**Chapter 2: Electric Vehicles and Infrastructure**

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CHAPTER 2. Electric Vehicles: Barriers and Solutions to Accelerated Market Development

2.1. Key Market Barriers: As noted in the Overview above, PEV adoption has been slower than some original market forecasts due primarily to high initial purchase price of some models, and range anxiety. Each of these issues is discussed below.

Perceived high cost: At market launch in 2011, “entry-level” PEVs initially carried MSRPs ranging from $29,000 - $40,000. Price reductions in 2013 lowered prices to MSRPs of $23,000 - $35,000, with Federal and State incentives reducing this cost by approximately $9,000 - $10,000. This challenge has been significantly mitigated by price cuts from many manufacturers, plus the beginnings of a robust used EV market. New PEVs in California are now available at prices of $13,000 after incentives, and modestly used Nissan Leafs can be had in the used market for as little as $10K or less. Many new PEVs are now less expensive than the average new vehicle, at $31,000 in 2013. However, some potential buyers may not have the tax liability to take all of the federal tax credit. One solution to this challenge is leasing, as manufacturers can take the incentives and offer a more attractive lease offer. The majority of California EV owners are in fact leasing, using the $2,500 California rebate to contribute to the down payment. Over the next several years, battery prices are expected to decline, driving overall vehicle price reductions. The federal Department of Energy (DOE) projects price-parity with internal combustion engine vehicles by 2022, based on battery pricing dropping from the current range of $500 per kWh of capacity to approximately $200/kWh or even less. Ongoing advances in lightweight design and materials will also enable cars to go farther and perform better per unit of power available.

Public Charging Infrastructure: According to a 2011 survey by Deloitte and Touche, for more than 80 percent of respondents, convenience to charge, range, and cost to charge were all “extremely important” or “very important” considerations for buying an EV. Charging time of two hours or less were critical for 55 percent of respondents, and widespread availability of public charging stations was very important for 85 percent of respondents. To address this issue, the Monterey Bay PEV Coordinating Council, partner organizations, and private site hosts have increased the number of EV charging stations in the region.

In addition, the Monterey Bay PEV Coordinating Council has outlined a range of policies and initiatives that local governments are encouraged to adopt, which include:

- Streamlining single-family residential charger installation
- Developing charging options for multi-unit developments
- Creating more comprehensive public EV charging networks
- Promoting EV-ready buildings and parking lots

Each of these challenges is discussed briefly below, along with policy recommendations for consideration by the AFV Steering Committee.

2.2. Single-Family Residential Charger Installation Streamlining Overview: Residential charging is the backbone of the EV charging infrastructure. It is the most convenient option for most drivers, and the least costly based on availability of special EV or “time-of-use” (TOU) utility rates. Overnight charging also poses a reduced burden on the utility grid, including its generation and distribution systems. Unfortunately, installation costs for charging at home can be highly variable, and generally these costs are passed on directly to the customer. Depending on the age and condition of electrical infrastructure
in a particular residence, the installation costs can vary widely. For example, a simple Level 2 installation, including hardware, may cost as little as $1200. However, if total electrical load of the home exceeds safety standards, a panel upgrade may be required. This can cost as much as $500 to $2500 additional. If conduit or trenching is required, these can add additional costs. Because of this expense, many PHEV drivers and BEV drivers that travel less than 50 miles per day are opting for Level 1 charging at home. This can often be done for free by using the portable charging equipment that comes with their car and a 110 volt outlet in a garage or driveway, though some homes may need a dedicated or new 110 outlet in a convenient location installed, which may cost a few hundred dollars.

To access a less expensive EV-specific electricity rate, SCE and PG&E customers can specify a “time-of-use” or TOU rate for their home or business, or purchase a separate meter to access a special EV-only rate. For all charging installations, contractors must pull a permit at the beginning of the job and – depending on the complexity of the work involved – they may be required to schedule an inspection with the local permitting authority to sign off on the work. In some cases, the combination of permitting, inspection, and utility “hand-offs” can result in significant delays before a charger installation is complete. The following chart indicates the complex set of “handoffs” required in many charging station installation scenarios.

### Residential Installation Process

- **Customer contacts utility to evaluate rate and meter options**
- **Electrician site visit—determines if customer has enough electrical capacity for new EV circuit and evaluates meter options and costs**
- **Utility Planner visits site to evaluate meter location (if requested by customer)**
- **Electrician or automaker infrastructure partner provides quote and contract to customer including panel upgrade if needed and second meter options if requested**
- **Customer Approves Estimate and Signs Contract**
- **Electrician pulls permit**
- **Electrician performs work**
- **Possible interim inspections for trenching or panel work**
- **City Inspects and Approves installation (or if issues notice of corrections). If no new meter, electrician trains customer on use and job is complete.**
- **City sends notice of final inspection to utility**
- **Utility Returns to Install Separate Meter (if necessary)**
- **If new meter Electrician turns on meter and trains customer on use. Job is complete.**

2.3. **Recommendations for Streamlining Residential EV Charger Installations:** Given the challenges that customers may face in installing residential EV charging stations, it is recommended that jurisdictions
establish low and flat fees for installation of charging stations and undertake additional streamlining recommendations identified below, with explanatory discussion following the chart.

### Recommendations for Streamlining Residential EV Charger Installations

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Next Steps</th>
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<tbody>
<tr>
<td>R.1. Develop a charger permit form identifying all required elements</td>
<td>1A. Distribute model PEV application and checklists to city/county leads. (See Appendix 1 for sample application). 2A. City/County leads to modify and adopt.</td>
</tr>
<tr>
<td>R.2. Provide installation process guidance and checklists</td>
<td></td>
</tr>
<tr>
<td>R.3. Establish reasonable – and flat – charger permit fees.</td>
<td>3A. Present information on existing fee structures and recommendation for standardization where feasible and appropriate. 3B. Report on any fee adjustments by localities.</td>
</tr>
<tr>
<td>R.5. Participate in training on EVSE technologies and installation</td>
<td>5A. Host EVSE product information and installation workshop for prospective site hosts and contractors.</td>
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### Discussion of Recommendations

**R1. Develop a charger permit form identifying all required elements:** Because of the relative novelty of EV charging equipment, some jurisdictions in the tri-County area may be uncertain regarding the appropriate format of the electrical permit to be issued. For jurisdictions that want to highlight EV charger-specific issues to guide contractors, site hosts, and inspectors, a sample charger-specific permit is provided in Appendix 1. This generic permit form highlights relevant sections of the National Electrical Code, and has been co-developed with the National Electrical Manufacturers’ Association (NEMA).

**R2. Provide installation process guidance and checklists:** The International Code Council and its various regional chapters have provided guidance for local permitting authorities on plan check and inspection procedures for both residential and commercial chargers. Exemplary guidance documents for California jurisdictions have been developed by the Tri-Chapter Uniform Code Council of the greater Bay Area, which is highlighted as a statewide model in the Ready, Set, Charge California! Guidelines for EV-Ready Communities. These guidance documents are included in Appendix 2 (for residential installations) and Appendix 3 (for commercial and multifamily installations).

**R3. Establish reasonable – and flat – charger permit fees.** Currently, permitting fees for Monterey Bay communities vary significantly. To encourage charger station adoption, communities with higher fees should consider targeted fee reductions that will help reduce the overall cost of EV ownership, and to reflect the reduced societal cost burden that EVs impose by virtue of their reduced greenhouse emissions and contributions to energy security.
R4. **Waive plan requirements for simple installations.** Many jurisdictions have recognized that most EV charging installations are as simple and straightforward as a typical water heater installation, and that they need not be subject to automatic plan submission and plan check requirements. Further, where plans are required without due cause, a substantial cost and time burden is imposed on would-be EV drivers and electrical contractors. It is recommended that Monterey Bay jurisdictions follow the lead of many major cities in California in waiving plan submission and plan check requirements for simple installations.

R.5. **Provide training on EVSE technologies and installation:** EV chargers and technologies are unfamiliar to many electrical contractors and building officials. To address this information gap, Plug-In Monterey Bay proposes to host a workshop for contractors and permitting officials in each County.

2.4. **Multi-Unit Residential Charger Installation Challenges and Solutions:** EV stakeholders face a more complex set of challenges in facilitating charger installations in multi-dwelling units (MDUs) – including condominiums, apartments, townhomes, and “garage-less” dwellings. A good introduction to the process of multi-family charger installation has been provided by San Diego Gas and Electric at their website: [http://sdge.com/sites/default/files/documents/PreppingMultiUnitsforPlugInVehicles.pdf](http://sdge.com/sites/default/files/documents/PreppingMultiUnitsforPlugInVehicles.pdf)

Depending on local circumstances, multi-unit dwelling residents and building owners may be challenged by these problems. For each problem, there is a mitigation, if not a perfect solution, but good will is required on both owner and tenant to work toward a fair and efficient allocation of costs and benefits.

- **Limited parking:** When lots are crowded or spaces are assigned or deeded, finding feasible spaces for chargers may require re-shuffling of designated parking or other use-policy changes. In the cases of deeded parking spaces, HOA’s may be justified in requiring that local residents pay the full cost of initial installations. However, in apartments, some cost-sharing may be feasible if building owners exercise their right to exact a surcharge on energy used at the site, or to charge a monthly lease fee for equipment that is retained by the apartment owner and re-assigned to future EV driving tenants.

- **Distance between utility meters, parking, and electrical panels:** A new 240V charging circuit typically requires a connection between the charger location and the EV owner’s electrical panel. In multi-family dwelling units, the electrical panel may be inside the residential unit and located at a long distance from the parking area. This can impose significant cost barriers. In new construction, provisions for EV readiness can be built in at nominal cost by running appropriate conduit and pre-wiring for EVSE. This will be discussed in the section to follow on updated building codes. For existing multi-unit buildings, a new program to develop 10,000 “make-ready” EV charging sites is being undertaken by NRG, an energy company now investing in California as part of its settlement of a lawsuit with the California Public Utilities Commission. These make-ready improvements will bring adequate power and stub-outs to the designated sites. In the first 18 months following the completion of the make-ready site, the site host is obligated to contract exclusively with NRG to install a Level 2 charger, after this time they could install a charger from any company.

NRG will also initiate installation of the charger once a specific EV driver is identified who will commit to utilize that site on a regular basis, e.g., as an employee of a business on the site, or as a resident of a multi-unit development on the site. During this 18 month NRG exclusive period,
the prospective charge station user must sign up for the NRG monthly subscription program to trigger the installation of the EVSE. In a legal settlement (related to past monopolistic pricing behavior of their Dynegy subsidiary), NRG is mandated to invest $100 million dollars to develop both “make-ready” sites and to install 200 Fast Chargers around the state. At this point, only Ventura County is eligible for the DC Fast Chargers (and the first one was installed in Camarillo), as installations will be focused on the greater Bay Area, the South Coast area, and the Central Valley. However, Monterey Bay communities are encouraged to pro-actively contact NRG to identify possibilities for potential development of the free “make-ready” sites.

- **Challenges to accessing off-peak charging rates:** Off-peak EV charging rates may require a new meter and utility service. Most MDUs have meters clustered in a central location. There may not be space to add another meter. In such cases, landlords or building managers may be permitted to simply establish a flat monthly fee for energy use. Alternative load management technologies for multi-unit scenarios are also available from EverCharge, a company that specializes in multi-dwelling EV charge management. EverCharge provides a “powershare” hardware device that can shift the electrical load among a number of charging devices and ensure that existing electrical panels are not overloaded. See [www.EverCharge.net](http://www.EverCharge.net) for more details. Other charger companies, including Coulomb Technologies, have billing solutions that work on multiple charger platforms to apportion energy costs to EVSEs among different multi-unit tenants and management. (See [http://www.coulombtech.com/products-apartments.php](http://www.coulombtech.com/products-apartments.php) for details.)

- **Limited electrical capacity:** Level 2 chargers typically require a minimum of a 40 amp circuit. Upgrading capacity can be costly and may trigger requirements to bring the property up to current building code. In these circumstances, power-sharing technology to enable multiple chargers to charge sequentially (rather than simultaneously) may reduce the burden, as referenced above. Another low-cost option is to deploy dedicated Level 1 chargers, which are already present in some garages and car ports. Level 1 charging may be adequate for overnight charging of EV owners that drive less than 50 miles per day. If common power is used in car ports, some condo living EV owners use low cost devices such as the “Kill-a-watt” meter, which is less than $20 to track energy use and reimburse the HOA.

Cost mitigation strategies can include placement of charging equipment in guest parking or other common areas. Where feasible, property management organizations or Home Owners’ Associations (HOAs) can adopt policies to install charging stations in common areas serviced by the same master meter that covers other common services such as landscape lighting. Rates can be established for RFID or credit card payment to the property management group and/or HOA to cover electricity costs based on vehicle time-of-use and maintenance costs.

Multi-family installations sometimes require engineered drawings that include: a) a site plan; b) a layout showing the electrical work needed and; c) specifications for the equipment. A plan check is usually required, including sign-off from a city engineer, planning and/or building departments, and the city or county fire marshal. With safety issues paramount, significant consolidation in the number of inspections may not be feasible. However, local jurisdictions can streamline approval processes by considering and implementing the streamlining recommendations below, adapted from the statewide Ready, Set, Charge California! Guidelines (see [www.ReadySetCharge.org](http://www.ReadySetCharge.org) for additional information).
2.5. Recommendations for Multi-Dwelling Residential Charger Installation

To summarize, EV stakeholders, including local governments, advocates, and property management associations will need to work closely together to develop a range of MDU solutions that will necessarily be site specific in most instances, and based on voluntary cooperation toward shared goals for a healthy environment and an energy-secure community. Where appropriate, municipalities and counties with larger numbers of residents in multi-unit dwellings may also wish to consider stronger policy options that could mandate multi-unit development stub-outs or actual charger installations, either in the context of new construction, major remodels, or at the time of sale. While these options are considered, additional education and outreach activities will be developed through the PCC partners, as identified in the initial recommendations below.

<table>
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<tr>
<th>Recommendations for Multi-Dwelling Residential Charger Installation</th>
<th>Next Steps</th>
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<tr>
<td><strong>R.6. Outreach to HOAs and property managers to offer MDU solutions</strong></td>
<td>6.A. Develop HOA solutions with utilities, industry experts, and installation contractors</td>
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</table>
| **R.7. Adopt building code amendments to mandate pre-wiring for EVSE in new and remodeled multi-unit buildings.** | 7.A. Present model EV-friendly building code amendments to city staff  
7.B. Report on results of outreach and engagement process |

Discussion of Recommendations

**R.7. Develop HOA solutions:** Owners, building managers, and renters who may wish to install EV charging stations need access to information about their charging needs, options, and potential solutions. To address these needs, Plug-in Monterey Bay will work with local stakeholders to present solutions for multi-unit developments. Solutions for multi-unit developments are inherently complex, insofar as MDU installations must typically conform to the association’s or development’s architectural standards and existing parking layout; economically access adequate power, with potential “re-shuffling” of parking assignments to permit cost-effective installations of EV charging stations for EV-driving tenants; develop protocols for cost-sharing of both capital and operating costs for the station, including energy and other maintenance and operational expenses.

To prepare for the possibility of installing EV charging equipment, stakeholders in a multi-unit complex may find it helpful to undertake these activities (adapted from guidance provided by San Diego Gas and Electric):

1. **Conduct a poll and provide information to residents on EVs:** Find out how many people in the building may be interested in EVs and when they might wish to buy one. It may help to provide some general information on EV costs, benefits, and availability, which can be found at [www.pluginamerica.org](http://www.pluginamerica.org).

2. **Access utility and EV advocacy organization resources:** Ecology Action in cooperation with the Monterey Bay EV Alliance offer information and periodic workshops to help consumers learn
about EV charging options, costs, and business models. It will be helpful to access online or workshop resources to inform stakeholders of the latest programs and technologies for EV charging. Charging technologies for multi-unit use range from simple “plug and charge” standalone units that are open to all users, to networked units with automated user ID and payment systems. Chargers with more advanced communication and scheduling can provide metering capabilities to track users’ use; access control; user-specific billing and service fee options; and remote control and monitoring capabilities. Single or multiple cord sets may be housed in a box mounted to a wall, pole, ceiling or floor, depending on site-specific needs. To get an idea of the wide array of EVSE options that are available for residential and commercial charging, visit Plug In America at www.pluginamerica.org/accessories, Advanced Energy at www.advancedenergy.org/transportation/evse, or GoElectricDrive at www.GoElectricDrive.com.

3. **Identify the challenges:** To address the needs at a site, practical obstacles need to be identified and addressed one by one. This list of prompts can help a MDU team identify the issues to be addressed:

- How well will the property layout – including the location and type of electric metering, wiring and parking spaces – accommodate the desired charging equipment?
- What existing rules in the covenants, conditions and restrictions (“CC&Rs”) would affect the installation of charging stations in common areas and private areas?
- Which assigned and unassigned parking spaces could accommodate EV charging equipment?
- What local regulations relate to common area use of charging infrastructure?
- Will some charging units, sidewalks, parking spaces need to meet Americans with Disabilities Act (ADA) standards for accessibility?
- How should property owners deal with initial equipment and service costs versus future tenant demands and needs?
- Consider partnering with an EVSE vendor, such as NRG, which may be able to offer installation, maintenance, and power as part of a monthly subscription program for the EV driver. (See www.evgonetwork.com for information on the free “make-ready” program for multi-unit residential developments in California.)

4. **Develop consensus on the scope of work:** The installation of EV chargers in a multi-unit development will require shared decisions by property owners, property managers and (in some cases) residents. To provide potential contractors a starting point for cost estimation, the MDU site host needs to determine:

- Estimated number of spaces to be served by charging equipment and in what configuration: Level 1 charging (at 110 volts, requiring a 10-12 hour recharge time), or Level 2 charging (requiring 240 volts and a 4-6 hour recharge time). Level 2 chargers are typically preferred and may be essential for Battery-Electric Vehicle (BEV) owners, whereas Level 1 charging may be adequate for PHEVs.
- Charger management preferences (networked with multi-party billing options, or non-networked without smart billing allocation).
- Suggested location(s).
5. **Choose a qualified contractor:** When selecting an installer for charging equipment, consider the contractor’s experience, licensing, insurance and training, such as the EVSE installation training offered through organizations like the National Electrical Contractors Association, International Brotherhood of Electrical Workers and Underwriters Laboratories.

6. **Coordinate on-site evaluation:** Prospective contractors will need to visit the site to answer any remaining questions about project requirements before providing estimates. As part of the evaluation, the contractor should calculate power loads with the added charging stations, decide whether existing electric panels need to be upgraded or replaced, and see whether the utility needs to upgrade electric service or install new electric meters. The contractor should coordinate with the utility for review of the project design and, if necessary, an on-site visit.

7. **Begin installation:** Once the contractor’s price quote is approved, the contractor will order the selected charging stations, obtain any necessary permits, place the utility service order, schedule installation, coordinate the project and arrange for any required inspections by SCE or PG&E and the city. (The chart below summarizes the critical pathway for project completion.)

8. **Inform residents:** Current and future residents should receive information on where, when, and how to use the new charging stations.

As the flow chart below indicates, there are a large number of steps involved in the installation of charging in a multi-unit development. To move through the process, it is helpful to reach out to charging station vendors and utility staff with hands-on experience in solving the many challenges in multi-unit building installations. Leading EV charger companies can be expected to provide some consulting assistance in cases where end users will be specifying their equipment.
R.7. **Adopt building code amendments to mandate pre-wiring for EVSE in new and remodeled multi-unit buildings.** A strong policy approach to advancing deployment of chargers in multi-unit development is mandated pre-wiring. The City of Beverly Hills was the first to mandate pre-wiring in 2011, and their policy can be viewed at [http://www.beverlyhills.org/business/constructionlanduse/commercialbuildings/electricvehiclecharging](http://www.beverlyhills.org/business/constructionlanduse/commercialbuildings/electricvehiclecharging)

Other jurisdictions, such as the City of Palo Alto, the County of Santa Clara, Sunnyvale, and Emeryville, are adopting similar standards, though no such building codes have been adopted yet on the Monterey Bay. The threshold for mandated pre-wiring can be set at new construction or at the time of a major remodel. In its role as an EV planning consultant to the Southern California Association of Governments (SCAG), the Luskin Center for Innovation at UCLA has also made a policy recommendation for the SCAG region (which includes Ventura County) that EV charging stations—not merely pre-wiring (also known as “stub-outs”)—be required of all multi-unit developments at the time of an ownership change. This may not be viewed as politically feasible even in the context of the EV planning process. However, in light of the NRG settlement requirement to develop 10,000 “make-ready” sites, it is likely that mandating actual EVSE installations may not be more costly over the next several years than mandating pre-wiring would be, since an EVSE can be procured and installed at a pre-wired location for potentially in the range of...
$1,000 to $3,000 per charger. Of course, all decisions regarding local building code enhancements that exceed the California building code (CalGreen) are under the jurisdiction of cities or (in the case of unincorporated areas) the relevant county. Therefore, recommendations of the PCC would be advisory to cities and counties, and it would likely require mobilization of additional political support to achieve the adoption of either a pre-wiring mandate or an actual charger installation mandate.

2.6. Comprehensive Regional Charging Network Development – Challenges and Solutions: As noted above, the Monterey Bay PEV Coordinating Council (MBPEVCC) and its partner network has been quite successful in building an initial network of EV chargers. The Coordinating Council actively sought out and encouraged sites to install equipment through various federal and state grant programs, and there are now over 200 public EVSE’s in our region, including XX DC Fast Chargers, and most cities have Level 2 public charging facilities. This initial backbone of public charging is only starting to meet the needs of the region’s PEV drivers in 2015 and beyond. To address the situation, the Monterey Bay PEVCC is actively pursuing grant opportunities to increase public charging opportunities and is encouraging workplaces, cities, businesses, multi-unit residential, and other property owners to invest in charging infrastructure.

To help further guide and catalyze the growth of a robust charging network in the region, the MBPEVCC infrastructure plan has mapped existing charging stations and identified potential new sites for infrastructure, including a minimum level of DC Fast Chargers. With completion of the CEC and DOE funded infrastructure planning process, Monterey Bay PEVCC will expand its outreach to ensure continued co-investment by both public and private entities in the development of the region’s EV charging infrastructure. In addition, local incentives to support PEV charging infrastructure – including deployment of Level 2 and DC Fast Charge stations -- is available. Importantly, the Monterey Bay Unified APCD has provided an EV infrastructure grant programs, which has provided an aggregate total of more than $XX,XXX,000 for EV charging infrastructure in the 2011-2015 period.

Encouragement of Local Charger Investment: In addition to leveraging publicly funded infrastructure deployed through larger EV charger companies, individual site owners in the PCC region are encouraged to invest their own resources in publicly accessible charging. Additional outreach activities will be conducted at the annual Green Car show developed by Ecology Action and REACH Strategies. Ecology Action and the Center for Sustainable Energy will also jointly produce EV Readiness workshops in each Monterey Bay county.

Private Partnership Funded Projects: EV charging infrastructure can also be deployed by local property owners via partnership arrangements with a charge station vendor (such as Chargepoint) or charge network operator (such as NRG) that may be willing to install, maintain, and operate the charging equipment at no cost to the owner. The vendors can collect monthly subscription plan fees (with unlimited charging privileges) or per session fees from EV drivers.

2.7. Recommendations for Comprehensive Charger Network Development: Siting recommendations for the regional EV Plan are based on the principle that Battery Electric Vehicles (BEVs) need charging to extend the range of their vehicles and plug-in hybrid owners strongly prefer to drive in EV mode over gas mode. In short, a robust public charging network enables more electric miles to supplant gas miles. To support enhanced electric range for all types of PEVs, including those with Fast Charge capability, both the Central Coast and Monterey Bay PEV Readiness Plans focus on highway corridors that connect Southern and Northern California along the 101 Freeway, workplace charging, regional commercial centers, and destination charging sites. Corridor charging locations with DC Fast Chargers located every
30 or 40 miles from Ventura County all the way through Santa Cruz County will enable Battery EVs to take longer trips and recharge from near empty to 80% charge in approximately thirty minutes.

Workplace charging can most effectively increase electric range for those PEV drivers whose effective all-electric range is less than their roundtrip commute distance to work. The PCC regional plan has identified prime locations in the tri-county region to host workplace charging. In addition, “destination charging” sites include popular shopping centers, parks, harbors, airports, train stations, colleges, government buildings, downtowns, beaches, and cultural facilities. Another key category for EV charging infrastructure is multi-unit developments (MUDs), discussed in Section 2C.

**Charger Network Development Recommendations**

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<th>Recommendation</th>
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<tr>
<td><strong>R.8.</strong> Pro-actively meet with EVSE providers to ensure PCC sites are prioritized</td>
<td>8A. Coordinate plans for Monterey Bay charger network deployment with key vendors, e.g., NRG, ChargePoint as part of ongoing site development processes. (Monterey Bay PEV Coordinating Council)</td>
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<tr>
<td><strong>R.9.</strong> Develop building code amendments that promote EV-ready and solar-ready buildings, parking facilities, and public works for new construction or major renovations.</td>
<td>9A. Promote model ordinances and guidelines specifying: -- minimum levels of pre-wiring (going beyond the raceway and conduit in the voluntary 2012 CalGreen standards) -- minimum levels of EV-ready parking, such as a 3% minimum for office, lodging, medical, and governmental; 1% minimum for retail, recreational, and cultural facilities; and 10% minimum for multiple-dwelling units, based on recommendations of the PCC and local stakeholders.</td>
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<tr>
<td><strong>R10.</strong> Integrate PEVs into local fleets</td>
<td>10A. Support participation by fleet managers in Green vehicle showcases hosted by Ecology Action and REACH Strategies 10B. Track and promote opportunities for special fleet lease/purchase deals offered by major OEMs</td>
</tr>
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**Discussion of Recommendations R-12 – R-14 to Advance Integrated EV Ecosystem Planning by Industry and Government:** The PCC Steering Committee and many cities and counties have benefitted from grant funded charging station projects, and new grant programs continue to be introduced through California Energy Commission solicitations. Priorities that are currently being addressed by vendors and PCC Steering Committee members include the following:

- **Corridor planning:** PCC has assessed high-priority siting options for DC Fast Charging on key travel routes. Of most importance is a corridor of charging stations along Highway 101, connecting our largest cities approximately every 30 miles. A second tier of sites include additional locations along Highway 101, as well as sites on other regional highways, some in key corridors connecting to I-5. Maps of suggested DC Fast Charging sites are included in Appendix R. New DCFC installations funded by the California Energy Commission are mandated to include an upgrade path to ensure dual compatibility between the current dominant DCFC standard – known as CHAdeMO (supported by Japanese manufacturers) – and the SAE Combo fast charging capabilities now being introduced by American and European manufacturers.
- **Surveying workplace and fleet EV users:** As part of the EV Readiness Planning effort, Ecology Action is surveying workplace and fleet charging users. Follow-on efforts will include informing workplaces and fleets of federal and state incentives and grant opportunities, education and questions answered, best practice sharing, fostering peer to peer relationships by connecting those having added EVs and/or charging infrastructure to those whom are considering it, and EV 101 events at selected large employers.

- **Coordinated response to upcoming CEC or other solicitations:** Monterey Bay PEVCC community stakeholders benefit from coordination of funding proposals among local agencies and prospective charging network operators. The MBPEVCC is monitoring solicitations and communicating options to local stakeholders as opportunities arise.

- **Possible deployment of subscription plans:** Subscription plans may raise issues of interoperability with other charging networks. Currently, some EV network vendors have made commitments to development of inter-operable networks – whereby consumers can have access to any charge station in a manner similar to the STAR system for Automated Teller Machine (ATM) inter-operability. These include the Collaboratev partnership launched by Chargepoint, and open networks such as Greenlot’s SKY network. However, these agreements have not yet been formalized across all vendors, and communication, clearance, and settlement protocols not yet fully developed. EV advocacy groups have pointed out that drivers will not be well-served if they must join multiple networks and pay multiple monthly network fees to have full access to California’s public EV chargers. The California Energy Commission has required open standards for grant opportunities. PCC is continuing to monitor this situation and will provide comment to vendors as plans are further developed.

- **Common protocols for identification of network operating and usage status.** Drivers need to know if charging stations are in operation or if they are being utilized. A National Electrical Manufacturers Association (NEMA) EV technical committee is working to develop and deploy these protocols, likely in the 2013-14 timeframe.

- **Possible deployment of reservation systems,** particularly for Fast Chargers. This issue is being discussed as part of the Collaboratev partnership, and standards are likely to emerge in 2015.

As noted in Recommendation #13 above, the EV infrastructure planning process will benefit from the inclusion of both public sector and industry input to ensure that selected sites meet community needs, and that installation, operation, and maintenance cost factors are all considered in evaluating public charging site opportunities. To that end, Ecology Action, on behalf of all MBPEVCC stakeholders, has reached out to key network operators, including NRG, Chargepoint, AeroVironment, and others, to ensure regional coordination of charger siting and program opportunities.

### 2.8. High-Level Siting Recommendations:

The following high-level siting recommendations are provided as a framework to guide ongoing siting work.

1. **Financial feasibility:** Select sites must be financially feasible given available installation incentives, or provide other real benefits to the site owners. (Note that average Level 2 installation costs are typically in the $3,500 to $4,500 range, although a broader cost range can sometimes be accommodated for larger-scale deployments.)
2. **Visibility and accessibility**: Select highest-utilization, highest-visibility, publicly accessible locations for the first few chargers. Examples include government office buildings, shopping malls, restaurants, hotels, parks, marinas, municipal parking garages, colleges, schools, and airports.

3. **Power supply**: Select a location where Level 1 (120/15A) or Level 2 (240V/40A), or Fast Charge (480 volt) electrical supply is or can be made available with relative ease and minimal cost.

4. **ADA Access**: Consider and comply with ADA guidelines for disabled access, and take precautions to ensure that charger cord management is optimized to reduce risk of accident or injury.

5. **Security**: Select secure locations with adequate lighting.

6. **Signage**: Provide enforcement and other signs that comply with the Manual on Uniform Traffic Control Devices (MUTCD) and California Vehicle Codes (CVC).

7. **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 bollards, while simultaneously taking into consideration ease of access to the charger, mobility of users, and foot traffic in the area.

In the Appendices below, sample language is provided addressing the following key elements of PEV infrastructure:

- **Standard plans, details and specifications** for public infrastructure projects to accommodate EV charging stations.
- **Ordinance language** requiring the installation of electric vehicle charging stations when significant development or redevelopment occurs.
- **Zoning code amendment language** requiring a percentage of parking spaces in new multi-unit dwelling projects to include EVSE.
- **Building and electrical code guidelines** requiring that:
  - Electrical supply infrastructure and equipment be scaled to accommodate PEVs
  - All new residential units should include basic infrastructure, such as conduits, junction boxes, wall space, and electrical panel and circuitry capacity to accommodate future upgrades for both EVSE and PV systems.

2.9. **Ratio of Charging Stations to PEVs**: The Electric Power Research Institute (EPRI) has conducted research on how much EV charging infrastructure is needed to serve a given level of PEVs, with a focus on workplace and public usage. EPRI developed a “benefits tested scenario” to arrive at a recommendation to guide planners seeking to establish a ratio of charging stations per vehicle. EPRI’s analysis yields a scenario in which the charging station-to-vehicle ratio ranged from 0.01 to 0.15 for BEVs and PHEVs. Applying this forecast to a long-range PEV regional estimate of 23,000 (which could be achieved by the early 2020s) yields the following EVSE deployment goal.
Based on analysis conducted by ICF International for the greater Bay Area PEV Readiness Plan, installation costs of Level 2 EVSE were estimated to range from $900-$2,350 for deployment at MDUs or workplaces. However, cost range can increase significantly for publicly-accessible charging, depending on site characteristics. For instance, trenching and cutting costs can increase the installation costs by upwards of $3,000-$5,000 for Level 2 EVSE installations. Costs can be much lower if EVSE are installed as part of new construction.

The level of investment required to support the forecasted PEV populations for the Region is difficult to estimate for many reasons. The most significant reasons include: a) it is unclear what the split between Level 1 and Level 2 charging needs will be as the market develops and expands; b) the costs of installation will vary considerably based on site characteristics; and c) the level of charging that will be required based on PEV technology and deployment trends is uncertain. If real-world ranges of 200 miles or more become the norm after 2020, the demand for public Level 2 charging may decline on a per vehicle basis, as an even higher percentage of charging will occur at home or at Fast Charge and (potentially) at switch stations. It is also important to note that Level 1 and Level 2 AC charging costs do not exist in a vacuum. DC Fast Charging and other emerging charging technologies may put downward pressure on the price and need for Level 1 and Level 2 charging.

Monterey Bay PEVCC stakeholders are pro-actively responding to opportunities for state and federal investment in charging infrastructure, in order to further extend the region’s charging network. PCC will continue to cultivate prospective sites and match them with EV Service Providers that use sustainable business models for the development and operation of a viable regional charging network that will leverage private and public resources for the benefit of the community as a whole.

### 2.10. Promotion of EV-ready (and Energy-Efficient) Buildings and Parking Lots

The highly variable cost of installing Level 2 EV infrastructure (ranging as widely as $2,000 or less to $10,000 or more) is due in large part to the fact that garages and parking areas – in residential and commercial structures – have not been consistently prepared with the requisite conduit and panel capacity to support a 240 volt plug in a convenient location. By requiring new conduit and stub-outs or plugs with appropriate capacity in the next generation of buildings and public works, the cost of new EV charger installations can be dramatically reduced. In response to this opportunity, many jurisdictions in California and beyond have adopted ordinances requiring the installation of EV charger (and solar photovoltaic) pre-wiring in new or substantially remodeled commercial and residential structures. Additionally, effective in July 2012, Title 24 of the state building code, also known as the CalGreen standards, recommended a voluntary standard that calls for new residential units to include a raceway and conduit from the subpanel or main service to the proposed location for the charging system, terminated into a listed box or cabinet. For

<table>
<thead>
<tr>
<th>Vehicle Forecast</th>
<th>L1 and L2 EVSE</th>
<th>EPRI Method (mid-level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHEV</td>
<td>BEV</td>
<td>low</td>
</tr>
<tr>
<td>18,854</td>
<td>4,753</td>
<td>2,647</td>
</tr>
</tbody>
</table>
multi-unit developments (greater than 2 units), the CalGreen standard recommends at least 3 percent of the total parking spaces, but not less than one, to be capable of supporting future EVSE for Level 2 charging (Part 11 A4.106.2). The current voluntary standards may be recommended for mandatory implementation in 2016.

Going beyond the CalGreen standards, local agencies may wish to add additional requirements for pre-wiring (as opposed to just the raceway and conduit). In addition, some jurisdictions are also specifically requiring actual installation of EV infrastructure for larger developments (e.g., over 10,000 square feet), as in the ordinance language developed by the city of Mountlake Terrace in Washington.

| Proposed Requirements for EV Charger Deployment |
|--------------------------|-----------------|
| **Land Use Type**        | **Percentage of Parking Spaces** |
| Multi-household residential | 10% (1 minimum) |
| Lodging                  | 3% (1 minimum) |
| Retail, eating and drinking establishment | 1% |
| Office, medical          | 3% (1 minimum) |
| Industrial               | 1% |
| Institutional, Municipal | 3% (1 minimum) |
| Recreational/Entertainment/Cultural | 1% |

As a starting point for PCC consideration, Recommendation R.14 above recommends a 3% “EV make ready” minimum for office, lodging, medical, and governmental; 1% minimum for retail, recreational, and cultural facilities; and 10% minimum for multiple-dwelling units.

2.11. **EVs and Solar Photovoltaic Connections:** EVs and distributed photovoltaic charging are highly complementary technologies, particularly when EV drivers switch to Time-of-Use rates that enable inexpensive nighttime “super off-peak” charging of EVs, with rates as low as 9 cents/kWh and use their solar array to feed valuable “on-peak” power to the grid, being credited at rates of 20-46 cents/kWh. By charging at night and allowing solar power to flow to the grid at the most lucrative daytime rates, EVs and solar operate in a synergistic manner to decrease the cost and quicken payback times for both technologies.

Given the environmental and economic synergy between EVs and renewable electricity, communities, NGOs, and industry partners should build on existing public education strategies that link outreach and awareness efforts on EVs and solar PV where feasible and appropriate. The Community Environmental Council is reinforcing this message through their “Driving on Sunshine” campaign. This slogan captures the benefits of EV + PV in an easy to understand and remember tagline and features blog posts on local residents that have solar and EVs, highlighting the economic, environmental and energy security advantages of using a local solar power array on a rooftop to power an EV (more information in section 4 below, and stories are available at [http://www.cecsb.org/tag/blog/driving-on-sunshine](http://www.cecsb.org/tag/blog/driving-on-sunshine)). At recent Green Car Shows, solar carports have been displayed, further linking the connection between solar and EVs in an exciting visual display seen by tens of thousands and information provided by solar companies.

Solar should also be encouraged at public charging sites, along with the addition of fixed battery storage that can enable stored solar power to supplant more expensive, peak rate, higher-carbon power from the grid. Solar and storage can also lessen the cost of higher daytime electricity rates often faced by
public charging, along with exorbitant demand charges that local utilities charge, particularly for DC Fast Charging. Additional barriers could be reduced by policy initiatives that link pre-wiring for EV chargers and solar PV, and mandated pre-wiring for EV chargers in new construction or major remodels. Future solar installations will be made easier by a new Title 24 energy code provision starting January 1, 2014, for new construction and major remodels. These code now requires solar readiness, with provisions such as requiring a SE to W facing part of roofs be “solar ready” with pathway for conduit from the solar zone to the main service panel and sufficient space reserved for solar at the service panel.

2.12. Charger Accessibility Issues and Americans with Disabilities Act (ADA) Compliance: EV Charging Stations must comply with provisions of the Americans with Disabilities Act. Unfortunately, there is not yet definitive state-level legal guidance on how provisions of the ADA will be applied to all of the specific issues that arise in EV charging. However, the statewide Ready, Set, Charge! Guide for EV Ready Communities represent the most authoritative guidance document to date, and was reviewed by a technical committee of leading EV experts. The guidance for ADA compliance is contained in Appendix H of this document. Local communities are strongly urged to follow the recommendations contained in this guidance.

2.13. EV-Related Signage: EV related signage can provide a substantial boost to EV community awareness. By providing signs for each EV charging station that comprehensively cover the surrounding streets, community members will be reminded that EVs are a mainstream mobility option, and that the community is “EV-ready.” Signage must conform to state and federal guidelines, which are discussed extensively in the Appendix. Monterey Bay communities are strongly recommended to budget adequately for signage as part of each newly approved EV charging station. A typical rule of thumb is to plan for sign costs of $250 each, multiplied by the number of signs needed. Signage guidelines can be found at the Governor’s Office of Planning and Research EV Community Readiness resource page at www.

2.14. Summary Checklist of EV-Friendly Policies and Practices for Monterey Bay Jurisdictions: The following checklist summarizes the recommendations above, while adding a final recommendation on the key issue of EV fleet deployment: Integrate PEVs into Local Fleets. Additional information on this recommendation and on the issue of EV fleets is contained in Section 2.15: Guidelines for EV Fleets.

<table>
<thead>
<tr>
<th>Checklist of EV-Friendly Policies and Practices for Monterey Bay Jurisdictions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommended Practice</strong></td>
</tr>
<tr>
<td>R.1. Develop a charger permit form identifying all required elements</td>
</tr>
<tr>
<td>R.2. Provide EV charger installation process guidance and checklists</td>
</tr>
<tr>
<td>R.3. Establish reasonable – and flat – charger permit fees</td>
</tr>
<tr>
<td>R.4. Waive plan requirements for simple installations</td>
</tr>
</tbody>
</table>
2.15. Effective PEV Marketing and Outreach: Consumer surveys indicate that a principal barrier to PEV deployment is initial purchase price of PEVs relative to equivalent ICES. However, when consumers are introduced to the full range of PEV models, and understand the very low-cost leasing deals now available, interest can be effectively sparked. Individual regions within the state, as well as the state as a whole, are now developing “Go EV” campaigns that provide “ride and drive” opportunities to bring PEVs directly to consumers via special PEV-only events at workplaces, malls, fairs, and other community events. These events build on existing networks of grass-roots organizations, including environmentally conscious businesses, environmental and consumer advocacy groups, EV organizations, Clean Cities coalitions, and others. Monterey Bay stakeholders are now working to expand PEV ride and drive events with additional state and local match funding.

Encouraging Adoption of PEVs via “EV 101” Activities, Green Car Shows, and other Educational Programs: PCC is actively educating the public, major employers, and fleets through Green Car Show and other events. The largest events include Green Car Shows produced by Ecology Action and the Monterey Bay EV Alliance (MBEVA), especially Earth Day. The Earth Day event also includes a large-scale “ride and drive” that provides the opportunity to drive or ride along in an electric or hybrid car. Green car shows also include “owner’s corners” where people can talk to local owners of various EV models, solar carports and solar companies that explain the benefits of driving on sunshine, charging station displays, and other educational opportunities. The other local major EV educational events occur during National Plug in Day in September, which was celebrated is supported by Ecology Action, MBEVA, the Sierra Club, MBUAPCD, and others.

Monterey Bay PEVCC members also periodically host workshops on EV 101 and EV policies, which include information on: EV product options (current and forthcoming); EV life-cycle costs; vehicle purchase incentives; EV infrastructure choices, costs, and incentives; the EV economic and environmental value proposition for the region; the current state of EV-readiness planning and EV-friendly policy deployment; and ways to connect with EV vendors.

Outreach to Inform and Encourage Workplace Charging: EV 101 events described above are now also including significant outreach to employers that are most likely to respond to the EV value proposition
and the imperative to provide robust EV charging infrastructure throughout the region. These include larger employers, property managers, retail establishments, businesses concerned with their sustainability profile and green image, public employers such as colleges, universities, and medical centers, transit agencies, and community-based organizations. The PEVCC is holding EV 101 events at select workplaces that already have charging infrastructure installed, highlighting that many long distance commuters can see significant cost savings by switching to a 100 mpge+ EV. The workshops also introduce local employee EV drivers to prospective EV drivers in a parking lot display of EVs, which helps establish peer to peer expert relationships with “EV champion drivers” in each workplace. Workplace charging and fleet resources, such as the U.S. Department of Energy (DOE) Clean Cities guide to EV fleets (http://www.afdc.energy.gov/pdfs/pev_handbook.pdf) and the companion guide to workplace charging (http://www.afdc.energy.gov/pdfs/51227.pdf) are made available, along with complementary local information on the websites of the Air Pollution Control Districts and Ecology Action.

**Development of Information Resources on EVs, Incentives, Charging, Utility Programs, and Support Services:** As noted above, information resources on EVs, incentives, charging, utility programs, and support services are being communicated at the Monterey Bay PEVCC outreach workshops (in 2015-16 and ongoing), and at annual Green Car events. Additionally, information resources are hosted on the Air Pollution Control District website and the Ecology Action website, with links to additional resources, including PG&E, EV automakers, Plug-in America, and GoElectricDrive, among many others.

**Plan for Outreach and Education for Building Inspectors, Utilities, Facilities, Public Works Personnel, and First Responders and Public Safety Officers:** As noted above, the Monterey Bay PEVCC will be hosting *EV infrastructure and readiness workshops* as part of the EV Readiness project, developed in collaboration with the Center for Sustainable Energy. These workshops bring together building inspectors and other local government staff (e.g., planners, sustainability officers, and city managers), along with utilities, facilities and public works personnel to address:

- EVSE location issues
- EVSE operations and product types
- EVSE Safety
- Inspection and compliance issues
- Installation process streamlining
- PEV-friendly public works guidelines
- PEV-friendly building codes

### 2.16. Recommendations for PEV Fleet Procurement and Management

**Context:** Monterey Bay fleet operators will be a key stakeholder group that can help to drive the EV transition across the region. EV adoption within fleets will provide direct benefit to fleet operators and the community -- through reduced emissions, enhanced energy security, and improved operating economies. Importantly, by lending their organizational “stamp of approval” to EVs, fleet operators will help communicate the message to consumers generally that the EV value proposition is strong and EV charging infrastructure will continue to grow. Therefore, the final recommendation of EV-related actions for consideration by local government stakeholders is to *Integrate PEVs into Local Fleets.*
**Purchase and Evaluation Criteria:** Total Cost of Ownership, Environmental Criteria, and Climate Action Plan Considerations: The current pipeline of EV models is dominated by light-duty vehicles (LDVs). However, an increasingly large variety of medium duty vehicles (MDVs) and heavy-duty vehicles (HDVs) are also on their way. Both public and private fleet operators are potential targets for EV procurement. Thus, for local governments, *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 the EV transition.

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 will increasingly focus specifically on accelerated integration of PEVs into the fleet mix.

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

- Reducing costs
- Preparing for future conditions (including potential fuel price spikes or supply disruptions) and regulatory requirements
- Reducing the fleet’s harmful impact on the environment and human health
- Support the advancement of AB 32 goals, SB 375 Sustainable Communities Strategies, and municipal and county-level Climate Action Plans

**Emissions Reduction Potential:** The advantages of electricity over other fuel sources has been well-documented by the California Air Resources Board, given the relatively low carbon content of California’s electricity grid. However, biofuel and hybrid emissions comparisons can be complex given the multiplicity of criteria air pollutants and greenhouse gases. To arrive at specific impacts, fleet managers can insert their own fleet variables into an emissions calculator based on the industry-standard model accepted by the DOE and the EPA, available through the Argonne National Labs at: [http://greet.es.anl.gov/fleet_footprint_calculator](http://greet.es.anl.gov/fleet_footprint_calculator). Additional information on GHG impacts resulting from PEV deployment in the Monterey Bay area is available in Appendix P of this document (GHG Impact Analysis).

**Cost Comparisons:** At current prices, PEV fueling costs are significantly less than competing fossil fuel or biofuel options. While the *initial* purchase price of PEV fleet vehicles is typically higher than comparably equipped conventional vehicles, PEV buyers often enjoy lower total cost of ownership, based on reduced 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 pure Battery-Electric Vehicles (BEVs), the maintenance burden is significantly reduced compared to either internal combustion engine (ICE) or plug-in hybrid (PHEV) alternatives. 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.
### Operating Cost Comparison

**ICE vs. BEV**

<table>
<thead>
<tr>
<th>Category</th>
<th>ICE (Internal Combustion Engine)</th>
<th>BEV (Battery Electric Vehicle)</th>
<th>Fuel Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (per mile)</td>
<td>$0.140 Avg. 25 MPG – reg. gas Cost per mi.: $56/400 miles = 14 cents/mile</td>
<td>$0.014 Electricity cost of 5.6 cents per kWh. 1kWh = 4 Mi. of driving distance = 1.4 cents per mile</td>
<td>10x less</td>
</tr>
<tr>
<td>Lifetime Costs (6 yrs./108k miles)</td>
<td>$15,120</td>
<td>$1,512</td>
<td>$13,608 savings in 6 Yrs.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Gasoline (ICE)</td>
<td>Electric (BEV)</td>
<td>Maintenance Savings</td>
</tr>
<tr>
<td>Est. routine service and engine wear</td>
<td>~$6,000</td>
<td>~$2,000</td>
<td>$4,000 savings in 6 Yrs.</td>
</tr>
<tr>
<td>Ownership</td>
<td>Gasoline (ICE)</td>
<td>Electric (BEV)</td>
<td>Ownership Savings</td>
</tr>
<tr>
<td>Est. Insurance (6 Yrs./108K mi.)</td>
<td>~$6,000</td>
<td>~$5,000</td>
<td>$1,000 savings in 6 Yrs.</td>
</tr>
<tr>
<td>Est. DMV Smog (6 Yrs./108K mi.)</td>
<td>~$400</td>
<td>~$50</td>
<td>$400 savings in 6 Yrs.</td>
</tr>
<tr>
<td>TOTALS</td>
<td>~$27,520</td>
<td>~$8,512</td>
<td>~$19,008/6 Yrs.</td>
</tr>
</tbody>
</table>

**Usage Pattern**

- **TERM:** 6 Yrs.
- **USAGE:** 18,000 mi. / Year
- **TOTAL Mileage:** 108,000

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\(^1\) 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.

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**Recommended Steps to Advance EV Fleet Deployment:** To engage a PEV-focused fleet initiative, it is recommended that fleet managers:

- Develop fuel efficiency targets (which are convertible to GHG and other criteria pollutant emissions factors)
- Analyze fleet duty cycles in comparison with available PEVs with regard to range, charging requirements, and operating costs
- Develop a comprehensive green fleet plan that includes goals, milestones, staff responsibilities, commitments from top management, and monitoring and implementation strategies.
- Assess opportunities for joint procurement with other public and private fleet operators, in cooperation with the California PEV Collaborative and statewide Clean Cities Coalitions.

**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. As of late 2013, PEV models 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, 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\(^2\), which tracks all classes of PEVs, and CalStart\(^3\), which focuses on medium and heavy-duty options.

**Co-Location of Fleet Charging with Publicly Accessible Charging:** 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 utility surcharges known as demand charges, as well as utility time-of-use rates to select an optimum configuration for their needs. 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 may not require the same level of power supply upgrade costs as Level 2 charging. For vehicles needing the fastest turnaround for demanding applications such as shuttle or taxi services, DC Fast Charging may be a high-priority need and worth the extra cost. It is important to note that it can be mutually advantageous for the general public and public fleet operators to co-locate fleet charging where practical. Specifically, many fleet vehicles may be gone most of the day and visitors could occupy charging stalls in the meantime. When visitors depart at closing time, then the fleet vehicle can be parked in that stall overnight.

**Publicly Accessible Charger Cost Factors:** The table below provides some indication of the range of costs likely in different charging circumstances:

\(^2\) [http://www.pluginamerica.org/](http://www.pluginamerica.org/)
\(^3\) [http://www.calstart.org](http://www.calstart.org)
## Estimated Vehicle Charging Times and Charger Hardware and Installation Costs

### Fleet Charging and Management:
Several manufacturers, including Aerovironment, Chargepoint, 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.

### Targets for PEV Fleets, Fleet Adoption Rates, and Strategies and Resources to Overcome Adoption Barriers:
To advance PEV plans, Monterey Bay fleet operators may wish to consult these key resources:

- U.S. DOE Clean Cities EV fleet handbook

- U.S. DOE Clean Cities EV and Alternative Fuel Vehicle (AFV) case studies

---

<table>
<thead>
<tr>
<th>Charger Type</th>
<th>Charge</th>
<th>Time to Charge Vehicles at Various States of Charge</th>
<th>Charger Hardware Costs</th>
<th>Installation Costs</th>
<th>Typical Range of Total Costs</th>
<th>Average Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Volt 16 kWh</td>
<td>Leaf 24 kWh</td>
<td>Tesla 53 kWh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Level 1 1.4 kW</td>
<td>Half</td>
<td>6 hrs</td>
<td>8.5 hrs</td>
<td>19 hrs</td>
<td>$300 - $500</td>
<td>$300 - $500</td>
</tr>
<tr>
<td>120V</td>
<td>Full</td>
<td>11 hrs</td>
<td>17 hrs</td>
<td>38 hrs</td>
<td>$200 - $6000 commercial</td>
<td>$500 - $1500 home</td>
</tr>
<tr>
<td>AC Level 2 7.5 kW</td>
<td>Half</td>
<td>1 hrs</td>
<td>1.5 hrs</td>
<td>3.5 hrs</td>
<td>$500 - $1500 home</td>
<td>$2000 - $6000</td>
</tr>
<tr>
<td>240V</td>
<td>Full</td>
<td>2 hrs</td>
<td>3 hrs</td>
<td>7 hrs</td>
<td>$500 - $2500/home</td>
<td>$3,000 – 5,000</td>
</tr>
<tr>
<td>DC Fast 50 kW</td>
<td>Half</td>
<td>10 min</td>
<td>15 min</td>
<td>35 min</td>
<td>$25,000</td>
<td>$15,000 - $30,000*6</td>
</tr>
<tr>
<td>480V</td>
<td>Full</td>
<td>20 min</td>
<td>30 min</td>
<td>70 min</td>
<td>$55,000</td>
<td></td>
</tr>
<tr>
<td>DC Fast 150 kW</td>
<td>Half</td>
<td>5 min</td>
<td>8 min</td>
<td>17 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>480 volts</td>
<td>Full</td>
<td>10 min</td>
<td>16 min</td>
<td>35 min</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

4 Hardware costs are trending downward quickly
5 For hard-to-serve installations, costs can vary upwards
6 Higher-cost units have multi-car charging capability
American Public Works Association (APWA) fleet resources
http://classic.apwa.net/ResourceCenter/index.asp?Section=equipment&SectionName=Equipment+Fleet+Management

California Energy Commission (CEC) links to funded fleet initiatives and infrastructure initiatives:
http://www.energy.ca.gov/drive/projects/electric.html

2.17. Current PEV Fleet Adoption in the Monterey Bay: Fleet adoption of Plug-in Electric Vehicles on the Monterey Bay is modest as of 2014. Surveys conducted Ecology Action found that a total of approximately XXX PEVs are currently deployed among major fleet operators responding to the survey, and the majority of these are low speed neighborhood electric vehicles at educational institutions. In fact, to our knowledge there are likely fewer than XX freeway capable EVs in Monterey Bay municipal fleets, with a handful in private fleets. (See the table below.) There are very few major private fleet operators in the region, and the largest national entities – UPS, and the US Postal Service, FedEx – have not yet deployed PEVs in the region or announced plans to do so. However, these entities are testing PEVs in other regions and it is anticipated that national fleet deployment plans may be announced in the 2015-16 period based on the results of current testing with Medium Duty Vehicles. As part of its dialogue with stakeholders and the overall regional planning effort, the Monterey Bay PEVCC has assessed barriers to increased PEV fleet adoption, and identified strategies to encourage adoption. These are articulated following the fleet table. Only larger public and private fleets with some Alt Fuel and/or PEV penetration were included in the table.

NOTE – THIS TABLE NEEDS UPDATING BY CEC - SB

<table>
<thead>
<tr>
<th>Fleet Operators</th>
<th>Vehicle Types (ICE)</th>
<th>Alt. Fuel Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Fleet</td>
<td>2-Wheel Light-Duty</td>
</tr>
<tr>
<td>Higher Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government/Corporate</td>
<td></td>
<td></td>
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<td></td>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.18. Barriers to Adoption and Strategies to Address the Barriers

- **Vehicle Cost Barriers:** Initial purchase price remains the primary obstacle to broader adoption of PEVs in fleets. However, fleet owners are more likely than individual consumers to consider the total cost of vehicle ownership. Therefore, efforts to address infrastructure, fueling, and vehicle costs in a holistic manner may prove more effective than targeting just one component of the PEV ecosystem.

- **Cost Strategies:** Existing state and federal incentives that lower the initial purchase price are enhancing PEV attractiveness for fleet PEV deployment. In some regions, including the Bay Area, South Coast, and Monterey regions, the local Air Districts are providing additional rebates for PEVs in fleets, based on AB 2766 and other programs. Regional air districts in the Monterey Bay area may wish to consider a pilot program to incentive PEV fleet deployments through buy-down of either vehicles or associated infrastructure. In addition, pro-active outreach to fleets will help to keep fleet operators current on PEV total cost of ownership. Based on many common fleet duty cycles and recently announced special fleet leasing programs, the TCO of a lower-cost BEV, such as a Nissan Leaf and Mitsubishi i-miev, is significantly advantageous compared to the ICE equivalent. As this data become more widely shared, it is anticipated that PEV fleet adoption in fleets will pick up. It is also important to note that fleet turnover rates are lengthening, such that PEV purchase opportunities will be emerging incrementally over the coming years.

As PEV costs are reduced, and TCO advantages increase year over year, it is anticipated that fleet adoption in the light-duty segment will increase significantly. In addition, according to recent testimony by the UPS National Fleet Manager, the TCO on a PEV variant of the UPS medium duty cargo van is very close to level with ICE versions based on the current incentive structure. As additional scale economies are achieved in the coming two to three years, a cross-over point is likely to be reached, and PEV deployment in the MDV segment will likely increase significantly.

- **Infrastructure and Fueling Cost Barriers:** Infrastructure and electric fueling costs can also pose barriers to adoption. For some companies, charging vehicles at night does not significantly increase peak electricity costs because the charging is occurring when other operations are closed or operating at reduced levels. However, for major delivery firms like UPS, peak charging time for PEVs—from about 7 PM to 4 AM—coincides with peak operations at warehouse and processing sites. As a result, new electricity infrastructure may be required and capacity charges would likely increase. Also, outreach to local government fleets indicates that many of the buildings where vehicles are currently located are at or near electrical capacity—as a result, additional panel upgrades and/or new transformers may be required. Although there are incentives available for EVSE installation, these incentives do not always cover the costs of electrical upgrades.

- **Infrastructure and Fueling Cost Reduction Strategies:** Infrastructure costs in some cases can be reduced if fleet chargers can be co-located with publicly accessible EVSE, where public charging revenue may be available during the day to offset capital and operating costs, while much fleet recharging would be done at night. In addition, battery-backed and solar-linked charging systems may provide additional revenue for grid services (such as frequency regulation) or solar net metering. For these installations, the Self-Generation Incentive Program (SGIP) is available for batteries, while a variety of California solar incentives are available for
solar PV. Time of use rates available from PG&E and Southern California Edison can substantially lower e-fueling costs. Finally, flexible leasing terms recently announced by Chargepoint are likely to be available for other EVSE vendors as well, which will make it possible for fleet operators to spread out EVSE payments over 5-8 years, thereby reducing or eliminating up-front expenditures. For private site owners, the 30% federal investment tax credit on EVSE may be available in future years, depending on Congressional action. In addition, some public entities with large procurements of qualifying equipment and vehicles may be able to participate in transactions where the value of the tax credit is reflected in the purchase price.

- **Limited PEV Models and Resale Value Uncertainty.** Limited PEV options, particularly in the medium and heavy-duty categories, as well as pick-up trucks, bucket trucks, and other utility vehicles, restrict purchasing opportunities for fleet operators with diverse needs. Further, newer versions of vehicle models currently in use tend to be purchased to replace older models, and PEV equivalents are still limited. Uncertainty about PEV resale value is also a challenge for fleet operators who need to forecast total cost of ownership with high accuracy.

- **Strategies to Address Limited PEV Models and Resale Value:** As a response to the issue of ambiguity regarding total cost of ownership, CALSTART is working on a total cost of ownership calculator to assist in determining cost when considering the purchase of PEVs. To more fully define operating cost, and to enhance operating revenue and resale value, PG&E has recently issued a Request for Proposals (RFP) to major automakers that calls for a demonstration fleet deployment that will develop new models for the integration of PEVs into Demand Response (DR) programs, whereby fleet operators could be provided discounts on energy costs or direct payments for fleets that agree to modulate charging in response to signals from the grid operator. Additionally, the PG&E pilot will work with automakers and fleet operators to assess the value of the battery when redeplored in a grid services configuration at the end of its useful vehicle life. This could enhance resale value of the vehicle or enable economic replacement of the battery.

- **EVSE Availability and Charge Time.** The operational range of PEVs work well for many fleet applications. However, some have less predictable day-to-day routes and some operators may have concerns about vehicle range in a region without widespread EVSE availability. In fact, some local fleets limit the geographic area employees can drive EVs, which reduces electric mileage per year and hinders payback. There may also be concerns about the lengthy charging time of some PEVs if fleet vehicles are operated on a higher mileage basis.

- **Strategies to Address EVSE Availability and Charging Time.** To address EVSE availability and charge time management issues, fleet operators have a range of EVSE options that can be carefully tailored to their needs based on specific duty cycles. For example, some fleets may be able to specify vehicles with smaller battery packs if, on fixed routes, they are able to deploy or co-locate either Level 2 or Fast Charge facilities that work for mid-day recharging. The savings on reduced battery needs could help pay for the necessary infrastructure. Also, for vehicles that rarely need recharging during the day, fleet operators can deploy Level 1 charging, which works well for overnight charging scenarios. While Level 1 equipment typically costs almost as much to procure and install, in many cases it will not require the panel or transformer upgrades that a bank of Level 2 chargers often requires. In such situations, the cost savings can be dramatic.

- **Accounting Practices.** The accounting practices of some fleets limit their ability to include fuel savings as part of their decision-making process for purchasing new vehicles. Therefore, their
purchase decisions do not reflect effective amortization of the higher costs of PEVs through fuel savings. To address this challenge, fleet operators can be introduced to updated accounting practices where fuel cost, vehicle price, and maintenance cost are considered as part of a total cost of ownership platform, making it easier to develop a business case for the purchase of PEVs in a fleet.

- **ADA Compliance.** Fleets interested in deploying PEVs may choose to make the associated EVSE publicly accessible. In this case, fleets will have to ensure that publicly available parking is compliant with ADA requirements. In some cases, this may increase the investment required significantly. To address this barrier, the Governor’s Office of Planning and Research is working on an electric vehicle charging station accessibility guidelines document (the draft is available at: [http://opr.ca.gov/docs/PEV_Access_Guidelines.pdf](http://opr.ca.gov/docs/PEV_Access_Guidelines.pdf)).

### 2.19. EVs in Rental Fleets

Integration of PEVs in rental fleets is a high priority for PEV ecosystem development, as market exposure to PEVs can be greatly accelerated if a broad variety of PEVs is available via major rental companies. In the Monterey Bay, the primary PEV rental experience to date is with Enterprise. On a national basis, Enterprise has 200+ PEVs in service, about 35 of which are in Southern California, with several in the city of Thousand Oaks (Ventura County). EVs were available at the Santa Barbara location until recently, when they were discontinued due to low utilization. Available PEVs include Leafs, Teslas, and a few Volt or Prius PHEVs. Enterprise is in discussion with Tesla about securing additional vehicles. Approximately ten locations are served with Type 2 chargers as of the end of 2013.

The biggest challenge Enterprise has faced is utilization; occupancy for BEVs in particular is far below standard offerings, and the firm is unable to make up for this gap via additional rate surcharges. Most customers are reluctant to take a chance with range issues while driving a BEV, and are not willing to pay a premium for the service. While market acceptance is improving, Enterprise would like to see it ramp up faster. According to a local Enterprise manager: “Range is the big show-stopper right now— they believe the range of a BEV is insufficient. However, many people are fine renting a PHEV as long as they don’t have to plug it in. That said, people in the know like the HOV lane access of the PEVs. No doubt the sands are shifting, and I have every expectation that broader market acceptance will be here, whether in the form of BEV, PHEV, or even fuel cell form.”

### 2.20. Multi-Unit Development Charging -- Cost Factors and Policy Options

**Overview:** The challenge of installing PEV charging in multifamily residences -- including apartments and condominiums -- is a key obstacle to full market penetration of EVs. The problems of multi-dwelling unit (MDU) charging include: insufficient number of parking spaces, constrained electrical room capacity, expensive installation costs, and multiple EV charging station users. Since much of the Monterey Bay’s urban population lives in some form of multi-unit residential building, EV owners in these buildings will need to find inexpensive and reliable ways to charge their EVs. The following discussion provides further detail on cost factors, MDU challenges from building owner and resident perspectives, and policy approaches adopted in Los Angeles, which can be considered by Monterey Bay stakeholders.
It should be noted that work on the MDU challenge in California has only just begun. The CEC has recently issued its first solicitation specifically targeting MDU issues. In addition, advisory documents have recently been developed by the California PEV Collaborative, available at http://www.evcollaborative.org/MuD. Given the resources now available via the PEV Collaborative, the discussion in this appendix is intended to summarize key opportunities for driving down costs through local policy approaches, especially mandated stub-outs and charger installations in new buildings and major remodels.

The City of Los Angeles was among the first municipality in California to begin tackling the MDU challenge, by adopting a Green Building Code mandating that all new single family and multifamily construction be equipped with the required electrical infrastructure and designated parking spaces to accommodate PEVs in the context of larger residential multi-family buildings. Of course, this initiative does not address existing housing stock. Therefore, in Los Angeles as on the Monterey Bay, property managers and homeowner association (HOA) boards must proceed on a voluntary basis until more robust legal requirements are in place, and cost factors must be addressed realistically.

Cost Range for Level 2 in MDU Contexts: Currently, EV charger installations in a multifamily building can range anywhere from $2,000 for a low-cost multifamily installation, to $10,000 or more for an apartment building requiring trenching to install a new conduit, a new circuit, and electric meter. One approach to reducing these costs is to carefully assess whether Level 1 (110 volt) charging may be adequate, as these equipment and installation costs are typically a fraction of the Level 2 requirement. This will be explored further in future phases of the Monterey Bay plan implementation process, as level 1 charging installations are just now being deployed in California, and industry understanding of cost, energy management, and liability factors are still evolving.

Choosing Charging Levels in MDU Contexts: EV charging requirements are influenced by the type of EV (BEV vs. PHEV), daily distance driven, electricity prices, driving style, load, and conditions such as temperature and grade. Battery charging times for the Nissan Leaf and Chevrolet Volt are indicated below for illustrative purposes.

<table>
<thead>
<tr>
<th>Vehicle Model</th>
<th>Battery Capacity</th>
<th>Hours to Fully Charge From Empty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Level 1 (110/120V)</td>
</tr>
<tr>
<td>Nissan Leaf (1)</td>
<td>24 kWh</td>
<td>20</td>
</tr>
<tr>
<td>Chevrolet Volt (2)</td>
<td>16 kWh</td>
<td>10</td>
</tr>
</tbody>
</table>

Sources: http://www.nissanusa.com/leaf-electric-car/faq/view/97#/leaf-electric-car/faq/view/97
http://www.chevrolet.com/volt/#technology

Drivers who are depleting the battery on a daily basis need to charge nightly. But if drivers deplete one third of the battery per day, they may only need to charge at a slower Level 1 (110 volt) rate. Further, drivers charging at work and at businesses that offer EV charging may not need to charge as frequently. The combination of all of these factors will impact the feasibility of a Level 1 vs. Level 2 charging station. A Level 1 charging station will typically be more suitable for PHEVs and other vehicles with smaller battery sizes similar to the Chevrolet Volt, while a Level 2 charging station is typically more suitable for
larger batteries, as in the Nissan Leaf. Level 1 charging typically may not require any new installation costs, as the charging device is portable and a 110 outlet is often available in an existing parking lot or garage. Further, the liability for the charger equipment more clearly rests with the tenant insofar as the portable charger is his or her property as part of the vehicle.

**Construction Constraints:** Parking access considerations are a crucial determinant of charging station installation costs. Installations are typically less expensive for parking spaces located a short distance from the electrical panel, and more expensive for parking spaces located farther away. Running a line from the electrical panel to the charging station can be the most difficult step in assuring power delivery to an EV. The crux of the problem lies in whether or not there is an existing conduit from the panel to the parking space. If a conduit does not exist, the farther away the charger is from the panel, the more creative, and the more expensive, the solutions become.

In many cases, building electrical panels are fully utilized and do not have any room to add new circuits. This problem can be overcome by adding panel capacity. Adding more than 400 Amps will typically trigger a plan review, meaning the applicant will incur higher costs. In addition, electrical room space can be a limiting factor. In apartment buildings, panels are usually located in electrical rooms, which are also where electricity meters can be located. Adding another panel can be an issue for some buildings that have small electrical rooms. Additionally, if the building owner decides to meter a circuit separately (i.e. sub-metering), then a new meter would have to be provided.

**Capital Cost Recovery:** HOAs, building managers, and building owners often oppose installations because of upfront capital costs and concern about ongoing utilization rates, particularly if the original tenant or unit owner moves away. Thus, the potential to at least break even on the installation is a key issue. Estimates by the Luskin Center at UCLA project break-even monthly fixed costs under low cost ($3,600) and high cost ($11,600) installations, assuming a 7-year loan term, with and without financial incentives of $2,000 each toward the total charger project. The fixed cost includes a relatively low-priced Level 2 charging station ($1,500), a city permit ($100), and low ($2,000) or high ($10,000) installation costs.

**Financing EV Charging Stations:** Most charging station installations in multifamily buildings will be financed by some entity representing the building’s ownership. For example, an HOA would finance the purchase and installation of a charging station in a condo, and a building owner would finance it in an apartment building. In both cases, the investing entity will pass costs onto users, and some entities might want to earn a profit. EV charging station users can pay a fixed cost to service the loan and pay for taxes. Payment can be made on a monthly basis, similar to the payment cycle for rental apartments and HOA fees, or it can be made incrementally during each EV charging session, with a fee assessed on a time-basis (e.g. by the second, minute or hour the EV is charging). Most HOAs are tax-exempt entities and would not typically seek a profit, but an apartment building managed by a real estate investment trust (REIT) may require a profit or break-even scenario. In many other circumstances, HOA dwellers with their own garages or deeded and immediately adjacent carports, the resident may be able to add an EV charging station without concern for HOAs.

**Negotiation Factors:** As representatives of a building’s common spaces, and as forums for residents to voice private interests, many HOAs may be willing to facilitate EV parking access solutions to the greatest extent possible. Parking spaces are negotiable and have a price – it is simply a matter of what concessions each party is willing to make, and what prices are deemed acceptable. The transaction could be between individuals, or between the HOA and individuals. For example, EV owners desiring a specific parking space might be willing to pay for it, or swap spaces with the owner of the parking space in
question, if acquiring the space lowers the total cost of installing charging stations. If several EV owners are interested in sharing a single space, the HOA, or even a new third party entity, could purchase the space, and recover costs by charging EV charging station users. Opportunities to make “fair” transactions should be explored first in order to minimize EV charging station installation costs.

Electricity Cost Factors: To ensure fairness to other tenants, charging station users must pay for the electricity consumed to charge their EVs. Using low time-of-use (TOU) rates, average monthly electricity costs are roughly $30 for seven-hour bi-nightly charging and $75 per month for seven-hour nightly charging, assuming a 24kWh battery and a Level 2 charging station. Total monthly costs, including electricity and fixed costs could range from slightly more than $75 to more than $400 per month. Apartment owners and managers can pass on the costs in the form of charges to users, but because of the transient nature of renters, and the small number of EV owners currently living, or wanting to live, in apartments, cost recovery within the tenancy of a particular apartment dweller will be challenging in many cases.

Requiring EVSE Installations at Point of Sale: Given the cost factors typically involved in a Level 2 installation scenario, the Luskin Center has proposed a mandate on multi-family building owners to upgrade their infrastructure at the time of sale, when a variety of other upgrades can be financed in a packaged approach. The applicable code language could emulate the existing Green Building Code, which applies only to certain types of new construction. This recommendation is considered a relatively bold and politically challenging approach.

Mandated EV Charging Code Options: The City of Los Angeles Green Building Code (Chapter IX, Article 9, of the Los Angeles Municipal Code), adopted on December 14, 2010, mandates newly constructed “low-rise” (single family residences, duplexes, and townhouses) and “high-rise” residential buildings to be charging station-ready. For low-rise buildings with private parking, either a 208/240 Volt 40 Amp outlet must be installed for each unit, or panel capacity and conduits for future installation of a 208/240 Volt 40 Amp outlet. All outlets must be located “adjacent to the parking area.” For low-rise buildings with common parking, the following options are available:

- A **minimum number of 208/240 Volt 40 Amp outlets**, equal to 5 percent of the total number of parking spaces, to be located within the parking area; or
- **Panel capacity for the future installation of 208/240 Volt 40 Amp outlets**, equal to a minimum of 5 percent of the total number of parking spaces, with a conduit terminating in the parking area; or
- **Additional service capacity, space for future meters, and conduit for future installation** of electrical outlets, equal to 5 percent of the total number of parking spaces, with the conduits terminating in the parking area.

High-rise buildings are required to provide 208/240 Volt 40 Amp outlets equal to 5 percent of the total number of parking spaces, with the outlets located in the parking area.

Developing Nearby Public Infrastructure: Apartment renters and residence owners (including live-aboard boat owners) who own EVs, but often do not have access to a dedicated parking space in the building, park curbside, or park in off-street lots, will have to think creatively about where to charge their vehicle. Allowing EV owners to use charging stations installed in public lots, or installed curbside, is one possible solution. Private lots, such as those belonging to schools, religious institutions, and businesses
may present opportunities in particular locations. Building or property owners may be incentivized to install EV Charging Stations by collecting additional fees (above the cost of electricity) that would help pay for the EVSE over time.

City of Los Angeles Green Building Code - EV Sections Pertaining to Multi-Unit Dwellings

ORDINANCE NO. 181480


THE PEOPLE OF THE CITY OF LOS ANGELES
DO ORDAIN AS FOLLOWS:

Section 1. Chapter IX of the Los Angeles Municipal Code is amended by adding a new Article 9, Green Building Code, to read as follows:

ARTICLE 9, DIVISION 4

MANDATORY MEASURES FOR NEWLY CONSTRUCTED LOW-RISE RESIDENTIAL BUILDINGS


1. For one- or two- family dwellings and townhouses, provide a minimum of:

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

The electrical outlet or conduit termination shall be located adjacent to the parking area.

2. For other residential occupancies where there is a common parking area, provide one of the following:

   a. A minimum number of 208/240 V 40 amp, grounded AC outlets equal to 5 percent of the total number of parking spaces. The outlets shall be located within the parking area; or
   b. Panel capacity and conduit for future installation of electrical outlets. The panel capacity and conduit size shall be designed to accommodate the future installation, and allow the simultaneous charging, of a

minimum number of 208/240 V 40 amp, grounded AC outlets, that is equal to 5 percent of the total number of parking spaces. The conduit shall terminate within the parking area; or

   c. Additional service capacity, space for future meters, and conduit for future installation of electrical outlets. The service capacity and conduit size shall be designed to accommodate the future installation, and allow the simultaneous charging, of a minimum number of 208/240 V 40 amp, grounded AC outlets, that is equal to 5 percent of the total number of parking spaces. The conduit shall terminate within the parking area.

When the application of the 5 percent results in a fractional space, round up to the next whole number.

ARTICLE 9, DIVISION 5

FOR NEWLY CONSTRUCTED NONRESIDENTIAL AND HIGH-RISE RESIDENTIAL BUILDINGS
99.05.106.5.2. Designated Parking. Provide designated parking, by means of permanent marking or a sign, for any combination of low-emitting, fuel-efficient, and carpool/van pool vehicles as follows:

Table 5.106.5.2

<table>
<thead>
<tr>
<th>Total Number of Parking Spaces</th>
<th>Number of Required Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9</td>
<td>0</td>
</tr>
<tr>
<td>10-25</td>
<td>1</td>
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<td>26-50</td>
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<td>76-100</td>
<td>8</td>
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<td>101-150</td>
<td>11</td>
</tr>
<tr>
<td>151-200</td>
<td>10</td>
</tr>
<tr>
<td>201 and over</td>
<td>At least 8 percent of total¹</td>
</tr>
</tbody>
</table>

¹When the application of this regulation results in the requirement of a fractional space, round up to the next whole number.

99.05.106.5.3.1. Electric Vehicle Supply Wiring. Provide a minimum number of 208/240 V 40 amp, grounded AC outlet(s), that is equal to 5 percent of the total number of parking spaces, rounded up to the next whole number. The outlet(s) shall be located in the parking area.

I hereby certify that this ordinance was passed by the Council of the City of Los Angeles, at its meeting of \( \text{DEC 1 & 4 2018} \)

JUNE LAGWAY, Clerk

By

Deputy

DEC \( \text{1 & 5 2018} \)

Mayor
2.21. Guidelines for Workplace Charging: The following overview of workplace charging is designed to inform employers, building owners, facility managers, and other key stakeholders about a broad range of issues pertaining to EVs at the workplace. Because workplace charging is so essential to the growth of the EV ecosystem, many organizations are beginning to provide resources on this important topic. The Monterey Bay PEVCC has drawn on materials made available by California sources as well as the Minnesota Pollution Control Agency, Advanced Energy of North Carolina, the Electric Power Research Institute, and EV Charging Pros, among others. A full list of resources on this and other EV issues is included at the end of this document.

As Electric Vehicles come to the market in ever-greater numbers, EV drivers will increasingly need and expect to recharge at work. While it is expected that the majority of charging will continue to occur at home at night -- when it is most convenient and affordable, the importance of workplace charging should not be underestimated. Individuals especially dependent on workplace charging will include drivers of BEVs and PHEVs with smaller-capacity batteries, employees who may not have ready access to home charging, corporate EV fleet users, and visitors who need to recharge to return to their destination or continue on their journey. Companies that provide charging are considered “leading edge” today, but soon the emphasis may shift, so that workplaces without charging resources will be considered “behind the times.”

Workplace charging also plays an important role in the overall public charging ecosystem, and in the public perception of EVs as a reliable and convenient mode of transport. The EV Project – a federally funded large-scale EV charging infrastructure project (led by Nissan and EcoTality) has demonstrated that the percentage of EV owners charging their vehicles outside the home grows as more publicly accessible charging becomes available. In other words, as more charging becomes available, more “electric miles” replace gasoline miles. Workplace charging can be an important component of the overall public charging network by providing additional “opportunity charging” for drivers who are running errands and need to give their EV a quick range-extending charge.

Research strongly supports the need for workplace charging opportunities. The Electric Power Research Institute (EPRI) estimated that 54% of non-residential parking occurs at the workplace -- where vehicle dwell time is typically between four to eight hours. This extended period can be an ideal time to provide EV owners with an extension in range. Workplace charging can typically provide EV owners an extra 15 – 70 miles of range depending on the charging infrastructure available. This matches well with the characteristics of typical commuters today, of whom 90 percent drive less than 40 miles one-way to work.

Getting Started: Successful efforts to increase workplace charging depend on EV drivers, their employers, and building owners being fully informed of the key program and infrastructure design issues involved. With this knowledge, workplace charging programs can pay for themselves over time, and be an effective marketing tool for a business or a building owner to attract and retain their highest value employees, tenants, and customers. The following guideline provides a summary of the initial issues that must be considered in developing an effective workplace charging program. Each of these issues will be considered in further detail below.

1. Survey employees’ interest in a workplace-charging program.
2. Discuss survey findings and EV charging needs amongst employees and key decision-makers: supervisors, building owner/manager, facilities technicians, and legal counsel.
3. Examine EV charging equipment options and compare the benefits and costs (e.g. Level 1, Level II, Fast Charging).

4. Decide who will own the EV charging equipment. It could be the company, the building/parking lot owner, or a 3rd party EV service provider.

5. Identify incentives and investment sources for workplace EV charging infrastructure.

6. Create an EV charging policy addressing workplace charging. Issues to be addressed include: who should get priority access to the chargers, when they will be accessible, how much charging will cost, and who will oversee ongoing operations and maintenance.

7. Contract with a certified electrician or EV consultant to determine ideal location(s), deal with local permitting, and install the equipment in an accessible location.

8. Install signage, alert employees and start charging!

Workplace Charging Benefits for Employers and Building Owners

The provision of workplace charging offers significant benefits for both employers and their current and future employees, visitors, and customers. Today, the provision of EV charging helps to differentiate a workplace as environmentally friendly, socially responsible, and technologically cutting-edge. As many workplaces begin to deploy EV charging infrastructure, EV charging may come to be seen as expected, just as a well-lit visitor parking lot is now considered essential to a welcoming and secure workplace. For the immediate future, however, workplace charging hosts can gain comparative advantage and enjoy these benefits as part of the EV vanguard:

- **Employee attraction & retention** - Many employees now or in the future will be driving EVs to make a personal contribution to environmental sustainability and energy security, and to enjoy the benefits and cost savings of electric drive. By installing EV chargers, employers can help retain current employees and attract new ones by staying on the leading edge of technological development and social responsibility.

- **Publicity & green credentials** - Showing leadership in supporting cutting-edge, clean transportation can raise the environmental profile and positive public perception of a business. In some construction and retrofit scenarios, LEED points are available for the installation of EV charging equipment. By deploying chargers in visible locations, a workplace also creates immediate awareness and “green curb appeal” for the organization and property. This awareness can be extended through promotional and marketing materials. In combination with solar installations, businesses can go even further in showcasing the coming era of “fossil-free” transportation and clean energy.

- **Fleet cost savings** - Going beyond EV charging for employees, a business can realize cost savings by transition its own fleet of company cars to EV, and charging them at the workplace. Studies show significant operating savings potential for EVs from both fuel savings and reduced service costs, leading to a substantial reduction in fleet total cost of ownership (TCO).

- **Triple Bottom Line Financial Reporting** – Triple bottom line (TBL) performance metrics -- reflecting people, planet, and profit -- are being used to communicate the economic, ecological,
and social success factors of a business, government, or nonprofit organization. With the ratification of the United Nations TBL standard accounting practices in 2007, and ongoing deployment of carbon accounting measures in California and nationwide, many organizations with a corporate social responsibility (CSR) initiative or specific obligations under AB 32 will need to report their greenhouse gas reduction results. EV charging facilities will encourage more “carbon-free commuting” and EVSE software can quickly and simply report the results in tons of GHG reduction.

**Workplace EV Charging Benefits for EV Owners**

- **Range security** - The opportunity to charge at work helps EV drivers to achieve “range security.” Knowing that they will be able to have the full range of the EV when they leave work is important -- and in some instances critical -- for those faced with long commutes or a lack of residential charging.

- **Range extensions** – For drivers of PHEVs, workplace charging can double daily “all electric” driving range – enabling extended driving before having to turn on the gas generator.

- **Preheating/cooling** - Using workplace charging can enable EV owners to preheat or pre-cool the car without draining the battery.

- **Increased incentive to purchase an EV** – The availability of workplace charging helps make the EV purchase decision easier – especially for BEV owners with longer commutes.

**2.22. Planning and Executing a Workplace EV Charging Program**

Implementing EV workplace charging is easiest when the employer is in full control of their entire campus. Singular control of the parking area, building, and electrical service streamlines decision-making and cost allocation. However, many employers confront more complex ownership and management scenarios that may involve a building that is owned by one entity, maintained by another entity, and with yet another entity operating the parking facility. For these more complex scenarios, the guidelines below will have to be modified to fit the specific ownership situation. One key to an effective program launch is to ensure the comprehensive education and engagement of all the relevant parties at the outset of the planning process.

Successful efforts will depend on both employer and employee engagement. Most of the workplaces that now offer EV charging for their employees began as an initiative of an existing or prospective EV driver, “evangelizing” the benefits of EV, ultimately leading to a top-level decision to provide workplace charging. In small organizations, informal conversation between colleagues is often enough to get the ball rolling. Medium and large-sized businesses may require a more formal process, and more complex ownership scenarios will typically require the convening of a management level designee, the building owner (if different from the employer), parking lot operator (if necessary), facilities operation staff, human resources, and legal counsel. Together, this team will need to assess employee interest in EV charging as a first step.
Evaluating Interest in Workplace EV Charging

To “right size” an EV workplace charging effort, a survey will help determine both short- and longer-term interest in owning EVs -- and the need for charging options at the workplace. Potential questions include:

- Do you own an electric vehicle?
- Is your vehicle a BEV or PHEV, and what is its “all electric” range?
- What is your commute length (one way)?
- How often do you drive your EV to work?
- Would the option to charge your car at work be desirable?
- How much time would you expect to charge your EV at work, assuming a Level 2 charger?
- Are you considering purchase or lease of an electric vehicle in the future?
- How soon do you plan on buying or leasing your next vehicle (any type)?
- If workplace charging were an option, would you be willing to pay for the service?

Company decision-makers should evaluate results and determine the potential number of charging stations that might be needed. EV ownership is expected to grow rapidly over the coming decade as production of EVs ramps up significantly, so implementing a workplace charging program should be done deliberately and with an eye for potential expansion in the future. For example, Google has a near-term goal that 5% of their employee parking spots will be equipped with EV charging.

For employers who do not own their buildings or control their parking facility, the parking operator and building management must be engaged. Lease renewals are often a good time to address these issues.

Identifying Charging Equipment Needs and Charging Levels: Determining what type of charging option to provide is critical to meeting driver needs. Factors such as EVSE system cost, electricity needs, potential electric supply upgrades, EVSE security, and maintenance will influence decisions. Survey results will inform decisions on charging needs. Where specific survey data is not available, national data may be useful. According to the US Department of Transportation Omnibus Household Survey the average commuter travels approximately 15 miles one way to work. Two out of three commuters (68 percent) reported a one-way commute of 15 miles or less, 22 percent traveled between 16 and 30 miles and 11 percent traveled more than 30 miles. Expansion of Level 2 charging (providing 8-20 miles per hour of EV range) is a preference that many EV owners share. Level 2 EVSE at the workplace provides robust range security and can enable one EVSE unit to serve multiple vehicles through the day if procedures are in place for owners to move cords between adjacent parking slots, and/or to swap vehicle locations at lunch or break times. With a host of popular EV smart phone apps, users can be notified when their EV is charged up.

While Level 2 charging is often the preferred solution, Level 1 often has significant cost advantages. Given the long time periods that many EV owners are parked at work, and the significant charge remaining on the batteries of short-haul commuters, Level 1 charging -- providing 2-5 miles per hour of EV range -- can be an excellent workplace charging solution. Implementing Level I charging at the workplace is a viable entry point for companies that want to get a feel for the technology and how it works before investing resources in faster charging solutions.
A Level 1 EVSE can be as simple as a three-pronged extension cord plugged into a standard grounded 110 outlet, utilizing the standard Level 1 portable charging device that comes with all EVs. Level 1 charging can be the easiest and most cost-effective way to rapidly expand EVSE infrastructure. Because of its simplicity and low costs, analysts predict in 2017 that 2.9 million of the total 4.1 million charging stations in the U.S. will be the Level 1 type. However, there a range of issues that must be taken into account by site hosts before moving toward the Level 1 solution.

Level 1 charging equipment solutions ranges widely in cost from the cost of an extension cord where adequate grounded outlets already exist, to $1,000+ per space for new conduit and electrical upgrades, depending on the power situation at the workplace. At the low end of the scale, a workplace can provide access to a three-pronged plug and the driver can use the charging cord set that comes standard with every vehicle. Alternatively, a workplace can procure a dedicated Level 1 EVSE with a J1772 connector for approximately $800, as is available from Clipper Creek. These devices can be either mounted on the wall or attached to a light pole for easy installation in the parking environment. However, use of plugs rather than J1772 connectors introduces greater hazards for the driver and potential liabilities for the site host. Furthermore, much of the cost advantage of the Level 1 installation can be eliminated if a J1772 charging station with a payment system is installed.

**Level One Payment Systems:** One of the impediments to wider use of Level One charging is that lower-cost “dumb” EV chargers do not have point-of-purchase transaction systems (such as credit card billing). However, IRS rules may require employers to track EV charging as a benefit. Further, many companies do not want to provide free charging, even at low-cost EV rates. To find a workaround to this problem, a company called Liberty Access Technologies has introduced a relatively inexpensive add-on keypad and customer code generator that enables site hosts to control access to “dumb” chargers or charging outlets, without paying the more costly network access fees imposed by some EVSE vendors. The charge authorization code can be issued by the site host or purchased from a payment kiosk or a mobile payment system via a mobile phone and credit card payment.

Each code is unique and cannot be reused once it has expired, protecting the lot owner and the consumer from potential fraud. Codes can be issued for periods ranging from several minutes to several months. A credit-card transaction fee is charged on a per transaction basis. Charging fees can also be directly debited from an employee’s expense account. One Liberty data system provides access control for up to ten Level One or Level Two chargers, enabling use of the far cheaper “dumb” chargers now on the market from companies like Eaton, Clipper Creek, AeroVironment, Leviton, and many others. (See www.liberetyplugins.com)

**Power Availability:** Another significant consideration for both Level 1 and Level 2 charging is power availability. Most Level 1 charging equipment requires that a 15 amp dedicated circuit breaker be installed in the electrical panel to support the equipment. However, if the workplace has determined via an employee survey that there is a need for multiple Level 1 stations, additional power supply may be required to support multiple, simultaneous charging sessions. In some environments, a workplace might need to install a dedicated 120/240 volt electrical panel, with a service rating of 120 to 200 amps to support the projected long-term demand for Level 1 charging. In addition, the location of the power room and distance relative to the proposed charging locations is critical to budgeting for a workplace charging installation. Additional cost considerations involve the distance of conduit requirements, the type of cable to be used to bring power to the locations, and possible cutting, trenching, and replacement of sidewalks and pavement.
Using Level 1 as a stepping stone, an employer can gain experience about how their employees are using workplace charging, gauge their satisfaction with Level 1 charging, and then make an informed choice to move (or not) to faster charging options.

**Hardware Cost Factors and Available Tax Credits:** Level 2 charging equipment has a wider range of costs, from $500 to $6,000 for the equipment (plus $1,500 to $5,000 or more for installation) depending on the physical layout of the parking area, the existing electric infrastructure, and the type of equipment purchased. The higher cost of some Level 2 chargers is typically due to the inclusion of support for credit card billing, as well as network charging software. Network software enables a variety of access protocols and flexible pricing for the units (e.g. differentiated costs for network subscribers, tenants, or drive-up “opportunity charging”), and can provide reservation features and more robust reporting functions.

There are also many different form factors available for Level 2 equipment -- from wall and bollard mounts to units with retractable cords. Some EV charging units are also available in dual port stations, which provide the ability to charge two vehicles simultaneously from a single device. Of course, Level 2 EVSE require a higher level of dedicated power than Level 1. Generally a dedicated 40 amp circuit breaker is required for each charger in the electrical panel. If a dual charger is being considered, then 80 amps of available power and two dedicated breakers must be installed.

At the end of 2014, the Investment Tax Credit for EV charging equipment expires, with 30% of the purchase price available as a tax credit. The specifics of the rebate and applicability to your tax situation should be assessed with a qualified tax professional or accountant. In certain circumstances, nonprofit or public organizations may be able to work with a financial intermediary to monetize some of the credit, though this is not always feasible.

**EV Charging Equipment Options – Information and Resource:** Decision makers looking at charging options can use online resources to assess the growing offerings of EVSE manufacturers and service providers. One of the most extensive listings of EV charging equipment is available via Plug-In America at [http://www.pluginamerica.org/accessories](http://www.pluginamerica.org/accessories). Another strong listing is at Plug-In Recharge: [http://www.pluginrecharge.com/p/evse-vendors.html](http://www.pluginrecharge.com/p/evse-vendors.html)

There are a growing number of vendors that sell EVSE equipment and offer turn-key installation and ongoing service. Some of these vendors and network operators require users who purchase their equipment to subscribe to a charging service and to make payment via credit card or radio-frequency identification (RFID) devices which control access to the EVSE and enable the owner to collect usage data. Charging can also be set up to be free for all or some users. The EVSE vendor typically shares in the revenue generated by the EVSE and charges service fees for managing payment transactions, maintenance and troubleshooting services for the EVSE.

Fast Charging (sometimes called Level 3) is less likely to be a good match for most workplace situations at this time due to the high equipment and installation cost. However, like most EV equipment, hardware cost is declining rapidly, and more EVs will likely be shipping with Fast Charging options (either the Japanese Chademo connector standard or the American and European SAE Combo 2 standard) if a workplace is located on a property with multiple buildings or a very large number of EV tenants, it might be feasible to provide a L3 solution, which could permit a large number of drivers to charge their vehicles throughout the day. (Google is planning a Level 3 installation, for example.) Currently, Level 3 costs are in the range of $20,000 - $40,000 for hardware, and $15,000 - $30,000 for installation.
EVSE Installation Budgeting – Factors to Consider

Itemized costs for workplace EVSE will vary for each site. Factors such as trenching, new electrical circuits, surface refurbishment, panel upgrades, and permitting will play a role. In some locales, there may be state or federal grant or incentive programs to help cover the cost of workplace charging. A typical budget might include the following line items:

- Material/Incidentals
- Equipment Rental (trencher for conduit)
- Sidewalk Demolition/Repair
- Labor (in-house)
- Labor (outside)
- EVSE (charging station)
- Incentives (if available to offset costs)
- Optional EVSE equipment (e.g. RFID card reader)
- Signage and/or Paint

Company Workplace Charging Policies: It is important to develop clear internal company policy about workplace EV charging. Issues that should be considered include the following:

- **Access to Charger-Equipped Parking:** Signage should clearly indicate that the EVSE parking space(s) are only to be occupied by EVs charging their vehicles. Access privileges can be extended to both employees and visitors, at the discretion of the employer. A policy regarding time limits per car may need to be defined if there is more demand than supply of charging. For more information about site signage requirements, please see Section I on *EV-Related Signage Guidelines* in the Appendix of this document. Additional information can be found in Ready, Set, Charge California document available at [http://www.baclimate.org/images/stories/actionareas/ev/guidelines/readysetcharge_evguidelines.pdf](http://www.baclimate.org/images/stories/actionareas/ev/guidelines/readysetcharge_evguidelines.pdf)

- **Registration and Liability Forms:** Some workplace charging programs require users to register to use the equipment and sign a standard waiver of liability. A registration form could include language requiring vehicle owners to agree that the business is not responsible for any costs related to vehicle purchase or repairs, nor for any damage to the vehicle while parked at the charging station. It could also provide a specific timeframe within which the business would be obligated to correct maintenance issues with the charging stations upon notice of the problem.

- **Time Restrictions on EVSE Access:** Employers must decide whether the EVSE can be used outside of normal business operating hours. A company may also decide to put the locations of the chargers on charging network maps, such as those operated by the Department of Energy or EV Charging News. These resources will make EV charger information available to the general public and enable a potential revenue flow for charging outside of business hours.

- **Equipment Security:** Level 1 charging often involves connectors and cables owned by the EV driver. Some of these cables can cost as much as $600, so it will be important to create as secure an environment as possible to prevent vandalism and theft. A commercial building in Silicon Valley with both workplace and public retail tenants has taken the step to enclose the
workplace-only charging units inside a fenced off area, providing a key to authorized drivers to unlock the equipment. This measure has effectively segregated the equipment from the public, while giving authorized drivers access. Other workplaces report little if any interference with driver-supplied charging equipment.

### Managing Access Following Complete Charging:

Employers must also decide what policies should govern EV drivers once EVs are fully charged. Must employees move their vehicles to enable another EV to use the charger? Many companies are asking drivers to sign an “EV Drivers’ Code of Conduct” that includes instructions on how to share spaces and notify other EV users that the spot is available. For example, most EV’s have easily readable dashboard lights that can be seen by anyone looking at the vehicle to indicate if the vehicle is currently charging. With appropriate protocols, some workplaces have policies that permit other drivers to move the charging device from one vehicle to another when a complete charge is indicated. Other policies call for notification via smartphone app, while leaving the responsibility for decoupling the charger to the original driver.

Auto manufacturers are also educating new EV drivers on standard “charging etiquette” For example, the Ford Motor Company has recently produced EV Etiquette documents which can be found here: [http://blog.ford.ca/2013/01/04/ev-etiquette-a-whole-new-ballgame/](http://blog.ford.ca/2013/01/04/ev-etiquette-a-whole-new-ballgame/) Many drivers also use timecards that can be displayed in vehicle windows indicating when the charger might be disconnected and used by a vehicle in the adjoining spot, as illustrated here: [http://blog.ford.ca/wp-content/blogs.dir/1/files/2012/12/Ford-EV-Etiquette-Plug-In-Card.pdf](http://blog.ford.ca/wp-content/blogs.dir/1/files/2012/12/Ford-EV-Etiquette-Plug-In-Card.pdf).

Generally, EV drivers understand that they are not parking and charging their vehicles in a spot for the full day, that they are actually occupying an “alternative fueling station” and are ready and able to calculate the time required to charge their vehicles and make arrangements in their schedule to move their vehicles when their charging sessions are over. A growing set of smartphone apps may enable EV drivers to plan, monitor, and schedule the charging of their vehicle. While it is up to the workplace to determine whether they want to limit car switching when charging is completed these applications often include reservation systems so cars can be scheduled and moved by the drivers as necessary. Ideally, the charging spot should be used as efficiently as possible so that any vehicle in the spot is actually charging up.

### Charging Money for Charging EVs – Policy Options for Employers:

Many EV workplace charging programs are free for employees. Since the number of EVs on the streets today is relatively small, this can be an affordable approach to initially incentivize employees to make a clean transportation choice. As the penetration of EVs expands, providing free charging may have to be reconsidered. Capital and operational costs for EV charging can be recovered over time through a charge-per-use or setting a monthly/yearly subscription rate. Level 2 charging equipment usually includes management software that allows workplaces to set the fee for a kWh of energy, a pre-defined length of a charging session, or to allow access to the unit for no fee during certain hours of the day. In the largest survey to date, the California Center for Sustainable Energy (CCSE) and the California Air Resources Board (ARB) found that California EV owners are willing to pay 40% – 70% more for public and workplace charging compared to standard residential electricity rates.

The cost of the electricity used to charge a single EV is minimal, comparable to per employee costs for coffee or snacks in a break room. For example the energy cost per kilowatt hour (kWh)
in the United States as reported by the Bureau of Labor statistics is .12 cents, in Los Angeles it is .20 cents. A Nissan LEAF goes approximately 3.5 miles per kWh of energy used. In order to obtain 20 miles of range (longer than the typical one-way commute in California) the Leaf would require 5.7 kWh of electricity, which would cost .68 cents at the national average electrical rate and up to $1.14 in Southern California Edison (SCE) territory. For comparison, a vehicle with an internal combustion engine might consume between $2.00 and $5.00 in gasoline to drive 20 miles. Given the 3.3 kWh charging unit in the LEAF, it would take close to two hours of charging to receive 20 miles of range in the battery. For an employee in SCE territory who utilizes workplace charging for five days/week, the total charge for energy would be $5.70 per week, for a 4 week working month the cost of energy would be $22.40 and a for 50 weeks a year the employee’s vehicle would consume $285 worth of energy.

It should be noted that if a company decides to make EV charging free for its employees, some legal experts think that it could be considered a reportable employee fringe benefit. Most Level 2 chargers include management reporting capabilities can provide individual statistics for each vehicle that has charged, including the time to charge and the amount of energy consumed. These reports can be used to provide information for employee benefit reporting.

Some companies have decided not to burden themselves with tracking individual vehicle energy consumption and instead have added an electric vehicle-charging component into an Employee Alternative Transportation initiative. Under this type of program, an individual employee is not charged directly for the energy their vehicle consumes, however a taxable benefit of $30 per month (or more as appropriate) is added to their benefit package. In either scenario, the cost of energy for an individual vehicle is relatively small. Given that EV charging may be a tax liability to your employees and require an employer reporting mechanism, consulting a tax attorney or advisor is recommended.

2.23. EVSE Siting, Installation, Signage, and Utility Notification: The workplace charger siting process should begin with the electrical contractor performing the initial site inspection. The contractor can pinpoint existing power supply options and upgrade requirements, and identify charging spots closest to the existing electrical infrastructure. Attention to ADA (Americans With Disabilities Act) requirements is important at this point, especially since ADA compliance requirements are subject to local interpretation. (The guidelines are available at 
http://www.baclimate.org/images/stories/actionareas/ev/guidelines/readysetcharge_evguidelines.pdf and should be consulted for a full discussion of ADA issues.) Many municipalities and local ordinances require that the first in a series of charging stations be accessible and use the ADA standard as their permitting guideline. Building an accessible EVSE spot also includes making sure that wheelchair users are able to access the charging station and cables and outlets are installed at accessible heights.

Aside from following ADA and National Electric Code guidelines on installation, safety considerations should also include efforts to reduce the potential of people tripping over EVSE cords, proper and sufficient lighting, potential shelter from weather, general personal/property security, clearly visible signage, and sufficient barriers to prevent a car from colliding with the EVSE.
For more information about where a charging station should be installed, ADA and site signage requirements please see the following sections of the Appendix to this document: Section C - Charger Installation Guidance for Commercial and Multi-Family Installations, Section H - Guidelines for Accessibility and ADA Compliance and Section I - EV-Related Signage Guidelines. Additional information can be found in Ready, Set, Charge California document available at http://www.baclimate.org/impact/evguidelines.html.

**EVSE Installers and Contractors:** A certified electrician should carry out EV charger installations. When hiring a contractor to install EVSE at a workplace, select one who is familiar with the National Electric Code Guidelines found in NEC Article 625, the specific guidelines for EV charging equipment and installation. Be sure to have key decision makers and key employees that will use the EVSE walk through the parking area with the certified electrician/contractor prior to beginning the installation. The electrician or general contactor will likely be the point person in coordinating local permitting, inspections, utility upgrades (if needed), equipment purchasing and installation of the EVSE. After installation, the electrician should walk through the EVSE and its operation with the owner of the equipment.

With the growing interest in EVs, targeted training and certification programs for EVSE installations are expanding. For example, UL (formerly Underwriters Laboratories) now offers an online and hands-on programs to familiarize technicians and safety inspectors with a wide range of electric vehicle products and technologies, including Section 625 of the National Electrical Code. The national electrical industry also has created the Electrical Vehicle Infrastructure Training Program (EVITP) to train and certify EV equipment installers. This has become the leading training program for EV charger installation – with co-sponsorship by the National Electrical Contractors Association (NECA) and the International Brotherhood of Electrical Workers (IBEW).

**Utility Notification Processes:** It is important to notify the local utility when Level 2 charging infrastructure is being installed. Business locations for EV charging infrastructure generally have robust electric service -- so that the addition of the first one or two Level 2 EVSE will not likely impact the local electrical distribution network and equipment. However, additional chargers on a single transformer may require an upgrade, and it is important for utilities to track each new installation as it occurs for system planning purposes.

Utilities also offer special EV charging rates. Typically, these rates have been established to incentivize drivers to charge their vehicles during off-peak times when electricity consumption is lowest (e.g. overnight). However, some rate incentives may apply during portions of the daytime hours as well, particularly during morning hours.

**Charger Signage:** EV charger signage must clearly show that the parking spot is only to be used by an EV. One emerging practice is to choose the signs indicating EV charging in a green rather than blue color. Blue is often associated with ADA parking spots and some drivers of traditional vehicles often think that those spots are available for them to use. This helps alleviate a phenomenon which EV owners refer to as “getting ICE’d” when they come to a public charging station spot only to find an Internal Combustion Engine (ICE) parked there. The cost of signs will typically range between $15 – $80, plus installation.

It can also be useful to paint the pavement of the parking space to provide further visual guidance for the EV charging space. The main consideration in painting the space is to use a high contrast color, so the information on the pavement is easily readable. For more information about site signage
EV Chargers and Renewable Energy: A unique benefit of driving electric is the capability to power them with clean, locally-produced solar or wind power. Use of renewable, green sources of electricity to power EVs is encouraged to prevent pollution from energy generation and to promote a robust local low-carbon energy economy. Installing a solar array adjacent to a plug-in charging station demonstrates that natural energy from the sun can be used to power vehicles. Solar power typically flows into the grid with a separate meter tracking how much electricity has been generated -- offsetting the grid power that is supplied to EVs through the EV charger.

The cost of a solar power is on a steep decline -- such that some systems may be installed with no upfront investment by a financing mechanism known as a Solar Power Purchase Agreement (PPA). For example, a 2kW solar installation provides savings sufficient to power an EV for 10,000 miles per year -- year after year -- with a one-time cost of approximately $7000 after incentives. Through a PPA, businesses also have the opportunity to own the asset by investing their own capital, or to enter into a PPA agreement whereby an energy company such as Solar City would own the asset but pass on some of the energy cost savings to the host business.

2.2.4. Sample Checklist for Workplace Charging: Establishing a workplace charging initiative can be a straightforward process for most organizations. It requires an executive to put together a team of key stakeholders to assess options and decide key issues. The following checklist references the major steps and components of the process.

1. **Determine employer/employee interest** in an EV charging program, including strategic drivers and potential for short-term and long-term utilization.
2. **Assess the concerns of property owners** and landlords.
3. **Have a certified electrician evaluate the power infrastructure** and upgrade options.
4. **Confirm utility rates, local permit requirements and operating revenue and expense.**
5. **Determine site plans** for EVSE infrastructure design.
6. **Select appropriate EVSE vendors** and equipment.
7. **Develop internal policies and programs** for EV drivers.
8. **Build-out site infrastructure**, including permits, power, charger installation, and signage.
9. **Turn on charging infrastructure and orient users** to charging policies and procedures.

2.25. Information Resources on EV Issues: The resources in this section provide additional information about Electric Vehicles for fleet and consumer use, charging infrastructure, sales trends, and policies.

- **DriveClean**: A guide for zero and near-zero emission vehicles from the California Air Resources Board. [http://www.driveclean.ca.gov](http://www.driveclean.ca.gov)
- **California PEV Collaborative**: Statewide official resource for California PEV readiness. [http://www.evcollaborative.org/](http://www.evcollaborative.org/)

requirements please see Section I - EV-Related Signage Guidelines in the Appendix of this document. Additional information can be found in Ready, Set, Charge California! at [http://www.baclimate.org/images/stories/actionareas/ev/guidelines/readysetcharge_evguidelines.pdf](http://www.baclimate.org/images/stories/actionareas/ev/guidelines/readysetcharge_evguidelines.pdf)
• **Plug-Share**: Provides charging station maps, and access to residential EV charging stations on a peer-to-peer basis, along with smartphone apps for EV charging, trip planning, and energy management. [http://www.plugshare.com/](http://www.plugshare.com/)

• **Best Practices in regional and state EV programs**: The Hawaii EV program website offers reports and case studies on Hawaii’s aggressive EV transition programs. [http://energy.hawaii.gov/programs/transportation-on-the-move/ev-ready-program](http://energy.hawaii.gov/programs/transportation-on-the-move/ev-ready-program)

• **Department of Energy (DOE): Alternative Fuels & Advanced Vehicle Data Center**: Provides information on EV and alternative fuel vehicles and petroleum reduction strategies.

• **Department of Energy resources**: The Department of Energy provides the following resources at: [http://www.afdc.energy.gov/fuels/electricity.html](http://www.afdc.energy.gov/fuels/electricity.html)
  - Hybrid and Plug-In Electric Vehicles fact sheet
  - Plug-In Electric Vehicle Handbook for Consumers
  - Plug-In Electric Vehicle Handbook for Electrical Contractors
  - Plug-In Electric Vehicle Handbook for Fleet Managers
  - Plug-In Electric Vehicle Handbook for Public Charging Station Hosts


• **Plug-in America** - A non-profit coalition of electric car owners and advocates. This site includes compendiums of information on current electric car models and charging equipment. [http://www.pluginamerica.org](http://www.pluginamerica.org)


• **U.S. DOE Clean Cities EV fleet handbook**

• **U.S. DOE Clean Cities EV and Alternative Fuel Vehicle (AFV) fleet case studies**

• **American Public Works Association (APWA) fleet resources**
  [http://classic.apwa.net/ResourceCenter/index.asp?Section=equipment&SectionName=Equipment+%26+Fleet+Management](http://classic.apwa.net/ResourceCenter/index.asp?Section=equipment&SectionName=Equipment+%26+Fleet+Management)

• **California Energy Commission (CEC) links to funding for EVs and EV infrastructure**:
  [http://www.energy.ca.gov/drive/projects/electric.html](http://www.energy.ca.gov/drive/projects/electric.html)

• **Methods for Estimating EV Deployment in the Region**: **Online Tool Tracks Electric Vehicle Purchases**: The California Center for Sustainable Energy (CCSE) released an online tool that shows details of **EV purchasing trends** based on rebates awarded by the statewide Clean Vehicle Rebate Project (CVRP). This is currently the most comprehensive single tool for estimating PEV deployment in the region, as it includes zip code level tracking. However, the tool does not take into account legacy EVs from the 1990’s (such as the original Toyota RAV.) It also does not take into account the initial portion of 2012 model year Chevrolet Volts, which were not eligible for
the state clean vehicle sticker. Subsequent Volts are included. It should be noted that as many as 25% of EV drivers may not take the state rebate. Therefore, CVRP data may undercount actual EV deployment.