxury cars. Given the rapidly evolving alternative fuel vehicle fleet market, fleet operators are advised to obtain the latest information from organizations such as Plug-in America,¹¹⁷ which tracks all classes of PEVs, and CalStart,¹¹⁸ which focuses on medium and heavy-duty options.

Fleet Charging Challenges

Fleet vehicle charging options span the full range from AC Level 1, AC Level 2, and DC Fast Charge options, depending on vehicle type and specific applications. As with any commercial charging arrangements, fleet managers need to be cognizant of demand charges and demand response programs, as well as utility time-of-use rates to select an optimum configuration for their needs. In addition, DC Fast Charging may accelerate battery replacement timetables, which must be factored into total cost of ownership (TCO) calculations. Where light-duty vehicles are likely to be stationary for 12 hours or more, AC Level 1 charging options may be most appropriate, as these will not require special wiring of EVSE. For vehicles needing the fastest turnaround in demanding applications such as shuttle or taxi services, DC Fast Charging may be a high-priority need and worth the extra cost. The table below provides some indication of the range of costs likely in different charging circumstances:

Fleet Charging and Management

Fleet operators have unique opportunity with software tools available to centrally manage charging status and charging information. Several manufacturers, including Aerovironment, ECOtality, Coulomb, GE, and others, currently have or plan to offer PEV fleet charging software of varying levels of sophistication. For example, the Coulomb Network Fleet Manager provides status and location of PEVs in the fleet via its fleet management application, indicating whether the vehicle is fully charged, charging, or not plugged in. E-mail or SMS summaries are available along with driver and vehicle workflow management. Analytics enable tracking and reporting of GHG reduction, fuel efficiency, and other data to manage and measure fleet performance by driver, vehicle, department, or fleet. Data on charge duration, start and stop times, and e-fuel use are available to be exported or integrated with other applications.

Charger Type	Charge	Time to Charge Vehicles at Various States of Charge			Charger Hardware Costs	Installation Costs	Typical Range of Total Costs	Average Total Costs
		Volt 16 kWh	Leaf 24 kWh	Tesla 53 kWh				
AC Level 1 1.4kW 120V	Half	6 hrs	8.5 hrs	19 hrs	\$300 - \$500	\$300 - \$500	\$600 – \$1000	\$900
	Full	11 hrs	17 hrs	38 hrs				
AC Level 2 7.5 kW 240V	Half	1 hrs	1.5 hrs	3.5 hrs	\$500 - \$1500 home	\$500 - \$2500 home \$3,000 – 5,000 commercial	\$1500 – \$4,000 home \$4,000 - \$11,000 commercial	\$2200/home \$8000/commercial
	Full	2 hrs	3 hrs	7 hrs	\$2000 - \$6000 commercial			
DC Fast 50 kW 480V	Half	10 min	15 min	35 min	\$25,000 \$55,000	\$15,000 -\$30,000*	\$40,000 \$85,000	\$65,000
	Full	20 min	30 min	70 min				
DC Fast 150 kW 480 volts	Half	5 min	8 min	17 min	\$25,000 \$55,000	\$15,000 -\$30,000*	\$40,000 \$85,000	\$65,000
	Full	10 min	16 min	35 min				

Table J - Estimated Vehicle Charging Times and Charger Hardware and Installation Costs

8 APPENDICES

8.1 GLOSSARY OF TERMS

Access Aisle: an accessible pedestrian space adjacent to or between parking spaces that provides clearances in conformance with Chapters 11A and 11B of the California Building Code Title 24 Part 2, and the Americans with Disabilities Act.¹²²

Comment: The surface slopes of accessible parking spaces and access aisles shall be the minimum possible and shall not exceed one unit vertical in 50 units horizontal (2-percent slope) in any direction.

Accessible Card-Reading Device: a battery charging station that meets the accessibility requirements of Chapter 11C of the California Building Code as modified by the 2010 ADA Standard.

Comment: The card-reading controls on a battery charging station that contains charging supply equipment to charge two or more vehicles simultaneously, and meets the accessibility requirements of Chapter 11C of the California Building Code and ADA for each space will qualify as an accessible card-reading device for each vehicle. (See section 3.5.2.1 for Chapter 11C of the California Building Code – Standards for Card Readers at Gasoline Fuel-Dispensing Facilities and 3.5.2.2 for equipment reach, control heights and approachability).

Accessible Electric Vehicle Charging Station: an electric vehicle charging station where the battery charging station equipment is approachable and usable by persons with disabilities in compliance with the California Building Code (Title 24) and ADA Standard.

Comment: This definition applies to Public Buildings, Public Accommodations, Multi-Unit Dwellings, Commercial Buildings and Publicly Funded Housing. The ADA Standard may contain scoping and technical criteria that does not occur within CBC Title 24.

Accessible Parking Required: means each lot or parking structure where parking is provided for the public as clients, guests or employees, shall provide accessible parking as required by the California Building Code (Title 24) and the most recent ADA Standard.

Comment: For the purposes of these guidelines an “accessible electric vehicle charging station” is distinct from an “accessible parking space”. The ADA Standard contains scoping and technical criteria that does not occur within CBC Title 24.

Accessible Parking Space: a parking space that is designed and constructed to comply with the scoping and technical forms of Title 24 and ADA Standards for accessible parking, and where accessible parking

is designated for vehicles displaying a Disabled Person (DP) placard or DP license plates.

Comment: CBC Title 24 and the ADA Standard contain scoping and technical requirements that differ from one another. Where a single space exists, it shall be a minimum of 9-feet wide with a 5-foot loading and unloading striped access aisle on the passenger side of the vehicle. Where two 9-foot spaces exist, they may share a 5-foot striped access aisle between them. [CBC Section 1129B.3]

Battery Charging Station: an electrical component assembly or cluster of component assemblies designed specifically to charge batteries within plug-in electric vehicles.

Comment: Battery charging stations include AC Level 1, AC Level 2, and DC Fast Charge (sometimes called DC Level 2) charging stations (see charging levels). Battery charging stations are also commonly referred to as chargers and charging stations.

Battery Electric Vehicle (BEV): any vehicle that operates exclusively on electrical energy from an off-board source that is stored in the vehicle’s batteries, and produces zero tailpipe emissions or pollution when stationary or operating.

Comment: Definition is a subcategory of “electric vehicle” and “plug-in electric vehicle”.

Battery Swap Station: a fully automated facility that will enable an electric vehicle with a swappable battery pack to enter a drive lane and exchange the depleted battery with a fully charged battery through an automated process.

Comment: Other terms commonly used are battery switch stations and battery exchange stations.

Charging: Occurs when the connector from the battery charging station (or standard outlet) is inserted into the electric vehicle inlet, and electrical power is being transferred for the purpose of recharging the batteries on board the electric vehicle.

Comment: Electricity may or may not be transferred at all times during the act of charging. As vehicle to grid (V2G) advancements occur, electricity may flow from the vehicle’s batteries back to the grid or facility. Another type of charging is through inductive means, where charging uses the electromagnetic field and there is no physical connection between the charging device and the battery. For the purposes of these guidelines, it is presumed that charging occurs via a direct connection (conductive charging) between the battery charging station and the electric vehicle inlet. AC charging

has an on-board charger that converts AC to DC to charge the batteries. DC charging provides DC current directly to the batteries, and the conversion from AC to DC occurs in the off-board EVSE.

AC Level 1	120V AC single phase current (12 amp); power 1.44 current (16 amp); power 1.92kW	DC Level 1	200-450V DC rated current ≤ 80 amp rated power ≤ 36 kW
AC Level 2	240V AC single phase rated current ≤ 80 amp rated power ≤ 19.2 kW	DC Level 2	200-450V DC rated current ≤ 200 amp rated power ≤ 90kW
AC Level 3	To be determined AC Single Phase or three phase?	DC Level 3	To be determined 200-600V DC rated current ≤ 400 amp?

Charging Levels: standardized indicators of electrical force, or voltage, at which an electric vehicle’s battery is recharged (see table above)

Comment: The charging configurations and ratings terminology in the table above are from SAE.¹²³ It is important to note that only the terms “AC Level 1” and “AC Level 2” are consistently used between industry and consumers. The use of “Level 3” is not consistently used at this time. Once Level 3 terms are defined, local governments should adopt amendments to adopted definitions.

Clean Air Vehicle Parking Space: any posted and/or marked parking space that identifies the use to be exclusively for the parking of a clean fuel vehicle as defined by the California Air Resources Board.

Comment: This term provides for a space(s) to be designated as a “Clean Air Vehicle” space for qualifying fuel-efficient vehicles and carpool/ van pool vehicles consistent with the California Green Building Standards (CALGreen) Code,¹²⁴ or potentially as a parking incentive by a public agency or private company for qualifying clean fuel vehicles as defined by the California Air Resources Board or local ordinance.

Clean Air Vehicle Sticker: California law allows use of High Occupancy Vehicle (HOV) lanes with only one occupant when the vehicle displays Clean Air Vehicle Stickers.¹²⁵

Clean Vehicle: any clean fuel vehicle identified by the State of California as qualifying for the California Clean Vehicle Incentives program.¹²⁶ Effective January, 2011 there are two types of vehicles that qualify: Zero Emission Vehicles (ZEV) and Plug-in Hybrid Electric Vehicles (PHEV) that qualify as Enhanced Advanced Technology, Partial Zero Emission Vehicles (EAT PZEV).

Comment: California law allows single-occupant use of HOV lanes by qualifying clean alternative fuel vehicles.¹²⁶ Use of these lanes with only one occupant requires a Clean Air Vehicle Sticker issued by the California Department of Motor Vehicles (DMV).

Clear Floor or Ground Space: a clear floor or ground space required to accommodate a single, stationary wheelchair and occupant is an area of 30 inches by 48 inches minimum, with slopes not steeper than 1:48 in any direction, both clear and unobstructed.

Comment: This space is referred to as “Level Accessible Area” in CBC Chapter 11C, when in front of a fuel dispenser with accessible card reading controls.

Connector: a device that, by insertion into an electric vehicle inlet establishes an electrical connection to the electric vehicle for the purpose of charging and information exchange. This device is part of the electric vehicle coupler. (Electric Vehicle Connector, California Electric Code, Article 625)

Coupler: a device that mates an electric vehicle inlet and electric vehicle connector set. (Electric Vehicle Coupler, California Electric Code, Article 625)

Electric Motorcycle: a battery electric vehicle having a seat or saddle for the use of the rider(s), designed to travel on not more than three wheels in contact with the ground, and is powered by an electric motor and produces zero emissions or pollution when stationary or operating.

Comment: In California, 3-wheel zero emission vehicles are classified as motorcycles and may accommodate a passenger.

Electric Vehicle (EV): any motor vehicle registered to operate on California public roadways and operates, either partially or exclusively, on electrical energy from the grid, or an off-board source, that is stored on-board for motive purpose. Electric vehicle includes: (1) a battery electric vehicle (BEV); (2) a plug-in hybrid electric vehicle (PHEV); (3) a neighborhood electric vehicle (NEV); (4) an electric motorcycle; (5) a fuel cell vehicle (FCV).

Comment: This definition provides for inclusion of a variety of plug-in electric vehicles and fuel cell vehicles and is designed for regulatory purposes, so that factors such as signage are not required to call out detailed differences among BEVs, PHEVs, NEVs and FCVs. Note that extended range electric vehicles (EREV) are not separately defined but are included in the definitional components for PHEV (i.e., an EREV is driven initially in all-electric mode by electricity from its battery, and is then driven in hybrid mode by electricity generated from a gasoline motor). The on-board energy source for a fuel cell vehicle (FCV) is hydrogen.

Electric Vehicle Charging Station (EVCS): a public or private parking space that is served by battery charging station equipment that has as its primary purpose the transfer of electric energy (by conductive or inductive means) to a battery or other energy storage device in a plug-in electric vehicle.

Comment: This definition combines the parking and battery charging characteristics into one definition as these features are functionally related.

Electric Vehicle Charging Station — Public: an electric vehicle charging station that is publicly owned and publicly available (e.g., Park & Ride lot, public library parking lot, on-street parking) or which is privately owned but publicly available (e.g., shopping center parking lot, commercial office parking garage).

Electric Vehicle Charging Station — Restricted: an electric vehicle charging station that is publicly owned and has restricted access (e.g., fleet parking for designated vehicles) or privately owned and has restricted access (e.g., single-family residence, designated employee parking).

Comment: This definition is provided to clarify that not all “public” parking, signage and accessibility requirements will apply to “restricted” EV Charging Stations.

Electric Vehicle Infrastructure (EVI): structures, machinery, and equipment necessary and integral to support an electric vehicle, including, but not limited to charging stations and battery swap stations.

Comment: This term is broader than Electric Vehicle Supply Equipment (EVSE) which refers to the charging equipment, cord and connector on the premises.

Electric Vehicle Parking Space: any posted parking space that identifies the use to be exclusively for the parking of an electric vehicle.

Comment: This term provides the potential for a space to be designated, perhaps as an incentive by a public agency or private company for electric vehicles when charging equipment is not provided.

Electric Vehicle Supply Equipment (EVSE): the conductors, including the ungrounded, grounded, and equipment grounding conductors and the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle. (California Electric Code, Article 625, NEC, Article 625).

Extended Range Electric Vehicle (EREV): see definition of Plug-in hybrid electric vehicle (PHEV)

Fuel Cell Vehicle (FCV): a vehicle that uses electricity produced by an on-board fuel cell to power motors located near the vehicle’s wheels. The fuel cell is powered by filling the fuel tank with hydrogen.

Comment: Since a fuel cell vehicle does not receive its electricity from the electrical grid or off-board source of electricity, it would not qualify to occupy an “Electric Vehicle Charging Station”, but would qualify to park in a “Clean Air Vehicle Parking Space” or an “Electric Vehicle Parking Space”. More information can be found on FCVs at: www.afdc.energy.gov/afdc/, which was the source of this definition.

Hybrid Electric Vehicle (HEV): a type of hybrid vehicle which combines a conventional internal combustion (ICE) propulsion system with an electric propulsion system.

Comment: A Hybrid Electric Vehicle does not plug into an off-board electrical source. The presence of the electric drive motor is intended to reduce tail pipe emissions and achieve better fuel economy than a conventional ICE.

Inlet: the device on the PEV into which the electric vehicle connector is inserted for charging and information exchange. This device is part of the electric vehicle coupler. For the purposes of this code, the electric vehicle inlet is considered to be part of the electric vehicle and not part of the electric vehicle supply equipment (EVSE). (Electric Vehicle Inlet, California Electric Code, Article 625, NEC, Article 625).

Internal Combustion Engine Vehicle (ICE): a vehicle with an engine that burns fuel within itself as a means of developing power.

Comment: Although the term internal combustion engine covers all types of reciprocating and rotary engines, it is typically used with reference to two stroke or four-stroke gasoline and diesel engines, and is the source of power for conventional vehicles.

Level Accessible Area: a ground space which is minimally 30 inches by 48 inches level and clear (with the long side of this space parallel to and centered [plus or minus 9 inches] with the face of the card-reading controls). This area shall be provided within 10 inches in plain view of the face of the accessible card-reading controls and shall be unobstructed by any features, except the electrical cable and connector when inserted in the electric vehicle.

Comment: As stated in CBC Chapter 11C, the slope of the level accessible area shall not be more than 2-percent in front of the card-reading controls, however the slope may extend to 5-percent where the authority having jurisdiction determines that, due to unusual site conditions, the 2-percent slope is not obtainable with the long side of this space parallel to and centered [plus or minus 9 inches] with the face of the card-reading controls. (CBC, Chapter 11C). The maximum slope in any direction in the ADA is 2 percent.

Motorized Bicycle: a device that has fully operative pedals for propulsion by human power, has an electric motor that has a power output of not more than 1,000 watts, and is incapable of propelling the device at a speed of more than 20 miles per hour on ground level. (California Vehicle Code Section 406)

Comment: A “moped” is a form of motorized bicycle and is capable of propelling the device at a maximum speed of not more than 30 miles per hour on level ground. For the purposes of these guidelines all motorized bicycles will be distinct from “electric vehicle” to enable local governments, by ordinance, to treat parking, operation and charging locations for them separately.

Motorized Electric Scooter: any two-wheeled device that has handle bars, a floorboard that is designed to be stood upon when riding, is powered by an electric motor, and produces zero emissions or pollution when stationary or operating. (California Vehicle Code Section 407.5 Motorized Scooters)

Comment: These vehicles are defined as being distinct from “electric vehicle” to enable local governments by ordinance, to treat parking, operation and charging locations for them separately, if that regulation is not in conflict with CVC section 21225. The 2010 ADA standard labels the same devices as electronic personal assistance mobility devices (EPAMDs).¹²⁷

Motorized Quadricycle and Motorized Tricycle: a “motorized quadricycle” is a four-wheeled device, and a “motorized tricycle” is a three-wheeled device, designed to carry not more than two persons, including the driver, and having either an electric motor or a motor with an automatic transmission developing less than two gross brake horsepower and capable of propelling the device at a maximum speed of not more than 30 miles per hour on level ground. The device shall be utilized only by a person who by reason of physical disability is otherwise unable to move about as a pedestrian or by a senior citizen as defined in Section 13000. (California Vehicle Code Section 407)¹²⁸

Comment: For the purposes of these guidelines, motorized quadricycles and motorized tricycles will be distinct from “electric vehicle” to enable local governments, by ordinance, to treat parking, operation and charging locations for them separately.

Neighborhood Electric Vehicle (NEV): an electrically powered, four-

wheeled self-propelled low-speed vehicle whose speed attainable in one mile is more than 20 miles per hour and not more than 25 miles on a paved level surface and has a gross vehicle weight of less than 3,000 pounds. (California Vehicle Code Section 385.5)¹²⁹

Comment: An NEV is a subcategory of “electric vehicle” and “plug-in electric vehicle”. In California, NEVs are limited to operate on roads posted 35 mph or less, but may cross higher speed roadways.

Non-Electric Vehicle: any motor vehicle that does not meet the definition of “electric vehicle” or “plug-in electric vehicle”.

Path of Travel: a continuous, unobstructed pedestrian passage by means of a level accessible area from the vehicle to the base of the accessible battery charging station, with or without card-reading controls to the inlet on the vehicle. It shall connect an accessible EV charging station to building and facility entrances and exits and other facility elements required to be accessible by Title 24 and/or ADA Standard. It shall include the clearance requirements under Title 24 and ADA Standard for wheelchair passage widths, and relationships of maneuvering clearances to wheelchair spaces.

Comment: For buildings and facilities the minimum clear width or single wheelchair passage shall be 36 inches continuously. The clear width may be reduced to 32 inches for a length no greater than 24 inches in length. CBC Chapter 11B, Section 1118B.1. For public right-of-way, exterior walks and sidewalks the clear width for single wheelchair passage shall be 48 inches minimum. [Source Title 24 Section 1133B.7]

Plug-in Electric Vehicle (PEV): any motor vehicle registered to operate on California public roadways and operates, either partially or exclusively, on electrical energy from the grid, or an off-board source, that is stored on-board for motive purpose. Plug-in Electric vehicle includes: (1) a battery electric vehicle (BEV); (2) a plug-in hybrid electric vehicle (PHEV); (3) a neighborhood electric vehicle (NEV); (4) an electric motorcycle.

Comment: This definition is similar to that of “electric vehicle”, but does not include a fuel cell vehicle. Note that extended range electric vehicles (EREV) are not separately defined but are included in the definitional components for PHEV (runs on electricity from its battery, and then it runs on electricity it creates from gas).

Plug-In Hybrid Electric Vehicle (PHEV): an electric vehicle that (1) contains an internal combustion engine and also allows power to be delivered to drive wheels by an electric motor; (2) charges its battery primarily by connecting to the grid or other off-board electrical source; (3) may additionally be able to sustain battery charge using an on-board internal-combustion-driven generator (EREV); and (4) has the ability to travel powered by electricity.

Comment: A PHEV is a subcategory of “electric vehicle” and “plug-in electric vehicle”. Note that extended range electric vehicles (EREV) are not separately defined but are included in the definitional components for PHEV (runs on electricity from its battery, and then it runs on electricity it creates from gas).

Point of Service: the battery charging station from which the charging service is provided.

Van Accessible Parking Space: an accessible parking space sized for a van.

Comment: Per Title 24 Section 1129B.4, one in every eight accessible parking spaces, but not less than one, shall be served by a loading and unloading access aisle 96 inches wide minimum placed on the side opposite the driver’s side when the vehicle is going forward into the parking space and shall be designated van accessible. ADA Standard Section 208.2 states for every six or fraction of six parking spaces required to comply with section 502, at least one shall be a van parking space. The ADA Standard requirements for a van parking space is an 11-foot wide “universal design” parking space with a 5-foot access aisle but a van parking space similar to that under Title 24 is permitted as an exception.

Zero Emission Vehicle (ZEV): any vehicle driven only by an electric motor that is powered by advanced technology batteries (BEV) or a hydrogen fuel cell (FCV), and produces zero tailpipe emissions or pollution when stationary or operating.

8.2 LIST OF ACRONYMS

AC	Alternating current, an electric current which changes direction with a regular frequency
AB 32	Assembly Bill 32-California Global Warming Solutions Act of 2006
AB 475	Assembly Bill 475-Vehicles: off-street parking: electric vehicles (2011)
AB 631	Assembly Bill 631-Public utilities: electric vehicle charging stations (2011)
ABAG	Association of Bay Area Governments
AFV	Alternative Fuel Vehicle
BAAQMD	Bay Area Air Quality Management District
BEV	Battery Electric Vehicle
CA MUTCD	California Manual on Uniform Traffic Control Devices
CALGreen	California Green Building Standards
CARB or ARB	California Air Resources Board
CBC	California Building Code
CAP	Climate Action Plan
CCR, Title 24	California Code of Regulations, Title 24 (commonly known as the California Building Standards Code)

CEC	California Electrical Code
CEC	California Energy Commission
CFC	California Fire Code
CO2	Carbon Dioxide
CPUC or PUC	California Public Utility Commission
CVC	California Vehicle Code
DC	Direct Current
DOE	Department of Energy
DOT	US Department of Transportation
EPRI	Electric Power Research Institute
EREV	Extended Range Electric Vehicle
EV	Electric Vehicle
EVCS	Electric Vehicle Charging Station
EVI	Electric Vehicle Infrastructure
EVSE	Electric Vehicle Supply Equipment
FHWA	Federal Highway Administration
GHG	Greenhouse Gases
HOA	Homeowners’ Association
ICC	International Code Council
ICE	Internal Combustion Engine
kWh	Kilowatt hour
LEED	Leadership in Energy and Environmental Design
MAGICC	Mid- Atlantic Grid Interactive Car Consortium
MTC	Metropolitan Transportation Commission
MUD	Multi-Unit Dwelling
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electrical Code
NEV	Neighborhood Electric Vehicle
NFPA	National Fire Protection Association
NREL	National Renewable Energy Laboratory
NRG	NRG Energy
PG&E	Pacific Gas and Electric Company
PEV	Plug-in Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
PJM	Pennsylvania-New Jersey-Maryland Interconnection
RFID	Radio Frequency Identification subscription service
SANDAG	San Diego Association of Governments
SAE	SAE International(Society of Automotive Engineers)
SB 209	Senate Bill 209-Common interest developments: electric vehicle charging stations (2011)
SDG&E	San Diego Gas and Electric
SCE	Southern California Edison
TAM	Transportation Authority of Marin
TOU	Time-of-use
TUCC	Tri-chapter Uniform Code Council
VMT	Vehicle Miles Traveled
V2B	Vehicle-To-Building
V2G	Vehicle-To-Grid
ZEV	Zero Emission Vehicle

8.3 MATRIX OF INCENTIVES

Incentive	How to Apply	Deadlines or Key Dates
Alternative Fuel Vehicle Refueling Property	IRS Form 8911—equipment must be placed in to service	Expires 12/31/11
ECOtality	www.theevproject.com/index.php	evpsupport@etecevs.com
Coulomb Technologies	www.chargepointamerica.com	Stations will be installed by 12/31/11
Los Angeles Department of Water and Power EVSE Rebate	www.ladwp.com/dadwp/cms/ladwp002056.jsp	The program will expire on June 30, 2013 or when the funds are exhausted, whichever occurs first
Electric Vehicle Charging Equipment (EVSE) Installation	www.baaqmd.gov	Contact Air District for additional details
California Energy Commission	www.energy.ca.gov/altfuels/index.html	Check website for application dates

Alternative Fuel Vehicle Refueling: This is a federal tax credit for commercial charging infrastructure. The credit amount is up to 30 percent of the cost, not to exceed \$30,000 for equipment placed into service in 2011. Consumers who purchase qualified residential fueling equipment may receive a tax credit of up to \$1,000.

ECOtality offers EVSE at no cost to individuals in the Los Angeles, San Diego, and San Francisco metropolitan areas. To be eligible for free home charging stations, individuals living within the specified areas must purchase a qualified plug-in electric vehicle (PEV) or plug-in hybrid electric vehicle (PHEV). Individuals purchasing an eligible PEV or PHEV should apply at the dealership at the time of vehicle purchase. The EV Project incentive program will also cover most, if not all of the costs of EVSE installation. All participants in the EV Project incentive program must agree to anonymous data collection after installation. Additional restrictions may apply.

Coulomb Technologies' ChargePoint America program offers EVSE at no cost to individuals or entities in the San Jose, San Francisco Bay, Sacramento, and Los Angeles metropolitan area. To be eligible for a public or commercial charging system, an entity must be located within the specified metropolitan areas and in defined potentially "high use" areas, and provide public access to the charging system.

Companies and municipalities may apply on the ChargePoint America Web site. To be eligible for free home charging stations, individuals living within the specified areas must purchase a qualified PEV or PHEV.

Individuals purchasing an eligible PEV or PHEV should apply for the ChargePoint America program at the dealership or with the vehicle manufacturer at the time of vehicle purchase. In most cases, installation will be paid for by the EVSE owner; some cities, states, and utilities, however, will provide funding towards installation costs. All participants in the ChargePoint America program must agree to anonymous data collection after installation. Additional restrictions may apply.

8.4 PUBLIC AGENCIES WITH ALTERNATIVE FUEL-RELATED INCENTIVES OR REQUIREMENTS

Public Agency	Incentive/Regulation	Year	Source
San Francisco Municipal Transportation Authority (SMFTA) and the Department of Environment	Incentive: \$2,000 per new alternative fuel vehicle on a first-come-first-serve basis	2010	"Mayor Newsom Announces that More than Half of San Francisco's Taxi Fleet is Alternative Vehicles." San Francisco's Office of the Mayor (Press Release) 2010-03-22.
San Jose Departments of Transportation, Airport, and Police	Incentive: If using a qualifying hybrid, taxi companies/drivers receive off-day access to Mineta San Jose International Airport	2005	Helmer, James R.; Sherry, William F.; and Robert L. Davis. "Taxicab Service Model Status Report." (Memorandum) 2006-11-27.
New York City Taxi and Limosine Commission	Incentive: Discounted price of medallions (2004) Regulation: All new taxis entering fleet beginning October 2008/October 2009 should have a fuel economy of 25/30 mpg (2007)	2004 2007	"Is That a Tinge of Green on New York's Yellow Cabs?" New York Times 2006-05-21. "Mayor Plans an All-Hybrid Taxi Fleet." New York Times 2007-05-23.
Boston Public Health Commission	Incentive: Hybrid taxi drivers get two "front of the line" passes per shift at Logan Airport (2007) Regulation: Boston mandated all taxi fleet must be converted to hybrid by 2015. (2008)	2007 2008	Clean Cities (April 2009). "Hybrid Taxis Give Fuel Economy a Lift." U.S. Department of Energy. < www.afdc.energy.gov/afdc/pdfs/45148.pdf >. "Boston's Taxi Fleet To Go Hybrid by 2015." The Boston Globe. 2008-08-29.
Texas Commission on Environmental Quality	Incentive: Taxi Owners can swap the permit of one non-hybrid vehicle for two permits valid only for hybrid electric vehicles.	2007	Alternative Fuels and Advance Vehicle Data Center (2010-07-28). "San Antonio is Switching to Hybrid Taxis." U.S. Department of Energy
Arlington County Board	Authorized existing taxi companies permission to add 35 hybrid cars	2007	(2007-09-07) "Arlington County: Board Gives Go Ahead

8.5 EVSE OPTIONS FOR MUDS - SITE ASSESSMENT CHECKLIST FOR PROPERTY OWNERS

Homeowners' Associations and Property Management Companies

General housing and metering characteristics:

1. What type of housing units do drivers live in?
Garden apartment (single-level around a courtyard)
Low-rise apartment (2 to 3 stories)
Mid-rise apartment (4 to 11 stories)
High-rise apartment (12+ stories)
Duplex/Triplex/Quadraplex (Typically investment/rental properties, individual/company owning multiple properties)
Townhouse (Typically individually-owned properties)
2. Are the units metered individually or collectively?
Individually
Collectively

Feasibility to install the EVSE on an existing electrical panel for the individual unit:

3. Is the electrical panel in the same building as the unit parking space?
Yes
No (Please skip to question 5.)
4. If yes, is the electrical panel in the same general area (level) as the parking space?
Yes, approximately _____ft. from the parking space. (Please skip to question 6.)
No
5. If no, where is the electrical panel?
In unit
In garage under unit
Clustered in meter room
Outside on side or back of building
6. Where is the parking space?
Subterranean garage with assigned parking
Subterranean garage with deeded parking
Surface parking
Assigned parking under units (physically attached to building with meters/panels)
Assigned parking (not physically attached to building with unit meters/panels)
Garages under units (Townhouses)
Tandem parking spaces (2 cars/space)
Guest parking
Unassigned parking

Valet parking

7. Are there existing 120V or 240V outlets in any of the parking areas?
Yes, connected to an individual meter.
Yes, connected to a common area meter.
No
8. Is there a space to install a 120V charger at the individual parking space (on a wall, post, or free-standing)?
Yes
No
9. What kind of electrical service does the customer have?
Single-phase
3-phase
10. What is the size of the resident's electrical panel?
Less than 60 amp
60 amp
60 to 100 amp
100 to 150 amp
150 to 200 amp
Over 200 amp
11. Is there room on individual unit panel for a new breaker?
If so, what size? (Check all that apply)
20 amp
40 amp
60 amp
80 amp
12. Is reconfiguration of the panel possible to create space for a 20 or 40 amp breaker? (i.e., remove unused circuits or combine circuits)
Yes
No, but it is possible to upgrade the existing service panel to a larger one.
No
13. If yes, how much additional capacity can be created?

Feasibility of a second meter to take advantage of special off-peak utility rates for EV charging:

14. What electrical rate does the customer currently have?
Tiered Rate
Flat Rate
Whole house TOU Rate
PEV TOU Rate
15. What impact does the EVSE have on the customer's electricity cost? (Customer should ask the utility to do a cost analysis)
16. Does the customer wish to take advantage of the special off-peak charging rate?
Yes
No
17. Is it physically possible to install a second meter and service panel that can connect to the EVSE located in the resident's parking space?
Yes
No
18. Is the customer a good candidate for a whole house time of use rate i.e., not using electricity during (daytime) peak hours?
Yes
No

Common Area Service

19. Is there a house meter for common areas and services?
Yes
No
20. Is the electrical panel that serves the common areas near an area where an EVSE could be installed and a car could be parked (i.e, guest parking) or a designated EV parking space)
Yes
No
21. Is there room on the common area panel for one or more new breakers for EVSEs?
Yes
No
22. If yes, how many EVSE could be accommodated if each requires a 40 amp breaker? _____
23. What electrical rate is the common area meter on?
24. What impact the charger(s) have on the electricity cost for the common area? (Customer should ask the utility to do a cost analysis)

25. How does the management company intend to recover the cost of charging from individual drivers?
26. Are there energy efficiency measures the property management could undertake to create additional capacity for EVSE without major electrical upgrades? Examples include switching from continuously operating fans to CO2 detectors, lighting retrofits, HVAC upgrades, PV installation and LED exit signs.
Yes
No (Please skip to question 28)
27. If so, conduct a detailed cost effectiveness evaluation.

New Meter and Service

28. Is it possible to add a brand new meter and service specifically for EVSE?
Yes
No
29. Is that permitted by the local utility?
Yes
No
30. Is there a utility cost for adding a new meter and service?
Yes (\$ _____)
No
31. Who pays for the cost of the utility work, (up to the meter) if any?

32. Who pays for the EVSE installation cost (beyond the meter)?

33. Who pays for the electricity cost? _____

Valet Parking

34. Does the complex have valet parking?
Yes
No
35. Can EVSE be installed in the valet area?
Yes
No
36. Can the valets be used to rotate vehicles?
Yes
No

8.6 EMISSION REDUCTION CALCULATIONS

It is difficult to calculate emission reductions specifically for EVSE since the plug-in vehicle is really the emission-reducing entity. However, since most battery powered vehicles cannot operate without being recharged, it seems reasonable to share at least some of the emissions benefit with the infrastructure. In general, kilowatt hours of charge can be translated into miles driven which can be translated into emissions reduced.

For example if a Nissan Leaf charges for 2 hours at 3.3 kilowatts per hour, it has gained a total of 6.6 kilowatts of battery capacity. For the 24 kilowatt hour Leaf battery pack this equates to 27.5% of the total battery capacity. Since the Leaf gets approximately 100 miles to a charge, 27.5% of the battery pack equates to 27.5 miles. If we assume that an equivalent gasoline vehicle would get about 27.5 miles per gallon the 27.5 miles represents the emissions reduction from one gallon of gas or 19.4 lbs¹³¹ (based on California Air Resources Board inventory emissions figures). At least some of the EVSE manufacturers are including GHG calculations in their data reporting programs.

8.7 CHECKLIST FOR BUILDING INSPECTORS FOR RESIDENTIAL EVSE INSTALLATION



CITY OF [NAME OF CITY]
 [Department Name]
 [Division Name]



ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE) INSTALLATION CHECKLIST

INFORMATION	PLAN CHECK NO.: _____	EXPIRATION DATE: _____	STATUS: _____
	PROJECT ADDRESS: _____		
	WORK DESCRIPTION: _____		
	APPLICANT'S NAME: _____	TEL. NO.: _____	
	ADDRESS: _____	EMAIL: _____	
INSTRUCTIONS	<p>Your application for a permit, together with plans and specifications, has been examined and you are advised that the issuance of a permit is withheld for the reasons hereinafter set forth. The approval of plans and specifications does not permit the violation of any sections of the Electrical Code or other local ordinances or state laws.</p> <p>In an effort to streamline the plan review process, please follow the steps outlined below to ensure that there is no delay in processing your application and reviewing your responses to these plan check comments.</p> <ul style="list-style-type: none"> • Comments with circled item numbers apply to this plan check. • Revised plans and calculations shall incorporate or address all comments marked on the original checked set of plans, calculations, and this plan review checklist. Provide a written response to each comment and show where and how it has been addressed. Identify the sheet number and detail or reference note on the revised plans where the corrections are made. Time spent searching for the corrected items on the revised plans or calculations will delay the review and approval process. Once all comments on the plans, calculations, and this checklist have been addressed, contact the plan check staff to schedule an appointment to review the changes made. 		
	PLAN REVIEWER: _____	TEL. NO.: _____	
	ADDRESS: _____		
	EMAIL: _____	WEBSITE: _____	

	<p>may contact the plan check staff by telephone from _____ to _____ M T W T H F.</p> <ul style="list-style-type: none"> • Bring the original checked set of plans and calculations along with this checklist to the meeting. Do not schedule an appointment meeting with the plan check staff until all comments have been addressed. • Incomplete, indefinite or faded drawings or calculations will not be accepted.
NOTE	<p>Numbers within the parenthesis () refer to the section of the applicable code. 2011 Edition of the California Electrical Code (CEC).</p>

A. GENERAL PERMITTING REQUIREMENTS

1. Provide site plan of project location and identify the proposed location of the Electric Vehicle Supply Equipment.
2. Demonstrate physical protection of Electric Vehicle Supply Equipment. (CEC 110.27)
3. Provide electrical load calculations of existing and/or proposed electrical system, including EVSE model number and full load amperage.
4. Provide electrical single line diagram of proposed work.

B. ELECTRICAL INSTALLATION REQUIREMENTS

Electric Vehicles – an automotive type vehicle for on-road use, such as passenger automotive, buses, van, neighborhood electric vehicles primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electrical current. (CEC Art. 625.2)

1. LOCATION IDENTIFICATION - Identify the equipment installation location.
2. INDOOR SITES:
 - a. Installation of Electric Vehicle Supply Equipment shall comply with California Electrical Code Article 625.29
 - b. Equipment Height – The coupling means of the electric vehicle supply equipment shall be stored at a height of 18 – 48 inches above the finished floor. (CEC Art 625.29(B))
3. SYSTEM CERTIFICATION - Verify the equipment is listed by a nationally recognized testing laboratory (as recognized by the Authority Having Jurisdiction).
4. FASTEN EQUIPMENT - Electric Vehicle Supply Equipment must be permanently connected and fastened in place unless (CEC Art. 625.13):
 - a. The supply equipment is rated at 125 volts, single phase, 15 or 20 amperes; or,
 - b. Electric Vehicle Supply Equipment is provided with an interlock that de-energizes the electric vehicle connector and its cable whenever the electric connector is uncoupled from the electric vehicle.
 - c. Electrical connection per manufacturer specifications.
5. EQUIPMENT PROTECTION – Electrical Vehicle Supply Equipment operating at 50 volts or more shall be guarded against accidental contact by approved enclosures. (CEC Art. 110.27)
6. DISCONNECTING MEANS – When equipment is rated more than 60 amps or more than 150 volts to ground, the disconnecting means shall be provided and installed in a readily accessible location. (CEC Art. 625.23)

8.8 TUCC EVSE GUIDANCE FOR SINGLE-FAMILY RESIDENCE INSTALLATIONS

ICC

TRI-CHAPTER

UNIFORM CODE COMMITTEE (TUCC)



POLICY NUMBER: 17

APPROVAL DATE: August 12, 2010

REVISION DATE: APRIL 14, 2011

SUBJECT: Electric Vehicle (EV) charging system in Single Family Residence (SFR)

This guideline is developed by the Tri-chapter Uniform Code Committee and is intended to enhance regional consistency in application and enforcement of the Building Code. Please verify acceptance of this guideline with your local building department prior to its application.

CODE REFERENCE (S):

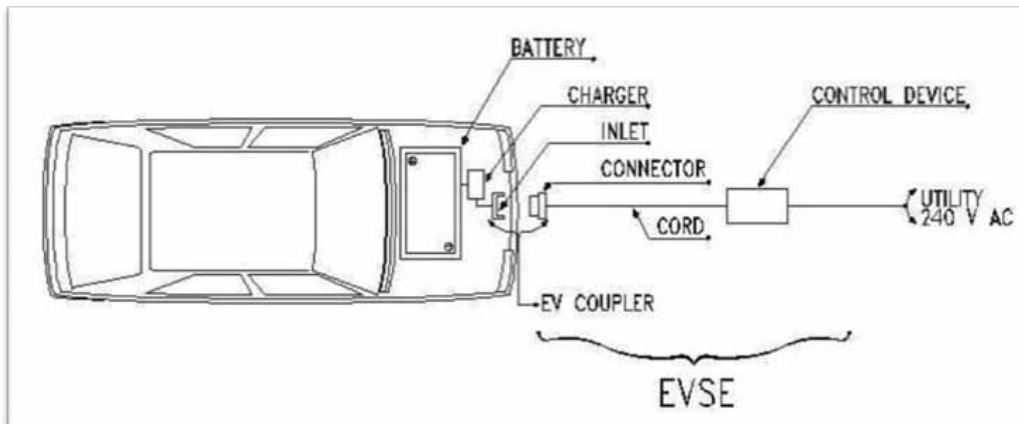
2010 California Electrical Code; Underwriters Laboratory (UL) listed charging system

ISSUE (S):

Efficient permitting and inspection for EV electric charging system will be required to help encourage the use of EV in California. Ideally with the proper documentation, permits to install Electric Vehicle Supply Equipment (EVSE) could be issued over-the-counter. As most jurisdictions have not dealt with EV charging system, a TUCC EV sub-committee was formed in June, 2010 to research and understand the technical requirement for EV and develop a guideline to expedite the permit and inspection process.

Sample EV Charging System

Electric Vehicle Supply Equipment (EVSE) consists of the connector, cord, and interface to utility power. Currently the interface between the EVSE and utility power will be directly hard-wired to the control device, and each automaker has its own EVSE design. A single design called the J1772 Standard EV coupler will be available soon that will be applicable for all electric vehicles.

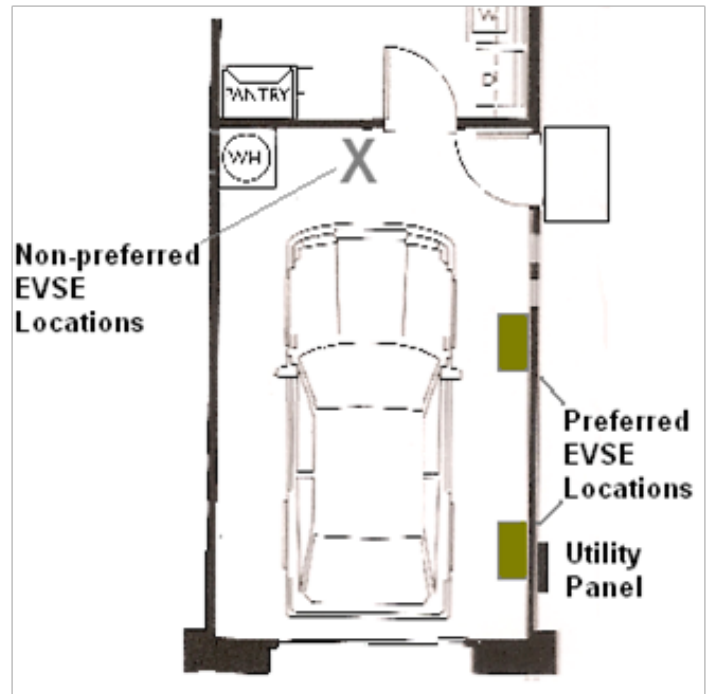


There are 2 levels of charging system for SFR – Level 1 (120 VAC, 15/20 A) and Level 2 (240 VAC, 40A). Level 2 is most likely be used because of less time to charge the vehicle.

Proposed Guidelines

An electrical permit is required for an EV charging system to be installed in the garage or carport of a SFR. The following information is required for a permit:

1. EV charging system information : level 1 or 2, EVSE system with UL listed number or other approved nationally recognized testing laboratory, in compliance with UL2202, “Standard for Electric Vehicle (EV) Charging System Equipment”
2. Existing electrical service panel information at the residence. Include EVSE load and circuit size to determine if electric panel upgrade is required.
3. Panel upgrade and electrical wiring shall be in conformance with the California Electrical code
4. Identify if a second electric meter is required to be installed because of electric utility rate for EV charging
5. Clarify EVSE location
6. EVSE shall be installed in accordance with manufacturer's guideline and must be suitable for the environment (indoor/outdoor).
7. Manufacturer installation guideline has to be available for the inspector at the site.



8.9 TUCC EVSE GUIDANCE FOR COMMERCIAL INSTALLATIONS

ICC

TRI-CHAPTER

UNIFORM CODE COMMITTEE (TUCC)



POLICY NUMBER: 18

APPROVAL DATE: April 14, 2011

SUBJECT: Commercial or Multi-Family Electric Vehicle (EV) charging station

This guideline is developed by the Tri-chapter Uniform Code Committee and is intended to enhance regional consistency in application and enforcement of the Building Code. Please verify acceptance of this guideline with your local building department prior to its application.

CODE REFERENCE (S):

2010 California Electrical Code (CEC)
2010 California Building Code (CBC)
2010 California Green Building Standards Code (CGBSC)
Underwriters Laboratory (UL) listed charging system

ISSUE (S):

TUCC approved the Residential EV charging system guideline on August 12, 2010. This is the second part of the guideline for commercial and multi-family electric vehicle charging system. The employment of electrical vehicles will greatly help to reduce the air pollutants to meet the State and Federal emission targets. Efficient permitting and inspection for EV electric charging system will help encourage the use of EV in California. Currently, there is no clear requirement in the building code regarding accessibility with EV charging station. A policy will provide consistency in EV permit approval in the Tri-chapter area. Ideally with complete documentation and plans, plan check can be reviewed on a short cycle (1 to 3 weeks of plan check turnaround time depending on the work load of individual jurisdictions).

Proposed Guideline:

A building and electrical permit are required for an EV charging system to be installed on commercial, industrial or multi-family dwelling properties.

Accessibility requirement:

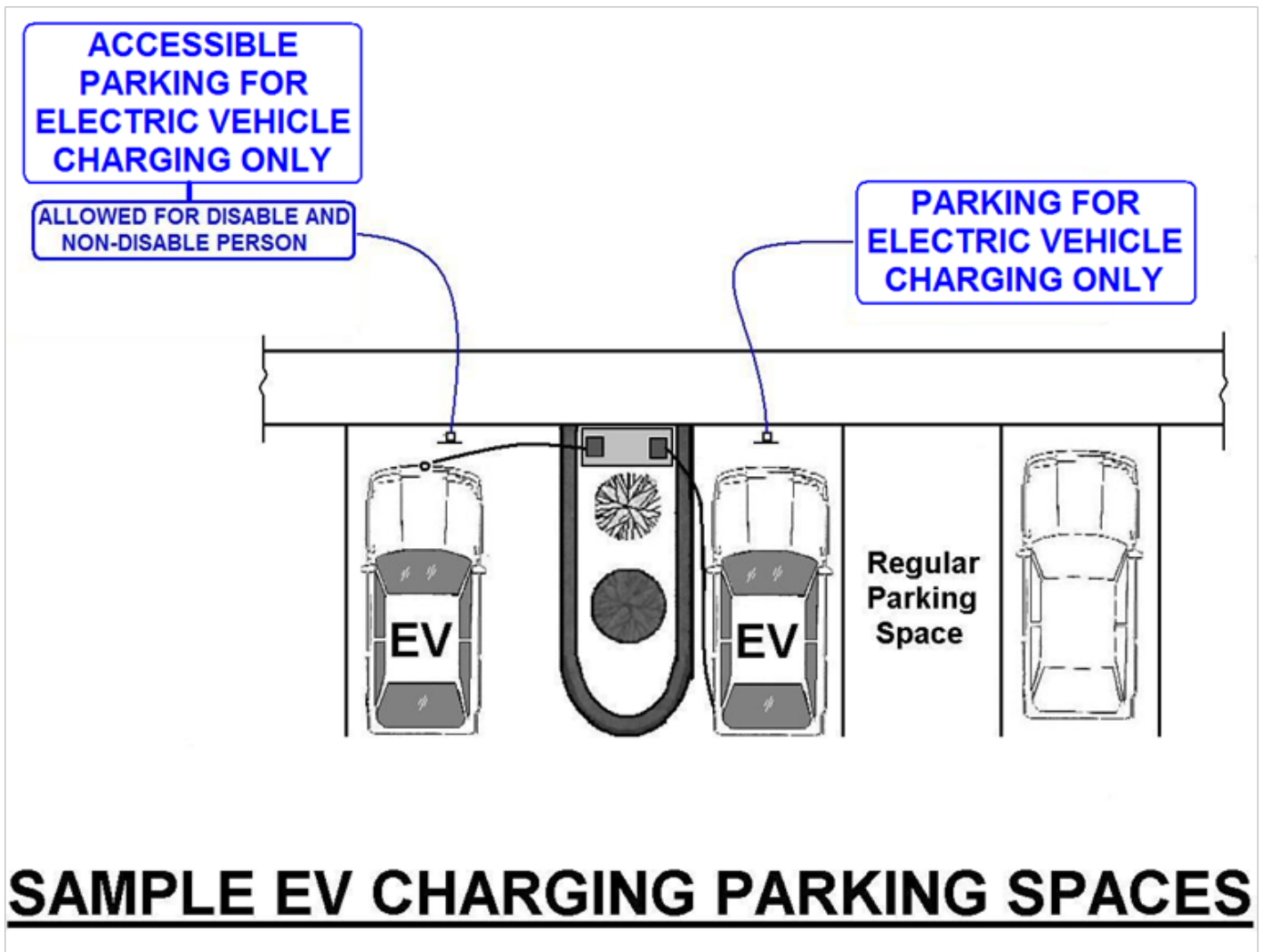
The minimum number of accessible charging stations required per site is one. The accessible EV charging parking space shall not be counted as one of the required accessible parking spaces as required by CBC, because the space is allowed to be used by non-disabled people. The size of the accessible EV charging parking space and its access aisle and other accessible requirement shall be in compliance with the current CBC, except it needs not be striped or provided with signage as required for accessible parking space. An informational sign shall be posted with suggested wording: "Parking for Electrical Vehicle charging only". Suggested wording for the accessible space: "Accessible parking for Electrical Vehicle charging only".

The accessible charging station equipment shall meet all applicable reach range provisions and accessible path under the current CBC accessibility requirement.

The EV charging parking space(s) may be counted towards the number of required low-emitting/fuel-efficient parking in the CGBSC.

Other requirements:

- Charging system equipment, EVSE (Electric Vehicle Service Equipment), installed inside individual garage of multi-family dwellings shall follow TUC policy #17 for EV charging system in single family dwelling, with the exception that Homeowners' Association or owner's approval (in the case of rental property) is required. Charging stations installed outside the multi-family dwelling buildings shall follow this guideline.
- Publicly available charging system shall follow this guideline. But lighting and shelter are important consideration at public sites.
- Identify all EV charging station locations on the plan.
- Identify if site is in the flood zone. If so, charging station shall be elevated or designed according to the flood requirement.
- Identify if a second electric meter is required to be installed because of electric utility rate for EV charging.
- EV system with UL listed number or other approved nationally recognized testing laboratory shall be provided on plan.
- Provide electric load calculation and design for the charging stations. Dedicated new branch circuits from the central meter distribution panel to the charging station may be required.
- Planning, Engineering and Fire Departments approval may be required.
- EVSE shall be installed in accordance with manufacturer's guideline and shall be suitable for the environment (indoor/outdoor).
- Manufacturer installation guideline shall be available for the inspector at the site.



8.10 NREL EVSE PERMITTING TEMPLATE

Permit for Charging Equipment Installation

Electric Vehicle Supply Equipment (EVSE)

Jurisdiction: City, State

Compliance with the following permit will allow the construction and operation of electric vehicle charging equipment at a residence in the City, State jurisdiction. This permit addresses one of the following situations:

- Only a branch circuit and meter would be constructed at the residence
- A hard-wired charging station would be constructed at the residence. The requirements for the charging station are taken directly out of the 2011 edition of the National Electrical Code (NEC) NFPA 70, Article 625 Electric Vehicle Charging System

This permit contains a general reference to the NEC or electrical code used in the jurisdiction. All work and installed equipment will comply with the requirements of the NEC or the electrical code used in the jurisdiction. The jurisdiction maintains the authority/responsibility to conduct any inspections deemed necessary to protect public safety; however, due to the projected plug-in hybrid electric vehicle (PHEV) volume, it is suggested for consideration that a qualified electrician be approved to self-inspect the system enabling system operation in advance of jurisdiction inspection. The charging station installer shall also be responsible for notifying or coordinating any work with the utility company where needed.

Section 1 of the permit application requires basic identifying information be submitted. Note that there is a separate portion of the form requesting information on the property owner who may not be the individual requesting the installation.

Section 2 of the permit application identifies which code needs to be complied with depending on whether a branch circuit and meter or a hard-wired charging station is being installed.

The technical installation requirements address the following specific elements of electric vehicle charging station safety:

- Listing and labeling requirements
- Wiring methods
- Breakaway requirements
- Overcurrent protection
- Indoor siting
- Outdoor siting

Section 3 consists of standard certification statement that could be modified as needed by the jurisdiction. By signing the certification statement, the applicant agrees to comply with the standard permit conditions and other applicable requirements. This consent would give the jurisdiction the option of allowing the applicant to proceed with installation and operation of the charging equipment.

Section 4 of the document gives an example of a checklist the jurisdiction could develop to track key information on the application. The example under section 4 contains only a few items of the many that the jurisdiction might wish to track.

This permit package also includes a schematic drawing depicting a typical indoor installation. In this installation the wiring path follows the exterior of the structure, and the charging station is located indoors. The NEC allows for interior wiring and outdoor installations. The purpose of the schematic is only to show how the charging station equipment could be arranged and is not intended to convey any permit requirements.

Application for Installation of Electric Vehicle Charging Equipment

NOTICE: The system must be installed in compliance with NFPA 70, National Electric Code, Article 625 or applicable Electrical Code currently adopted and enforced within the jurisdiction of installation. All associated work with circuits, electrical service and meters shall be completed in compliance with NFPA 70, national electric code, or applicable electrical code currently adopted and enforced within the jurisdiction of installation.

Section 1: Permit Applicant Information

Name:		
Installation Street Address (P.O. box not acceptable):	Contact Person:	Phone Number: () -
City:	County:	State: ZIP Code:
Owner Name:	Street Address:	Phone Number: () -
City:	State:	ZIP Code:
Submitter's Name/Company	Street Address:	Phone Number: () -
City:	State:	ZIP Code:
General description of equipment to be installed:		

Section 2: Permit Code Information

NEC Chapter or Article	DESCRIPTION
Chapter 2 and 3	Branch Circuit A new electrical box added on a branch circuit shall comply with NFPA 70 National Electrical Code® Chapter 2 Wiring and Protection and Chapter 3 Wiring Methods and Materials and all administrative requirements of the NEC or the electrical code in effect in the jurisdiction
625.4	VOLTAGES Unless other Voltages are specified, the nominal ac system voltages of 120, 120/240, 208Y/120, 240, 480Y/277, 480, 600Y/347, and 600 Volts shall be used to supply equipment
625.5	LISTED OR LABELED All electrical materials, devices, fittings, and associated equipment shall be listed or labeled.
625.9	WIRING METHODS The electric vehicle coupler shall comply with 625.9(A) through (F). (A) Polarization. The electric vehicle coupler shall be polarized unless part of a system identified and listed as suitable for the purpose. (B) Noninterchangeability. The electric vehicle coupler shall have a configuration that is noninterchangeable with wiring devices in other electrical systems. Nongrounding-type electric vehicle couplers shall not be interchangeable with grounding-type electric vehicle couplers. (C) Construction and Installation. The electric vehicle coupler shall be constructed and installed so as to guard against inadvertent contact by persons with parts made live from the electric vehicle supply equipment or the electric vehicle battery. (D) Unintentional Disconnection. The electric vehicle coupler shall be provided with a positive means to prevent unintentional disconnection. (E) Grounding Pole. The electric vehicle coupler shall be provided with a grounding pole, unless part of a system identified and listed as suitable for the purpose in accordance with Article 250. (F) Grounding Pole Requirements. If a grounding pole is provided, the electric vehicle coupler shall be so designed that the grounding pole connection is the first to make and the last to break contact.

625.13	<p>ELECTRIC VEHICLE SUPPLY EQUIPMENT Electric vehicle supply equipment rated at 125 volts, single phase, 15 or 20 amperes or part of a system identified and listed as suitable for the purpose and meeting the requirements of 625.18, 625.19, and 625.29 shall be permitted to be cord-and-plug-connected. All other electric vehicle supply equipment shall be permanently connected and fastened in place. This equipment shall have no exposed live parts.</p>
625.14	<p>Rating Electric vehicle supply equipment shall have sufficient rating to supply the load served. For the purposes of this article, electric vehicle charging loads shall be considered to be continuous loads.</p>
625.15	<p>Markings The electric vehicle supply equipment shall comply with 625.15(A) through (C). (A) General. All electric vehicle supply equipment shall be marked by the manufacturer as follows: FOR USE WITH ELECTRIC VEHICLES (B) Ventilation Not Required. Where marking is required by 625.29(C), the electric vehicle supply equipment shall be clearly marked by the manufacturer as follows: VENTILATION NOT REQUIRED The marking shall be located so as to be clearly visible after installation. (C) Ventilation Required. Where marking is required by 625.29(D), the electric vehicle supply equipment shall be clearly marked by the manufacturer, "Ventilation Required." The marking shall be located so as to be clearly visible after installation.</p>
625.16	<p>Means of Coupling The means of coupling to the electric vehicle shall be either conductive or inductive. Attachment plugs, electric vehicle connectors, and electric vehicle inlets shall be listed or labeled for the purpose.</p>
625.17	<p>Cable The electric vehicle supply equipment cable shall be Type EV, EVJ, EVE, EVJE, EVT, or EVJT flexible cable as specified in Article 400 and Table 400.4. Ampacities shall be as specified in Table 400.5(A)(1) for 10 AWG and smaller, and in Table 400.5(A)(2) for 8 AWG and larger. The overall length of the cable shall not exceed 7.5 m (25 ft) unless equipped with a cable management system that is listed as suitable for the purpose. Other cable types and assemblies listed as being suitable for the purpose, including optional hybrid communications, signal, and composite optical fiber cables, shall be permitted.</p>
625.18	<p>Interlock Electric vehicle supply equipment shall be provided with an interlock that de-energizes the electric vehicle connector and its cable whenever the electrical connector is uncoupled from the electric vehicle. An interlock shall not be required for portable cord-and-plug-connected electric vehicle supply equipment intended for connection to receptacle outlets rated at 125 volts, single phase, 15 and 20 amperes.</p>
625.19	<p>Automatic De-Energization of Cable The electric vehicle supply equipment or the cable-connector combination of the equipment shall be provided with an automatic means to de-energize the cable conductors and electric vehicle connector upon exposure to strain that could result in either cable rupture or separation of the cable from the electric connector and exposure of live parts. Automatic means to de-energize the cable conductors and electric vehicle connector shall not be required for portable cord-and-plug-connected electric vehicle supply equipment intended for connection to receptacle outlets rated at 125 volts, single phase, 15 and 20 amperes.</p>
625.21	<p>Overcurrent Protection Overcurrent protection for feeders and branch circuits supplying electric vehicle supply equipment shall be sized for continuous duty and shall have a rating of not less than 125 percent of the maximum load of the electric vehicle supply equipment. Where noncontinuous loads are supplied from the same feeder or branch circuit, the overcurrent device shall have a rating of not less than the sum of the noncontinuous loads plus 125 percent of the continuous loads.</p>
625.22	<p>Personnel Protection System The electric vehicle supply equipment shall have a listed system of protection against electric shock of personnel. The personnel protection system shall be composed of listed personnel protection devices and constructional features. Where cord-and-plug-connected electric vehicle supply equipment is used, the interrupting device of a listed personnel protection system shall be provided and shall be an integral part of the attachment plug or shall be located in the power supply cable not more than 300 mm (12 in.) from the attachment plug.</p>
625.23	<p>Disconnecting Means For electric vehicle supply equipment rated more than 60 amperes or more than 150 volts to ground, the disconnecting means shall be provided and installed in a readily accessible location. The disconnecting means shall be capable of being locked in the open position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed. Portable means for adding a lock to the switch or circuit breaker shall not be permitted.</p>
625.25	<p>Loss of Primary Source Means shall be provided such that, upon loss of voltage from the utility or other electrical system(s), energy cannot be back fed through the electric vehicle and the supply equipment to the premises wiring system unless permitted by 625.26.</p>
625.26	<p>Interactive Systems Electric vehicle supply equipment and other parts of a system, either on-board or off-board the vehicle, that are identified for and intended to be interconnected to a vehicle and also serve as an optional standby system or an electric power production source or provide for bi-directional power feed shall be listed as suitable for that purpose. When used as an optional standby system, the requirements of Article 702 shall apply, and when used as an electric power production source, the requirements of Article 705 shall apply.</p>

625.28	Hazardous (Classified) Locations Where electric vehicle supply equipment or wiring is installed in a hazardous (classified) location, the requirements of Articles 500 through 516 shall apply.
625.29	Indoor Sites Indoor sites shall include, but not be limited to, integral, attached, and detached residential garages; enclosed and underground parking structures; repair and nonrepair commercial garages; and agricultural buildings. (A) Location. The electric vehicle supply equipment shall be located to permit direct connection to the electric vehicle. (B) Height. Unless specifically listed for the purpose and location, the coupling means of the electric vehicle supply equipment shall be stored or located at a height of not less than 450 mm (18 in.) and not more than 1.2 m (4 ft) above the floor level. (C) Ventilation Not Required. Where electric vehicle nonvented storage batteries are used or where the electric vehicle supply equipment is listed or labeled as suitable for charging electric vehicles indoors without ventilation and marked in accordance with 625.15(B), mechanical ventilation shall not be required. (D) Ventilation Required. Where the electric vehicle supply equipment is listed or labeled as suitable for charging electric vehicles that require ventilation for indoor charging, and is marked in accordance with 625.15(C), mechanical ventilation, such as a fan, shall be provided. The ventilation shall include both supply and exhaust equipment and shall be permanently installed and located to intake from, and vent directly to, the outdoors. Positive pressure ventilation systems shall be permitted only in buildings or areas that have been specifically designed and approved for that application. Mechanical ventilation requirements shall be determined by one of the methods specified in 625.29(D)(1) through (D)(4). (1) Table Values. For supply voltages and currents specified in Table 625.29(D)(1) or Table 625.29(D)(2), the minimum ventilation requirements shall be as specified in Table 625.29(D)(1) or Table 625.29(D)(2) for each of the total number of electric vehicles that can be charged at one time. (2) Other Values. For supply voltages and currents other than specified in Table 625.29(D)(1) or Table 625.29(D)(2), the minimum ventilation requirements shall be calculated by means of general formulas stated in article 625.39(D)(2). (3) Engineered Systems. For an electric vehicle supply equipment ventilation system designed by a person qualified to perform such calculations as an integral part of a building's total ventilation system, the minimum ventilation requirements shall be permitted to be determined in accordance with calculations specified in the engineering study. (4) Supply Circuits. The supply circuit to the mechanical ventilation equipment shall be electrically interlocked with the electric vehicle supply equipment and shall remain energized during the entire electric vehicle charging cycle. Electric vehicle supply equipment shall be marked in accordance with 625.15. Electric vehicle supply equipment receptacles rated at 125 volts, single phase, 15 and 20 amperes shall be marked in accordance with 625.15(C) and shall be switched, and the mechanical ventilation system shall be electrically interlocked through the switch supply power to the receptacle.
625.30	Outdoor Sites Outdoor sites shall include but not be limited to residential carports and driveways, curbside, open parking structures, parking lots, and commercial charging facilities. (A) Location. The electric vehicle supply equipment shall be located to permit direct connection to the electric vehicle. (B) Height. Unless specifically listed for the purpose and location, the coupling means of electric vehicle supply equipment shall be stored or located at a height of not less than 600 mm (24 in.) and not more than 1.2 m (4 ft) above the parking surface.

Section 3: Certification Statement

I hereby certify that the electrical work described on this permit application shall be/has been installed in compliance with the conditions in this permit, NFPA 70, national electric code, Article 625, or applicable electrical code currently adopted and enforced within the jurisdiction of installation. Furthermore, all associated work with circuits, electrical service and meters shall be/has been completed in compliance with NFPA 70, national electric code, or applicable electrical code currently adopted and enforced within the jurisdiction of installation. By agreeing to the above requirements, the licensee or owner shall be permitted to construct and operate the charging station.

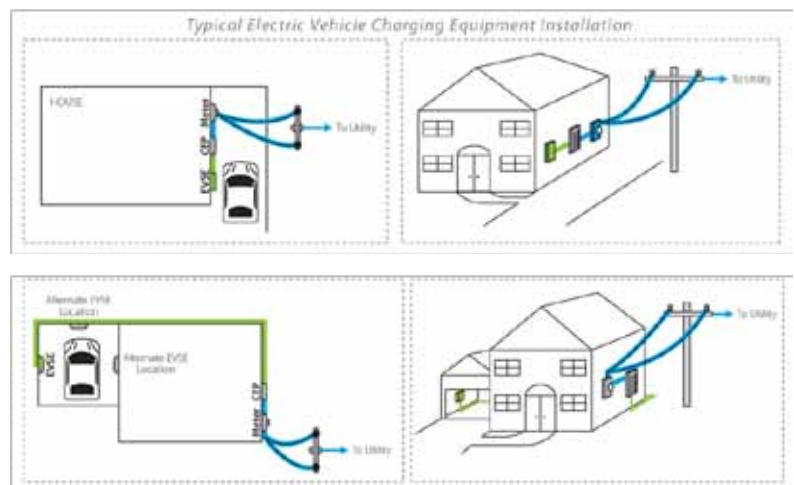
Signature of Licensee:

Date:

Section 4: Jurisdiction Checklist

Information each jurisdiction would add to permit:

- Date utility notified of work completed
- Information on installation sent to tax assessor
- Indoor/outdoor location
- Modification to existing service required
- Other items as determined by the jurisdiction



8.12 OREGON TEMPORARY RULE ON EVCS PERMITTING AND INSPECTION PROTOCOL

Electrical Vehicle Charging Station
 Temporary Rule Effective: 9-26-08
 OAR 918-311-0065

Electric Vehicle Charging Station Statewide Permit and Inspection Protocol

- (1) To ensure a path for the emerging technology and enable the installation of charging stations for electric vehicles, the following permit and inspection protocols will apply throughout the state, notwithstanding contrary provisions contained in the Oregon Electrical Specialty Code.
- (2) Building officials and inspectors shall permit and allow installation of an electric vehicle charging station that has a Building Codes Division's special deputy certification label without further testing or certification.
- (3) Persons installing an electric vehicle charging station must obtain a permit for a feeder from the inspecting jurisdiction. No other state building code permit is required.
- (4) The jurisdiction may perform up to two (2) inspections under the permit issued in subsection (3) above.
- (5) Inspection of the installation is limited to examining the feeder for compliance with the following Oregon Electrical Specialty Code provisions:
 - (a) Overcurrent protection, per articles 225 and 240;
 - (b) Physical protection of conductors, per article 300;
 - (c) Separation and sizing of the grounding and neutral conductors, per article 250.20; and
 - (d) Provisions for locking out the breaker for maintenance, per chapter 4.
- (6) For the purpose of this rule, the service, feeder, and charging station pedestal will be considered a single structure as defined by the Oregon Electrical Specialty Code. The structure's owner may opt to install a grounding electrode system to supplement lightning protection, but cannot be required to do so.

8.11 LEADING DOMESTIC AND INTERNATIONAL EV INITIATIVES

City/ Region	Regional Goals	Key Policies & Incentives
Amsterdam 2.2M reg. pop.	Amsterdam Electric: http://www.nieuwamsterdamsklimaat.nl/amsterdam_electric/amsterdam_electric/	
	2014: 1000 L2 chargers, 20 FCs 2015: 10K PEVs 2040: 200,000 PEVs ("100% EV")	<ul style="list-style-type: none"> ▪ €15K to €45K rebate per PEV ▪ All charge points supplied with green power ▪ Free electricity (until 2014) & free parking for PEVs
Austin 1.7M reg. pop.	Austin Energy Plug-in Electric Vehicle Readiness Initiative City of Austin Electric Transportation 2010-2020 Roadmap (pdf)	
	2012: 4000 PEVs 2015: 4000 PEVs 2020: 192,000 PEVs (10% of vehicles)	<ul style="list-style-type: none"> ▪ Rebate of up to \$1500 for residential L2 chargers (\$28M investment by Austin Energy – municipal utility) ▪ \$50/year unlimited charging from Austin Energy under consideration ▪ NRG charger network to be installed http://texasishotblog.org/?p=1280
Beijing 22+ M reg. pop.		
	2011: 5000 PEVs 2012: 30000 PEVs 2014: 36000 L2, 100 FCs, 1 Bat. Swp.	<ul style="list-style-type: none"> ▪ Rebate of up to ≈\$9250 per BEV and ≈\$7500 per BHEV ▪ Rebate of up to 30% for Charger ▪ PEVs favored in Licensing Lottery and receive free license plates

Berlin 4.5M reg. pop.	E-mobility Berlin: http://www.rwe-mobility.com/web/cms/en/236726/rwemobility/	
	2009: 150 PEVs 2011: 500 L2 chargers 2020: 1M PEV in greater Germany	<ul style="list-style-type: none"> ▪ BEV and PEV exempt from annual circulation tax for five years ▪ 100% renewable electricity supplied through RWE mobility ▪ Free charger and electricity for 18 months with RWE contract
Changzhou 4.5M city pop.	Insufficient Data Available	
	Insufficient Data Available	
Chicago 9.5M reg. pop.		
	2011: 230 L2 chargers, 50 FCs 2011: 300+ PEVs	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500 ▪ Rebate of up to \$1000 for residential L2 chargers ▪ State Rebate including ICE to PEV conversion up to \$4000 ▪ HOV toll lane access
Copenhagen/ Denmark 1.9M reg. pop.		
	2011: 300 charge points, 1 FC 2011: 1 Battery Swap Station 2011: 150+ PEVs	<ul style="list-style-type: none"> ▪ BEV and PEV exempt from through 2015 ▪ Free parking in downtown Copenhagen ▪ Large percentage of electricity in Denmark from renewable sources
Denver 2.6M reg. pop.	Denver Clean Cities: http://www.lungusa.org/associations/states/colorado/events-programs/denver-metro-clean-cities.html	
	2011: 500 PEVs 2013: 7000 PEVs	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500 ▪ State PEV Rebate up to \$6000 ▪ Rebate of up to \$1000 for residential L2 chargers ▪ PEV Charging Schedule available through Electric Utility
Houston 6.1M reg. pop.		
	2010: 10 charge points 2012: 50 L2, 50 FCs 2012: 100 PEVs for city fleet	<ul style="list-style-type: none"> ▪ Federal Rebate of up to \$7500 ▪ Rebate of up to \$1000 for residential L2 chargers ▪ City Vehicles Charge free for three years ▪ NRG Energy charging plans from \$49-\$89/ month
Israel 7.5M reg. pop.	Better Place: http://www.betterplace.com/	
	2011: 5000 PEVs 2012: 25000 PEVs 2016: 100,000+ PEVs	<ul style="list-style-type: none"> ▪ Pending 10% purchase tax on BEV versus 90% on ICE. ▪ Free charge point at home and work through Better Place
London 13M reg. pop.	https://www.sourcelondon.net/ London EV Delivery Plan 2009	
	2015: 25000 charge points 2015: 31000 PEVs 2020: 100,000 PEVs	<ul style="list-style-type: none"> ▪ Rebate of up to £5,000 for qualifying vehicles ▪ Charge membership £100 per year, no electricity fee ▪ No Congestion Charge for BEV (potential savings £2000+ per year)
Los Angeles 15.25M reg. pop.		
	2010: 400 charge Points 2011: Update of 86 existing charge points	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500, State Rebate up to \$5000 ▪ Rebate of up to \$1000 for residential L2 chargers, Utility rebate up to \$2000 for first 5000 charger customers and EV Rate Plan ▪ HOV toll lane access, preferred or free parking
Miami 5.5M reg. pop.		
	2010: RFP pending for installation of charger(s)	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500 ▪ Rebate of up to \$1000 for residential L2 chargers ▪ ICE to PEV conversion up to \$5000 ▪ HOV toll lane access

Montreal 3.6M reg. pop.	Transportation Electrification QUÉBEC GOVERNMENT 2011-2020 ACTION PLAN FOR ELECTRIC VEHICLES	
	2011: 65+ PEVs 2020: 118,000 PEVs (25% of all new passenger vehicles)	<ul style="list-style-type: none"> ▪ Québec Government up to \$8,000 in 2012 PHEV and BEV ▪ Québec Government up to \$1,000 for residential charger in 2012 ▪ PEV parking and charging with green license plate
New York 19M reg. pop.	PlaNYC	
	2009: 500+ PEVs 2011: 100 L2 2011: 14%-16% of new vehicles PEVs	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500 ▪ Rebate of up to \$1000 for residential L2 chargers ▪ HOV lane access
Ontario Province 13.2M reg. pop.	http://www.mto.gov.on.ca/english/dandv/vehicle/electric/electric-vehicles.shtml	
	2011: estimated 25 L2 2020: 5% of passenger vehicles PEVs in greater Canada	<ul style="list-style-type: none"> ▪ \$5,000-\$8,500 for PHEV and BEV based on battery size ▪ EV charging infrastructure mandated in new homes in some locations ▪ Ontario government contributed \$1 million to education
Orlando / Tampa 6M combined reg. pop.	http://www.plugandgonow.com/	
	2010: 5 City fleet PEVs 2012: 300+ PEVs	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500 ▪ Rebate of up to \$1000 for residential L2 chargers ▪ HOV lane access, preferred parking ▪ "Fast Track" online charger permitting
Paris 11.8M reg. pop.		
	2011: 300+ charge points 2011: 3000 BEVs 2015: 400,000 charge points and 700,000 PEVs in greater France	<ul style="list-style-type: none"> ▪ Rebate up to €5,000 for new vehicle purchase with CO₂ emissions of 60 gr/km or less ▪ Most Charge points City owned and installed
Philadelphia 6.1M reg. pop.		
	2011: estimated 20 L2 2011: 18 PEVs	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500 ▪ Rebate of up to \$1000 for residential L2 chargers ▪ \$500 alternative fuel vehicle rebate from Department of Environmental Protection ▪ Residents can purchase 100% percent renewable electricity
Portland 2.25M reg. pop.	http://www.chargeportland.com/	
	2010: 50+ PEVs 2011: 1000 PEVs in greater metro. 2011: est. 500 charge points	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500 ▪ Rebate of up to \$1000 for residential L2 chargers ▪ \$750 alternative fuel vehicle conversion credit ▪ 24-48 hour charger permitting
San Diego 3.1M reg. pop.		
	2011: 1500 L2 public and 1000 L2 residential charge points 2011: 50 PEVs at UC San Diego	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500 ▪ Federal rebate of up to \$1000 for residential L2 chargers ▪ Goal of 33% renewable power, Existing residential EV Time-of-use Charging Rates
Seattle 3.4M reg. pop.	http://www.seattle.gov/environment/EV.htm	
	2011: 50 L2 2011: 26 BEVs in Municipal Motor Pool	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500 ▪ Rebate of up to \$1000 for residential L2 chargers ▪ Three day charger permitting ▪ Charge points supplied with green power

Toronto 5M reg. pop.	http://www.fleetwise.ca/ Toronto Green Fleet Plan 2008-2011	
	2012: 300 PEVs 2020: 5% of passenger vehicles PEVs in greater Canada	<ul style="list-style-type: none"> ▪ \$5,000-\$8,500 for PHEV and BEV based on battery size ▪ Ontario government contributed \$1 million to education ▪ HOV lane access with PEV license plate
Vancouver 2.1M reg. pop.	http://vancouver.ca/sustainability/electric_vehicles.htm	
	2011: Pilot program for public charge points	<ul style="list-style-type: none"> ▪ Rebate of up to \$2000 ▪ City bylaws require charge point pre-wiring for 20% of parking in new apartment buildings and all new single-family homes
Washington D.C. 5.6M reg. pop.		
	2010: Request for Information on EV charging 2015: 30+ L2	<ul style="list-style-type: none"> ▪ Federal PEV Rebate of up to \$7500 ▪ Rebate of up to \$1000 for residential L2 chargers ▪ 3-year vehicle excise tax exemption, up to \$2,000 per PHEV ▪ Reduced vehicle registration fee (\$36 for two years)

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5 CHARGING STATION INSTALLATION STRATEGIES

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8 APPENDICES

122. Unless otherwise noted, definitions are modeled after those presented in Sonoma County Electric Vehicle Charging Station Program and Installation Guidelines. July 2011. <http://www.sonoma-county.org/prmd/docs/misc/ev_prog_guidelines.pdf>.
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